Hawboldt Industries (1989) Ltd.
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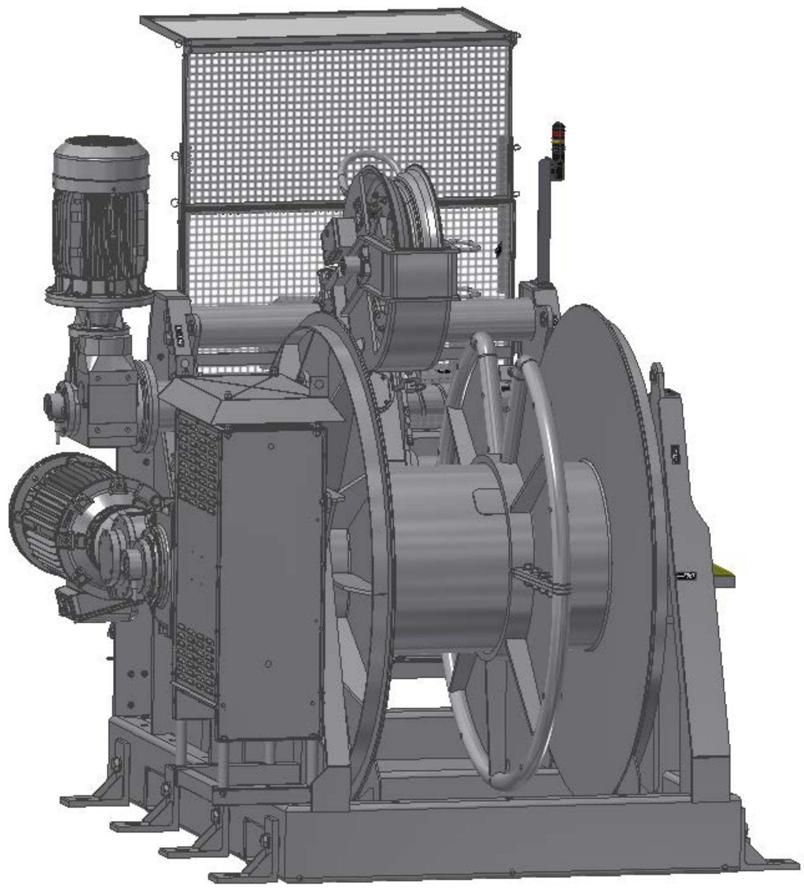
SPRE-3464

INSTALLATION, OPERATION & MAINTENANCE MANUAL



Customer: University of US San Diego	**Sales Order:** 38579
Purchase Order: 92043515	**Serial Number(s):** 1943-1
Purchase Date: 09 JUL 2019	

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REVISION HISTORY

Rev	Date	Description	Issued By
-	29-FEB-2020	First issue.	DHM
1	24-MAR-2022	Revised Electrical Drawings, General Assembly, and VFD Settings.	PMV

1.0: WARRANTY

This section contains the Hawboldt Industries (1989) Ltd. – Standard Terms and Condition of Sale.

Hawboldt Industries (1989) Ltd. – Standard Terms and Condition of Sale

HAWBOLDT INDUSTRIES (1989) LTD.
220 Hwy 14, Chester, NS B0J 1J0
herein referred to as "HAWBOLDT"

GENERAL CONDITIONS OF SALE

I. Design and improvement of our equipment is a continuous process. Hawboldt, therefore, reserves the right to make design improvements after receipt of an order. Photographs and other illustrations or advertising matter represent generally the goods offered, but are not binding in detail.

II. Delivery dates are estimated as accurately as possible, but are not guaranteed in any way unless otherwise specifically provided for in this proposal.

III. Unless otherwise specifically provided for in this proposal, this offer does not include a penalty clause of any kind and acceptance of this offer may not create, by its terms, any such penalty clause.

IV. Prices quoted herein are based on current duty and currency exchange rates where applicable, and Hawboldt reserves the right to adjust prices to compensate for any changes in these rates, should it be necessary to do so.

V. Notwithstanding any conditions printed on the Purchaser's order form, in accepting this offer the Purchaser agrees to the following TERMS AND CONDITIONS OF SALE which are also detailed on the Hawboldt Acknowledgment and Acceptance of Order Form, and these Terms and Conditions only will apply unless otherwise specifically provided in this proposal.

TERMS AND CONDITIONS OF SALE

l. **CONTRACT OF SALE -** This order is accepted on, and is subject to, the terms and conditions set forth on the face hereof and below, none of which may be varied or added to except in writing, signed by HAWBOLDT'S duly authorized representative. Any inconsistent matters, terms or conditions in Purchaser's order or confirmation will not be binding on Hawboldt. HAWBOLDT HEREBY EXPRESSLY OBJECTS TO ANY ADDITIONAL OR DIFFERENT TERMS IN ANY OF PURCHASER'S DOCUMENTS.

2. **COMPLETION -** Unless otherwise provided on the face hereof, time for the completion of manufacture of the machinery and equipment covered by this order (hereinafter called the "Machinery") shall be computed from the date of the Acknowledgment and Acceptance of Order, or from the date on which Hawboldt has received from the Purchaser any information, drawings, data, patterns, or other material which are to be supplied by the Purchaser and are necessary to proceed with the manufacture of the machinery, whichever is the latest. Hawboldt shall not be responsible for delays in delivery or any failure to deliver due to causes beyond its control including without limitations: acts of God or the public enemy; mobilization; blockades; embargoes, revolution; civil commotions, riots; fires; floods; winds; earthquakes; epidemics; quarantine restrictions; explosions; accidents; other catastrophes; strikes; slowdowns; lock-outs or other labour difficulties; the acts; laws or regulations of any government or governmental authority; federal, provincial, local or foreign, including safety, health and environmental regulations; unusual weather; delays of sub-contractors or suppliers; or inability to obtain shipping facilities, labour, raw materials, supplies, fuel or power.

3. **MINIMUM INVOICE -** The minimum single invoice or billing charge is $150.00

4. **PAYMENTS -** If payment of any part of the purchase price is not made as provided on the face hereof, Hawboldt reserves the right to discontinue manufacture of the Machinery until such payment has been made and to revoke any further credit, whereupon Hawboldt shall have the right to receive payment before any further shipment of Machinery. In the case of any delay in payment or in establishing agreed security for payment, time for completion may, at Hawboldt's option, be extended for a corresponding period. When any payment is due upon shipment or delivery and shipment is delayed for any cause beyond Hawboldt's control, payment shall be made when the machinery is ready for shipment. Purchaser agrees that any letters of credit or other guarantee of payment shall be maintained fully valid until final payment has been made. IF PAYMENT IS NOT MADE WITHIN THIRTY DAYS FROM THE DATE OF SHIPMENT UNDER THE TERMS OF THIS AGREEMENT, PURCHASER AGREES TO PAY HAWBOLDT AN ADDITIONAL SUM EQUAL TO 2% PER MONTH, 24% PER ANNUM OF THE UNPAID PURCHASE PRICE UNTIL PAYMENT IS MADE.

5. **SECURITY INTEREST -** Hawboldt retains a vendor's lien in the machinery to secure payment in full of the purchase price and any and all other payments which may be or become payable to Hawboldt hereunder. If possession of the Machinery is given to the Purchaser before full payment, the Purchaser shall execute any additional instruments including without limitation security agreements and financing statements necessary to perfect or maintain Hawboldt's vendor's lien and shall pay or reimburse Hawboldt for all filing and recording costs including without limitation, any taxes payable upon filing or recording. In the event of default in payment of any installment of the purchase price when due, the entire balance thereof shall, at Hawboldt's option, become immediately due and payable, and Hawboldt shall have and may exercise all the rights of a secured party then in force under the laws of the Province of Nova Scotia, Canada or such other province or state as may then have jurisdiction over the machinery, including without limitation the right to repossess the Machinery with or without legal process.

6. **DELIVERY AND PURCHASE PRICE -** Unless otherwise provided on the face hereof, delivery is to be made Ex-Works Hawboldt's plant, Chester, Nova Scotia, Canada. Risk of loss within the meaning of the Sale of Goods act of the Province of Nova Scotia shall pass to the Purchaser at the stated point of delivery. The purchase price includes ordinary packing for shipment, but if special packing or tie-down and blocking to anchor the machinery to the transport vehicle is required, Hawboldt is to be reimbursed for the cost thereof. The shipping charges are the responsibility of the customer. Unless otherwise stated in the purchase order, Hawboldt will select a suitable courier to deliver the goods. The goods will be delivered, with freight charges being on a "collect" basis. The goods will be insured unless otherwise specified by the customer. Any freight or insurance costs, which may be included in the purchase price, are based on rates at the date of the Acknowledgment and Acceptance of Order and any increase shall be paid by the Purchaser.

7. **WARRANTIES -** Hawboldt warrants that it will repair F.O.B. its factory or furnish without charge F.O.B. its factory, a similar part to replace any material in its machinery which, during the earlier of 1 year after the said machinery is put into operation or 18 months after the date of shipment of the machinery from its plant, is proved to the satisfaction of Hawboldt to have been defective at the time it was sold, provided that all parts claimed defective shall be returned, properly identified, to Hawboldt's factory, charges prepaid.
This Warranty to repair applies only to new and unused machinery, which, after shipment from the factory of Hawboldt, has not been altered, changed, repaired or treated in any manner whatsoever unless such alteration, change, repair or treatment has been previously authorized in writing by Hawboldt or has been performed by the authorized service representative of Hawboldt.
This Warranty to repair is the only Warranty either express, implied, or statutory, upon which the said machinery is sold; the company's liability in connection with this transaction is expressly limited to the repair or replacement of defective parts, all other damages and warranties, statutory or otherwise, being hereby expressly waived by the Purchaser.
Component parts and equipment not manufactured by Hawboldt are warranted only to the extent they are warranted by the supplier to Hawboldt. Hawboldt will use reputable suppliers.
Hawboldt shall not be liable for any incidental or consequential damages for breach of any warranty and the Purchaser's sole remedy for breach of any warranty or for any negligence of Hawboldt shall be as set forth herein.
Hawboldt makes no warranty that the machinery shall be merchantable or fit for any particular purpose nor does it make any other warranty, express or implied except as is expressly set forth herein. Hawboldt warrants that the machinery will conform to the description on the face hereof; that it will convey good title thereto; that such goods will be delivered free from any lawful security interest or other lien or encumbrance unknown to the purchaser except as otherwise expressly provided herein.
No representative of Hawboldt has authority to change this Warranty or this contract in any manner whatsoever and no attempt to repair or promise to repair or improve the machinery covered by this contract by any

representative of Hawboldt shall waive any consideration of the contract or change or extend this Warranty in any manner whatsoever.

8. **LIABILITY** - Purchaser agrees to hold Hawboldt harmless from, and to indemnify it against, any and all claims, demands, actions, and causes of action of any nature whatsoever, and any expenses incident to the defence thereof, for injury to or death of persons and loss of or damage to property arising in connection with the Machinery or the assembly, erection, operation, or use thereof.
Hawboldt shall be under no obligation after shipment to assemble, erect or test the machinery unless specifically provided for on the face hereof. If the contract provides for instruction or installation services, Hawboldt's sole obligation with respect thereto shall be to provide the purchaser at his expense, (unless otherwise provided herein) an experienced person or persons, who shall become the agent or agents of the Purchaser and remain such for the period provided. Hawboldt shall under no circumstances be liable to the Purchaser or anyone else for any acts or omissions of any such person or persons.

9. **TAXES -** All present and future sales, use, excise and similar taxes imposed by any federal, provincial, local or foreign government which Hawboldt may be required to pay or collect with respect to the machinery or the sale, transportation, storage, use or consumption thereof shall be for the account of the Purchaser to the extent permitted by law. Unless otherwise stated in the proposal, Federal and Provincial sales taxes are not included in prices quoted for domestic sale. With the exception of the province of Nova Scotia, the purchaser is responsible for remittance of Provincial taxes.

10. **NON-CANCELLABLE** - This order is not subject to cancellation or revision by the Purchaser except with Hawboldt's written consent. Cancellation charges will be:
(a) Fifteen percent (15%) of the total purchase price to cover Sales Administration and handling costs, plus
(b) The cost of all unfinished material and the shop labour with overhead plus component cancellation charges from Hawboldt's vendors if any, plus Engineering costs incurred with overhead, plus profit in proportion to the state of completion of the product at the time of cancellation of the order. Upon payment to Hawboldt as above provided, all equipment manufactured under the contract will become the property of the Purchaser.

11. **NON-ASSIGNABLE** - Neither this contract nor any interest herein is assignable or transferable without the express written consent of Hawboldt.

12. **WAIVER -** Any waiver by either the Purchaser or Hawboldt of a breach by the other of any provision of this contract of sale shall not be deemed a waiver of future compliance therewith, and all provisions shall remain in full force and effect, notwithstanding any such waiver.

13. **LIMITATION OF ACTION -** No action shall be brought by the Purchaser for any alleged breach by Hawboldt of this Contract of Sale more than one (1) year after the occurrence of the cause of such alleged breach of contract.

14. **APPLICABLE LAW -** This contract shall be governed and construed according to the law of the Province of Nova Scotia, Canada.

15. **DELAY IN SHIPMENT** - Prices quoted are based on shipment dates indicated. If shipment is delayed at the request of the customer, or because of incomplete shipping information/documentation, or a delay in receipt of customers order confirmation, or because of delay in receipt of Letter of Credit (if applicable), Hawboldt reserves the right to review extra costs resulting from delay and increase prices accordingly.

16. **INSPECTION AND TESTING -** The equipment quoted will be subject to standard Hawboldt inspection and testing before shipment. Any other inspection or testing required by the customer must be specified at time of the order and shall be at the customer's expense unless otherwise stated in the proposal. Customer will be responsible for costs of inspection and tests requested after Hawboldt's acceptance of the order and any costs resulting from delay in shipment.

17. **QUANTITIES** - Prices quoted are based on the purchase of the quantities indicated. Prices may be adjusted by Hawboldt if quantities other than those quoted are actually purchased.

SPECIAL CONDITIONS FOR EXPORT SALES

A. **EXPORT LICENSE** - if any Canadian regulation requires an export license, Hawboldt will apply for such license at its expense, and Purchaser agrees to furnish all information required for such license application. In case Hawboldt is unable to secure an export license, the contract between the parties shall be cancelled without liability on either party.

B. **IMPORT LICENSE -** If an import license is required, it is to be provided by Purchaser who will see that it remains valid and effective until the import has been completed.

C. **REGULATIONS -** The making and performance of the contract between the parties are subject to compliance with all applicable laws and regulations of the Canadian Government and agencies thereof, and in case any such law or regulation should prevent Hawboldt from performing or completing the contract in accordance with the terms thereof, then the contract may be terminated by Hawboldt upon written notice to the Purchaser. In such event, Hawboldt and any surety for Hawboldt will be relieved of all further obligation to proceed; any guaranty deposit or surety bond furnished by Hawboldt shall immediately be returned to Hawboldt and Hawboldt is to be paid the proportion of the contract price, including profit, represented by the expenditure made and the obligations contracted to the date of such termination. Upon return to Hawboldt of any guaranty deposit or surety bond and payment to Hawboldt as above provided, all equipment manufactured under the contract will become the property of the Purchaser.

D. **PAYMENT TERMS** - Unless other mutually agreed to payment terms are arranged in advance in writing, payment will be by Irrevocable Letter of Credit Confirmed by any Chartered Canadian Bank, payable at sight. Unless otherwise stated in the body of this proposal, equipment will be supplied ex-works (not including shipping preparation and loading) INCO International Chamber of Commerce, 2000 Revision, Publication 560, with payment to be made against the Confirmed Irrevocable Letter of Credit upon presentation of shipping documents. The Letter of Credit shall be established with Hawboldt 's bank, all charges for the account of the Buyer.

E. **SHIPMENT DATE** - Equipment offered in this proposal is "estimated" to be ready for shipment in the time frame indicated on the proposal. Shipment date is based on receipt of firm order, a Letter of Credit acceptable to Hawboldt, and down payment (if required) at our Chester, Nova Scotia Office. Shipping date will be confirmed at time of order.

F. **CURRENCY AND TAXES** - Unless otherwise stated prices quoted are in Canadian funds, and do not include any import duties, customs fees or taxes of country of import. No Canadian taxes are applicable or included.

G. **PACKAGING** - Unless otherwise stated prices quoted are on shipment in suitable ocean containers. However, Hawboldt has the facilities to partial crate or full crate the equipment quoted. Prices for this service can be quoted at the customer's request.

H. **FEES** - All handling and freight forwarding fees are to the account of the buyer.

I. **DOCUMENTATION REQUIREMENTS** - Received for Shipment Ocean Bills of Lading or Freight Forwarders Certificate of Receipt in cases where customer has specified use of a freight forwarder.

2.0: SPECIFICATION

2.1: DESCRIPTION

The SPRE-3464 winch is a portable general-purpose winch to be used for any type of deployment. The winch frame is designed to fit the UNOLS standard 2'x2' bolt pattern and has lift points for equal length slings and fork pockets. The electrical controls panel and braking resistor are integrated into the winch skid and require a single point power connection making installation quick and easy. It is a single drum, direct pull type unit driven by a right-angle helical bevel gearbox and totally enclosed non-ventilated (TENV) electric motor with integral failsafe. The failsafe brake is a parking brake only and should not be used for dynamic braking. Dynamic braking is achieved through the variable frequency drive and braking resistor.

The winch has a hollow stub shaft to accommodate a Focal 180 model slip ring. If using a slip ring the cable should connect to the slip-ring inside winch drum where there are a few service loops of cable before it is clamped to a fixing point.

The winch has a smooth drum so that it can accommodate various sized cable and line hardware. The cable is passed through a hole in the drum barrel along the flange and clamped on the inside of the barrel.

The winch uses a PLC controlled in-line levelwind which is capable of variable speeds for spooling cable of various diameters. The levelwind includes a sheave with large curved aluminum cheek plates for passing line hardware up to 6" diameter. The sheave contains sensors for payout and line speed data, as well as a load pin in the axle for tension measurement. A lead screw, driven by helical-bevel gearbox and electric motor, is used to traverse the level wind sheave across the drum. Sensors measuring drum and screw rotation are used to control the levelwind position and Hawboldt spooling system is used to manage the levelwind from the HMI on the control console. The levelwind can also be parked for deployments where it is not required to pass cable through sheave.

The winch is controlled from a control console mounted on the winch which houses operator devices as well as Hawboldt's sunlight readable HMI interface. This console gives full control and monitoring of winch and levelwind. A wired remote belly pack is also supplied that can be connected to the winch. Remote control is limited to winch operation only with limited monitoring (no HMI).

2.2: PERFORMANCE

The performance values shown below are the maximum and must not be exceeded.

Wire Layer	Approx. Diameter (inch)	Pull (lbs)	Line Speed (ft/min)
Bare Drum	25.03	10,000	92
Full Drum	63.10	3,950	232

2.3: SPECIFICATIONS

Parameter	Value
Weight (Operation)	9850 lbs (no drum flange)
Drum Capacity	2,400 m of 1” Wire
Bare Drum Diameter	24”
Flange Diameter	64”
Distance Between Flanges	34”
Main Electrical Supply	480VAC/3PH/60HZ/90A
Control Voltage	24 VDC

2.4: PAINT SPECIFICATION

This piece of equipment was painted at factory with the following 3 part paint system:

1 coat – International Interzinc 52 Zinc-Epoxy primer (green)

1 coat – International Interseal 670 HS Modified Epoxy tie-coat

1 coat – International Interfine 629 HS Modified Acrylic Top Coat (Color FS26270)

WARNING! Chipped, cracked or worn paint must be repaired to prevent corrosion of surfaces.

The winch frame has been hot dip galvanized for enhanced corrosion protection. Generally the galvanized coating can be repaired with cold galvanizing compound spray paint.

3.0: INSTALLATION

3.1: INSTALLATION

The General Arrangement drawing in the drawing section of this manual provides the layout of the winch including overall dimensions and footprint. The winch foundation should allow for easy installation and removal as well as ample drainage.

WARNING! A paint repair has been included in your shipment. Refer to Appendix C for directions on how to repair paint chips. If paint is not touched up after installation, components will start to rust.

WARNING! All bare metal surfaces on your winch have been coated with a rust prevention coating (Tectyl 506) prior to shipping. This coating should be removed from the levelwind guide rods and lead screw before use. Refer to Appendix C on instructions for removal.

3.1.1. ALIGNMENT

The winch levelwind has been designed for a maximum horizontal fleeting angle of +/-5°. Ensure that the horizontal fleeting angle does not exceed this by measuring the cable angle with the level wind positioned at each flange. A vertical fleeting angle of +45° to -10° must also be maintained during normal operation.

These statements are true for use with the levelwind.

3.1.2. BOLT-DOWN INSTALLATION

The winch has 8x 1”-8 UNC threaded bosses in the frame for installing custom brackets for mounting to any bolt pattern.

The winch has been supplied with brackets installed to match the UNOLS 2’x2’ bolt pattern. If a non-UNOLS bolt pattern is required, simply remove these brackets and replace with the custom brackets.

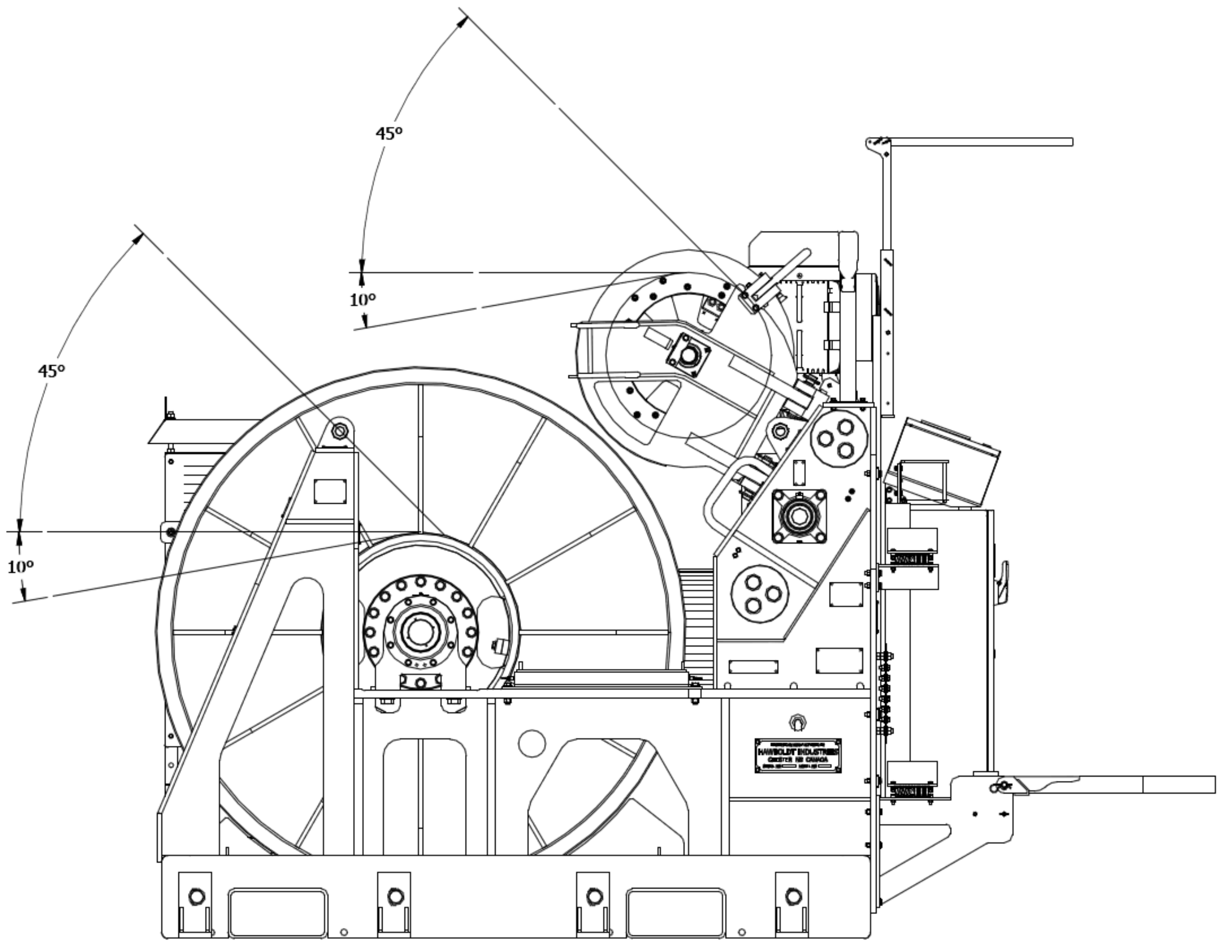
1”-8 UNC Gr.8 fasteners shall be used for mounting brackets to the winch frame.
1”-8 UNC 316 SS (ASTM F593H) fasteners shall be used mounting the brackets to the deck.

Torque specifications can be found in the Appendix of this manual.

Refer to the General Arrangement drawing in the drawings section of this manual for footprint details.

3.1.3. REEVING ARRANGEMENTS

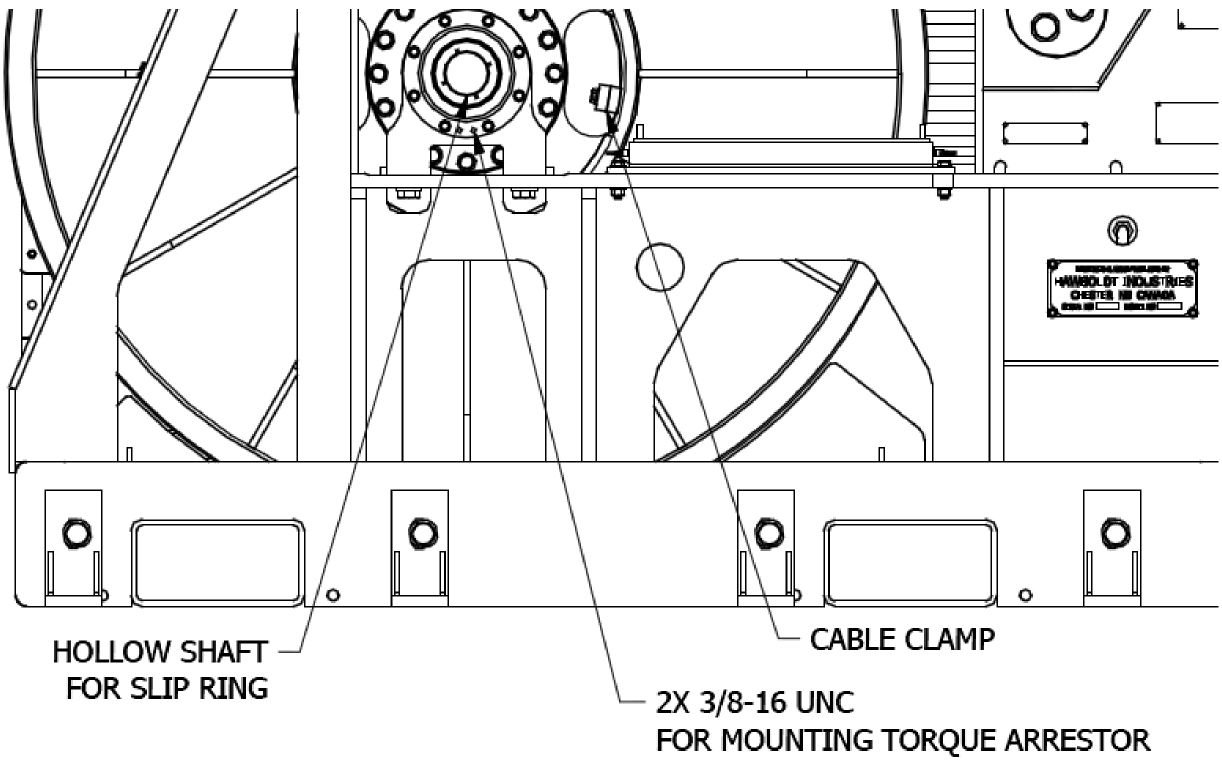
The winch can be used in two different orientations/reeving arrangements. The standard arrangement for the winch is to reeve the cable through the levelwind sheave. In this arrangement, tension and payout are monitored through sensors on the levelwind. The second arrangement is to have the cable exit directly off the drum. This arrangement allows for lower cable exit, however tension and payout cannot be monitored. The two acceptable arrangements are shown in the image below.



3.1.4. CABLE TERMINATION

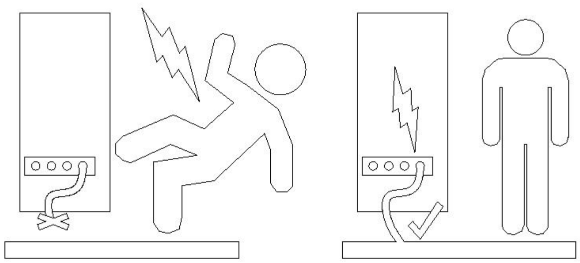
The winch drum includes provisions for Focal 180 Model slip ring as shown in the following image. The slip ring and cable are customer supply and will not be terminated by Hawboldt Industries. Openings in the drum core provide access to the cable and cable clamp. It is recommended that several service loops of cable should left wound inside the drum core to allow for re-termination of the cable.

Hawboldt has provided a cable clamp for ½" wire rope. Clamps for various size cables are available upon request.

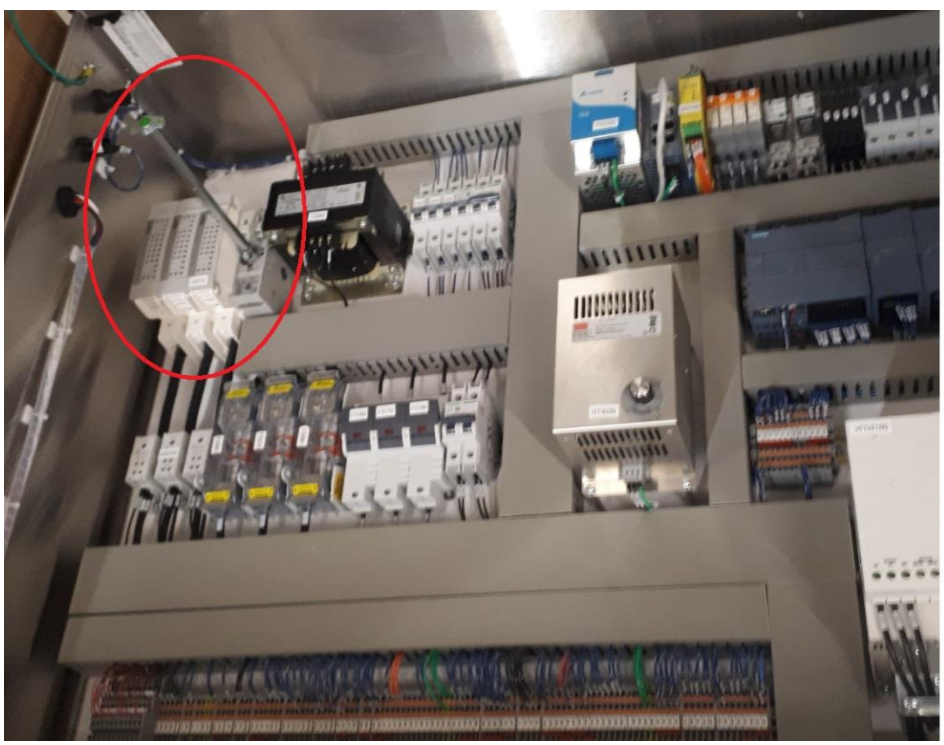


3.2: ELECTRICAL INSTALLATION

It is critical on installations that that the winch is bonded to the ship or mounting structure with 6 AWG copper wire or equivalent. This will increase the safety to the operational personal in case of electrical failure. This connection can be made the main bonding bar located to the left of the main panel.



The main power connection can be made at the large main panel. If a receptacle, plug, and length of wire are not provided, a power connection can be made inside the main large panel at the disconnect switch. A hole will have to be drilled preferable in the bottom of the panel. Use an appropriate marine rated cable gland for the diameter of wire. A grounding lug is provided inside of the panel. Note the standing platform will have to be removed in order to open the main panel.



The winch requires ~440-480VAC, 3 Phase, 90amps. The phases can be in any order and will not affect the operation. A grounding lug is provided to the left of the disconnect switch on one of the back plate mounting bolts, or bolted to the panels grounding stud.

Refer to electrical schematic 7400371 and interconnection diagram 7400373 for connection details.

The customer is responsible for ensuring the termination meets all required safety standards and specifications.

The winch is supplied with a pluggable hard wired ~40’ remote belly pack that allows remote control of winch. To connect the belly pack, first remove the protective caps from the mating connectors. Inspect the electrical pins and cups on both connectors to ensure they are free from debris. If any pins or cups are damaged, they will need to be fixed before a good connection can be made. The plug can only be plugged in one way. Gently rotate the wired connector until it slides into the mating panel connector. To lock the connector in place, turn the outside cuff until it locks. Connecting belly pack is optional and winch can be operated from winch mounted local console without it. It is recommended to disconnect and store belly pack in a dry space if it is not in use.

After an electrical connection and bonding is made to the machine, power can be applied. To turn the machine on, rotate the large disconnect switch to the ON position. The alarm buzzer will immediately sound. This is normal as e-stops energize in a fault state. Press the “RESET” button to silence the alarm. If the alarm does not silence, ensure all the e-stop buttons are “pulled off”.


SIEMENS
RESET
REMOTE
LOCAL CONTROL
WINCH PAYOUT
WINCH HAUL IN
D401010
LEVELWIND JOG
D401009

4.0: SAFETY

4.1: WARNINGS

Before operating this equipment familiarize yourself with all controls and their function. Equipment should only be operated by fully trained personnel.

The holding power of the brakes and proper functioning of all machine controls must be verified before the equipment is operated to ensure the operating conditions.

4.2: SAFETY RECOMMENDATIONS

It is essential to take precautions to ensure the safety of the operator and the crew while operating the winch system. The operator is to have a thorough knowledge of the winch system capabilities and always be present at the controls while the winch is running. The following recommendations are offered as a guide to safe operation:

- The equipment must be well maintained and be in good operating condition.
- Never attempt to clean or lubricate equipment components while the equipment is running.
- Never operate the controls until it is certain that all crew are clear of moving gear.
- Never exceed the maximum load ratings.
- Be sure the equipment is properly lubricated before use. See section on lubrication and maintenance.
- Never use this equipment to carry or lift people. It is not designed for this purpose.
- Before starting the system, be sure all controls move freely and are in the neutral position.
- Operate the controls smoothly to prevent shock loads to both the equipment and rigging.

5.0: SYSTEM OPERATION

Before Operation Begins:

- **WARNING!** When operating the winch the condition of the equipment must always be monitored by the operator with a clear view of the equipment.
- Use smooth, gentle motion with the joysticks. Sudden movements may damage equipment.
- The failsafe gearbox brake is a parking brake only and should not be used for dynamic braking. If this brake is subjected to dynamic braking, the winch should be taken out of service immediately and the brake replaced. See section 6.3.3.

5.1: WINCH REGULAR OPERATION - STEP BY STEP GUIDE

The following step by step guide is recommended for regular daily operation of the winch.

1. On the ship deck, visually inspect the winch and its surroundings for any irregularities before operation. Inspect the following:
    a. The winch drum is clear to rotate.
    b. The level wind is clear to move.
    c. The level wind guide rods, and acme screw have a thin layer of grease.
    d. Check the maintenance log in Appendix A to ensure routine maintenance has been performed.
2. If not already on turn Starter Panel disconnect switch on to establish power.

    WARNING! It is recommended to always keep power on to panel even when winch is not in use. This ensures anti-condensation heaters are powered.
3. When it is safe to operate winch, ensure all E-Stops are depressed and reset the safety circuit by pressing Local Console Reset button.
4. Navigate to HMI Alarms screen. There should be no warnings/alarms active. If there are warnings/alarms active refer to Alarms screen for more information on how to alleviate.

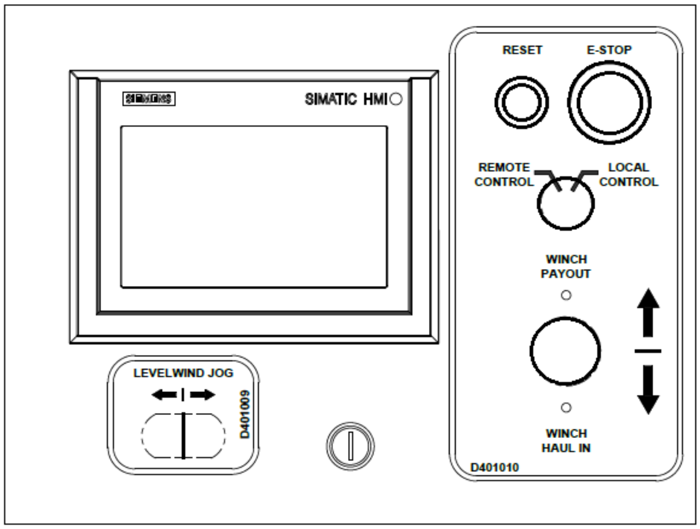
1. **Disconnect Switch:** Disconnects 480VAC supply power to the system. Switch must be in off position to open panel door.

   WARNING! Always ensure power is off before servicing equipment.

2. **Power On Light:** Illuminates blue when power is present.
3. **Alarm:** Illuminated and audible alarm.
4. **Ethernet Connectors:** [Right Side] Remote programming ports.
5. **Remote Connector:** Allows connecting remote belly pack cable while maintaining weather-tight panel seal. Both connector ends are supplied with caps that must be applied when belly pack is disconnected to maintain weather-tight panel seal.

5.1.1. LOCAL CONSOLE

This is the primary control console of the winch and the default control location at power-up. It is permanently affixed on the winch frame with direct view of the winch drum and level wind.



1. **Emergency Stop Button:** Trips the safety circuit which immediately stops the levelwind, winch drum, and engages the brake. Once de-pressed the safety circuit needs to be reset for winch to be operational. The safety is reset through the Reset button.
2. **Reset Button:** Resets the following:
   - Safety circuit: Once all E-Stop buttons are de-pressed and it is safe to operate press to reset safety circuit (instantaneous). This is a hardware reset and is the only method to reset safety.
   - Control system warnings/alarms: Reset control system warnings/alarms. Can also be reset from HMI Alarms screen.
3. **Winch Joystick:** Controls winch speed. The joystick has a center lock to prevent accidental operation of the winch. To operate winch, lift the joystick center lock and move it off center. The more the joystick is moved off center the faster the winch will turn. Moving the joystick forward will cause the winch to pay out; moving the joystick backward will cause the winch to heave. The maximum output of the joystick is configurable through the HMI main Line Control screen JS Max %; setting it lower than 100% allows for finer speed control across the joystick motion. The winch will only respond to joystick command if local control is active.

   WARNING! In case of a control system failure the conditions above will prevent operation of the winch. In emergency situations backup winch and level wind hydraulic controls can be used.

4. **Levelwind Jog Thumbstick:** Allows operator to jog level wind. Turning switch right moves level wind right (away from cable entry side); turning switch left moves level wind left (towards cable entry side). The jog speed is configurable through the HMI LW Control screen Jog Speed %.

   Please read the attached EZ spool and ProSpool manuals for jogging behavior while in auto spooling mode.

WARNING! Always maintain direct visual contact with the drum and level wind condition when jogging level wind.

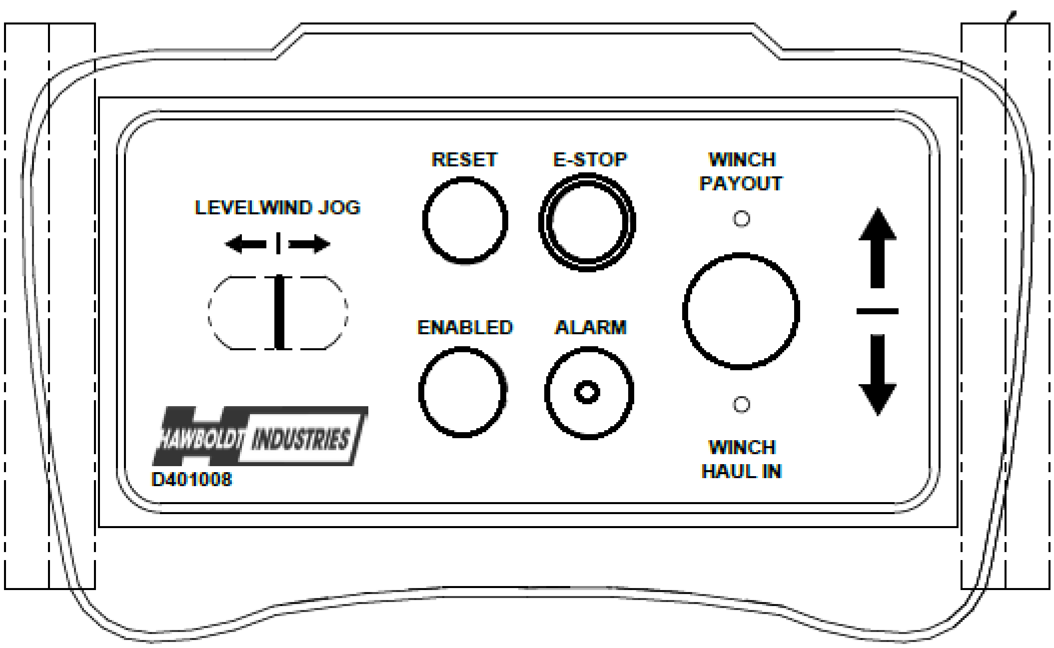
5. **HMI Touchscreen:** Includes all winch control and monitoring interface. The HMI is sunlight readable and rated for harsh outdoors use. The HMI is operational with any type of gloves.

5.1.2. REMOTE BELLY PACK

Remote belly pack is a secondary, optional control console that allows operating winch from a remote location. It is supplied with approximately 40' of cable to be connected to the main panel remote connector. Remote belly pack offers simplified controls of winch; however functions that require direct monitoring of winch condition are only available from local console.

WARNING! Remote control must only be granted after winch has been operated locally and qualified as ready for operation. When operating remotely the condition of the winch must always be monitored with a clear view directly or through appropriate closed circuit monitoring.

Remote belly pack is supplied with ergonomic handles and a neck strap for mobility.



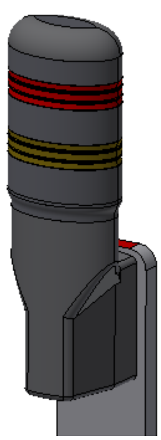
1. **Emergency Stop Button:** Trips the safety circuit which cuts power to the HPU pump and immediately engages the brake. Once de-pressed the safety circuit needs to be reset for winch to be operational.

WARNING! E-Stop button is only monitored if belly pack is connected to starter panel. If console is not connected pressing E-Stop will *not* trip safety circuit and *not* bring winch to a stop. If belly pack is not connected it is recommended to store it away from any operation stations.

2. **Enabled Indicator:** Illuminates when remote belly pack is in control.
3. **Winch Joystick:** Controls winch speed. To operate winch, ensure Remote Control switch is turned on and move joystick off center. The more the joystick is moved off center the faster the winch will turn. Moving the joystick forward will cause the winch to pay out; moving the joystick backward will cause the winch to heave. The maximum output of the joystick is configurable through the HMI main Line Control screen Joystick Max %; setting it lower than 100% allows for finer speed control across the joystick motion. The winch will only respond to joystick command if remote control is active, i.e. Remote Control switch light is on.
4. **Alarm Light/Buzzer:** Flashes/Buzzes when any warning or alarm is active. See the local HMI/Alarm Screen for a more detailed description.

5.1.3. BEACON LIGHTS

The winch is equipped with high luminance beacon lights mounted above the winch frame for 360° visibility. The beacon lights are intended to notify ship personnel when winch is being operated as well as when warning/alarms are active.



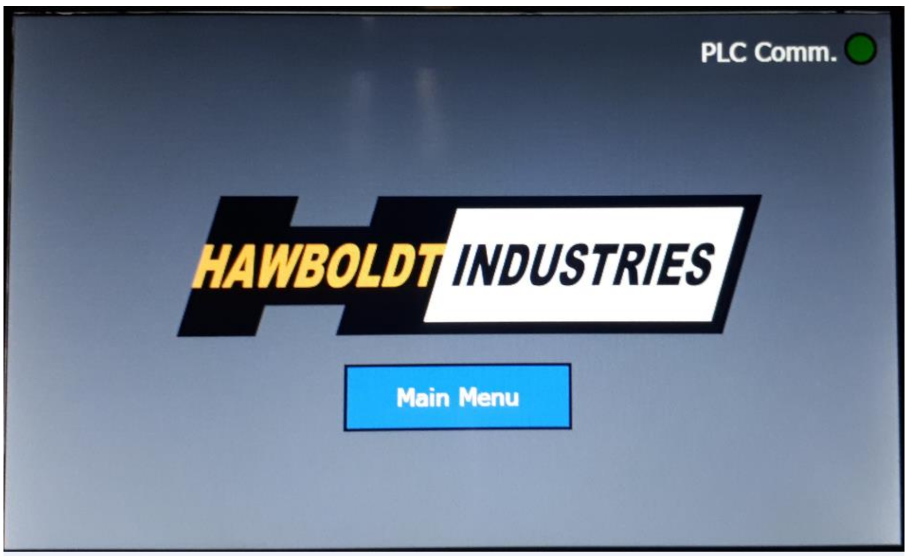
1. **Red Beacon Light (Top):** Solid for any Alarms, flashes for warnings.

   See the local HMI/Alarm Screen for a more detailed description.
2. **Amber Beacon Light (Bottom):** Illuminates steady when power is on. It flashes when the drum or level wind is running.

5.2: DESCRIPTION OF HMI OPERATIONAL SCREENS

5.2.1. START SCREEN

The start screen is the first screen available when the machine is first turned on, or when you press the HAWBOLDT logo on the main menu. **While in this screen the levelwind and winch inputs are disabled.**



PLC Comm.: Shows the current status of the communication between the PLC and the HMI. Blinking Green color is for good communication, and red error icon, or solid green color for PLC communication loss.

Main Menu Button: Touch this button to go the Main Screen

5.2.2. MENU SCREEN

The Menu screen is accessible from all screens by pressing the bottom Tension/Payout/Speed bar, which causes menu to slide up.

Top Display Console: Shows the current Tension, Payout, and Speed. Pressing this top bar will bring you to your last screen.

Date & Time: Can be set in “Screen Settings”.
Hawboldt Logo: Button to bring you back to Start Screen (lock controls).

Login: Used to access setup and maintenance menus.

Line Control: Activates main winch display screen.

Screen Settings: Activates general display settings screen.

Alarms: Activates fault, warning, display screen.

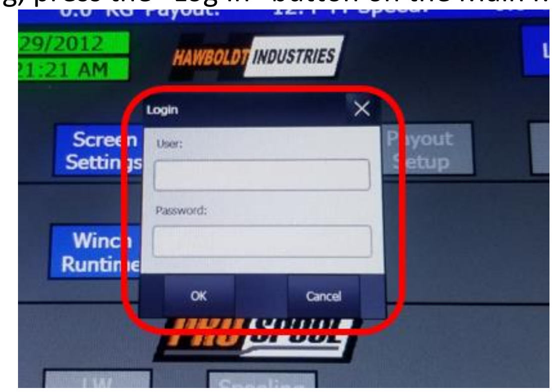
Winch Runtime: Activates screen displaying the current total drum runtime, as well as maintenance interval alarm.

ProSpool / EZ Spool:

The operator can toggle between using two different spooling controls. Non applicable buttons will "hide". See "EZSPOOL VS PROSPOOL" chapter for a comparison of these mode to decide what one to use for your application.

Setup Buttons GRAY: "Tension Setup", "Payout Setup", "Speed Setup", "Winch Setup", [ProSpool] "LW Setup", and "Spooling Configs" can only be accessed when you log into "operate" or "admin" user. These buttons are gray when disabled, and will turn blue when you are logged in.

__Log In:__
To activate the log in dialog, press the "Log In" button on the Main Menu.



There are two levels of logging in. The first level, "operate", grants access to most of the setup screens. The second, "admin", grants access to all screens.

Username: operate
Password: 0046

Username: admin
Password: 2672

To log out, press the "Log Out" button. The user will also be logged out automatically after five minutes of inactivity.

5.2.3. LINE CONTROL

This screen primary function is to provide the operator large readable cable tension, payout length and speed displays, which are the most important values to monitor during winch operation.

Depending on the spooling mode selected, the lower buttons will change accordingly.

Tension, Payout, Speed Display: Display the current line information about the winch. These displays can be moved in different orders on the screen in another menu. The refresh rates, decimal points, warning & alarm levels are also set in different menus. The "max" values remain on the screen until "Max Reset" is pressed. The units can be changed with the drop down arrow next to the value.

Tension Graph: This graph time can be changed (10s, 60s, 5min, 30min, 60min), as well as the max and min in the "Screen Settings" menu. It displays a trend of the tension reading.

Reset payout: This will reset the payout count to the value in the "Payout Setup" screen. Not the value loaded will be in whatever payout units are currently being used (M, KM, FT, MI, NM).
Reset Max: Clears the current Max value form the indicators. The current max tension value will be evaluated and potentially inserted in the "top 10" the "Tension Setup" screen, along with the date and time that tension happened.

Reverse LW (EZ Spool Only): Only visible when "EZ Spool" is selected. This will reverse the feeding direction of the level wind if it happens to be feeding the wrong direction.

Level Wind Mode Selector (ProSpool and EZ Spool):

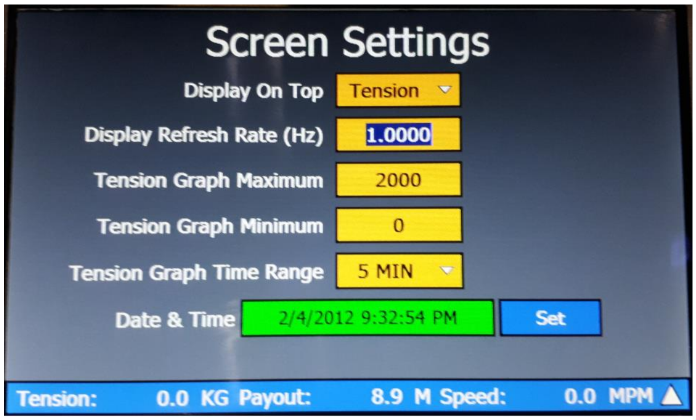
> **Manual LW**: Disables any automatic feeding. The level wind can be manually jogged into position.
>
> **Pro Auto LW / Easy Auto LW** – Enables automatic spooling, either ProSpool or EZ Spool depending on what is selected.
>
> **LW Park** – The level wind joystick(s) are disabled and the LW will remain where it is.

LW %: Scales the level wind joystick value. For fine control, a lower value of 10% can be used. For faster more reactive motions, use 80%.

Winch %: Scales the winch joystick maximum value. For fine control, a lower value of 30% can be used. For faster more reactive motions, use 100%.

Bottom Console: Shows the current Tension, Payout, and Speed. Pressing anywhere on this bottom bar will bring you to the "Main Menu".

5.2.4. SCREEN SETTINGS



Display On Top: Choose between Tension, Payout and Speed to be displayed on the top of the "Line Control" Screen.

Display refresh rate (Hz): How often you want the tension, payout, and speed values to be updated in the read outs.

Tension Graph Maximum: Maximum value for the tension graph.

Tension Graph Minimum: Minimum value for the tension graph.

Tension Graph Time Range: Range of the tension graph.

Date and Time: Current date and time. The time and date must be entered in the same format it is displayed in. Date and time format is MM/DD/YYYY HH:MM:SS AM/PM.

Set: Press to change the time, press again to confirm.

Bottom Console: Shows the current Tension, Payout, and Speed. Pressing anywhere on this bottom bar will bring you to the "Main Menu".

5.2.5. TENSION SETUP

[Log in Required] The tension setup screen allows you to change the decimal places of the tension display as well as calibrate the load pin.

Load Pin Calibration: Activated screens for load pin calibration.

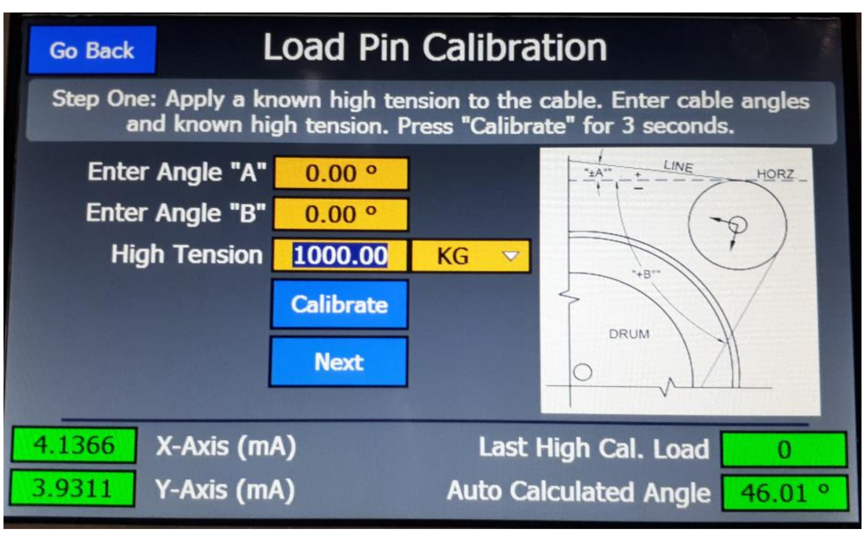
Peak Tension History: Activates a screen displaying the last 10 top tensions.

Decimal Places: Changes how many decimals are displayed.

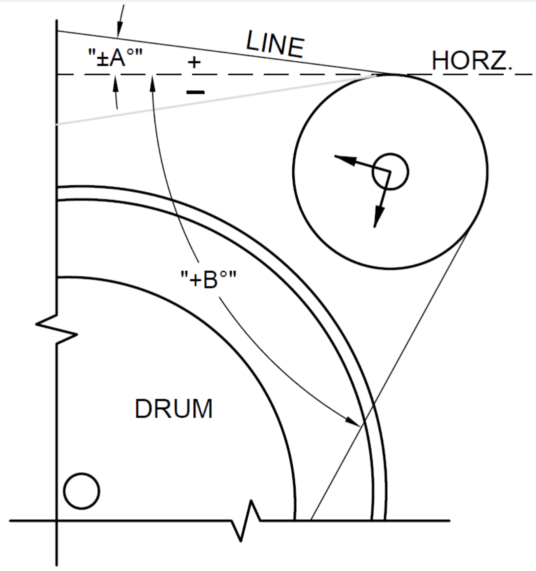
Warning & Alarm: These values are read only and come from the current ProSpool line configuration.

<u>**Load Pin Calibration (High):**</u>

Load pins should be calibrated periodically to ensure accurate readings. They should also be calibrated after being overloaded, or if they are new as well. Two point calibration can be carried out by following the instruction on the touch screen. After calibration, the tension display will be accurate even with variable line angle.



Enter Angle “A” & “B”: Enter the angle in +-degrees with the diagram as shown.



High Tension: Enter the known tension on the line. Select the units of the tension.

Calibrate: Once a known load has been applied to the cable, press and hold this button to save.

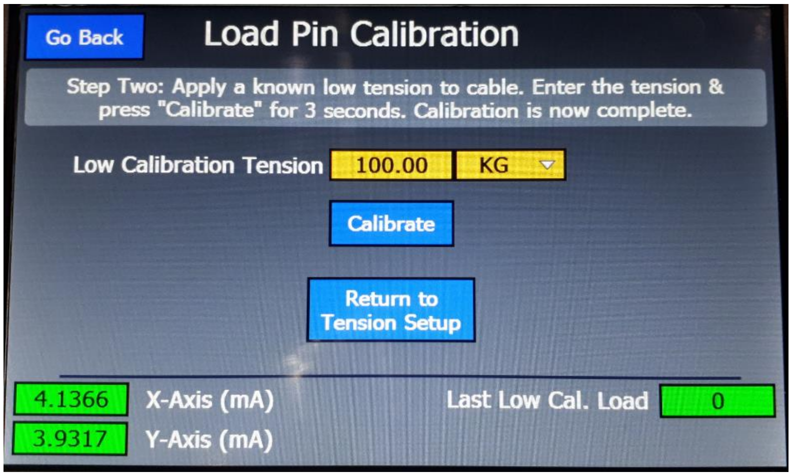
Next: Activate the low point save screen, which is the second part to two point calibration.

X & Y Axis (mA): Displays the current signal form the dual axis load pin. These should be between 3.5 – 22mA. If they are outside that range, the load pin may be damaged.

Last High Cal. Load: Displays the last calibration load value.

Auto Calculated Angle: The winch can automatically calculate the drum to sheave angle (“B”). This is used to ensure accurate tension reading even if the line exit angle changes.

Load Pin Calibration (Low):

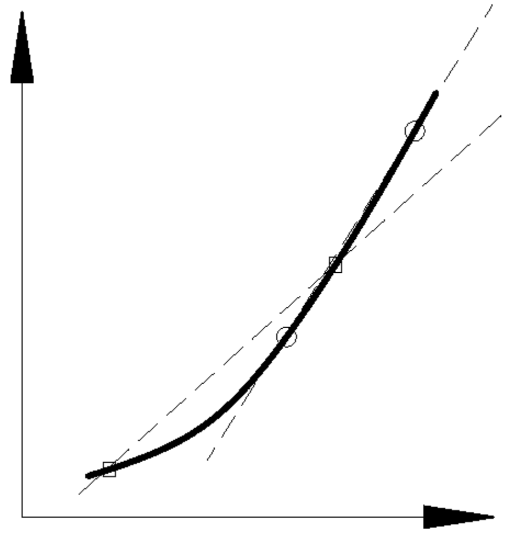


To complete calibration, remove the high load from the cable, and apply a smaller one.

Low Calibration Tension: Enter the known tension on the line. Select the units of the tension.

Calibrate: Once a known load has been applied to the cable, press and hold this button to save.

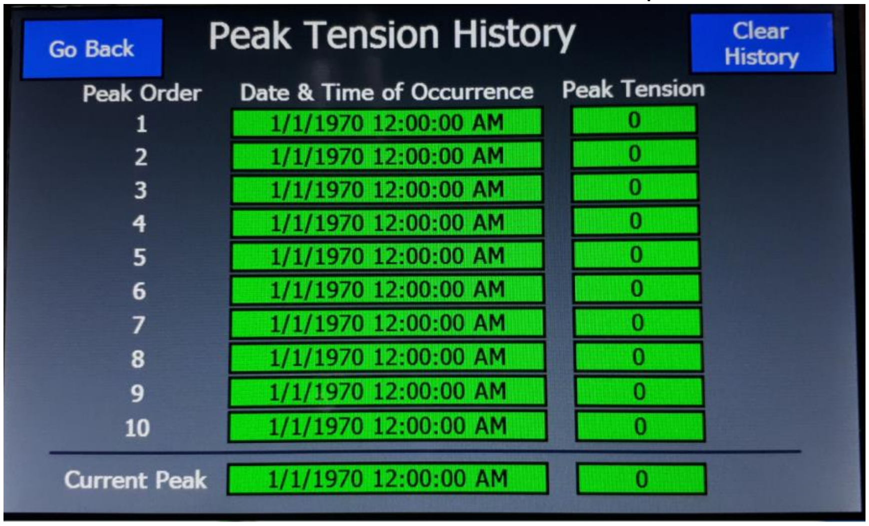
Note that the load pin signal is not linear. If you are mostly working with high loads, you will get more accurate results if you calibrate in the between the bottom third and top of the safe working range. If more accuracy is required in the lower range, calibrate with very low and top two thirds of the safe working range.



Return to Tension Setup: Brings you back to the tension setup screen.

Peak Tension History:

The tensions are evaluated and saved whenever “Max Reset” in pressed in the line.



History maintains peaks in descending order, with biggest peak stored under point 1 and smallest peak stored under point 10.

All peak tension values are displayed in the display unit set on Tension Setup screen.

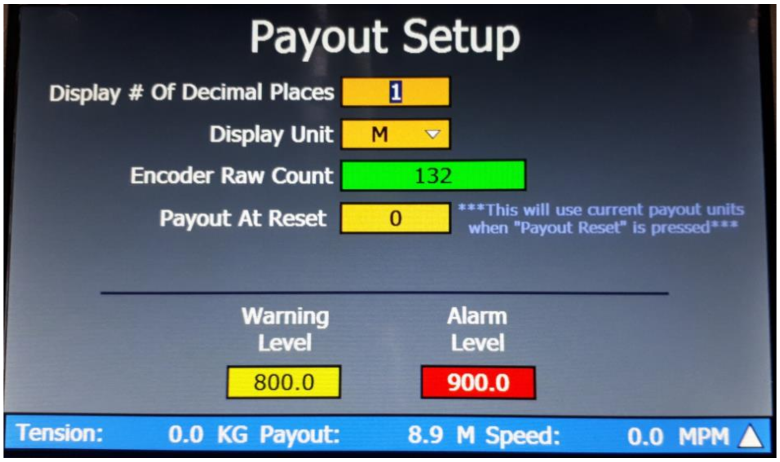
After 10 high peaks have been stored history will stop storing new peaks that might be considered high, but are not higher than what is already stored. After processing peak tension history it is recommended to clear it by pressing and holding Clear History button for 3 seconds. Clearing history resets all 10 peak tension points to 0, which allows storing new peaks.

Date & Time of Occurrence is displayed in the following format:

MM/DD/YYYY HH:MM:SS AM/PM

5.2.6. PAYOUT SETUP

[LOG IN REQUIRED]



Decimal Places: Changes how many decimals are displayed.

Display Units: Select what units payout is in.

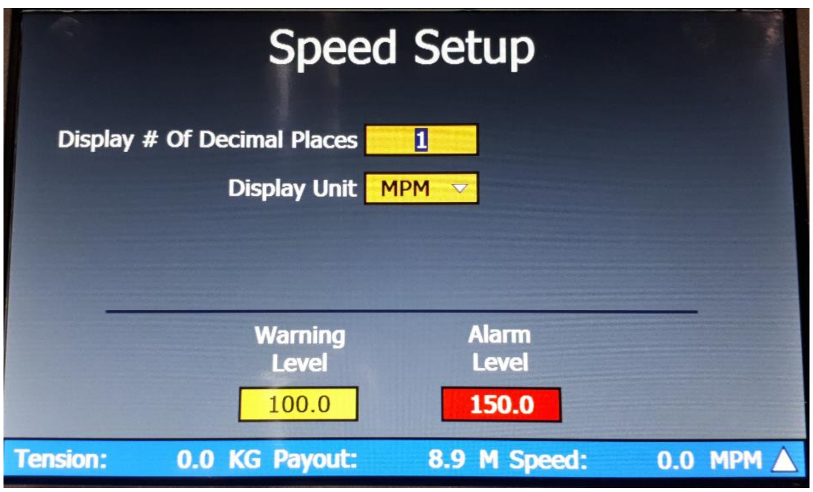
Encoder Raw Count: Read only value displaying the sheave count. Mostly for trouble shooting.

Payout at Reset: When “Reset Payout” is pressed in the “Line Control” screen, this value will be loaded. Note that the value has no units, so whatever units you are currently using when the reset button is pressed will be applied.

Warning & Alarm: These values are read only and come from the current ProSpool line configuration.

5.2.7. SPEED SETUP

[LOG IN REQUIRED]



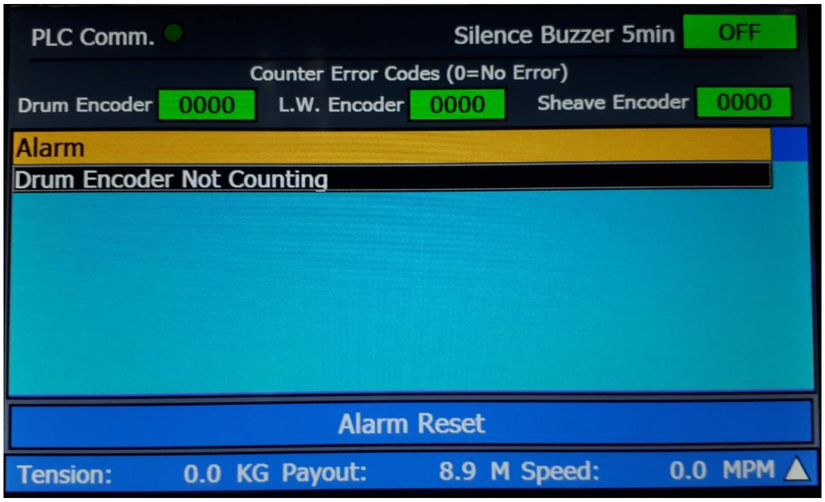
Decimal Places: Changes how many decimals are displayed.

Display Units: Select what units speed is in.

Warning & Alarm: These values are read only and come from the current ProSpool line configuration.

5.2.8. ALARMS

This screen displays the current alarms, warnings, and diagnostic cautions in the system. Alarms will have a steady tone buzzer. Warnings will have a timed tone buzzer, and diagnostic cautions will not produce any alarm, but will appear on the “Alarm” screen list. Pressing the “Reset Button” or the soft key “Alarm Reset” will attempt to clear the error. If the error persists, it will need to be fixed.



Alarm Text	Cause	Effect	Corrective Action
LW VFD Fault	Level wind VFD has faulted	Level wind will not move	Open the panel, and read fault code on VFD, review VFD manual
Winch VFD Fault	Winch VFD has faulted	Winch will not move	Open the panel, and read fault code on VFD, review VFD manual
Breaker Trip Local Panel DC3	CB4031 Tripped	Local control power failure	Reset breaker, if re-trip, find fault
Breaker Trip PLC Out DC4	CB6191 Tripped	PLC output failure, no winch or LW	Reset breaker, if re-trip, find fault
Breaker Trip BP, Sensors, DC5	CB8290 Tripped	Sensor and belly pack power failure	Reset breaker, if re-trip, find fault
Estop Active	Estop is active	No winch or LW	Reset push buttons, reset
Payout Alarm Level	Payout Level High	Solid alarm	Set max higher, or heave in
Tension Alarm Level	Tension Level High	Solid alarm	Set max higher, or relieve load
Speed Alarm Level	Speed Level	Solid alarm	Set mac higher, or reduce

	High		speed
Brake Resistor Temp Alarm	Brake resistor air temp >160*C	Solid alarm	Reduce regen (payout load holding)
Brake Chopper Ground Fault	Electrical current leak	Winch will not run	Increase trigger threshold, find ground fault before further use.

Warnings	**Cause**	**Corrective Action**
Belly Pack Not Conn. For Remote	"Remote" control is selected but belly pack is not connected	Connect belly pack
X-Axis Tension Pin Failure	Load pin signal error	Fix connection, replace load pin
Y-Axis Tension Pin Failure	Load pin signal error	Fix connection, replace load pin
REM L.W. JS Sig. Out Of Range	Remote level wind joystick error	Fix connection, replace joystick
REM Winch JS Sig Out Of Range	Remote winch joystick error	Fix connection, replace joystick
LOC L.W. JS Sig Out Of Range	Local level wind joystick error	Fix connection, replace joystick
LOC Winch JS Sig Out Of Range	Local winch joystick error	Fix connection, replace joystick
ProSpool LW Not Homed	PS level wind not homed	Home level wind
ProSpool Home EOT	PS home end of travel	Fix connection, replace sensor
ProSpool End EOT	PS end, end of travel	Fix connection, replace sensor
ProSpool LW Following Err	PS cannot keep up to set point	Increase "P" value, jog closer to SP when moving to auto.
ProSpool LW Auto Dir Err	PS output is sending the level wind the wrong way	"invert" the output in prospool setup
Payout Warning Level	Payout at warning level	Set warning level higher, or heave in
Speed Warning Level	Speed at warning level	Set warning level higher, or reduce winch speed
Tension Warning Level	Tension at warning level	Set warning level higher, or reduce load
Brake Resistor Temp Warning	Brake resistor is getting hot	Reduce regen (payout load holding)
VFD Panel Too Hot	VFD panel is above alarm level	Reduce loading, cool panel down

Diagnostic Caution	Corrective Action / Description
LOC L.W. JS Switch Err B	joystick error condition, fix wiring / replace joy stick
LOC L.W. JS Not Calibrated	Joystick requires calibration
LOC Winch JS Switch Err Both	joystick error condition, fix wiring / replace joy stick
LOC Winch JS Switch Err A	joystick error condition, fix wiring / replace joy stick
LOC Winch JS Switch Err B	joystick error condition, fix wiring / replace joy stick
LOC Winch JS Not Calibrated	Joystick requires calibration
Drum Encoder Not Counting	Drum encoder may be disconnected or broken
Sheave Encoder Error	Sheave prox. sensors may be disconnected or broken
Sheave HSC Error	High speed counter has issue (see error output in Alarms)
LOC L.W. JS Switch Err A	joystick error condition, fix wiring / replace joy stick
LOC L.W. JS Switch Err Both	joystick error condition, fix wiring / replace joy stick
Local Winch Joystick No Signal	joystick error condition, fix wiring / replace joy stick
REM L.W. JS Switch Err Both	joystick error condition, fix wiring / replace joy stick
REM L.W. JS Switch Err A Switch	joystick error condition, fix wiring / replace joy stick
REM L.W. JS Switch Err B Switch	joystick error condition, fix wiring / replace joy stick
REM Winch JS Switch Err Both	joystick error condition, fix wiring / replace joy stick
REM Winch JS Switch Err A Switch	joystick error condition, fix wiring / replace joy stick
REM Winch JS Switch Err B Switch	joystick error condition, fix wiring / replace joy stick
Remote Winch JS Not Calibrated	Joystick requires calibration
REM L.W. JS Not Calibrated	Joystick requires calibration
ProSpool LW Motion Err	PS is trying to move level wind, but no motion was detected
ProSpool LW HSC Alarm	High speed counter has issue (see error output in Alarms)
ProSpool Drum HSC Alarm	High speed counter has issue (see error output in Alarms)
Remote Belly Pack Active	The belly pack is connected and active
Active EOT Slow Zone	Slow zones are set up, and the LW is currently in one
EOT Slow Zone Not Set Up	No slow zones set up

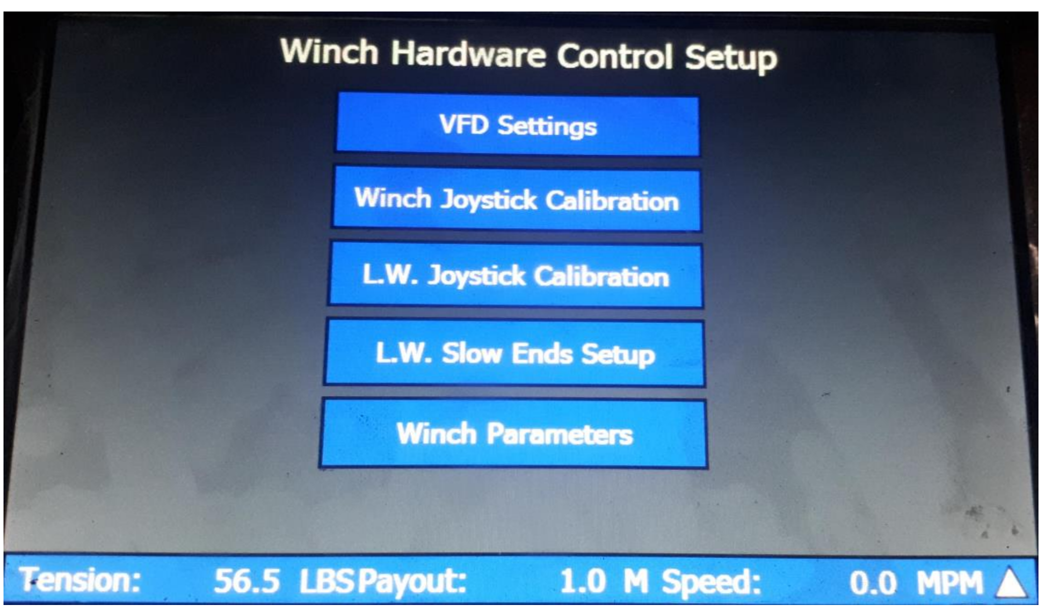
5.2.9. WINCH RUNTIME

Total Runtime: Displays the current total drum run time of the winch.

Runtime Since Last Maintenance: Displays the current elapsed drum run time since the last maintenance reset.

Maintenance Required Warning Hours: The interval amount between maintenance hours. This can be reset, and changed when logged in.

5.2.10. WINCH SETUP



[LOG IN REQUIRED ALL FIELDS]

VFD Settings: Navigate to VFD settings, panel temp alarm, current leak menu.

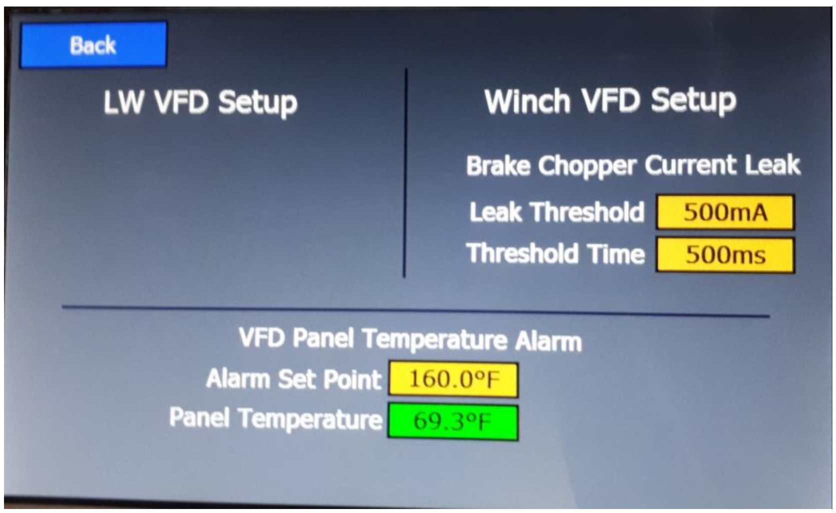
Winch Joystick Calibration: Navigate to calibration of winch joystick (belly pack and local).

L.W. Joystick Calibration: Navigate to calibration of level wind joystick (belly pack and local).

L.W. Slow Ends Setup: Navigate to set up the slow ends set points.

Winch Parameters: Navigate to winch parameters (sheave pitch diameter).

5.2.11. VFD SETTINGS



Actual variable frequency drive parameters are entered on the drives themselves, see the attached settings list.

Current Leak Detection: For the winch drive, it has a brake chopper with a brake resistor mounted on the front right side, ahead of the winch gearbox. During “regeneration” operations, the power being created from the inertia of the drum, or load lowering will be converted to DC voltage in the drive. When this voltage is high enough, it is converted to heat over the “brake resistor”. Due to the nature of the brake resistor handling high DC voltage (~700VDC), it is critical any ground faults are detected before they cause an issue. To ensure the safety of the personal and operation of the winch, the machine MUST BE BONDED to the ship or mounting structure.

To detect current leaking, a current transducer has been placed around the power lines going to the brake resistor. If any current is detected leaving the system, the winch will be shut down.

Leak Threshold: How much current is allowed to leak to the surrounding environment in mA. Note that above 500mA is considered very dangerous

Threshold Time: How long that the max current setting is allowed to leak for in milliseconds before shutting the drive down.

VFD Panel Temperature Alarm: The VFD cabinet has a temperature transmitter which can notify the operator the panel is getting to hot. The frequency drives will eventually fault if they get too hot.The alarm will provide a warning beep and indicator with warning text.

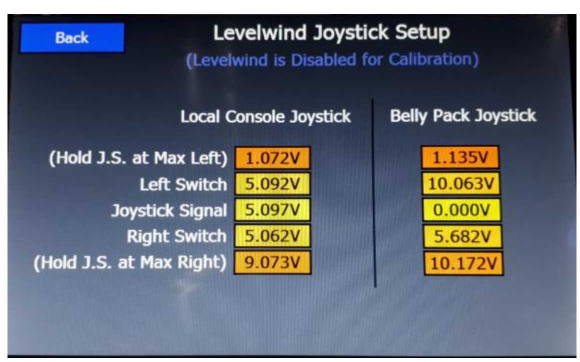
Alarm Set Point: Enter VFD max operating temperature in *F.

5.2.12. WINCH JOYSTICK CALIBRATION

If a joystick is ever replaced or the PLC is re-programmed, you may need to calibrate the joystick. Note that this is for the winch joystick(s) at the local console, and belly pack. You will need to switch the control to whatever joystick you are trying to calibrate. **The winch will be disabled during calibration, and the drum will not spin.**

5.2.13. L.W. JOYSTICK CALIBRATION

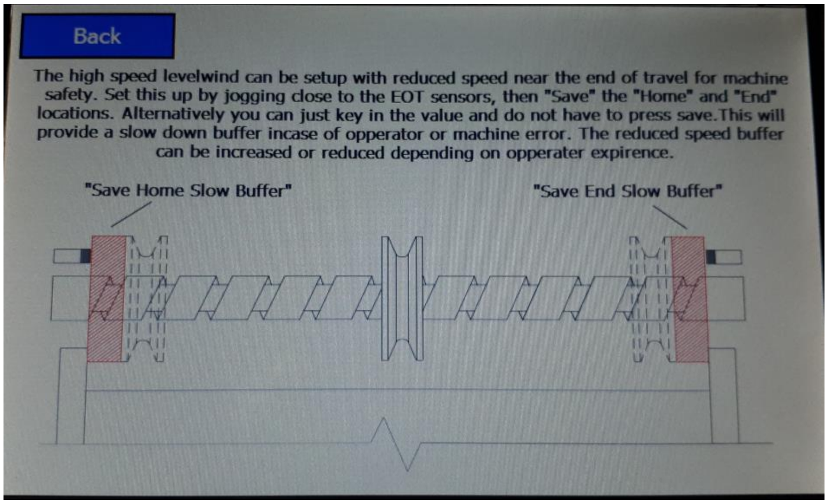
If a joystick is ever replaced or the PLC is re-programmed, you may need to calibrate the joystick. Note that this is for the level wind joystick(s) at the local console, and belly pack. You will need to switch the control to whatever joystick you are trying to calibrate. **The level wind will be disabled during calibration and the drum will not spin.**

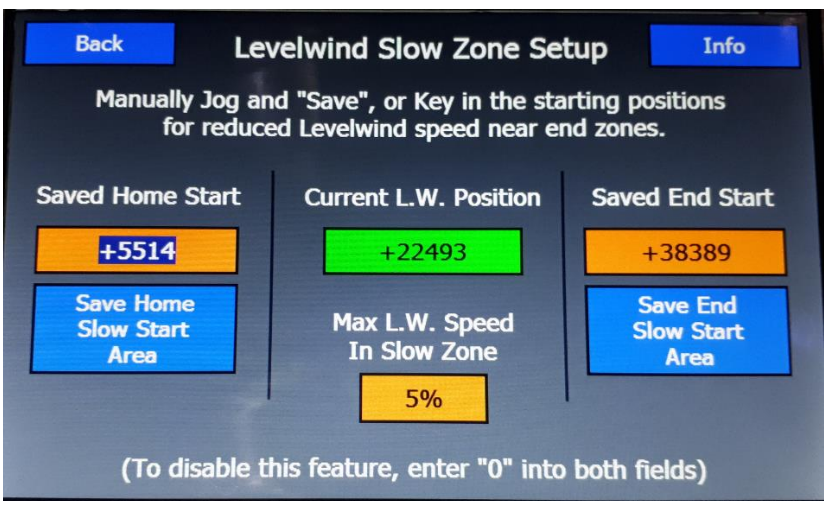


5.2.14. L.W. SLOW END SETUP

Due to the speed of level wind on this winch, an inexperienced user can accidently crash the level wind into the winch frame if they do not slow down near the ends of the level wind travel. To prevent this from happening, “Slow Zones” can be set. Pressing the “Info” button activates a small screen describing how to set up the zones.

Note that the count is taken from the level wind encoder. If you reset the encoder in ProSpool, you will need to reset these ends.



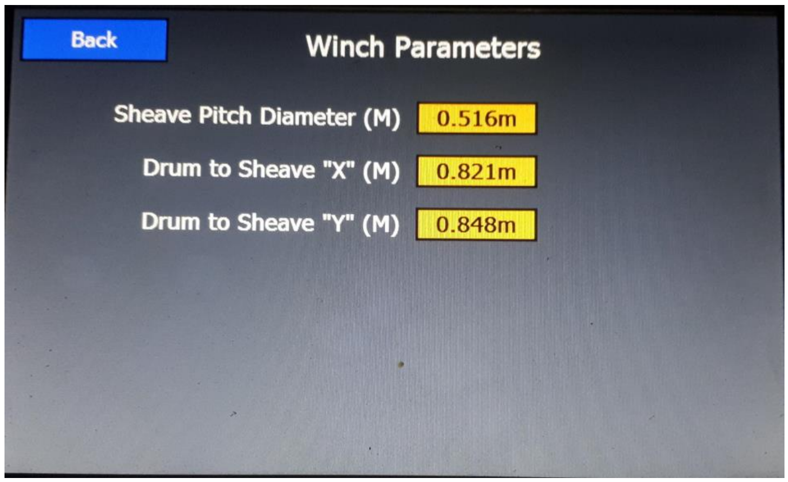


Save Home Slow Start Area: Jog to where you want the level wind to begin to slow down, press save until the number updates.

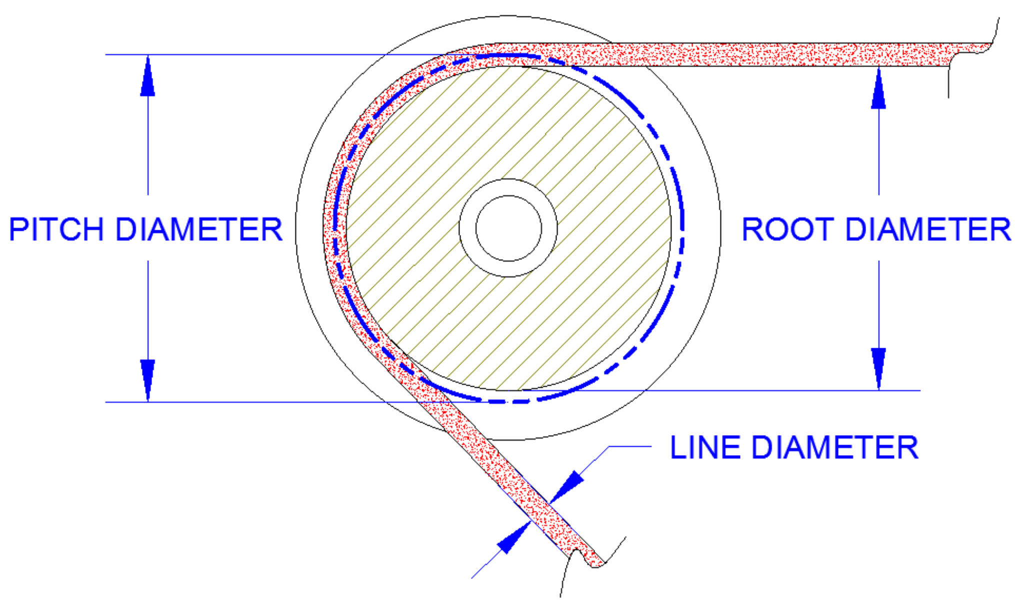
Save End Slow Start Area: Jog to where you want the level wind to begin to slow down, press save until the number updates.

Max L.W. Speed in Slow Zone: Max Speed the level wind can travel in the direction of the end of travel in the slow zone. Set between 5-10%.

5.2.15. WINCH PARAMETERS



Sheave Pitch Diameter (M): Is the sheave root diameter, plus the line diameter. It is important this value is accurate for payout and speed to be reading correctly. Note this value is always in meters.



Drum to Sheave "X" And "Y": This values should never be changed. Ensure they are as follows.

X = 0.821m & Y = 0.848m

5.2.16. EZ SPOOL VS PROSPOOL

ProSpool is best suited for complex and demanding spooling application. It is generally used for perfectly round/pitched cable on “grooved shell” with a highly accurate machined drum.
ProSpool allows for 10 different cable/drum configurations to be entered. It provides animated graphics and displays the current drum “layer” and “wrap”. It requires a lot of setup, and understanding to use proficiently.

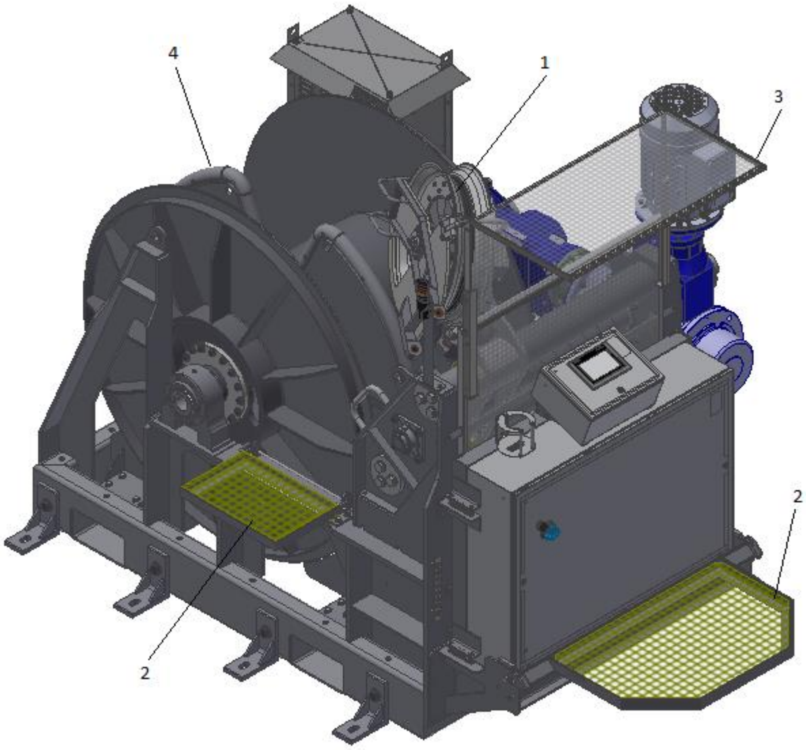
EZ Spool is best suited for general purpose cable/rope/tether spooling. It requires very little settings or understanding to operate well. It has a stripped back user interface and provides only critical feedback.

ProSpool and EZ Spool manuals are attached in Appendix D of this manual.

5.3: WINCH MECHANICAL FEATURES

The winch has a number of mechanical features which are used in the regular operation of the winch. These include:

1. Levelwind sheave opening for cable removal
2. Operator platform deployment and stow
3. Safety Screen deployment and stow
4. Center flange removal and installation

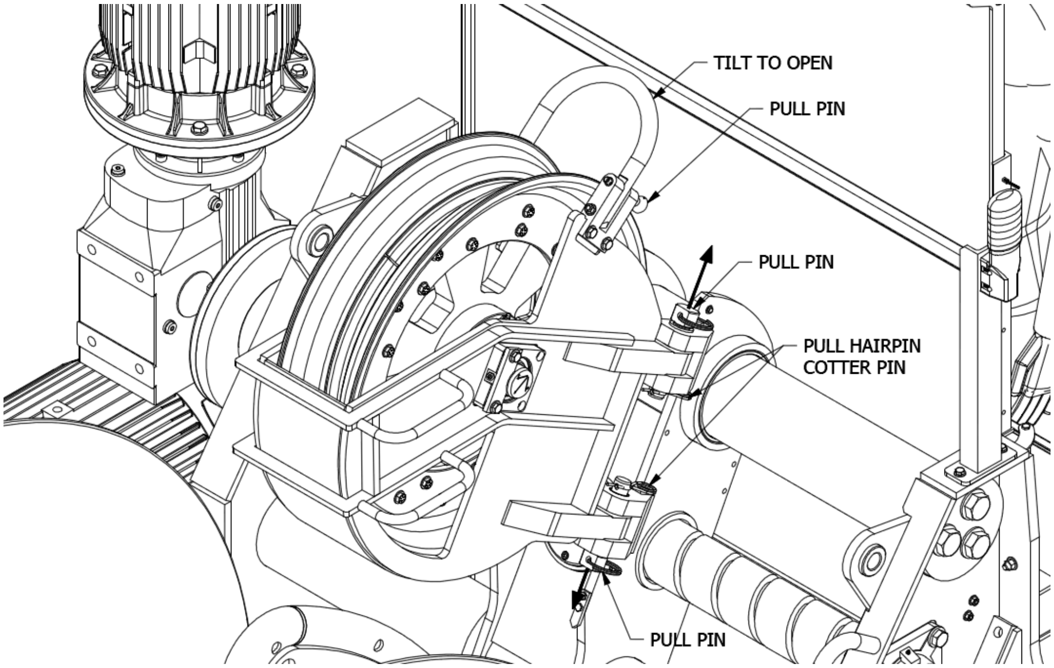


5.3.1. LEVELWIND SHEAVE OPENING

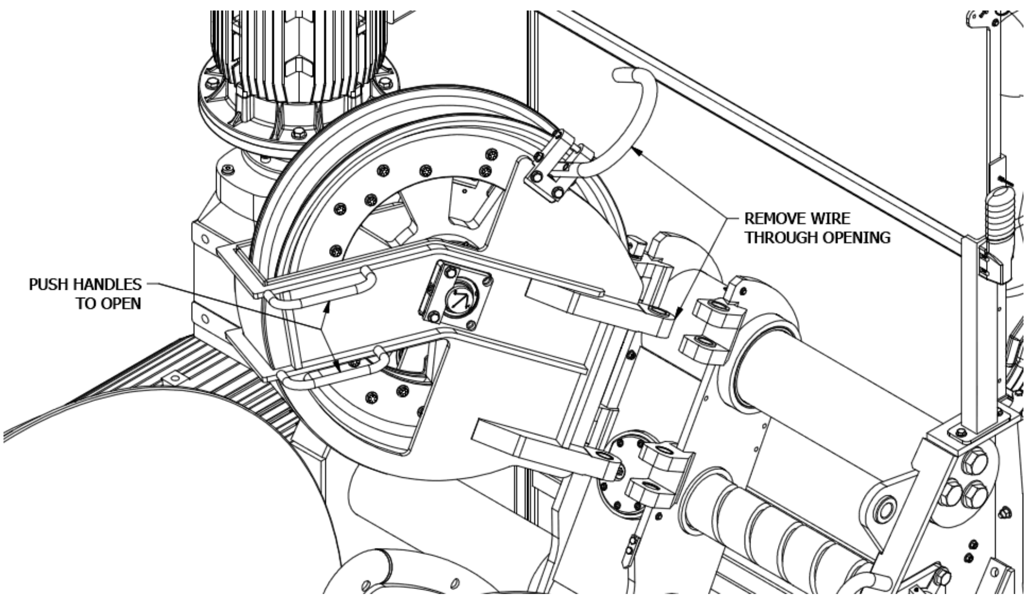
The levelwind sheave is mounted on a hinge to allow for the removal of the cable from the sheave. To do this the two 1” pins on the **non-drive side** of the levelwind carriage The side platform may be lowered for easier access to the levelwind. Steps to remove cable from sheave:

1. Remove retaining pin from cable keeper on top of sheave assembly and open cable keeper.

2. Remove cotter pins holding sheave pins in place and withdraw the two main pins on the **non-drive side** of the winch.



3. Push sheave towards drive side of winch, allowing it to rest on the stops on the opposing side.



4. Remove cable from sheave, close sheave and reinstall sheave pins & cotter pins. Close cable keeper.

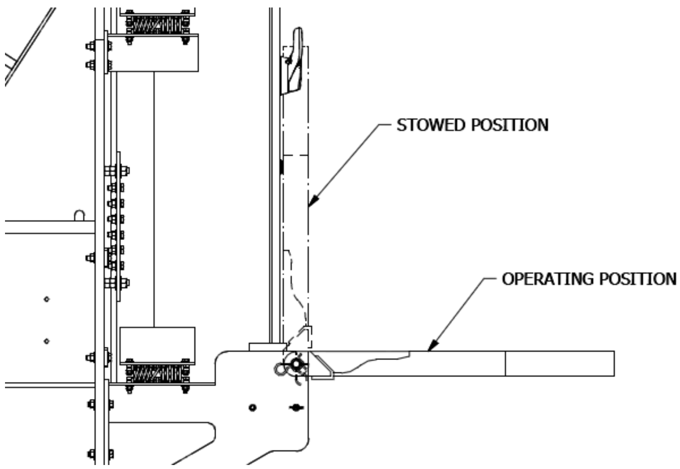
WARNING: The main pins must be reinstalled correctly with hairpin cotter pins. Incorrect installation of these pins may result in the sheave opening while under load which could result in injury or death.

WARNING: main pins on drive side of sheave should only be removed for sheave maintenance and only after disconnecting wires leading from levelwind sheave to levelwind carriage.

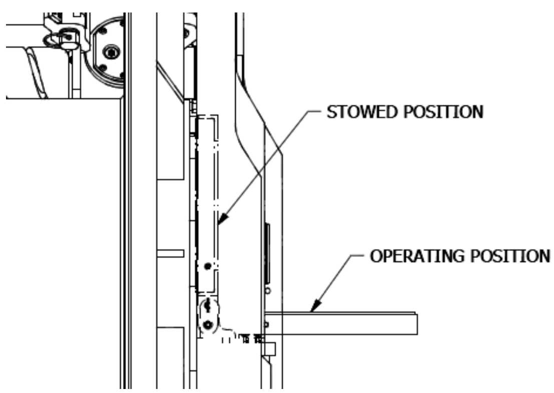
5.3.2. FOLDING PLATFORMS

The winch has two platforms, the rear operator's platform and the side maintenance platform. The side platform has an adjacent step and handle built into the winch frame for ease of access.

The rear platform is held in the stowed position by two ¼" pins, which when removed allow the platform to be lowered into a horizontal position. In the lowered position the platform is help in place by metal stops on the electrical enclosure frame.

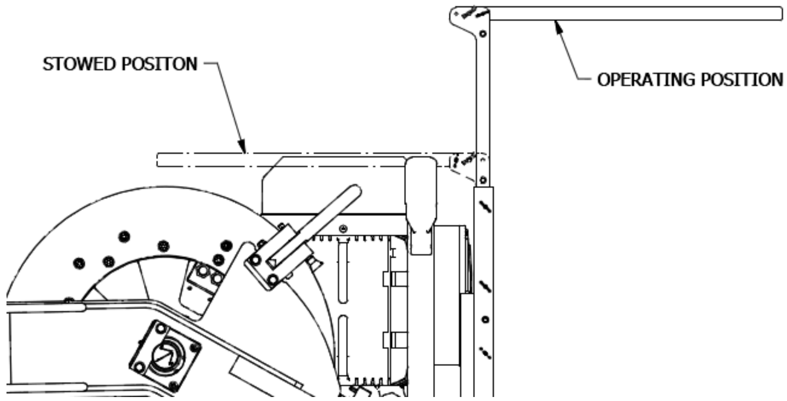


The side platform is help in the stowed position by two ¼" pins which when removed allow the platform to lower and rest on a nylon pad mounted on the frame of the winch.



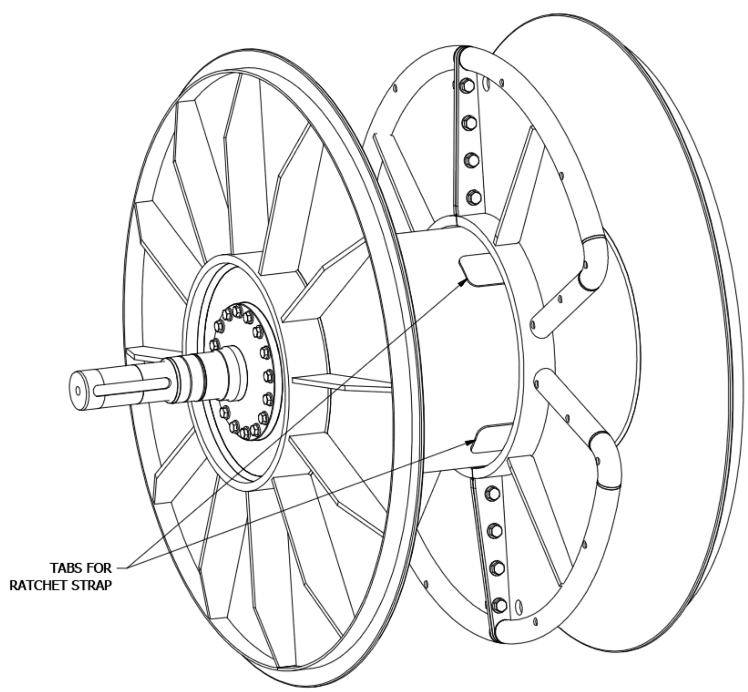
5.3.3. OPERATOR SCREEN

The operator position is protected from the winch by a screen made of 1/8" welded SS316 mesh. The screen consists of a lower portion that is fixed in place, an upper piece that is pinned in position and is lowered for shipping, and an overhead portion that is moved into a stowed position for shipping.

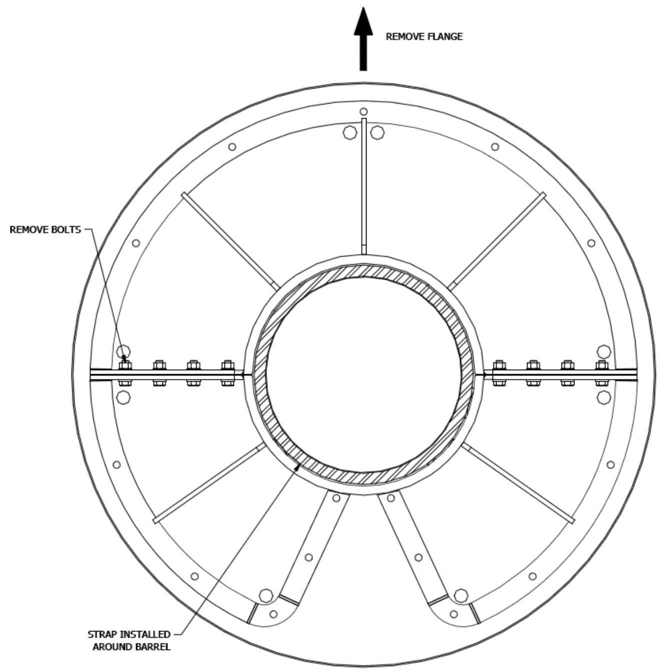


5.3.4. CENTER FLANGE REMOVAL

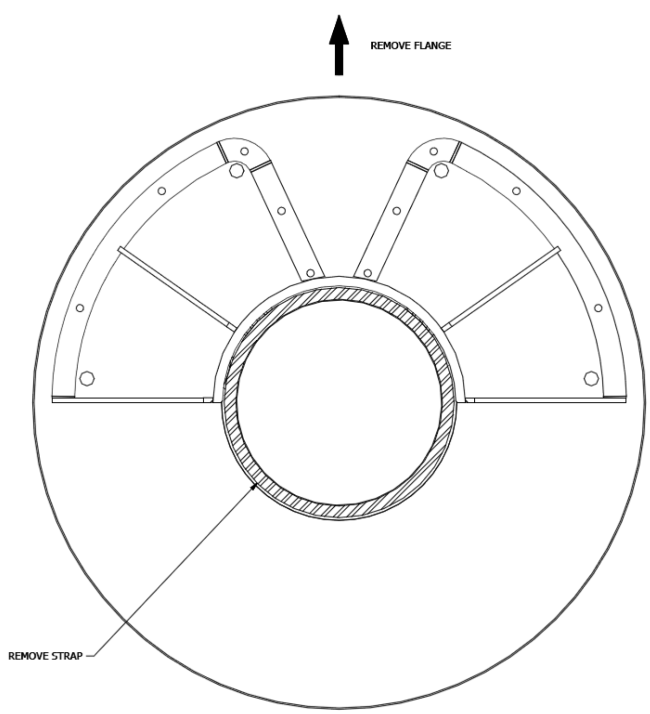
The center flange is fastened to the drum with 3/4”-10 x 2-1/4” bolts, four per side. The flange half containing the notch has two tabs that are flush with the barrel of the drum.



To remove the center flange, rotate the drum so the notched flange half is facing downwards and fasten a ratchet strap firmly around the barrel and across the two tabs. This is to hold the notched flange on the drum while the other half is removed. Once the strap is affixed to the drum, a crane should be attached to the un-notched flange half, which is facing upwards, to take the weight of the flange half when the bolts are loosened off. Next loosen and remove the 8 bolts and lift the un-notched flange off with the crane.



Finally, rotate the drum so the notched half is facing upwards, attach the crane, and loosen the ratchet strap to lift the notched flange half off the drum.



6.0: MAINTENANCE

6.1: STORAGE

It is the responsibility of the customer to assure deck machinery is properly stored and maintained once the goods are received.

The equipment may be stored out of doors provided that it is well greased and any damaged painted areas are repaired.

WARNING! A paint repair kit has been included in your shipment. Refer to Appendix C for directions on how to repair paint chips. If paint is not touched up after installation, components will start to rust.

WARNING! All bare stainless steel surfaces on your winch have been coated with a rust prevention coating (Tectyle 506) prior to shipping. This coating should be removed from the levelwind guide rods and lead screw before use. Refer to Appendix C on instructions for removal.

Precautions should also be taken when an installed system is shut down for long periods of time. If possible, the system should be started every two or three weeks to ensure internal parts are lubricated and to prevent the premature failure of seals and to reduce levels of condensation.

6.2: LUBRICATION

Although Hawboldt Industries uses materials and finishes well suited for use in severe marine environments it is imperative that a comprehensive lubrication maintenance program be utilized to assure long term reliability. If the unit is not used for extended periods, all points requiring periodic lubrication are to be attended to every 6 months and prior to restarting. Any excess grease is to be wiped off.

The lubrication section of the maintenance log (Appendix A) should be used to ensure proper lubrication intervals are maintained.

Refer to the Lubrication Drawing in the Drawings Section for grease point locations.

Refer to gearbox maintenance manuals for proper lubrication instructions.

6.2.1. BALL AND ROLLER BEARING LUBRICATION

There are multiple bearing housings on this winch containing bearings and radial shaft lip seals. These housings are designed to flush the old grease through the bearing and out the lip seals.

Apply grease through the grease nipple until fresh grease can be seen exiting the housing. It is recommended, if possible, to rotate the bearings slowly while greasing to ensure proper distribution of grease. Remove excess grease with a rag after all moving parts have stopped.

The levelwind bearing housing is designed to purge grease on the screw thread side. No grease should exit on the encoder side.

The drum shaft bearing housings are designed to purge grease on both sides of the bearing housing.

WARNING: If the grease is exiting on the wrong side, then the bearing will not receive proper lubrication which may result in premature failure. Check the seal condition and orientation.

6.2.2. BUSHING LUBRICATION

All bushings are designed with passages for grease lubrication and grease fittings for application with a grease gun. Apply grease until fresh grease can be seen exiting the sides of the bushings, and remove excess grease with a rag.

6.2.3. SCREW & GUIDE ROD LUBRICATION

The levelwind screw and guide rods facilitate the linear motion of the levelwind carriage and require a thin film of grease at all times in order to function properly and to avoid premature wear. Grease can be applied to the acme screw and guide rods by brush or spray can.

Grease should also be applied to the levelwind blade housing and carriage bushings to ensure that the internal components are well lubricated.

Maintain a thin film, and apply new grease every 20 hours of operation, or a minimum of once a month.

6.2.4. GEARBOX OIL

The operator is responsible for routine maintenance on the main drive gearbox. The following activities shall be performed as part of gearbox maintenance:

- For first time use, after 100 hours of duty (run-in) change the gearbox oil.
- Oil changes should be performed when the gearbox is hot so that particles maintain suspended in the oil, and to facilitate drainage.
- Subsequent oil changes should be performed at the intervals recommended in the gearbox manual.
- Do not mix different types of oil.
- Periodically check the levels (about once a month) and top up if necessary.

For additional information on gearbox maintenance refer to the gearbox maintenance manual in the component literature section.

Utilize the maintenance log in Appendix A to schedule and record gearbox maintenance.

6.3: MECHANICAL MAINTENANCE

Hawboldt Industries mechanical components are designed for high duty operation. It is imperative that a comprehensive maintenance program be utilized to ensure long term reliability. The mechanical maintenance section of the maintenance log (Appendix A) should be used to ensure proper maintenance intervals are maintained.

Components that require mechanical maintenance include:

- Ball and Roller Bearings
- Tightening of Critical Bolts
- Parking Brake

In addition to these items, please review the component literature section for additional maintenance information on sub-components.

6.3.1. BALL AND ROLLER BEARINGS

Ball and roller bearings may require replacement prematurely if a proper lubrication schedule is not maintained, or as expected after many hours of use. Replacement of ball and roller bearings can be logged using the mechanical maintenance log in Appendix A.

Signs of a worn bearing could be recognized by abnormal bearing noise, unstable motion, or misalignment during operation.

6.3.2. TIGHTENING OF CRITICAL BOLTS

All bolts should be checked for looseness and tightened periodically to ensure that they have not loosened due to vibration of equipment during operation. Critical bolts must be tightened to the specified torque values. Hawboldt recommends checking bolts after the first 100 hours of operation, and once every 6 months thereafter. Tightening of critical bolts can be logged using the mechanical maintenance log in Appendix A.

Critical bolts are bolts which are in the primary load path of the winch. The torque specifications for critical bolts are shown on the assembly drawings. The torque specifications on the assembly drawings are based on a k value of 0.15, lubricated. Reference torque charts can be found in Appendix B.

After the bolts have been tightened the paint must be touched up to avoid corrosion.

6.3.3. PARKING BRAKE

The failsafe motor brake should be tested periodically to verify its holding torque. Hawboldt recommends that the brake be tested once every 6 months or 1000 hrs of operation (whichever occurs first) to 125% of the rated winch pull. If the brake slips when loaded to 125% or less, the brake pack must be replaced.

The failsafe motor brake is a parking brake only and should not be used for dynamic braking. Here a few ways in which the brake can be subjected to dynamic braking:

- Insufficient electrical power to fully release the brake
  - Example: Stick-slip while paying in or out.
  - Example: “Dragging” noises while paying in our out.
- Slippage due to excessive loading.
  - Example: Joystick centered and brake applied, but the load causes winch to payout
    - If this occurs, the operator should put the winch in heave immediately.
- Brake applied while drum is rotating
  - Example: E-stop is pressed while the winch is paying out under load

If this brake is subjected to dynamic braking, the performance of the brake may be compromised. If any of the above scenarios have occurred or are suspected, the winch brake must be inspected for wear and replaced if damaged.

6.4: DECALS

Your equipment was shipped from the factory with a set of decals applied.

Should any of these decals be missing, they could prevent the proper operation and/or maintenance of the unit which may result in personal injury or property damage.

If any of these decals are missing, please contact us for a replacement.

Order the decal(s) by stating decal description, number, and quantity. A complete list of decals can be found in the drawings section of this manual.

6.5: SPARE PARTS

Two sets of offshore spares have been supplied with the winch. The following table contains a list of offshore spare parts:

HAWBOLDT PART NUMBER	MANUFACTURER	DESCRIPTION	QTY
34-00304-396	Hawboldt	Sheave Hinge Pin	4
34-00304-431	Hawboldt	Sheave Bumper Plate	4
34-00304-591	Hawboldt	Sheave Hinge Pin Bushing, 1” LG	8
34-00304-900	Hawboldt	Helical Blade, 4” Screw	1
34-00304-590	Hawboldt	Sheave Hinge Pin Bushing, 1.5” LG	4
34-00304-039	Hawboldt	Sheave Liner	1
34-00304-484	Hawboldt	Sleeve Bushing	6
34-00304-904	Hawboldt	Flanged Bushing	2
5408423	SKF	Radial Shaft Seal – Drum Bearing, Outside	1
5408451	SKF	Radial Shaft Seal – Drum Bearing, Inside	1
5408555	SKF	V-Ring Seal	1
5406547	SKF	Radial Shaft Seal –Encoder Shaft	2
5405122	SKF	Angular Contact Bearing – Levelwind Drive	3
5408454	SKF	Spherical Roller Bearing – Drum Bearing	1
5400027	SKF	Flanged Bearing – Levelwind Idler	1
5405795	SKF	Radial Shaft Seal – Levelwind Drive	1
5408661	SKF	Lock Nut – Levelwind Screw	1
5408565	SKF	Tapered Roller Bearing – Sheave	2
5408574	SKF	Washer – Sheave	1
5408573	SKF	Radial Shaft Seal – Sheave	2
5408577	SKF	Spherical Plain Bearing – Load Pin	2
34-00304-586	Sensy	Load Pin – 14 KIP – Dual Axis	1
5408630	McMaster-Carr	Quick Release Pin	4
5408708	McMaster-Carr	Lanyard	4
5408698	McMaster-Carr	Lanyard	4
5406174	McMaster-Carr	Hex Nut, Bronze	20
5405981	McMaster-Carr	Quick Release Pin	1
5407212	McMaster-Carr	Quick Release Pin	4
5408716	McMaster-Carr	Lanyard	2
5409030	McMaster-Carr	Clevis Pin	2
5409031	McMaster-Carr	Flanged Bushing	6
5408631	McMaster-Carr	Clevis Pin	2
5405988	Omron	Proximity Sensor – NC	2
5403849	Omron	Proximity Sensor – NO	2
5408517	Parker	O-Ring – 2-160, 70 Duro	1
5402865	Parker	O-Ring – 2-375, 70 Duro	1

5408440	Parker	O-Ring – 2-167, 70 Duro	2
5405222	Stright-Mackay	Zinc Anode	2
5406446	Turck	Incremental Encoder	2
5406451	Turck	Encoder Cable	2
N/A	Generic	Grease Fitting, 90 Deg	1
N/A	Generic	Grease Fitting, Straight	5
34-00304-085	IDEC	Light, Beacon	1
	Stromag	Motor Mounted Parking Brake	1
5406839	Hawboldt	Paint Touch-up Kit	1
5404607	SIEMENS	PLC	1
5404756	SIEMENS	PLC card	1
5406021	SIEMENS	PLC Card	1
5406400	SIEMENS	HMI	1
5408563	ABB	Winch VFD	1
5408564	ABB	Levelwind VFD	1
5409025	AccuAmp	Current Leak Transducer	1
5408352	DELTA	DC power supply	1
5407909	Danfoss	Thumb joystick (10-90%)	1
5408650	PQ	Main joystick (20ma-12ma-4ma)	1
5406915	SOURIAU	Plug Receptacle	1
5406916	SOURIAU	Connector Plug	1
5406244	SOURIAU	Connector cap receptacle	1

7.0: FACTORY ACCEPTANCE TEST

This section contains the completed Factory Acceptance Test (FAT) reports.

HAWBOLDT INDUSTRIES

Factory Acceptance Test for

General Purpose Electric Mooring Winch
Model# *SPRE-3466/S*

Document Approvals

Hawboldt Industries

Project Leader: ______________________ Date: __________

Test Technician: ______________________ Date: 22 Jan 20

Quality Assurance Representative: ______________________ Date: 22-JAN-'20

University of California San Diego

Customer Representative: ______________________ Date: 1/22/2020

Customer Representative: ______________________ Date: __________

Document Name:	FAT 1942 / 1943
Issue Date:	15-Jan-'20
Hawboldt Project Number:	1943
Product Serial Number:	1943
Test Date:	20-Jan-'20
Revision:	1

REVISION STATUS SHEET

Issue No.	Issue Date	Revision #	Revision Date	Description of Change	Prepared By
1	13-Jan-'20	0	13-Jan-'20	Original Issue	ARM
2	15-Jan'20	1	15-Jan-'20	Changed test values, Changed test order Added Level Wind Tests	ARM

TABLE OF CONTENTS

1.0 GENERAL

All tests will be coordinated by the Quality Specialist and the Engineering Department. In the event that a discrepancy should arise during or subsequent to any testing performed, the Engineering Department shall be consulted for resolution. Test results will be recorded on the applicable test data sheets contained within this procedure.

2.0 PURPOSE OF TEST

The purpose of this test is to subject the winch; Model # ***SPRE-3466/S*** subject to fulfill the performance and testing criteria outlined in this document.

3.0 APPLICABLE DOCUMENTS

a) Purchase Order #: PO 92043515

b) Drawing #: 34-00304-000 Revision A

c) Quote #: Q12536A

4.0 TEST FACILITY

Hawboldt Industries (1989) Ltd.
220 Windsor Rd, Highway #14,
Chester, Nova Scotia, B0J 1J0

5.0 AVAILABLE TEST EQUIPMENT & TEST APPARATUS

Table 1: Equipment

Item	Qty	Device	Description / Model Number
1	1	Power Source	Hydraulic Test Stand
2	1	Resistive loads	A-Frame Test Stand
3	1	Test Rope	
4	1	Stopwatch	Reed Instruments, SW 600
5	1	Pressure Gauge	
6	1	Dynamometer	

Note: If required, equivalent equipment may be used at the discretion of Hawboldt Industries.

6.0 CALIBRATION

All test facilities, test equipment and reference standards used to calibrate measurement equipment utilized in conducting the tests specified herein were calibrated in accordance with ISO 9001-2015. Calibration records are available for items that required calibration.

7.0 EQUIPMENT SPECIFICATIONS

Table 2: Dimension Confirmations

Dimension	Nominal	Actual
Bare Drum Diameter	24"	24 3/16"
Flange Diameter	~~66"~~ 64" ARM 20-JAN-'20	64 5/16"
Distance Between Flanges	34"	34 1/8"
Overall Height	96 - 1/2"	96 1/2"
Overall Length	127 – 5/8"	129" (STEP DOWN) (105" STEP UP)
Overall Width	75 – 2/5"	76"
Overall Dry Weight (No Oil or Wire)	9000 LBS	

Note: Actual dimensions are to match the nominal dimensions within a tolerance of +/- 1/16" unless otherwise stated.

Table 3: Component Identification

Component	Make	Model	Serial Number
~~Hydraulic~~ Motor ELECTRIC	MGM	SM 160 MB4	1939 1358

ARM 20-JAN-20
SEE NOTES PAGE

8.0 SPEED TEST

8.1 Objective:

- To test the maximum line speed under no load.

8.2 Setup:

- Remove all wire ropes from the winch. Place a mark on the drum flange and an aligning mark on the winch frame. Bare drum OD is approximately 24" inches, so 1 revolution of the bare drum is equivalent of 6.283 ft. Therefore to achieve a line pull of 92ft/min @ bare drum a RPM of 13 will be required.

$$\frac{24}{12} \times \pi = 6.283 \frac{ft}{rev}; \qquad \frac{92\ ft/min}{6.283\ ft/rev} = 13.051 \cong \mathbf{13\ rev/min}$$

8.3 Procedure:

- Clear the area of non-essential personnel.
- Stroke the valve to the full speed position and measure the bare drum speed.

8.4 Acceptance Criteria:

- The bare drum speed is to be at least 13 RPM in both pay-in and pay-out positions.

Table 4: Speed Test Measurements

Measurements			
Characteristic Measured	**Specified Min**	**Measured Value**	**Pass/Fail**
Bare drum speed			
Pay-in	13 RPM	17 RPM	PASS
Pay-out	13 RPM	17 RPM	PASS

8.5 Verification Sign-Off:

Hawboldt Test Technician: ______________ Date: 20 Jan 20

Hawboldt Quality Specialist: ______________ Date: 20 - JAN - 20

Notes/Remarks:

9.0 LEVEL WIND SPEED TEST

9.1 Objective:

- To test the maximum level wind speed under no load.

9.2 Setup:

- Remove all wire ropes from the winch. Put level wind to home position.

9.3 Procedure:

- Clear the area of non-essential personnel.
- Stroke the valve to the full speed position and measure the level wind speed from end to end.

9.4 Acceptance Criteria:

- The level wind should be able to go from end to end in 4 to 5 sec. in both directions.

Table 5: Speed Test Measurements

Measurements			
Characteristic Measured	**Specified Range**	**Measured Value**	**Pass/Fail**
Bare drum speed			
Pay-in	4-5 Sec	4.5 sec	Pass
Pay-out	4-5 Sec	4.5 sec	Pass

9.5 Verification Sign-Off:

Hawboldt Test Technician: ____________ Date: 22 Jan 20

Hawboldt Quality Specialist: ____________ Date: 22-JAN-'20

Notes/Remarks:

10.0 STATIC PULL TEST

10.1 Objective:

- To demonstrate stall pull within specified limit of 10, 000 lbs (4,536 kg) bare drum.

10.2 Setup:

- Mount the winch to a suitable anchor point.
- Securely attach on end of wire to drum, and the other to an suitable anchor point.
- A dynamometer will be mounted between the winch and test bed cleat to measure the force applied.

10.3 Procedure:

- Clear the area of non-essential personnel.
- Stroke valve to the heave position and record the maximum continuous line pull.

10.4 Acceptance Criteria:

- The winch will satisfactorily meet the continuous duty pull of 10, 000 lbs (4,536 kg) bare drum.

Table 6: Winch Pull Test Measurements

Measurements			
Characteristic Measured	**Specified Limit**	**Measured Value**	**Pass/Fail**
Stall Pull	≥ 10,000 lbs	12,000 LBS	PASS

10.5 Verification Sign-Off:

Hawboldt Test Technician: ______ Date: 22 Jan 20

Hawboldt Quality Specialist: ______ Date: 22-JAN-'20

Notes/Remarks:

11.0 BREAK PULL TEST

11.1 Objective:

- To test the winch brake at a load of **1.5 X SWL = 1.5 X 10, 000 lbs = 15, 000 lbs.**

11.2 Setup:

- Wind several wraps (6 minimum) onto the drum, and attach the free end to a test cylinder and hard point on the deck.

11.3 Procedure:

- Connect the free end of the test rope to the test cylinder and load cell in series.
- Clear the area of non-essential personnel.
- Operate the winch to take up slack in the test rope.
- Release the joystick and observe the brake is applied.
- Operate the test Cylinder until the pull of 15, 000 lbs. is obtained.
- Observe the winch for slippage. Record any observations in the Notes/Remarks section below.

11.4 Acceptance Criteria:

- The brake must hold a load of **1.5 X SWL = 1.5 X 10, 000 lbs = 15, 000 lbs.**
- The brake must hold the load for 2 minutes, or as instructed by the Customer Rep., with no movement in winch drum.

Table 7: Break Pull Test Measurements

Measurements			
Characteristic Measured	**Specified Min**	**Measured Value**	**Pass/Fail**
Applied load	15, 000 lbs	15, 050 LBS (DROPPED 50 LBS)	PASS
Brake Test	No movement for 2 min	2:03 (MIN:SEC)	PASS

11.5 Verification Sign-Off:

Hawboldt Test Technician: [signature] Date: 22 Jan 20

Hawboldt Quality Specialist: [signature] Date: 22-JAN-'20

Notes/Remarks: 15,200 LBS @ 2:00 MIN THROUGH SHEAVE HELD FINE
LOAD PIN ACCURACY ISSUE - FIXED 22-JAN-'20

12.0 LEVEL WIND DYNAMIC TEST

12.1 Objective:

- Dynamic load test @ ~~**10, 000 lbs**~~ bare drum pull **through level wind.**

9, 850 LBS USED
ACM 22-JAN-'20

12.2 Setup:

- Wind several wraps (6 minimum) onto the drum, and attach the free end to a load.
- Measure and record the weight of the test load using a dynamometer.
- A lift weight should be positioned under the test mast and connected to the winch using the wire rope.

12.3 Procedure:

- Clear the area of non-essential personnel.
- Lift the load and stop paying in instantly and observe the results.
- Lower the load and stop paying out instantly and observe the results.

12.4 Acceptance Criteria:

- The load should not fall.

Table 8: Dynamic Load Test Measurements

Measurements		
Weight Lifted	**Characteristic Measured**	**Pass/Fail**
~~10,000 lbs~~ 9,850	Pay-In Load suspension	PASS
	Pay-Out Load Suspension	PASS

12.5 Verification Sign-Off:

Hawboldt Test Technician: ____________ Date: 22 Jan 20

Hawboldt Quality Specialist: ____________ Date: 22-JAN-'20

Notes/Remarks: 9850 LBS USED

13.0 TEST EQUIPMENT AND CALIBRATION SUMMARY

The following items, used in this procedure, have been calibrated in accordance with ISO 9001-2015.

Table 9: Calibrated Equipment Due Dates

ITEM	EQUIPMENT/MAKE/MODEL	SERIAL NO.	LAST CAL.	CAL. DUE
1	HI - 117 ⟷	DILLON; DYNAMOMETER DEDX2700549	25-OCT-19	25-OCT-'20

14.1 Verification Sign-Off:

Hawboldt Test Technician: [signature] Date: 22 JAN 20

Hawboldt Quality Specialist: [signature] Date: 22-JAN-'20

Notes/Remarks:

Factory Acceptance Test

Model Number: SPRE-3466/S Serial No. **1943**

TEST REMARKS

① CUT BOLT ENDS OF OP. STAND OR CHANGE BOLT ✓
② LOAD PIN ACCURACY
↳ MUST BE WITHIN 3% - VERIFIED ✓
③ REMOVE LIFTING LUGS FROM BRAKE RESISTOR ✓
④ REMOVE SHARP EDGES → CUP HOLDER ✓
BRAKE RESISTOR ✓

LOAD PIN CALIBRATION: ✓
→ USED 9850 LBS

→ TEST BELLY PACK + ALARMS ✓

⑤ LVL WIND HANDLE BUSTED ✓

~~BREVINI GEARBOX~~
~~ITEM B00 28465~~
~~FAM BPH323K~~
~~S/N 03459639~~

SWAPPED WITH 1939

BREVINI GEARBOX
FAM B0028635
S/N 03443215 ARM
10-MAR-20

STROMAG
D - 06844
TYP: 4 BZFM 25M
401-07430
NR : 6219 00591

BONITRON
MODEL: M3775RG - H030C - 3R - 316SSE - 180L
S/N : 2870

8.0: COMPONENT LITERATURE

This section contains a list of the manufacturer's information.

HAWBOLDT PART NUMBER	MANUFACTURER	MODEL CODE	DESCRIPTION
5408916	ABB	ACS880-01-052A-5	Winch VFD
5408564	ABB	ACS355-03U-23A1-4+J404	Levelwind VFD
5408621	BONITRON	M3775RG-H030C-3R-316SS	Braking Resistor
5408400	BREVINI	BPH323K/102.5/IEC200 B3 (D.100)	Gearbox
5408411	EMOD	SMFKOB 200L/4T	Electric Motor
5408557	MGM	SM 160 MB4 KW_11.0 230/460/60 B5 CL_F S2_30MIN IP56	Electric Motor
5406402	IDEC	LD6A-2GQB-RYC	Beacon Light
5403849	OMRON	E2A-M18KS08-WP-B1 5M	Proximity Sensor (Normally Open)
5405988	OMRON	E2A-M18KS08-WP-B2 5M	Proximity Sensor (Normally Closed)
34-00304-586	SENSY	5000-FORC001023	Load Pin
N/A	SKF	N/A	Bearing Maintenance
5408558	STM	OMF 112/3 F1 50 1/13.1 160B5	Gearbox
5408411	Stromag	4 BZFM 25	Parking Brake
5406446-5406451	TURCK	Ri360P0-EQR24M0-INCRX2-H1181	Incremental Encoder
5408650	PQ	M115SL15S72	Joystick
5407909	Danfoss	JCS120-0005	Thumb Joystick

ABB industrial drives

Firmware manual
ACS880 primary control program

Power and productivity
for a better world™

List of related manuals

Drive hardware manuals	Code (English)
**ACS880-01 drives hardware manual*	3AUA0000078093
**ACS880-04 drive modules (200 to 710 kW, 300 to 700 hp) hardware manual*	3AUA0000128301
ACS880-04XT drive module packages (500 to 1200 kW) hardware manual	3AXD50000025169
ACS880-04 single drive module packages hardware manual	3AUA0000138495
**ACS880-07 drives (45 to 710 kW, 50 to 700 hp) hardware manual*	3AUA0000105718
**ACS880-07 drives (560 to 2800 kW) hardware manual*	3AUA0000143261
ACS880-14 and -34 single drive packages hardware manual	3AXD50000022021
**ACS880-17 drives hardware manual*	3AXD50000020436
**ACS880-37 drives hardware manual*	3AXD50000020437
ACS880-104 inverter modules hardware manual	3AUA0000104271
ACS880-107 inverter units hardware manual	3AUA0000102519

Drive firmware manuals and guides	
ACS880 primary control program firmware manual	3AUA0000085967
ACS880 drives with primary control program, quick start-up guide	3AUA0000098062
Adaptive programming application guide	3AXD50000028574
Drive application programming manual (IEC 61131-3)	3AUA0000127808

Option manuals and guides	
ACX-AP-x assistant control panels user's manual	3AUA0000085685
Drive composer Start-up and maintenance PC tool User's manual	3AUA0000094606
Manuals and quick guides for I/O extension modules, fieldbus adapters, encoder interfaces, etc.	

You can find manuals and other product documents in PDF format on the Internet. See section *Document library on the Internet* on the inside of the back cover. For manuals not available in the Document library, contact your local ABB representative.

*A list of links to all manuals applicable to this product is available in the Document library:

Product	Code
ACS880-01 drives	9AKK105408A7004
ACS880-04 drive modules (200 to 710 kW, 300 to 700 hp)	9AKK105713A4819
ACS880-07 drives (45 to 710 kW, 50 to 700 hp)	9AKK105408A8149
ACS880-07 drives (560 to 2800 kW)	9AKK105713A6663
ACS880-17 drives	9AKK106354A1499
ACS880-37 drives	9AKK106354A1500

Firmware manual

ACS880 primary control program

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6. Parameters

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8. Fault tracing

9. Fieldbus control through the embedded fieldbus interface (EFB)

10. Fieldbus control through a fieldbus adapter

11. Control chain diagrams

Further information

1

Introduction to the manual

What this chapter contains

This chapter describes the contents of the manual. It also contains information on the compatibility, safety and intended audience.

Applicability

This manual applies to ACS880 primary control program version 2.4x.

The firmware version of the control program is visible in parameter *07.05 Firmware version*, or the System info in the main menu on the drive control panel.

Safety instructions

Follow all safety instructions delivered with the drive.

- Read the **complete safety instructions** before you install, commission, or use the drive. The complete safety instructions are delivered with the drive as either part of the *Hardware manual*, or, in the case of ACS880 multidrives, as a separate document.
- Read the **firmware function-specific warnings and notes** before changing parameter values. These warnings and notes are included in the parameter descriptions presented in chapter *Parameters*.

Target audience

This manual is intended for people who design, commission, or operate the drive system.

Contents of the manual

This manual contains the following chapters:

- *Using the control panel* provides basic instructions for the use of the control panel.
- *Control locations and operating modes* describes the control locations and operating modes of the drive.
- *Program features* contains descriptions of the features of the ACS880 primary control program.
- *Application macros* contains a short description of each macro together with a connection diagram. Macros are pre-defined applications which will save the user time when configuring the drive.
- *Parameters* describes the parameters used to program the drive.
- *Additional parameter data* contains further information on the parameters.
- *Fault tracing* lists the warning and fault messages with possible causes and remedies.
- *Fieldbus control through the embedded fieldbus interface (EFB)* describes the communication to and from a fieldbus network using the embedded fieldbus interface of the drive.
- *Fieldbus control through a fieldbus adapter* describes the communication to and from a fieldbus network using an optional fieldbus adapter module.
- *Control chain diagrams* showing the parameter structure within the drive.

Related documents

Note: A quick start-up sequence for a speed control application is provided by *ACS880 drives with primary control program, Quick start-up guide* (3AUA0000098062), delivered with the drive.

A list of related manuals is printed on the inside of the front cover.

Terms and abbreviations

Term/abbre-viation	Definition
AC 800M	Type of programmable controller manufactured by ABB.
ACS800	A product family of ABB drives
ACS-AP-I	Types of control panel used with ACS880 drives
ACS-AP-W	
AI	Analog input; interface for analog input signals
AO	Analog output; interface for analog output signals
BCU	Type of control unit used in ACS880 drives, primarily those with parallel-connected inverter or supply modules.
D2D	Drive-to-drive; communication link between drives that is implemented by application programming. See *Drive application programming manual (IEC 61131-3)* (3AUA0000127808 [English])
DC link	DC circuit between rectifier and inverter
DDCS	Distributed drives communication system; a protocol used in communication between ABB drive equipment
DI	Digital input; interface for digital input signals
DIO	Digital input/output; interface that can be used as a digital input or output
DO	Digital output; interface for digital output signals
Drive	Frequency converter for controlling AC motors. The drive consists of a rectifier and an inverter connected together by the DC link. In drives up to approximately 500 kW, these are integrated into a single module (drive module). Larger drives typically consist of separate supply and inverter units. The ACS880 primary control program is used to control the inverter part of the drive.
DriveBus	A communication link used by, for example, ABB controllers. ACS880 drives can be connected to the DriveBus link of the controller.
DTC	Direct torque control. See page *42*.
EFB	Embedded fieldbus interface. See page *513*.
FAIO-01	Optional analog I/O extension module
FBA	Fieldbus adapter
FCAN-01	Optional CANopen adapter
FCNA-01	Optional ControlNet adapter
FDCO-0x	Optional DDCS communication module
FDIO-01	Optional digital I/O extension module
FDNA-01	Optional DeviceNet adapter
FEA-03	Optional I/O extension adapter
FECA-01	Optional EtherCAT® adapter
FEN-01	Optional TTL encoder interface module
FEN-11	Optional absolute encoder interface module

Term/abbre-viation	Definition
FEN-21	Optional resolver interface module
FEN-31	Optional HTL encoder interface module
FENA-11	Optional Ethernet/IP, Modbus/TCP and PROFINET IO adapter
FENA-21	Optional dual-port Ethernet/IP, Modbus/TCP and PROFINET IO adapter
FEPL-02	Optional POWERLINK adapter
FIO-01	Optional digital I/O extension module
FIO-11	Optional analog I/O extension module
FPBA-01	Optional PROFIBUS DP adapter
FPTC-01	Optional thermistor protection module.
FPTC-02	Optional ATEX-certified thermistor protection module for potentially explosive atmospheres.
FSCA-01	Optional Modbus/RTU adapter
FSO-xx	Optional safety functions module
HTL	High-threshold logic
ID run	Motor identification run. During the identification run, the drive will identify the characteristics of the motor for optimum motor control.
IGBT	Insulated gate bipolar transistor; a voltage-controlled semiconductor type widely used in inverters and IGBT supply units due to their easy controllability and high switching frequency
INU-LSU	Type of optical *DDCS* communication link between two converters, for example the *supply unit* and the *inverter unit* of a drive system.
Inverter unit	In large drives (> 500 kW approx.), the part of the drive that converts DC to AC for the motor. Consists of one or more inverter modules and their auxiliary components.
I/O	Input/Output
ISU	An IGBT supply unit; type of supply unit implemented using IGBT switching components, used in regenerative and low-harmonic drives.
Line-side converter	See *supply unit*.
LSU	See *supply unit*.
ModuleBus	A communication link used by, for example, ABB controllers. ACS880 drives can be connected to the optical ModuleBus link of the controller.
Motor-side converter	See *inverter unit*.

Term/abbre-viation	Definition
Network control	With fieldbus protocols based on the Common Industrial Protocol (CIP^{TM}), such as DeviceNet and Ethernet/IP, denotes the control of the drive using the Net Ctrl and Net Ref objects of the ODVA AC/DC Drive Profile. For more information, see www.odva.org, and the following manuals: • *FDNA-01 DeviceNet adapter module User's manual* (3AFE68573360 [English]), and • *FENA-01/-11 Ethernet adapter module User's manual* (3AUA0000093568 [English]).
Parameter	User-adjustable operation instruction to the drive, or signal measured or calculated by the drive
PID controller	Proportional–integral–derivative controller. Drive speed control is based on PID algorithm.
PLC	Programmable logic controller
Power unit	Contains the power electronics and power connections of the drive (or inverter module). The drive control unit is connected to the power unit.
PTC	Positive temperature coefficient
PU	See *power unit*.
RDCO-0x	DDCS communication module
RFG	Ramp function generator.
RO	Relay output; interface for a digital output signal. Implemented with a relay.
SSI	Synchronous serial interface
STO	Safe torque off
Supply unit	In large drives (> 500 kW approx.), the part of the drive that converts AC to DC. Consists of one or more supply modules and their auxiliary components. An IGBT supply unit (*ISU*) is also capable of feeding regenerative energy back into the supply network.
TTL	Transistor-transistor logic
UPS	Uninterruptible power supply; power supply equipment with battery to maintain output voltage during power failure
ZCU	Type of control unit used in ACS880 drives (primarily in drive modules, or inverter/supply units consisting of a single power module). Consists of an I/O board built into a plastic housing. Depending on the type of hardware, the control unit may be integrated into or fitted onto the drive/inverter module, or installed separately.

Cybersecurity disclaimer

This product is designed to be connected to and to communicate information and data via a network interface. It is Customer's sole responsibility to provide and continuously ensure a secure connection between the product and Customer network or any other network (as the case may be). Customer shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

See also section *User lock* (page *89*).

2

Using the control panel

Refer to *ACX-AP-x assistant control panels user’s manual* (3AUA0000085685 [English]).

3

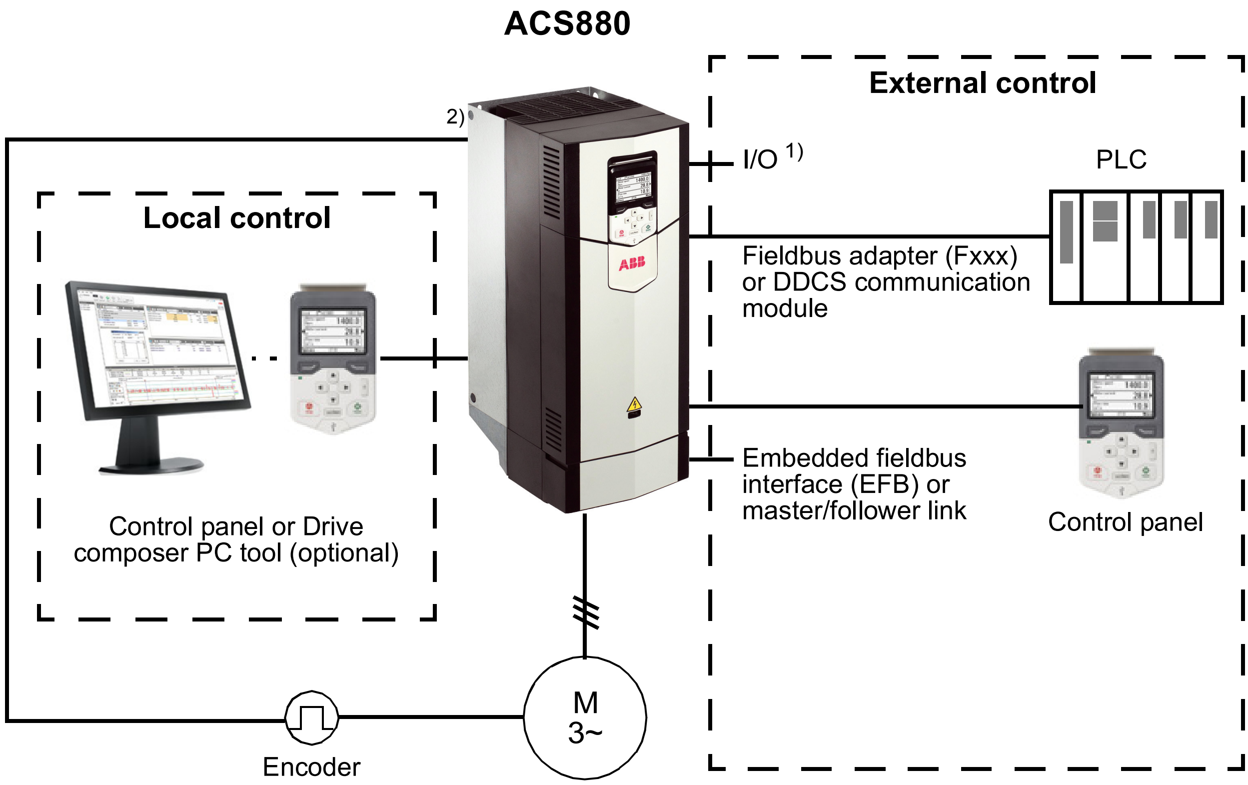
Control locations and operating modes

What this chapter contains

This chapter describes the control locations and operating modes supported by the control program.

Local control vs. external control

The ACS880 has two main control locations: external and local. The control location is selected with the Loc/Rem key on the control panel or in the PC tool.



1) Extra inputs/outputs can be added by installing optional I/O extension modules (FIO-xx) in drive slots.

2) Encoder or resolver interface module(s) (FEN-xx) installed in drive slots.

Local control

The control commands are given from the control panel keypad or from a PC equipped with Drive composer when the drive is set to local control. Speed and torque control modes are available for local control; frequency mode is available when scalar motor control mode is used (see parameter *19.16 Local control mode*).

Local control is mainly used during commissioning and maintenance. The control panel always overrides the external control signal sources when used in local control. Changing the control location to local can be prevented by parameter *19.17 Local control disable*.

The user can select by a parameter (*49.05 Communication loss action*) how the drive reacts to a control panel or PC tool communication break. (The parameter has no effect in external control.)

External control

When the drive is in external control, control commands are given through
- the I/O terminals (digital and analog inputs), or optional I/O extension modules
- the embedded fieldbus interface or an optional fieldbus adapter module
- the external (DDCS) controller interface
- the master/follower link, and/or
- the control panel.

Two external control locations, EXT1 and EXT2, are available. The user can select the sources of the start and stop commands separately for each location by parameters *20.01*…*20.10*. The operating mode can be selected separately for each location (in parameter group *19 Operation mode*), which enables quick switching between different operating modes, for example speed and torque control. Selection between EXT1 and EXT2 is done via any binary source such as a digital input or fieldbus control word (see parameter *19.11 Ext1/Ext2 selection*). The source of reference is selectable for each operating mode separately.

Using the control panel as an external control source

The control panel can also be used as a source of start/stop commands and/or reference in external control. Selections for the control panel are available in the start/stop command source and reference source selection parameters.

Reference source selection parameters (except PID setpoint selectors) have two selections for the control panel. The difference between the two selections is in the initial reference value after the reference source switches to the control panel.

The panel reference is saved whenever another reference source is selected. If the reference source selection parameter is set to *Control panel (ref saved)*, the saved value is used as the initial reference when control switches back to the panel. Note that only one type of reference can be saved at a time: for example, attempting to use the same saved reference with different operating modes (speed, torque, etc.) causes the drive to trip on *7083 Panel reference conflict*. The panel reference can be separately limited by parameters in group *49 Panel port communication*.

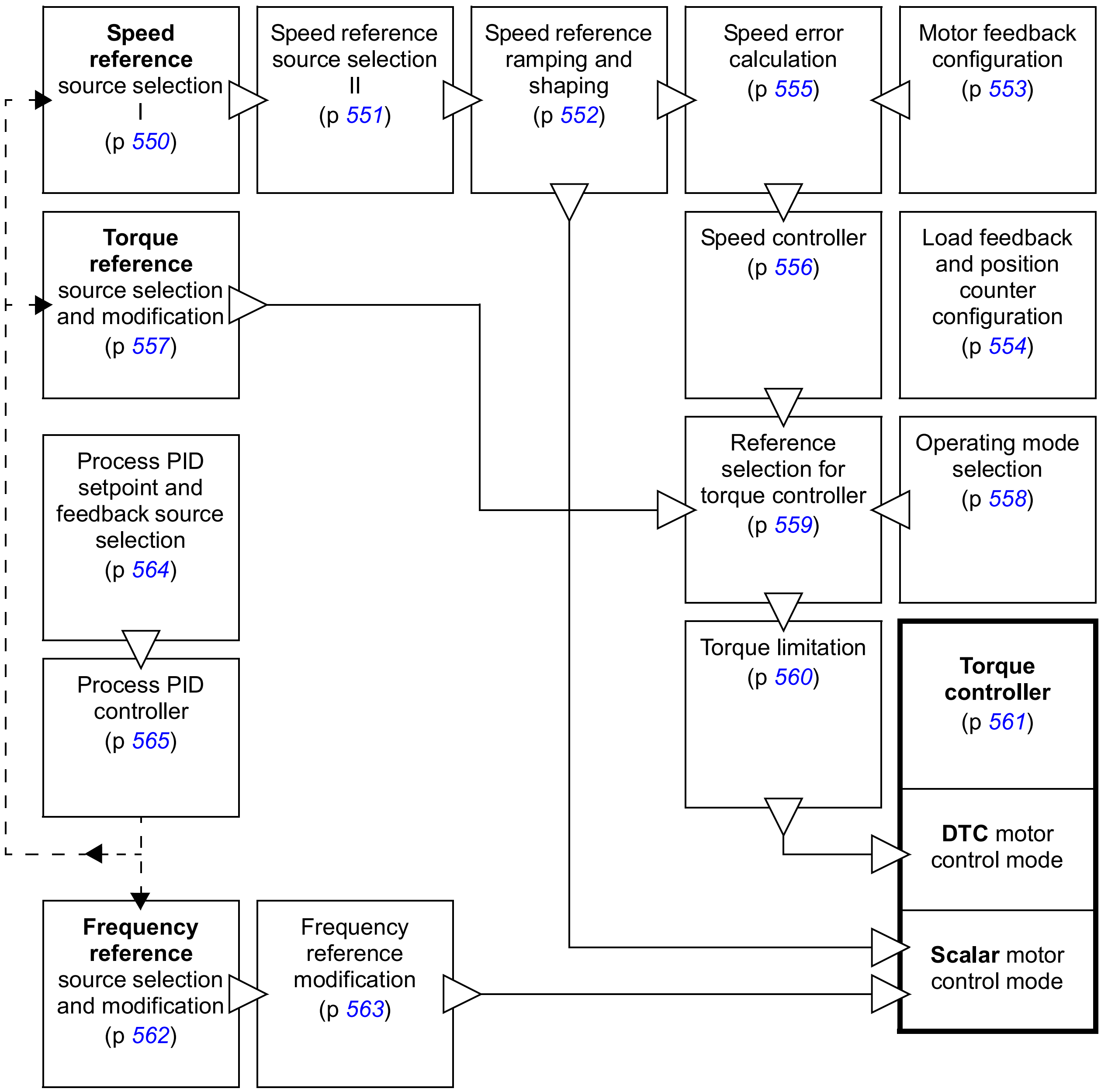
With the reference source selection parameter set to *Control panel (ref copied)*, the initial panel reference value depends on whether the operating mode changes with the reference source. If the source switches to the panel and the operating mode does not change, the last reference from the previous source is adopted. If the operating mode changes, the drive actual value corresponding to the new mode is adopted as the initial value.

The process PID setpoint selectors in parameter groups *40 Process PID set 1* and *41 Process PID set 2* only have one setting for the control panel. Whenever the control panel is selected as the setpoint source, operation resumes using the previous setpoint.

Operating modes of the drive

The drive can operate in several operating modes with different types of reference. The mode is selectable for each control location (Local, EXT1 and EXT2) in parameter group *19 Operation mode*.

The following is a general representation of the reference types and control chains. The page numbers refer to detailed diagrams in chapter *Control chain diagrams*.



Speed control mode

The motor follows a speed reference given to the drive. This mode can be used either with estimated speed as feedback, or with an encoder or resolver for better speed control accuracy.

Speed control mode is available in both local and external control. It is also available both in DTC (Direct Torque Control) and scalar motor control modes.

Torque control mode

Motor torque follows a torque reference given to the drive. Torque control is possible without feedback, but is much more dynamic and accurate when used in conjunction with a feedback device such as an encoder or a resolver. It is recommended that a feedback device is used in crane, winch or lift control situations.

Torque control mode is available in DTC motor control mode for both local and external control locations.

Frequency control mode

The motor follows a frequency reference given to the drive. Frequency control is only available in scalar motor control mode.

Special control modes

In addition to the control modes mentioned above, the following special control modes are available:

- Process PID control. For more information, see section *Process PID control* (page *65*).
- Emergency stop modes Off1 and Off3: Drive stops along the defined deceleration ramp and drive modulation stops.
- Jogging mode: Drive starts and accelerates to the defined speed when the jogging signal is activated. For more information, see section *Jogging* (page *55*).

4

Program features

What this chapter contains

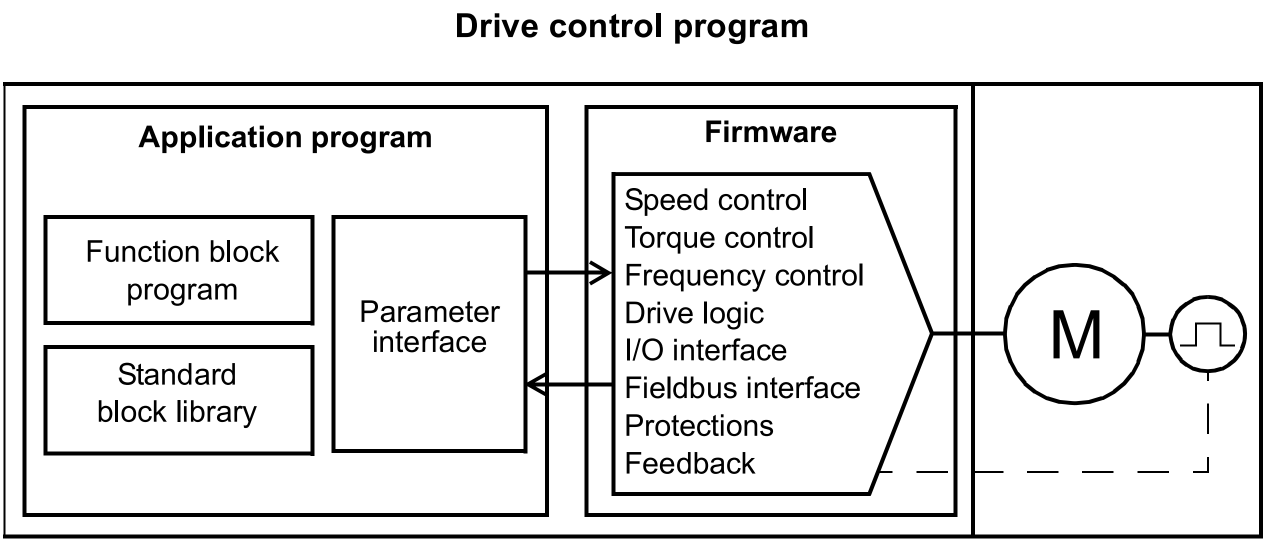
The control program contains all of the parameters (including actual signals) within the drive. This chapter describes some of the more important functions within the control program, how to use them and how to program them to operate.

WARNING! Make sure that the machinery into which the drive is integrated fulfils the personnel safety regulations. Note that the frequency converter (a Complete Drive Module or a Basic Drive Module, as defined in IEC 61800-2), is not considered as a safety device mentioned in the European Machinery Directive and related harmonized standards. Thus, the personnel safety of the complete machinery must not be based on a specific frequency converter feature, but it has to be implemented as defined in the application specific regulations.

Drive configuration and programming

The drive control program is divided into two parts:

- firmware program
- application program.



The firmware program performs the main control functions, including speed and torque control, drive logic (start/stop), I/O, feedback, communication and protection functions. Firmware functions are configured and programmed with parameters, and can be extended by application programming.

Programming via parameters

Parameters configure all of the standard drive operations and can be set via

- the control panel, as described in chapter *Using the control panel*
- the Drive composer PC tool, as described in *Drive composer user's manual* (3AUA0000094606 [English]), or
- the fieldbus interface, as described in chapters *Fieldbus control through the embedded fieldbus interface (EFB)* and *Fieldbus control through a fieldbus adapter*.

All parameter settings are stored automatically to the permanent memory of the drive. However, if an external +24 V DC power supply is used for the drive control unit, it is highly recommended to force a save by using parameter *96.07 Parameter save manually* before powering down the control unit after any parameter changes have been made.

If necessary, the default parameter values can be restored by parameter *96.06 Parameter restore*.

Adaptive programming

Conventionally, the user can control the operation of the drive by parameters. However, the standard parameters have a fixed set of choices or a setting range. To further customize the operation of the drive, an adaptive program can be constructed out of a set of function blocks.

The Drive composer pro PC tool (version 1.10 or later, available separately) has an Adaptive programming feature with a graphical user interface for building the custom program. The function blocks include the usual arithmetic and logical functions, as well as eg. selection, comparison and timer blocks. The program can contain a maximum of 20 blocks. The adaptive program is executed on a 10 ms time level.

For selecting input to the program, the user interface has pre-selections for the physical inputs, common actual values, and other status information of the drive. Parameter values as well as constants can also be defined as inputs. The output of the program can be used eg. as a start signal, external event or reference, or connected to the drive outputs. Note that connecting the output of the adaptive program to a selection parameter will write-protect the parameter.

The status of the adaptive program is shown by parameter *07.30 Adaptive program status*. The adaptive program can be disabled by *96.70 Disable adaptive program*.

For more information, see the *Adaptive programming application guide* (3AXD50000028574 [English]).

Application programming

The functions of the firmware program can be extended with application programming. Application programmability is optionally available for the ACS880 primary control program.

Application programs can be built out of function blocks based on the IEC 61131-3 standard using a PC tool available separately.

For more information, see *Programming manual: Drive application programming (IEC 61131-3)* (3AUA0000127808 [English]).

Control interfaces

Programmable analog inputs

The control unit has two programmable analog inputs. Each of the inputs can be independently set as a voltage (0/2…10 V or -10…10 V) or current (0/4…20 mA) input by a jumper or switch on the control unit. Each input can be filtered, inverted and scaled. The number of analog inputs can be increased by installing FIO-11 or FAIO-01 I/O extensions (see *Programmable I/O extensions* below).

The drive can be set to perform an action (for example, to generate a warning or fault) if the value of an analog input moves out of a predefined range.

Settings

Parameter group *12 Standard AI* (page *151*).

Programmable analog outputs

The control unit has two current (0…20 mA) analog outputs. Each output can be filtered, inverted and scaled. The number of analog outputs can be increased by installing FIO-11 or FAIO-01 I/O extensions (see *Programmable I/O extensions* below).

Settings

Parameter group *13 Standard AO* (page *155*).

Programmable digital inputs and outputs

The control unit has six digital inputs, a digital start interlock input, and two digital input/outputs (I/O that can be set as either an input or an output).

One digital input (DI6) doubles as a PTC thermistor input. See section *Motor thermal protection* (page *78*).

Digital input/output DIO1 can be used as a frequency input, DIO2 as a frequency output.

The number of digital inputs/outputs can be increased by installing FIO-01, FIO-11 or FDIO-01 I/O extensions (see *Programmable I/O extensions* below).

Settings

Parameter groups *10 Standard DI, RO* (page *139*) and *11 Standard DIO, FI, FO* (page *146*).

Programmable relay outputs

The control unit has three relay outputs. The signal to be indicated by the outputs can be selected by parameters.

Relay outputs can be added by installing FIO-01 or FDIO-01 I/O extensions.

Settings

Parameter group *10 Standard DI, RO* (page *139*).

Programmable I/O extensions

Inputs and outputs can be added by using I/O extension modules. One to three modules can be mounted on the slots of the control unit. Slots can be added by connecting an FEA-03 I/O extension adapter.

The table below shows the number of I/O on the control unit as well as optional I/O extension modules.

Location	Digital inputs (DI)	Digital I/Os (DIO)	Analog inputs (AI)	Analog outputs (AO)	Relay outputs (RO)
Control unit	6 + DIIL	2	2	2	3
FIO-01	-	4	-	-	2
FIO-11	-	2	3	1	-
FAIO-01	-	-	2	2	-
FDIO-01	3	-	-	-	2

Three I/O extension modules can be activated and configured using parameter groups 14…16.

Note: Each configuration parameter group contains parameters that display the values of the inputs on that particular extension module. These parameters are the only way of utilizing the inputs on I/O extension modules as signal sources. To connect to an input, choose the setting *Other* in the source selector parameter, then specify the appropriate value parameter (and bit, for digital signals) in group 14, 15 or 16.

Settings

- Parameter groups *14 I/O extension module 1* (page *159*), *15 I/O extension module 2* (page *178*), *16 I/O extension module 3* (page *182*).
- Parameter *60.41* (page *353*).

Fieldbus control

The drive can be connected to several different automation systems through its fieldbus interfaces. See chapters *Fieldbus control through the embedded fieldbus interface (EFB)* (page *513*) and *Fieldbus control through a fieldbus adapter* (page *537*).

Settings

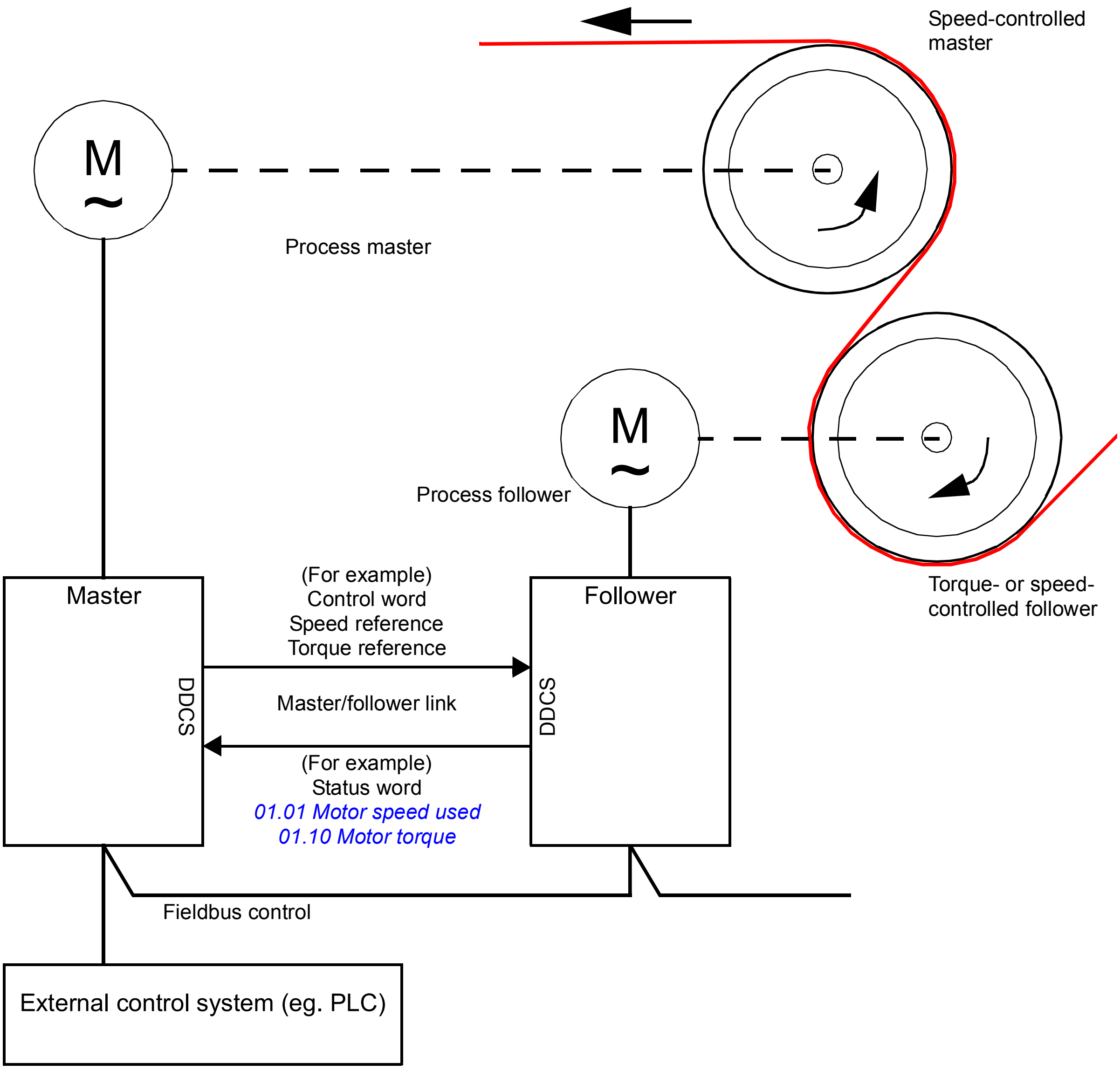
Parameter groups *50 Fieldbus adapter (FBA)* (page *325*), *51 FBA A settings* (page *333*), *52 FBA A data in* (page *334*), and *53 FBA A data out* (page *335*), *54 FBA B settings* (page *335*), *55 FBA B data in* (page *336*), *56 FBA B data out* (page *337*), and *58 Embedded fieldbus* (page *337*).

Master/follower functionality

General

The master/follower functionality can be used to link several drives together so that the load can be evenly distributed between the drives. This is ideal in applications where the motors are coupled to each other via gearing, chain, belt, etc.

The external control signals are typically connected to one drive only which acts as the master. The master controls up to 10 followers by sending broadcast messages over an electrical cable or fiber optic link. The master can read feedback signals from up to 3 selected followers.



The master drive is typically speed-controlled and the other drives follow its torque or speed reference. In general, a follower should be

- torque-controlled when the motor shafts of the master and the follower are rigidly coupled by gearing, chain etc. so that no speed difference between the drives is possible
- speed-controlled when the motor shafts of the master and the follower are flexibly coupled so that a slight speed difference is possible. When both the master and the follower are speed-controlled, drooping is also typically used (see parameter *25.08 Drooping rate*). The distribution of load between the master and follower can alternatively be adjusted as described under *Load share function with a speed-controlled follower* below.

Note: With a speed-controlled follower (without load sharing), pay attention to the acceleration and deceleration ramp times of the follower. If the ramp times are set longer than in the master, the follower will follow its own acceleration/deceleration ramp times rather than those from the master. In general, it is recommended to set identical ramp times in both the master and the follower(s). Any ramp shape settings (see parameters *23.16*…*23.19*) should only be applied in the master.

In some applications, both speed control and torque control of the follower are required. In those cases, the operating mode can be switched by parameter (*19.12 Ext1 control mode* or *19.14 Ext2 control mode*). Another method is to set one external control location to speed control mode, the other to torque control mode. Then, a digital input of the follower can be used to switch between the control locations. See chapter *Control locations and operating modes* (page *19*).

With torque control, follower parameter *26.15 Load share* can be used to scale the incoming torque reference for optimal load sharing between the master and the follower. Some torque-controlled follower applications, eg. where the torque is very low, or very low speed operation is required, may require encoder feedback.

If a drive needs to quickly switch between master and follower statuses, one user parameter set (see page *88*) can be saved with the master settings, another with the follower settings. The suitable settings can then be activated using eg. digital inputs.

Load share function with a speed-controlled follower

Load sharing between the master and a speed-controlled follower can be used in various applications. The load share function is implemented by fine-tuning the follower speed reference with an additional term based on a torque reference. The torque reference is selected by parameter *23.42 Follower speed corr torq source* (by default, reference 2 received from the master). Load share is adjusted by parameter *26.15 Load share* and activated by the source selected by *23.40 Follower speed correction enable*. Parameter *23.41 Follower speed correction gain* provides a gain adjustment for the speed correction. The final correction term added to the speed reference is shown by *23.39 Follower speed correction out*. See the block diagram on page *555*.

Notes:

- The function can be enabled only when the drive is a speed-controlled follower in remote control mode.
- Drooping (*25.08 Drooping rate*) is ignored when the load share function is active.
- The master and follower should have the same speed control tuning values.
- The speed correction term is limited by the speed error window parameters *24.44 Speed error window low* and *24.43 Speed error window high*. An active limitation is indicated by *06.19 Speed control status word*.

Communication

A master/follower link can be built by connecting the drives together with fiber optic cables (may require additional equipment depending on existing drive hardware), or by wiring together the XD2D connectors of the drives. The medium is selected by parameter *60.01 M/F communication port*.

Parameter *60.03 M/F mode* defines whether the drive is the master or a follower on the communication link. Typically, the speed-controlled process master drive is also configured as the master in the communication.

The communication on the master/follower link is based on the DDCS protocol, which employs data sets (specifically, data set 41). One data set contains three 16-bit words. The contents of the data set are freely configurable using parameters *61.01*…*61.03*. The data set broadcast by the master typically contains the control word, speed reference and torque reference, while the followers return a status word with two actual values.

The default setting of parameter *61.01 M/F data 1 selection* is *Follower CW*. With this setting in the master, a word consisting of bits 0…11 of *06.01 Main control word* and four bits selected by parameters *06.45*…*06.48* is broadcast to the followers. However, bit 3 of the follower control word is modified so that it remains on as long as the master is modulating, and its switching to 0 causes the follower to coast to a stop. This is to synchronize the stopping of both master and follower.

Note: When the master is ramping down to a stop, the follower observes the decreasing reference but receives no stop command until the master stops modulating and clears bit 3 of the follower control word. Because of this, the maximum and minimum speed limits on the follower drive should not have the same sign – otherwise the follower would be pushing against the limit until the master finally stops.

Three words of additional data can optionally be read from each follower. The followers from which data is read are selected by parameter *60.14 M/F follower selection* in the master. In each follower drive, the data to be sent is selected by parameters *61.01*…*61.03*. The data is transferred in integer format over the link, and displayed by parameters *62.28*…*62.36* in the master. The data can then be forwarded to other parameters using *62.04*…*62.12*.

To indicate faults in the followers, each follower must be configured to transmit its status word as one of the above-mentioned data words. In the master, the corresponding target parameter must be set to *Follower SW*. The action to be taken when a follower is faulted is selected by *60.17 Follower fault action*. External events (see parameter group *31 Fault functions*) can be used to indicate the status of other bits of the status word.

Block diagrams of the master/follower communication are presented on pages *566* and *567*.

Construction of the master/follower link

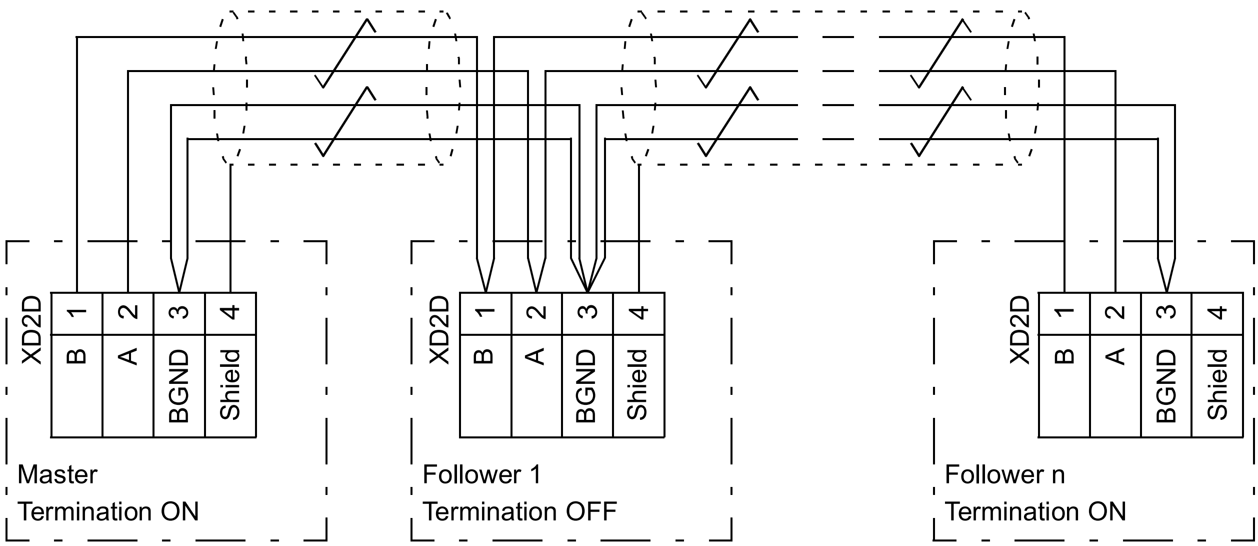
The master/follower link is formed by connecting the drives together using either

- shielded twisted-pair cable between the XD2D terminals of the drives*, or
- fiber optic cables. Drives with a *ZCU* control unit require an additional FDCO DDCS communication module; drives with a *BCU* control unit require an RDCO module.

*This connection cannot co-exist, and is not to be confused with, drive-to-drive (D2D) communication implemented by application programming (detailed in *Drive application programming manual (IEC 61131-3)*, 3AUA0000127808 [English]).

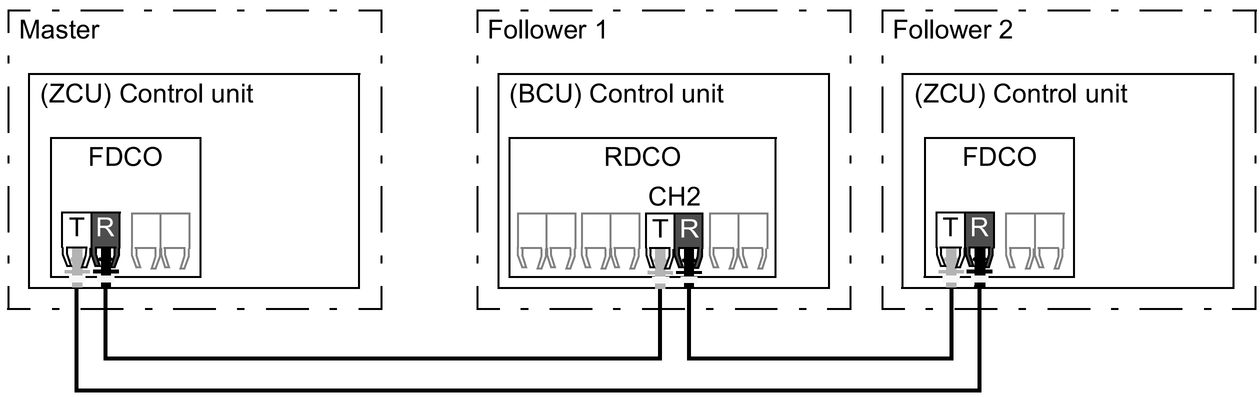
Connection examples are shown below. Note that a star configuration using fiber optic cables requires an NDBU-95C DDCS branching unit.

Master/follower wiring with electrical cable



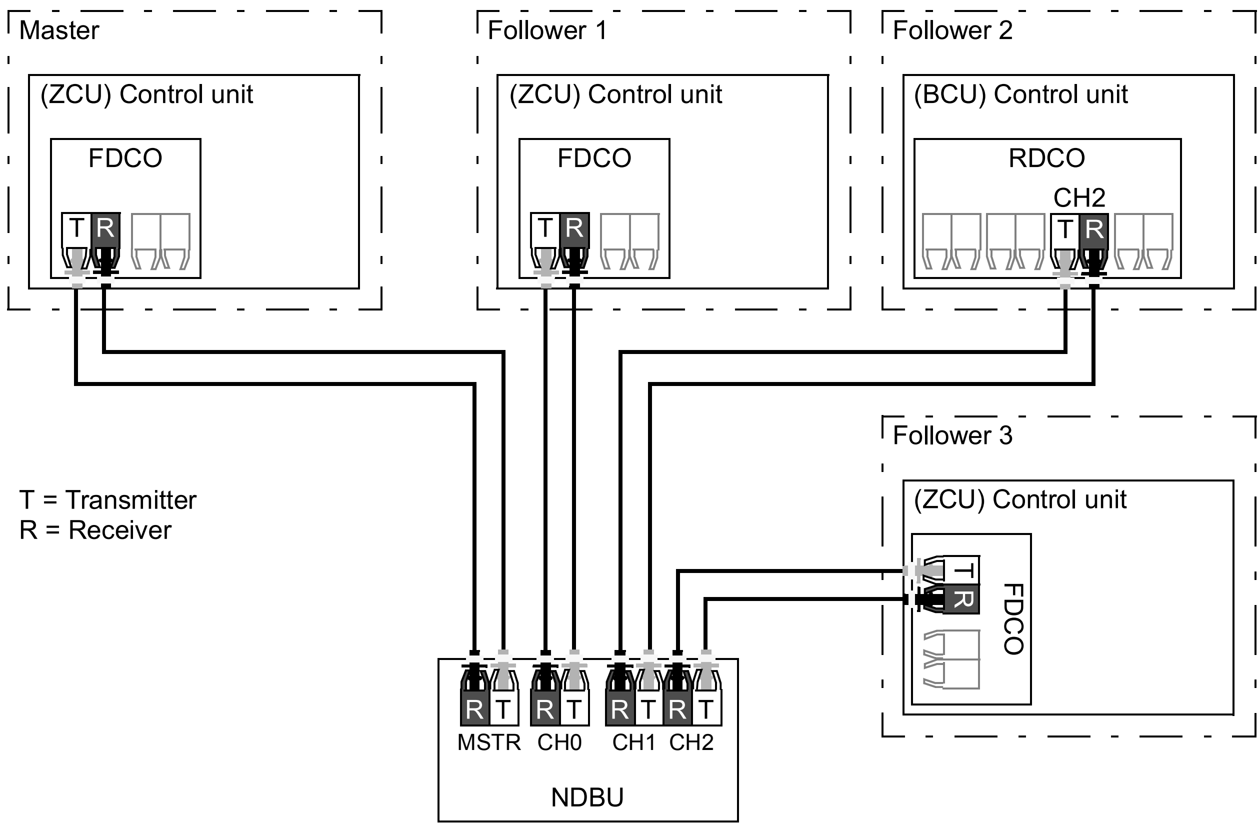
See the hardware manual of the drive for wiring and termination details.

Ring configuration with fiber optic cables



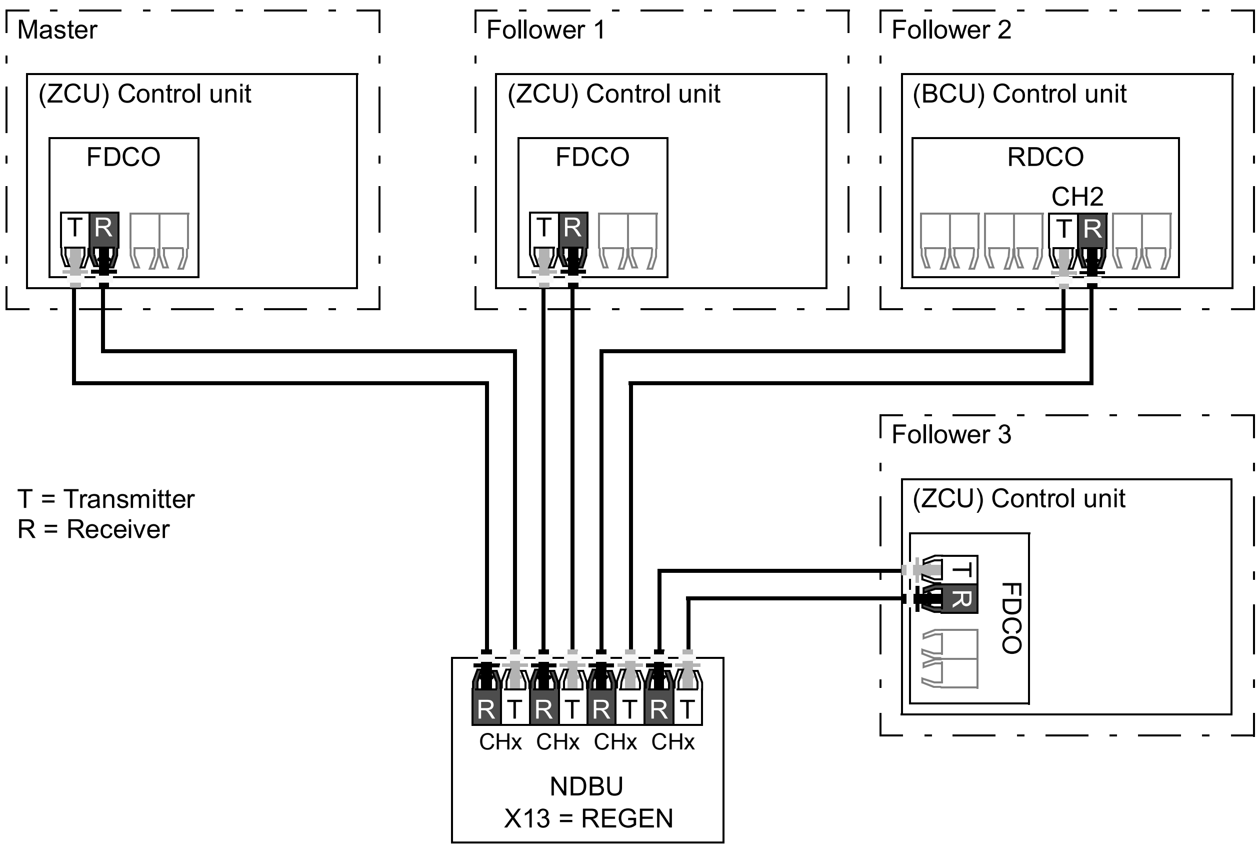
T = Transmitter; R = Receiver

Star configuration with fiber optic cables (1)



T = Transmitter
R = Receiver

Star configuration with fiber optic cables (2)



Example parameter settings

The following is a checklist of parameters that need to be set when configuring the master/follower link. In this example, the master broadcasts the Follower control word, a speed reference and a torque reference. The follower returns a status word and two actual values (this is not compulsory but is shown for clarity).

Master settings:

- Master/follower link activation
  - *60.01 M/F communication port* (fiber optic channel or XD2D selection)
  - (*60.02 M/F node address* = 1)
  - *60.03 M/F mode* = *DDCS master* (for both fiber optic and wire connection)
  - *60.05 M/F HW connection* (*Ring* or *Star* for fiber optic, *Star* for wire)
- Data to be broadcast to the followers
  - *61.01 M/F data 1 selection* = *Follower CW* (Follower control word)
  - *61.02 M/F data 2 selection* = *Used speed reference*
  - *61.03 M/F data 3 selection* = *Torque reference act 5*
- Data to be read from the followers (optional)
  - *60.14 M/F follower selection* (selection of followers that data is read from)
  - *62.04 Follower node 2 data 1 sel* … *62.12 Follower node 4 data 3 sel* (mapping of data received from followers)

Follower settings:

- Master/follower link activation
  - *60.01 M/F communication port* (fiber optic channel or XD2D selection)
  - *60.02 M/F node address* = 2…60
  - *60.03 M/F mode* = *DDCS follower* (for both fiber optic and wire connection)
  - *60.05 M/F HW connection* (*Ring* or *Star* for fiber optic, *Star* for wire)
- Mapping of data received from master
  - *62.01 M/F data 1 selection* = *CW 16bit*
  - *62.02 M/F data 2 selection* = *Ref1 16bit*
  - *62.03 M/F data 3 selection* = *Ref2 16bit*
- Selection of operating mode and control location
  - *19.12 Ext1 control mode* = *Speed* or *Torque*
  - *20.01 Ext1 commands* = *M/F link*
  - *20.02 Ext1 start trigger type* = *Level*
- Selection of reference sources
  - *22.11 Speed ref1 source* = *M/F reference 1*
  - *26.11 Torque ref1 source* = *M/F reference 2*
- Selection of data to be sent to master (optional)
  - *61.01 M/F data 1 selection* = *SW 16bit*
  - *61.02 M/F data 2 selection* = *Act1 16bit*
  - *61.03 M/F data 3 selection* = *Act2 16bit*

Specifications of the fiber optic master/follower link

- Maximum fiber optic cable length:
  - FDCO-01/02 or RDCO-04 with POF (Plastic Optic Fiber): 30 m
  - FDCO-01/02 or RDCO-04 with HCS (Hard-clad Silica Fiber): 200 m
  - For distances up to 1000 m, use two NOCR-01 optical converter/repeaters with glass optic cable (GOF, 62.5 micrometers, Multi-Mode)
- Maximum shielded twisted-pair cable length: 50 m
- Transmission rate: 4 Mbit/s
- Total performance of the link: < 5 ms to transfer references between the master and followers.
- Protocol: DDCS (Distributed Drives Communication System)

Settings and diagnostics

Parameter groups *60 DDCS communication* (page *345*), *61 D2D and DDCS transmit data* (page *357*) and *62 D2D and DDCS receive data* (page *362*).

External controller interface

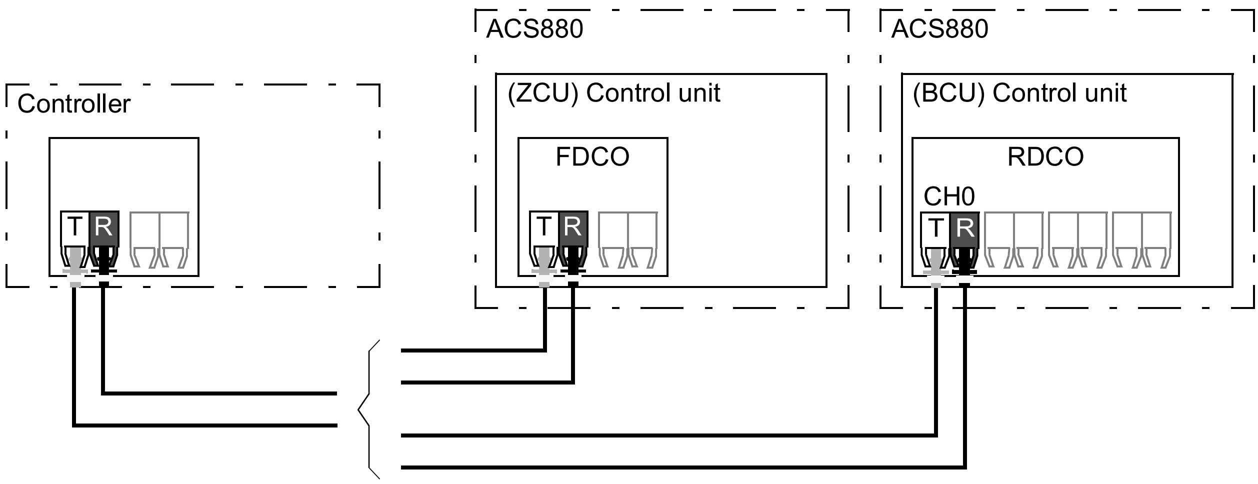
General

The drive can be connected to an external controller (such as the ABB AC 800M) using either fiber optic or twisted-pair cable. The ACS880 is compatible with both the ModuleBus and DriveBus connections.

Topology

An example connection with either a ZCU-based or BCU-based drive using fiber optic cables is shown below.

Drives with a *ZCU* control unit require an additional FDCO DDCS communication module; drives with a *BCU* control unit require an RDCO or FDCO module. The BCU has a dedicated slot for the RDCO – an FDCO module can also be used with a BCU control unit but it will reserve one of the three universal option module slots. Ring and star configurations are also possible much in the same way as with the master/follower link (see section *Master/follower functionality* on page *31*); the notable difference is that the external controller connects to channel CH0 on the RDCO module instead of CH2. The channel on the FDCO communication module can be freely selected.



T = Transmitter; R = Receiver

The external controller can also be wired to the D2D (RS-485) connector using shielded, twisted-pair cable. The selection of the connection is made by parameter *60.51 DDCS controller comm port*.

Communication

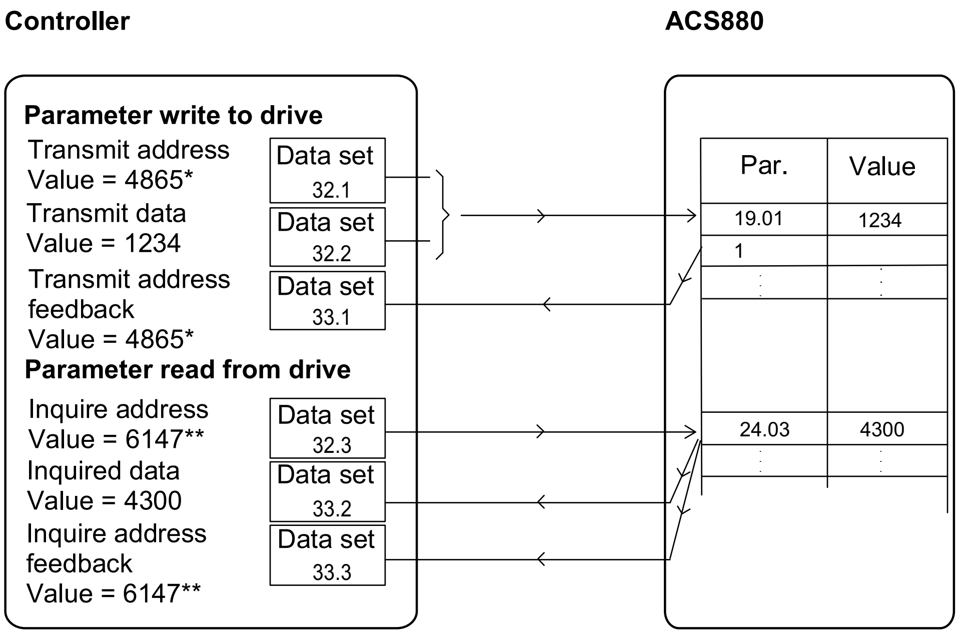
The communication between the controller and the drive consists of data sets of three 16-bit words each. The controller sends a data set to the drive, which returns the next data set to the controller.

The communication uses data sets 10…33. The contents of the data sets are freely configurable, but data set 10 typically contains the control word and one or two references, while data set 11 returns the status word and selected actual values. For

ModuleBus communication, the ACS880 can be set up as a “standard drive” or an “engineered drive” by parameter *60.50 DDCS controller drive type*. ModuleBus communication uses data sets 1…4 with a “standard drive” and data sets 10…33 with an “engineered drive”.

The word that is defined as the control word is internally connected to the drive logic; the coding of the bits is as presented in section *Contents of the fieldbus Control word (ABB Drives profile)* (page *543*). Likewise, the coding of the status word is as shown in section *Contents of the fieldbus Status word (ABB Drives profile)* (page *544*).

By default, data sets 32 and 33 are dedicated for the mailbox service, which enables the setting or inquiry of parameter values as follows:



*19.01 -> 13h.01h -> 1301h = 4865
**24.03 -> 18h.03h -> 1803h = 6147

By parameter *60.64 Mailbox dataset selection*, data sets 24 and 25 can be selected instead of data sets 32 and 33.

The update intervals of the data sets are as follows:
- Data sets 10…11: 2 ms
- Data sets 12…13: 4 ms
- Data sets 14…17: 10 ms
- Data sets 18…25, 32, 33: 100 ms.

Settings

Parameter groups *60 DDCS communication* (page *345*), *61 D2D and DDCS transmit data* (page *357*) and *62 D2D and DDCS receive data* (page *362*).

Control of a supply unit (LSU)

General

With drives that consist of a supply unit and one inverter unit, the supply unit can be controlled through the inverter unit. (In drive systems consisting of multiple inverter units, this feature is not typically used.) For example, the inverter unit can send a control word and references to the supply unit, enabling the control of both units from the interfaces of one control program.

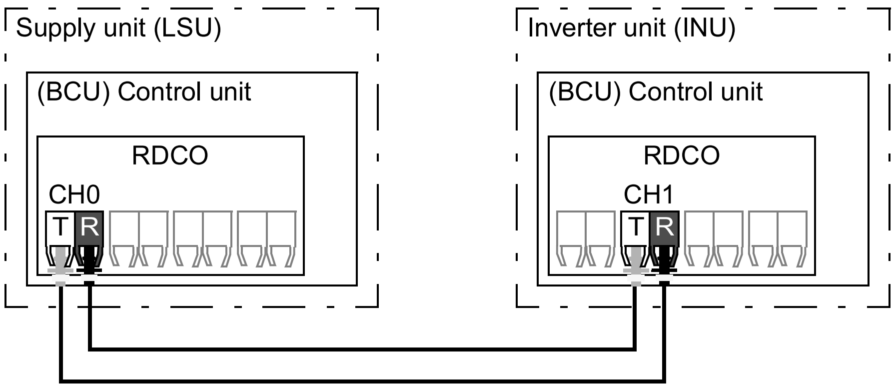
Note: This function is only supported by inverter units with a BCU control unit.

For more information, refer to the firmware manual of the other converter.

Topology

The control units of the supply unit and the inverter unit are connected by fiber optic cables. With BCU-x2 control units equipped with RDCO modules, CH1 of the inverter is connected to CH0 of the supply unit.

An example connection with a BCU-based drive system is shown below.



T = Transmitter; R = Receiver

The fiber optic link specifications stated under *Specifications of the fiber optic master/follower link* (page *37*) apply.

Communication

The communication between the converters and the drive consists of data sets of three 16-bit words each. The inverter unit sends a data set to the supply unit, which returns the next data set to the inverter unit.

The communication uses data sets 10 and 11, updated at 2 ms intervals. Data sets 10 is sent by the inverter unit to the supply unit, while data set 11 is sent by the supply unit to the inverter unit. The contents of the data sets are freely configurable, but data set 10 typically contains the control word, while data set 11 returns the status word.

With ACS880 single drives with a separate supply unit, the basic communication is initialized by parameter *95.20 HW options word 1*. If the supply unit is regenerative, it is possible to send a DC voltage and/or reactive power reference to it from inverter parameter group *94 LSU control*.

Settings

- Parameters *06.36*…*06.43* (page *132*) and *95.20 HW options word 1* (page *395*).
- Parameter groups *60 DDCS communication* (page *345*), *61 D2D and DDCS transmit data* (page *357*), *62 D2D and DDCS receive data* (page *362*) and *94 LSU control* (page *390*).

Motor control

Direct torque control (DTC)

The motor control of the ACS880 is based on direct torque control (DTC), the ABB premium motor control platform. The switching of the output semiconductors is controlled to achieve the required stator flux and motor torque. The switching frequency is changed only if the actual torque and stator flux values differ from their reference values by more than the allowed hysteresis. The reference value for the torque controller comes from the speed controller or directly from an external torque reference source.

Motor control requires measurement of the DC voltage and two motor phase currents. Stator flux is calculated by integrating the motor voltage in vector space. Motor torque is calculated as a cross product of the stator flux and the rotor current. By utilizing the identified motor model, the stator flux estimate is improved. Actual motor shaft speed is not needed for the motor control.

The main difference between traditional control and DTC is that torque control operates at the same time level as the power switch control. There is no separate voltage and frequency controlled PWM modulator; the output stage switching is wholly based on the electromagnetic state of the motor.

The best motor control accuracy is achieved by activating a separate motor identification run (ID run).

See also section *Scalar motor control* (page *58*).

Settings

Parameters *99.04 Motor control mode* (page *411*) and *99.13 ID run requested* (page *414*).

Reference ramping

Acceleration and deceleration ramping times can be set individually for speed, torque and frequency reference.

With a speed or frequency reference, the ramps are defined as the time it takes for the drive to accelerate or decelerate between zero speed or frequency and the value defined by parameter *46.01 Speed scaling* or *46.02 Frequency scaling*. The user can switch between two preset ramp sets using a binary source such as a digital input. For speed reference, also the shape of the ramp can be controlled.

With a torque reference, the ramps are defined as the time it takes for the reference to change between zero and nominal motor torque (parameter *01.30 Nominal torque scale*).

Special acceleration/deceleration ramps

The acceleration/deceleration times for the jogging function can be defined separately; see section *Jogging* (page *55)*.

The change rate of the motor potentiometer function (page *68*) is adjustable. The same rate applies in both directions.

A deceleration ramp can be defined for emergency stop (“Off3” mode).

Settings

- Speed reference ramping: Parameters *23.11*…*23.19* and *46.01* (pages *212* and *316*).
- Torque reference ramping: Parameters *01.30*, *26.18* and *26.19* (pages *115* and *237*).
- Frequency reference ramping: Parameters *28.71*…*28.75* and *46.02* (pages *246* and *316*).
- Jogging: Parameters *23.20* and *23.21* (page *215*).
- Motor potentiometer: Parameter *22.75* (page *210*).
- Emergency stop (“Off3” mode): Parameter *23.23 Emergency stop time* (page *215*).

Constant speeds/frequencies

Constant speeds and frequencies are predefined references that can be quickly activated, for example, through digital inputs. It is possible to define up to 7 constant speeds for speed control and 7 constant frequencies for frequency control.

⚠ **WARNING:** Constant speeds and frequencies override the normal reference irrespective of where the reference is coming from.

Settings

Parameter groups *22 Speed reference selection* (page *204*) and *28 Frequency reference chain* (page *240*).

Critical speeds/frequencies

Critical speeds (sometimes called “skip speeds”) can be predefined for applications where it is necessary to avoid certain motor speeds or speed ranges because of, for example, mechanical resonance problems.

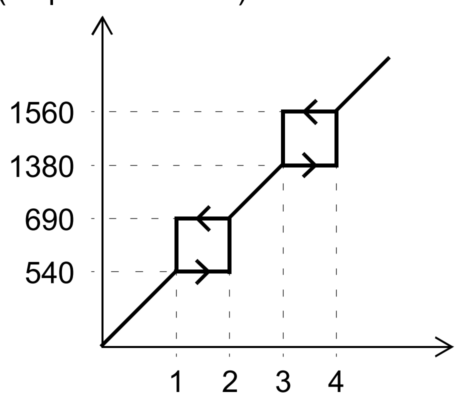
The critical speeds function prevents the reference from dwelling within a critical band for extended times. When a changing reference (*22.87 Speed reference act 7*) enters a critical range, the output of the function (*22.01 Speed ref unlimited*) freezes until the reference exits the range. Any instant change in the output is smoothed out by the ramping function further in the reference chain.

The function is also available for scalar motor control with a frequency reference. The input of the function is shown by *28.96 Frequency ref act 7*, the output by *28.97 Frequency ref unlimited*.

Example

A fan has vibrations in the range of 540 to 690 rpm and 1380 to 1560 rpm. To make the drive avoid these speed ranges,

- enable the critical speeds function by turning on bit 0 of parameter *22.51 Critical speed function*, and
- set the critical speed ranges as in the figure below.



1	Par. *22.52* = 540 rpm
2	Par. *22.53* = 690 rpm
3	Par. *22.54* = 1380 rpm
4	Par. *22.55* = 1560 rpm

Settings

- Critical speeds: parameters *22.51*…*22.57* (page *209*)
- Critical frequencies: parameters *28.51*…*28.57* (page *245*).

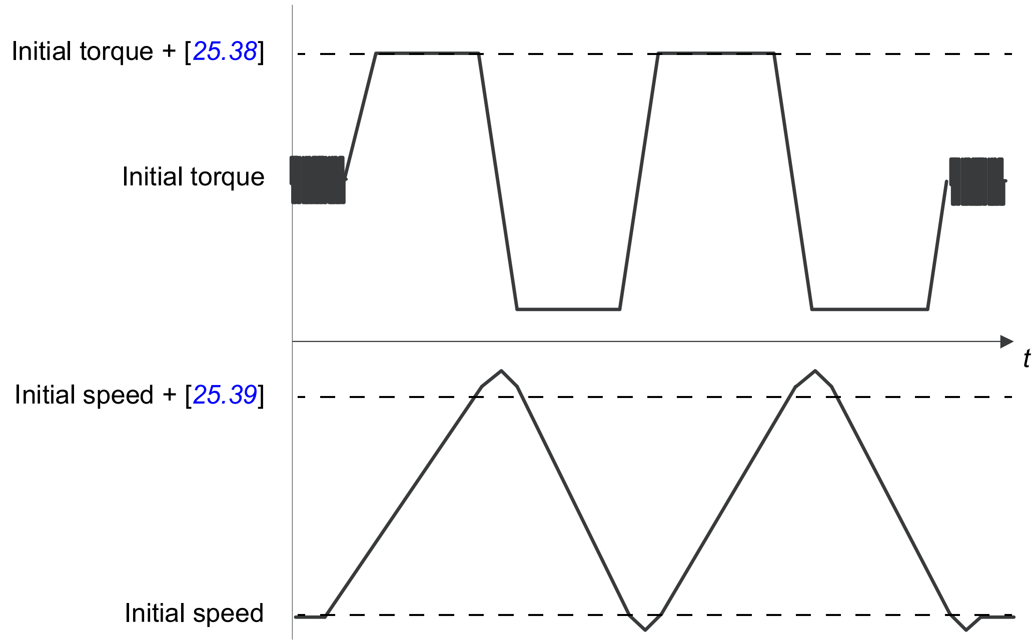
Speed controller autotune

The speed controller of the drive can be automatically adjusted using the autotune function. Autotuning is based on an estimation of the mechanical time constant (inertia) of the motor and machine.

The autotune routine will run the motor through a series of acceleration/deceleration cycles, the number of which can be adjusted by parameter *25.40 Autotune repeat times*. Higher values will produce more accurate results, especially if the difference between initial and maximum speeds is small.

The maximum torque reference used during autotuning will be the initial torque (ie. torque when the routine is activated) plus *25.38 Autotune torque step*, unless limited by the maximum torque limit (parameter group *30 Limits*) or the nominal motor torque (*99 Motor data*). The calculated maximum speed during the routine is the initial speed (ie. speed when the routine is activated) + *25.39 Autotune speed step*, unless limited by *30.12 Maximum speed* or *99.09 Motor nominal speed*.

The diagram below shows the behavior of speed and torque during the autotune routine. In this example, *25.40 Autotune repeat times* is set to 2.



Notes:

- If the drive cannot produce the requested braking power during the routine, the results will be based on the acceleration stages only, and not as accurate as with full braking power.
- The motor will exceed the calculated maximum speed slightly at the end of each acceleration stage.

Before activating the autotune routine

The prerequisites for performing the autotune routine are:

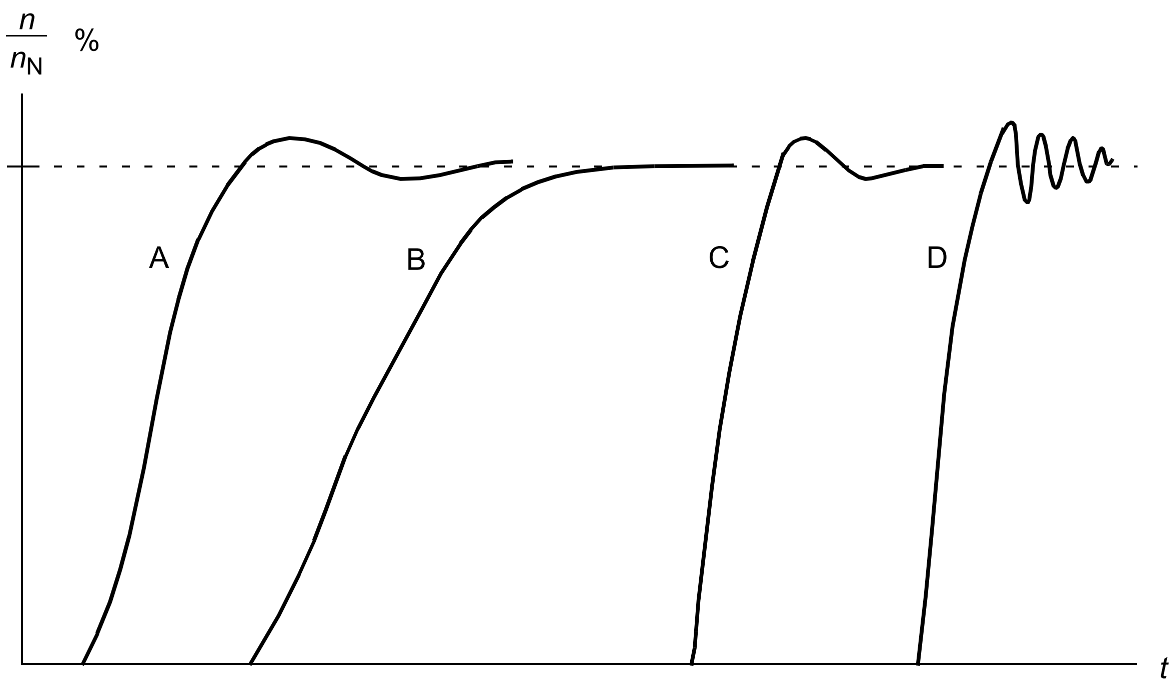
- The motor identification run (ID run) has been successfully completed
- Speed and torque limits (parameter group *30 Limits*) have been set
- The speed feedback has been monitored for noise, vibrations and other disturbances caused by the mechanics of the system, and
  - speed feedback filtering (parameter group *90 Feedback selection*)
  - speed error filtering (*24 Speed reference conditioning*) and
  - zero speed (parameters *21.06* and *21.07*)

  have been set to eliminate these disturbances.
- The drive has been started and is running in speed control mode.

After these conditions have been fulfilled, autotuning can be activated by parameter *25.33 Speed controller autotune* (or the signal source selected by it).

Autotune modes

Autotuning can be performed in three different ways depending on the setting of parameter *25.34 Speed controller autotune mode*. The selections *Smooth*, *Normal* and *Tight* define how the drive torque reference should react to a speed reference step after tuning. The selection *Smooth* will produce a slow but robust response; *Tight* will produce a fast response but possibly too high gain values for some applications. The figure below shows speed responses at a speed reference step (typically 1…20%).



A: Undercompensated
B: Normally tuned (autotuning)
C: Normally tuned (manually). Better dynamic performance than with B
D: Overcompensated speed controller

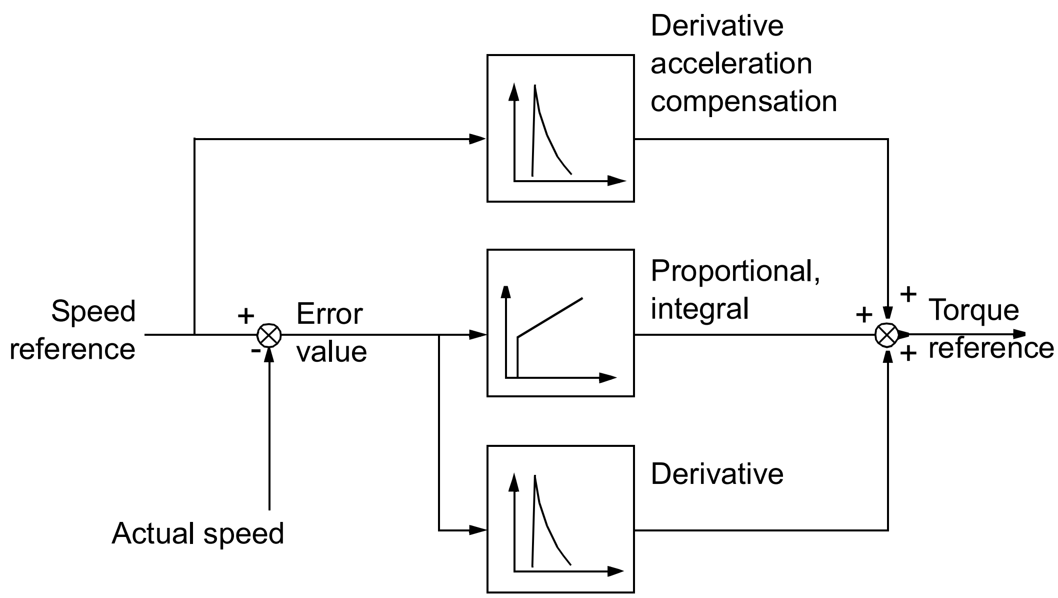
Autotune results

At the end of a successful autotune routine, its results are automatically transferred into parameters

- *25.02 Speed proportional gain* (proportional gain of the speed controller)
- *25.03 Speed integration time* (integration time of the speed controller)
- *25.37 Mechanical time constant* (mechanical time constant of the motor and machine).

Nevertheless, it is still possible to manually adjust the controller gain, integration time and derivation time.

The figure below is a simplified block diagram of the speed controller. The controller output is the reference for the torque controller.



Warning indications

A warning message, *AF90 Speed controller autotuning*, will be generated if the autotune routine does not complete successfully. See chapter *Fault tracing* (page *473*) for further information.

Settings

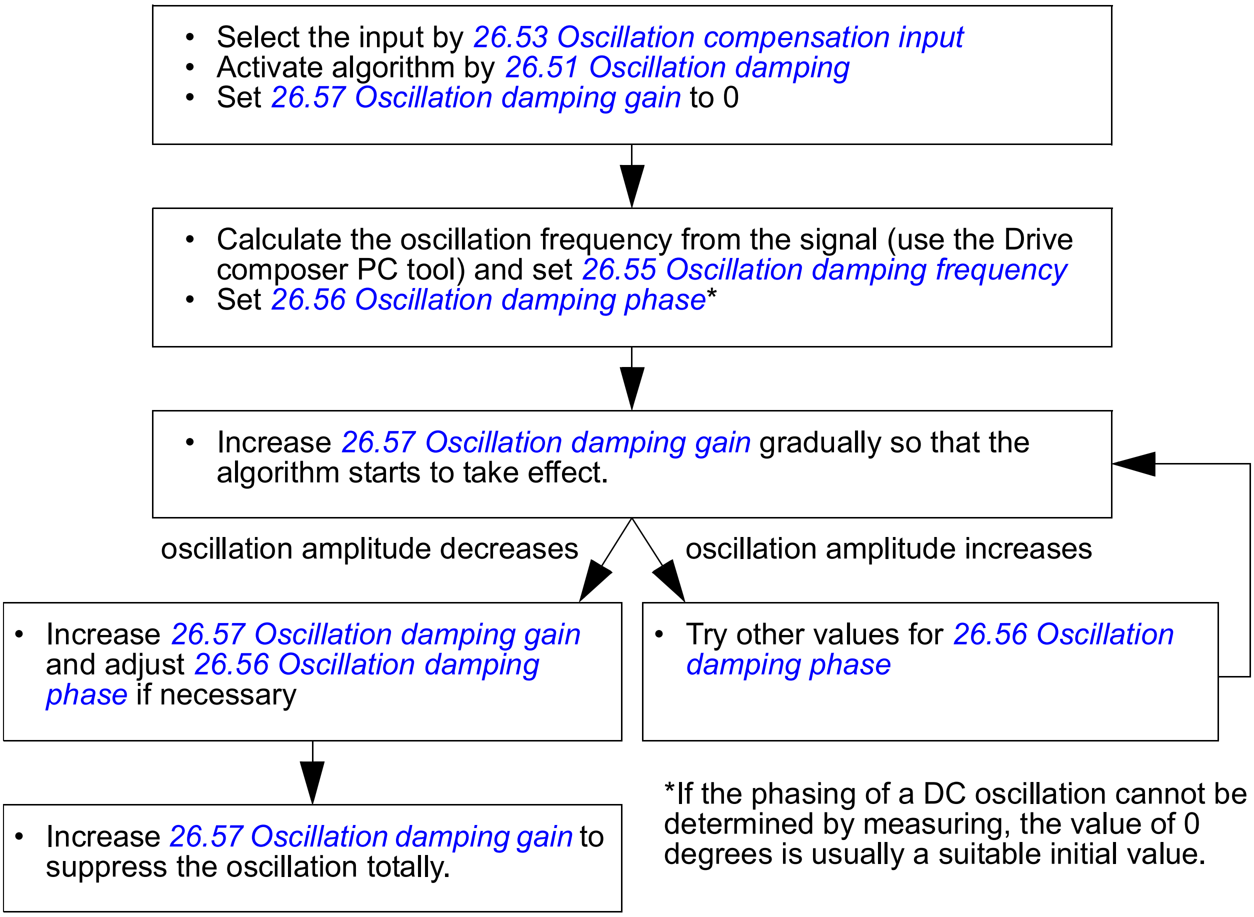
Parameters *25.33*…*25.40* (page *232*).

Oscillation damping

The oscillation damping function can be used to cancel out oscillations caused by mechanics or an oscillating DC voltage. The input – a signal reflecting the oscillation – is selected by parameter *26.53 Oscillation compensation input*. The oscillation damping function outputs a sine wave (*26.58 Oscillation damping output*) which can be summed with the torque reference with a suitable gain (*26.57 Oscillation damping gain*) and phase shift (*26.56 Oscillation damping phase*).

The oscillation damping algorithm can be activated without connecting the output to the reference chain, which makes it possible to compare the input and output of the function and make further adjustments before applying the result.

Tuning procedure for oscillation damping



Note: Changing the speed error low-pass filter time constant or the integration time of the speed controller can affect the tuning of the oscillation damping algorithm. It is recommended to tune the speed controller before the oscillation damping algorithm. (The speed controller gain can be adjusted after the tuning of this algorithm.)

Settings

Parameters *26.51*…*26.58* (page *238*).

Resonance frequency elimination

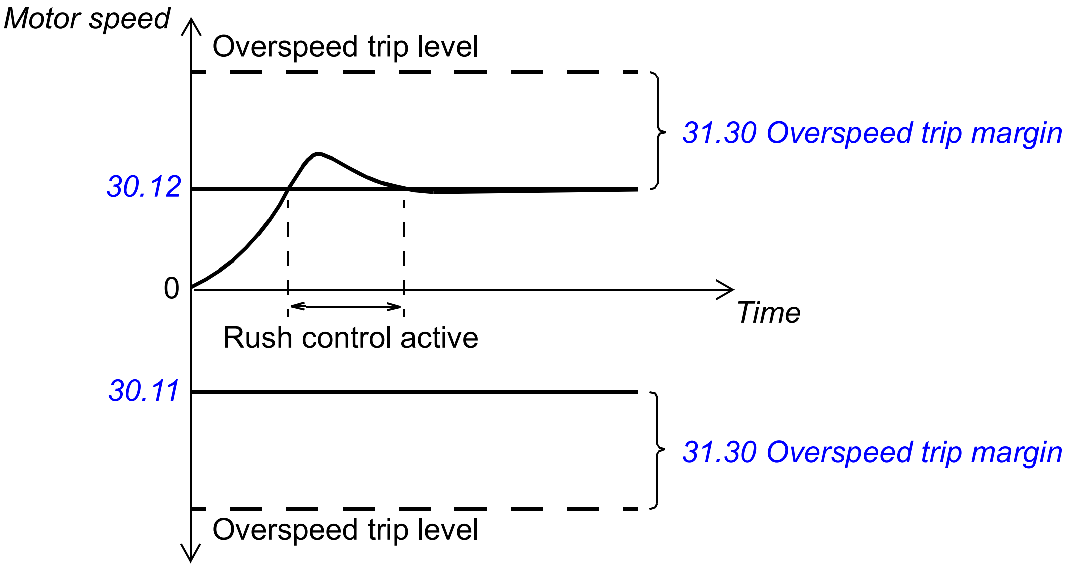
The control program contains a notch filter function for removing the resonance frequencies from the speed error signal.

Settings

Parameters *24.13*…*24.17* (page *219*).

Rush control

In torque control, the motor could potentially rush if the load were suddenly lost. The control program has a rush control function that decreases the torque reference whenever the motor speed exceeds *30.11 Minimum speed* or *30.12 Maximum speed*.



The function is based on a PI controller. The proportional gain and integration time can be defined by parameters. Setting these to zero disables rush control.

Settings

Parameters *26.81 Rush control gain* and *26.82 Rush control integration time* (page *240*).

Encoder support

The program supports two single-turn or multiturn encoders (or resolvers). The following optional interface modules are available:

- TTL encoder interface FEN-01: two TTL inputs, TTL output (for encoder emulation and echo) and two digital inputs
- Absolute encoder interface FEN-11: absolute encoder input, TTL input, TTL output (for encoder emulation and echo) and two digital inputs
- Resolver interface FEN-21: resolver input, TTL input, TTL output (for encoder emulation and echo) and two digital inputs
- HTL encoder interface FEN-31: HTL encoder input, TTL output (for encoder emulation and echo) and two digital inputs
- HTL/TTL encoder interface FSE-31 (for use with an FSO-xx safety functions module): Two HTL/TTL encoder inputs (one HTL input supported at the time of publication).

The interface module is to be installed onto one of the option slots on the drive control unit. The module (except the FSE-31) can also be installed onto an FEA-03 extension adapter.

Encoder echo and emulation

Both encoder echo and emulation are supported by the above-mentioned FEN-xx interfaces.

Encoder echo is available with TTL, TTL+ and HTL encoders. The signal received from the encoder is relayed to the TTL output unchanged. This enables the connection of one encoder to several drives.

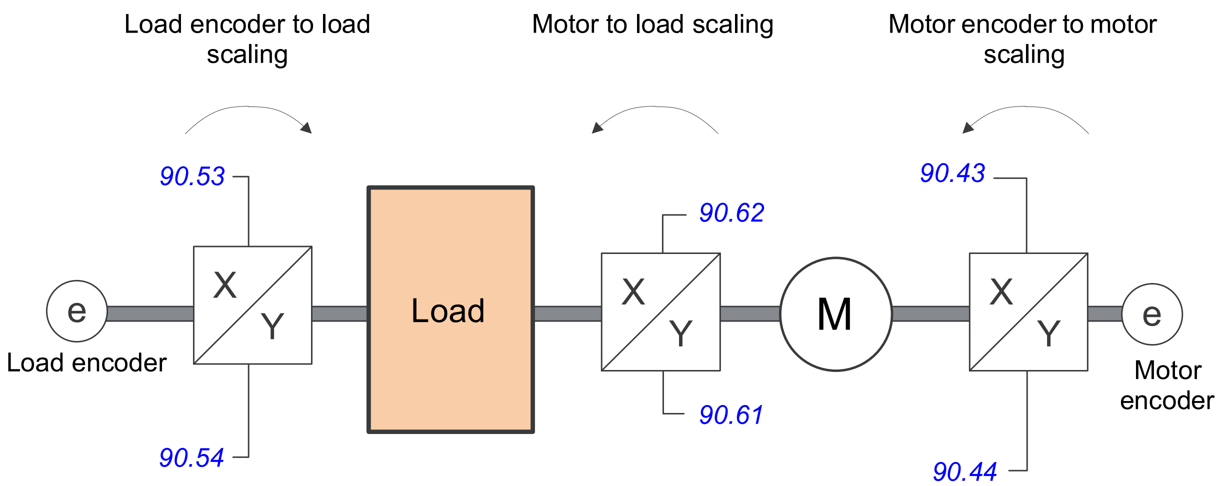
Encoder emulation also relays the encoder signal to the output, but the signal is either scaled, or position data converted to pulses. Emulation can be used when absolute encoder or resolver position needs to be converted to TTL pulses, or when the signal must be converted to a different pulse number than the original.

Load and motor feedback

Three different sources can be used as speed and position feedback: encoder 1, encoder 2, or motor position estimate. Any of these can be used for load position calculation or motor control. The load position calculation makes it possible, for example, to determine the position of a conveyor belt or the height of the load on a crane. The feedback sources are selected by parameters *90.41 Motor feedback selection* and *90.51 Load feedback selection*.

For detailed parameter connections of the motor and load feedback functions, see the block diagrams on pages *553* and *554*. For more information on load position calculation, see section *Position counter* (page *51*).

Any mechanical gear ratios between the components (motor, motor encoder, load, load encoder) are specified using the gear parameters shown in the diagram below.



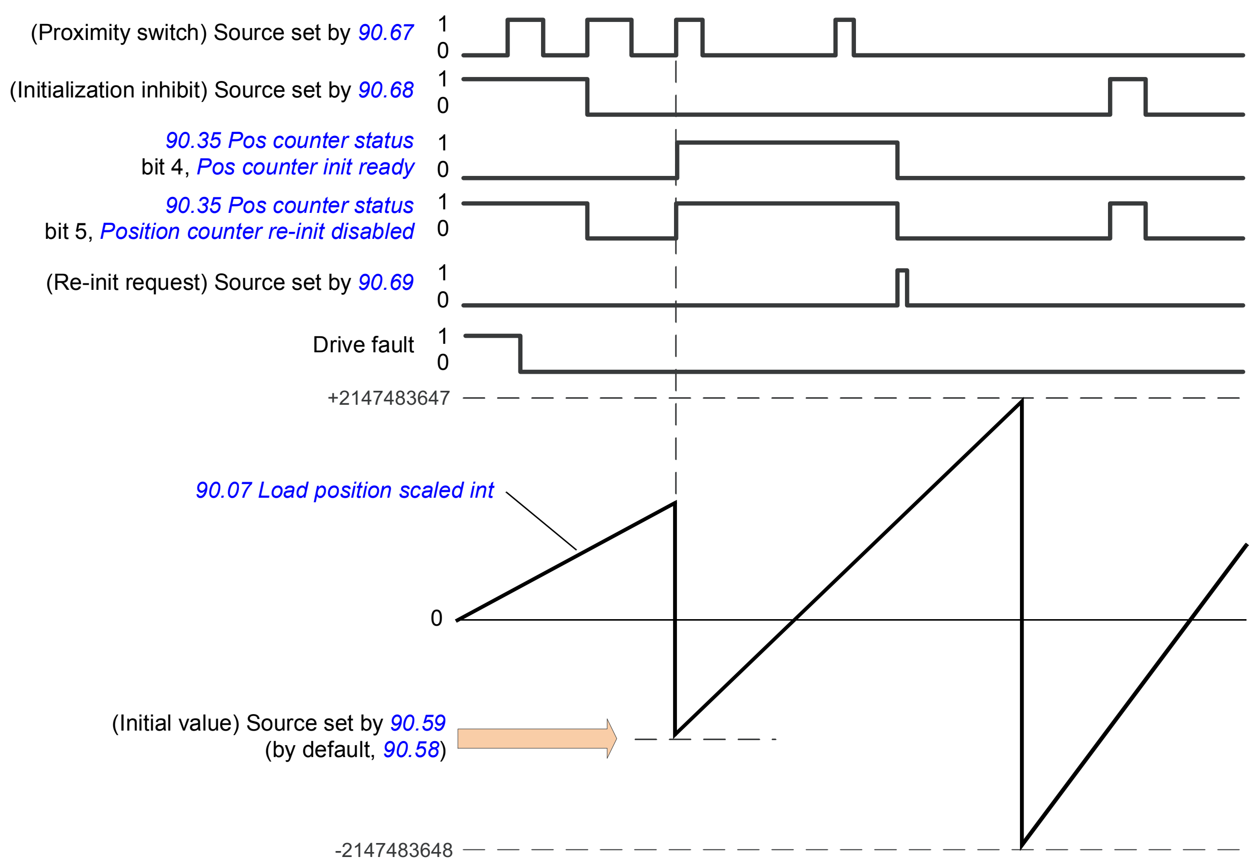
Any gear ratio between the load encoder and the load is defined by *90.53 Load gear numerator* and *90.54 Load gear denominator*. Similarly, any gear ratio between the motor encoder and the motor is defined by *90.43 Motor gear numerator* and *90.44 Motor gear denominator*. In case the internal estimated position is chosen as load feedback, the gear ratio between the motor and load can be defined by *90.61 Gear numerator* and *90.62 Gear denominator*. By default, all of the ratios mentioned above are 1:1. The ratios can only be changed with the drive stopped; new settings require validation by *91.10 Encoder parameter refresh*.

Position counter

The control program contains a position counter feature that can be used to indicate the position of the load. The output of the counter function, parameter *90.07 Load position scaled int*, indicates the scaled number of revolutions read from the selected source (see section *Load and motor feedback* on page *50*).

The relation between revolutions of the motor shaft and the translatory movement of the load (in any given unit of distance) is defined by parameters *90.63 Feed constant numerator* and *90.64 Feed constant denominator*. This gear function can be changed without the need of a parameter refresh or position counter reinitialization.

For detailed parameter connections of the load feedback function, see the block diagram on page *554*.



The position counter is initialized by setting a known physical position of the load into the control program. The initial position (for example, the home/zero position, or the distance from it) can be entered manually in a parameter (*90.58 Pos counter init value int*), or taken from another parameter. This position is set as the value of the position counter (*90.07 Load position scaled int*) when the source selected by *90.67*

Pos counter init cmd source, such as a proximity switch connected to a digital input, is activated. A successful initialization is indicated by bit 4 of *90.35 Pos counter status*.

Any subsequent initialization of the counter must first be enabled by *90.69 Reset pos counter init ready*. To define a time window for initializations, *90.68 Disable pos counter initialization* can be used to inhibit the signal from the proximity switch. An active fault in the drive will also prevent counter initialization.

Encoder error handling

When an encoder is used for load feedback, the action taken in case of an encoder error is specified by *90.55 Load feedback fault*. If the parameter is set to *Warning*, the calculation will continue smoothly using estimated motor position. If the encoder recovers from the error, the calculation will smoothly switch back to encoder feedback. The load position signals (*90.04*, *90.05* and *90.07*) will continue to be updated all the time, but bit 6 of *90.35 Pos counter status* will be set to indicate potentially inaccurate position data. In addition, bit 4 of *90.35* will be cleared upon the next stop as a recommendation to reinitialize the position counter.

Parameter *90.60 Pos counter error and boot action* defines whether position calculation resumes from the previous value over an encoder error or control unit reboot. By default, bit 4 of *90.35 Pos counter status* is cleared after an error, indicating that reinitialization is needed. With *90.60* set to *Continue from previous value*, the position values are retained over an error or reboot; bit 6 of *90.35* is set however to indicate that an error occurred.

Note: With a multiturn absolute encoder, bit 6 of *90.35* is cleared at the next stop of the drive if the encoder has recovered from the error; bit 4 is not cleared. The status of the position counter is retained over a control unit reboot, after which position calculation resumes from the absolute position given by the encoder, taking into account the initial position specified by *90.58*.

WARNING! If the drive is in stopped state when an encoder error occurs, or if the drive is not powered, parameters *90.04*, *90.05*, *90.07* and *90.35* are not updated because no movement of the load can be detected. When using previous position values (*90.60 Pos counter error and boot action* is set to *Continue from previous value*), be aware that the position data is unreliable if the load is able to move.

Reading/writing position counter values through fieldbus

The parameters of the position counter function, such as *90.07 Load position scaled int* and *90.58 Pos counter init value int*, can be accessed from an upper-level control system in the following formats:

- 16-bit integer (if 16 bits are sufficient for the application)
- 32-bit integer (can be accessed as two consequent 16-bit words).

For example, to read parameter *90.07 Load position scaled int* through fieldbus, set the selection parameter of the desired dataset (in group 52) to *Other* – *90.07*, and select the format. If you select a 32-bit format, the subsequent data word is also automatically reserved.

Configuration of HTL encoder motor feedback

1. Specify the type of the encoder interface module (parameter *91.11 Module 1 type* = *FEN-31*) and the slot the module is installed into (*91.12 Module 1 location*).
2. Specify the type of the encoder (*92.01 Encoder 1 type* = *HTL*). The parameter listing will be re-read from the drive after the value is changed.
3. Specify the interface module that the encoder is connected to (*92.02 Encoder 1 source* = *Module 1*).
4. Set the number of pulses according to encoder nameplate (*92.10 Pulses/revolution*).
5. If the encoder rotates at a different speed to the motor (ie. is not mounted directly on the motor shaft), enter the gear ratio in *90.43 Motor gear numerator* and *90.44 Motor gear denominator*.
6. Set parameter *91.10 Encoder parameter refresh* to *Refresh* to apply the new parameter settings. The parameter will automatically revert to *Done*.
7. Check that *91.02 Module 1 status* is showing the correct interface module type (*FEN-31*). Also check the status of the module; both LEDs should be glowing green.
8. Start the motor with a reference of eg. 400 rpm.
9. Compare the estimated speed (*01.02 Motor speed estimated*) with the measured speed (*01.04 Encoder 1 speed filtered*). If the values are the same, set the encoder as the feedback source (*90.41 Motor feedback selection* = *Encoder 1*).
10. Specify the action taken in case the feedback signal is lost (*90.45 Motor feedback fault*).

Example 1: Using the same encoder for both load and motor feedback

The drive controls a motor used for lifting a load in a crane. An encoder attached to the motor shaft is used as feedback for motor control. The same encoder is also used for calculating the height of the load in the desired unit. A gear exists between the motor shaft and the cable drum. The encoder is configured as Encoder 1 as shown in *Configuration of HTL encoder motor feedback* above. In addition, the following settings are made:

- (*90.43 Motor gear numerator* = 1)
- (*90.44 Motor gear denominator* = 1)

  (No gear is needed as the encoder is mounted directly on the motor shaft.)
- *90.51 Load feedback selection* = *Encoder 1*

- (*90.53 Load gear numerator* = 1)
- *90.54 Load gear denominator* = 50

The cable drum turns one revolution per 50 revolutions of the motor shaft.

- (*90.61 Gear numerator* = 1)
- (*90.62 Gear denominator* = 1)

(These parameters need not be changed as position estimate is not being used for feedback.)

- *90.63 Feed constant numerator* = 7
- *90.64 Feed constant denominator* = 10

The load moves 70 centimeters, ie. 7/10 of a meter, per one revolution of the cable drum.

The load height in meters can be read from *90.07 Load position scaled int*, while *90.03 Load speed* displays the rotational speed of the cable drum.

Example 2: Using two encoders

One encoder (encoder 1) is used for motor feedback. The encoder is connected to the motor shaft through a gear. Another encoder (encoder 2) measures the line speed elsewhere in the machine. Each encoder is configured as shown in *Configuration of HTL encoder motor feedback* above. In addition, the following settings are made:

- (*90.41 Motor feedback selection* = *Encoder 1*)
- (*90.43 Motor gear numerator* = 1)
- *90.44 Motor gear denominator* = 3

The encoder turns three revolutions per one revolution of the motor shaft.

- *90.51 Load feedback selection* = *Encoder 2*

The line speed measured by encoder 2 can be read from *90.03 Load speed*. This value is given in rpm which can be converted into another unit by using *90.53 Load gear numerator* and *90.54 Load gear denominator*. Note that the feed constant gear cannot be used in this conversion because it does not affect *90.03 Load speed*.

Example 3: ACS 600 / ACS800 compatibility

With ACS 600 and ACS800 drives, both the rising and falling edges from encoder channels A and B are typically counted to achieve best possible accuracy. Thus the received pulse number per revolution equals four times the nominal pulse number of the encoder.

In this example, an HTL-type 2048-pulse encoder is fitted directly on the motor shaft. The desired initial position to correspond the proximity switch is 66770.

In the ACS880, the following settings are made:

- *92.01 Encoder 1 type* = *HTL*
- *92.02 Encoder 1 source* = *Module 1*
- *92.10 Pulses/revolution* = 2048
- *92.13 Position estimation enable* = *Enable*
- *90.51 Load feedback selection* = *Encoder 1*
- *90.63 Feed constant numerator* = 8192 (ie. 4 × value of *92.10*, as the received number of pulses is 4 times nominal. See also parameter *92.12 Resolver polepairs*)
- The desired "data out" parameter is set to Other – *90.58 Pos counter init value int* (32-bit format). Only the high word needs to be specified – the subsequent data word is reserved for the low word automatically.
- The desired sources (such as digital inputs or user bits of the control word) are selected in *90.67 Pos counter init cmd source* and *90.69 Reset pos counter init ready*.

In the PLC, if the initial value is set in 32-bit format using low and high words (corresponding to ACS800 parameters POS COUNT INIT LO and POS COUNT INIT HI), enter the value 66770 into these words as follows:

Eg. PROFIBUS:

- FBA data out x = POS COUNT INIT HI = 1 (as bit 16 equals 66536)
- FBA data out (x + 1) = POS COUNT INIT LO = 1234.

ABB Automation using DDCS communication, eg.:

- Data set 12.1 = POS COUNT INIT HI
- Data set 12.2 = POS COUNT INIT LO

To test the configuration of the PLC, initialize the position counter with the encoder connected. The initial value sent from the PLC should immediately be reflected by *90.07 Load position scaled int* in the drive. The same value should then appear in the PLC after having been read from the drive.

Settings

Parameter groups *90 Feedback selection* (page *370*), *91 Encoder module settings* (page *379*), *92 Encoder 1 configuration* (page *382*) and *93 Encoder 2 configuration* (page *388*).

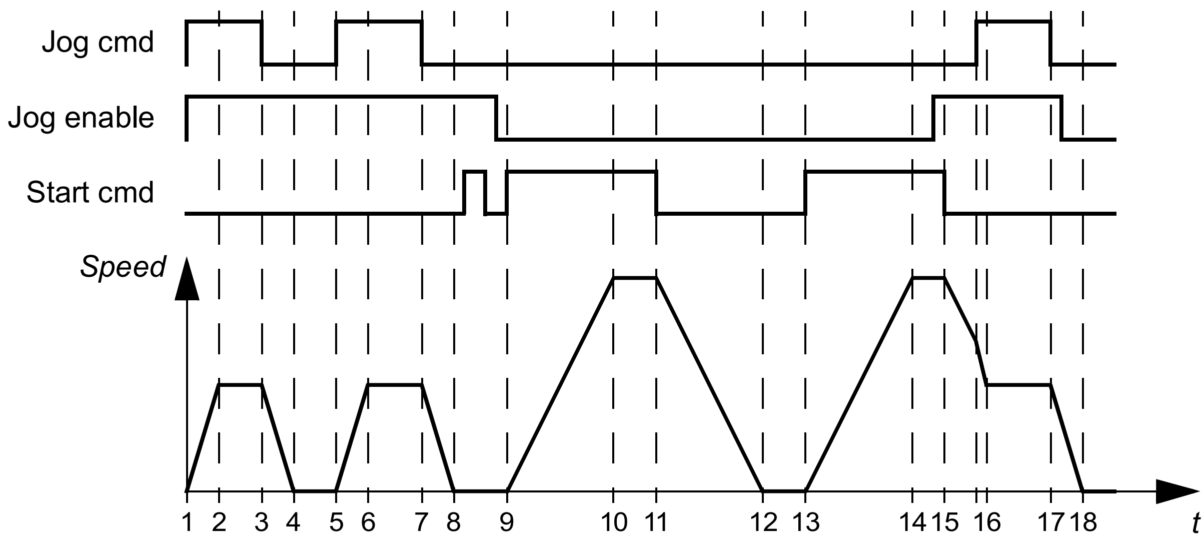
Jogging

The jogging function enables the use of a momentary switch to briefly rotate the motor. The jogging function is typically used during servicing or commissioning to control the machinery locally.

Two jogging functions (1 and 2) are available, each with their own activation sources and references. The signal sources are selected by parameters *20.26 Jogging 1 start source* and *20.27 Jogging 2 start source*. When jogging is activated, the drive starts and accelerates to the defined jogging speed (*22.42 Jogging 1 ref* or *22.43 Jogging 2* *ref*) along the defined jogging acceleration ramp (*23.20 Acc time jogging*). After the activation signal switches off, the drive decelerates to a stop along the defined jogging deceleration ramp (*23.21 Dec time jogging*).

The figure and table below provide an example of how the drive operates during jogging. In the example, the ramp stop mode is used (see parameter *21.03 Stop mode*).

Jog cmd = State of source set by *20.26 Jogging 1 start source* or *20.27 Jogging 2 start source*
Jog enable = State of source set by *20.25 Jogging enable*
Start cmd = State of drive start command.



Phase	Jog cmd	Jog enable	Start cmd	Description
1-2	1	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
2-3	1	1	0	Drive follows the jog reference.
3-4	0	1	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.
4-5	0	1	0	Drive is stopped.
5-6	1	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
6-7	1	1	0	Drive follows the jog reference.
7-8	0	1	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.
8-9	0	1->0	0	Drive is stopped. As long as the jog enable signal is on, start commands are ignored. After jog enable switches off, a fresh start command is required.
9-10	x	0	1	Drive accelerates to the speed reference along the selected acceleration ramp (parameters *23.11*…*23.19*).

Phase	Jog cmd	Jog enable	Start cmd	Description
10-11	x	0	1	Drive follows the speed reference.
11-12	x	0	0	Drive decelerates to zero speed along the selected deceleration ramp (parameters *23.11*…*23.19*).
12-13	x	0	0	Drive is stopped.
13-14	x	0	1	Drive accelerates to the speed reference along the selected acceleration ramp (parameters *23.11*…*23.19*).
14-15	x	0->1	1	Drive follows the speed reference. As long as the start command is on, the jog enable signal is ignored. If the jog enable signal is on when the start command switches off, jogging is enabled immediately.
15-16	0->1	1	0	Start command switches off. The drive starts to decelerate along the selected deceleration ramp (parameters *23.11*…*23.19*). When the jog command switches on, the decelerating drive adopts the deceleration ramp of the jogging function.
16-17	1	1	0	Drive follows the jog reference.
17-18	0	1->0	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.

See also the block diagram on page *552*.

Notes:

- Jogging is not available when the drive is in local control.
- Jogging cannot be enabled when the drive start command is on, or the drive started when jogging is enabled. Starting the drive after the jog enable switches off requires a fresh start command.

WARNING! If jogging is enabled and activated while the start command is on, jogging will activate as soon as the start command switches off.

- If both jogging functions are activated, the one that was activated first has priority.
- Jogging uses the speed control mode.
- Ramp shape times (parameters *23.16*…*23.19*) do not apply to jogging acceleration/deceleration ramps.
- The inching functions activated through fieldbus (see *06.01 Main control word*, bits 8…9) use the references and ramp times defined for jogging, but do not require the jog enable signal.

Settings

Parameters *20.25 Jogging enable* (page *196*), *20.26 Jogging 1 start source* (page *196*), *20.27 Jogging 2 start source* (page *197*), *22.42 Jogging 1 ref* (page *208*), *22.43*

Jogging 2 ref (page *208*), *23.20 Acc time jogging* (page *215*) and *23.21 Dec time jogging* (page *215*).

Scalar motor control

It is possible to select scalar control as the motor control method instead of DTC (Direct Torque Control). In scalar control mode, the drive is controlled with a speed or frequency reference. However, the outstanding performance of DTC is not achieved in scalar control.

It is recommended to activate scalar motor control mode

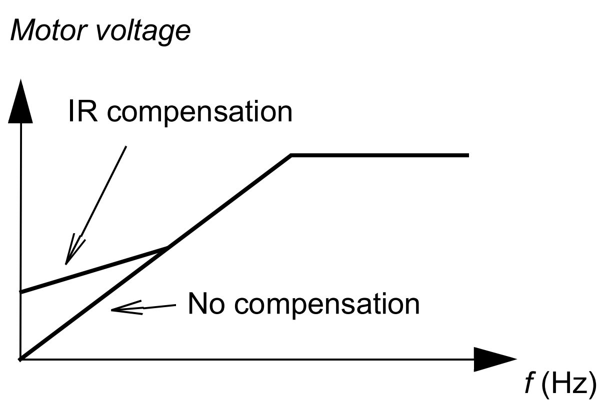
- if the nominal current of the motor is less than 1/6 of the nominal output current of the drive
- if the drive is used without a motor connected (for example, for test purposes)
- if the drive is equipped with a sine filter
- if the drive runs a medium-voltage motor through a step-up transformer, or
- in multimotor drives, if
    - the load is not equally shared between the motors,
    - the motors are of different sizes, or
    - the motors are going to be changed after motor identification (ID run)

In scalar control, some standard features are not available.

See also section *Operating modes of the drive* (page *22*).

IR compensation for scalar motor control

IR compensation (also known as voltage boost) is available only when the motor control mode is scalar. When IR compensation is activated, the drive gives an extra voltage boost to the motor at low speeds. IR compensation is useful in applications that require a high break-away torque. In step-up applications, voltage cannot be fed through the transformer at 0 Hz, so an additional breakpoint is available for defining the compensation near zero frequency.



In Direct Torque Control (DTC), no IR compensation is possible or needed as it is applied automatically.

Settings

- Parameters *19.20 Scalar control reference unit* (page *188*), *97.12 IR comp step-up frequency* (page *408*), *97.13 IR compensation* (page *408*) and *99.04 Motor control mode* (page *411*)
- Parameter group *28 Frequency reference chain* (page *240*).

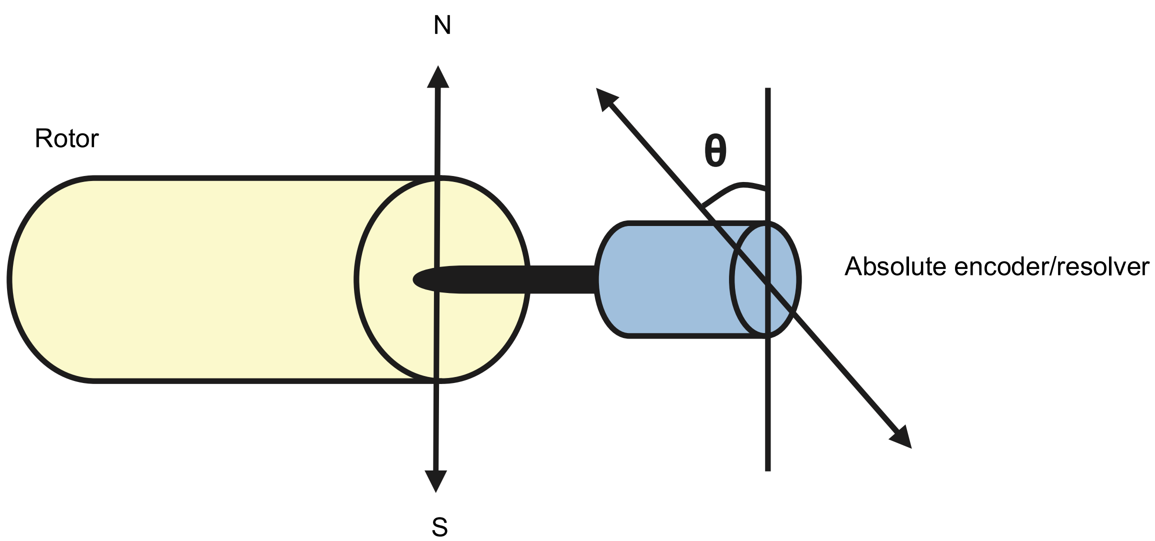
Autophasing

Autophasing is an automatic measurement routine to determine the angular position of the magnetic flux of a permanent magnet synchronous motor or the magnetic axis of a synchronous reluctance motor. The motor control requires the absolute position of the rotor flux in order to control motor torque accurately.

Sensors like absolute encoders and resolvers indicate the rotor position at all times after the offset between the zero angle of rotor and that of the sensor has been established. On the other hand, a standard pulse encoder determines the rotor position when it rotates but the initial position is not known. However, a pulse encoder can be used as an absolute encoder if it is equipped with Hall sensors, albeit with coarse initial position accuracy. Hall sensors generate so-called commutation pulses that change their state six times during one revolution, so it is only known within which 60° sector of a complete revolution the initial position is.

Many encoders give a zero pulse (also called Z-pulse) once during each rotation. The position of the zero pulse is fixed. If this position is known with respect to zero position used by motor control, the rotor position at the instant of the zero pulse is also known.

Using the zero pulse improves the robustness of the rotor position measurement. The rotor position must be determined during starting because the initial value given by the encoder is zero. The autophasing routine determines the position, but there is a risk of some position error. If the zero pulse position is known in advance, the position found by autophasing can be corrected as soon as the zero pulse is detected for the first time after starting.



The autophasing routine is performed with permanent magnet synchronous motors and synchronous reluctance motors in the following cases:

1. One-time measurement of the rotor and encoder position difference when an absolute encoder, a resolver, or an encoder with commutation signals is used
2. At every power-up when an incremental encoder is used
3. With open-loop motor control, repetitive measurement of the rotor position at every start
4. When the position of the zero pulse must be measured before the first start after power-up.

Note: In closed-loop control, autophasing is performed automatically after the motor identification run (ID run). Autophasing is also performed automatically before starting when necessary.

In open-loop control, the zero angle of the rotor is determined before starting. In closed-loop control, the actual angle of the rotor is determined with autophasing when the sensor indicates zero angle. The offset of the angle must be determined because the actual zero angles of the sensor and the rotor do not usually match. The autophasing mode determines how this operation is done both in open-loop and closed-loop control.

The rotor position offset used in motor control can also be given by the user – see parameter *98.15 Position offset user*. Note that the autophasing routine also writes its result into this parameter. The results are updated even if user settings are not enabled by *98.01 User motor model mode*.

Note: In open-loop control, the motor always turns when it is started as the shaft is turned towards the remanence flux.

Bit 4 of *06.21 Drive status word 3* indicates if the rotor position has already been determined.

Autophasing modes

Several autophasing modes are available (see parameter *21.13 Autophasing mode*).

The turning mode (*Turning*) is recommended especially with case 1 (see the list above) as it is the most robust and accurate method. In turning mode, the motor shaft is turned back and forward (±360/polepairs)° in order to determine the rotor position. In case 3 (open-loop control), the shaft is turned only in one direction and the angle is smaller.

Another turning mode, *Turning with Z-pulse*, can be used if there is difficulty using the normal turning mode, for example, because of significant friction. With this mode, the rotor is turned slowly until a zero pulse is detected from the encoder. When the zero pulse is detected for the first time, its position is stored into parameter *98.15 Position offset user*, which can be edited for fine-tuning. Note that it is not mandatory to use this mode with a zero pulse encoder. In open-loop control, the two turning modes are identical.

The standstill modes (*Standstill 1*, *Standstill 2*) can be used if the motor cannot be turned (for example, when the load is connected). As the characteristics of motors and loads differ, testing must be done to find out the most suitable standstill mode.

The drive is capable of determining the rotor position when started into a running motor in open-loop or closed-loop control. In this situation, the setting of *21.13 Autophasing mode* has no effect.

The autophasing routine can fail and therefore it is recommended to perform the routine several times and check the value of parameter *98.15 Position offset user*.

An autophasing fault (*3385 Autophasing*) can occur with a running motor if the estimated angle of the motor differs too much from the measured angle. This could be caused by, for example, the following:

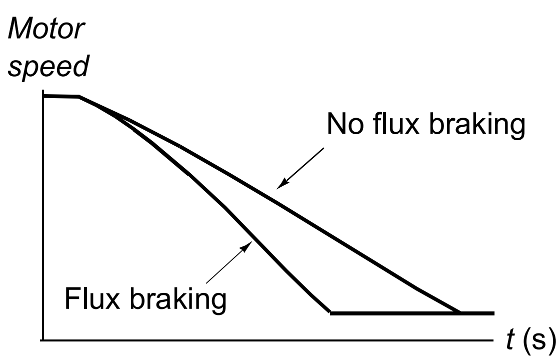
- The encoder is slipping on the motor shaft
- An incorrect value has been entered into *98.15 Position offset user*
- The motor is already turning before the autophasing routine is started
- *Turning* mode is selected in *21.13 Autophasing mode* but the motor shaft is locked
- *Turning with Z-pulse* mode is selected in *21.13 Autophasing mode* but no zero pulse is detected within a revolution of the motor
- The wrong motor type is selected in *99.03 Motor type*
- Motor ID run has failed.

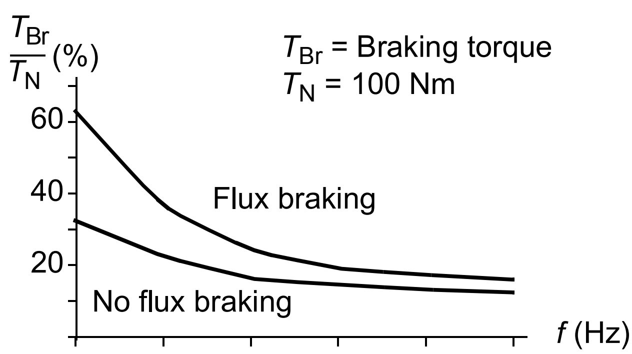
Settings and diagnostics

Parameters *06.21 Drive status word 3* (page *130*), *21.13 Autophasing mode* (page *202*), *98.15 Position offset user* (page *411*) and *99.13 ID run requested* (page *414*).

Flux braking

The drive can provide greater deceleration by raising the level of magnetization in the motor. By increasing the motor flux, the energy generated by the motor during braking can be converted to motor thermal energy.





The drive monitors the motor status continuously, also during flux braking. Therefore, flux braking can be used both for stopping the motor and for changing the speed. The other benefits of flux braking are:

- The braking starts immediately after a stop command is given. The function does not need to wait for the flux reduction before it can start the braking.
- The cooling of the induction motor is efficient. The stator current of the motor increases during flux braking, not the rotor current. The stator cools much more efficiently than the rotor.
- Flux braking can be used with induction motors and permanent magnet synchronous motors.

Two braking power levels are available:

- Moderate braking provides faster deceleration compared to a situation where flux braking is disabled. The flux level of the motor is limited to prevent excessive heating of the motor.
- Full braking exploits almost all available current to convert the mechanical braking energy to motor thermal energy. Braking time is shorter compared to moderate braking. In cyclic use, motor heating may be significant.

WARNING: The motor needs to be rated to absorb the thermal energy generated by flux braking.

Settings

Parameter *97.05 Flux braking* (page *406*).

DC magnetization

DC magnetization can be applied to the motor to

- heat the motor to remove or prevent condensation, or
- to lock the rotor at, or near, zero speed.

Pre-heating

A motor pre-heating function is available to prevent condensation in a stopped motor, or to remove condensation from the motor before start. Pre-heating involves feeding a DC current into the motor to heat up the windings.

Pre-heating is deactivated at start, or when one of the other DC magnetization functions is activated. With the drive stopped, pre-heating is disabled by the safe torque off function, a drive fault state, or the process PID sleep function. Pre-heating can only start after one minute has elapsed from stopping the drive.

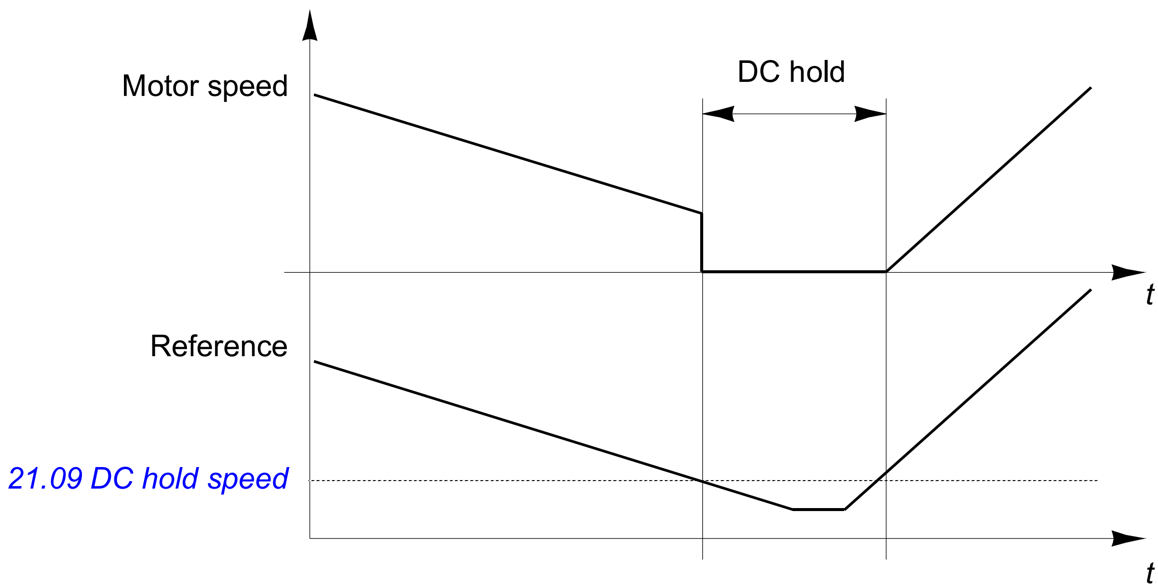
A digital source to control pre-heating is selected by parameter *21.14 Pre-heating input source*. The heating current is set by *21.16 Pre-heating current*.

Pre-magnetization

Pre-magnetization refers to DC magnetization of the motor before start. Depending on the selected start mode (*21.01 Start mode* or *21.19 Scalar start mode*), pre-magnetization can be applied to guarantee the highest possible breakaway torque, up to 200% of the nominal torque of the motor. By adjusting the pre-magnetization time (*21.02 Magnetization time*), it is possible to synchronize the motor start and, for example, the release of a mechanical brake.

DC hold

The function makes it possible to lock the rotor at (near) zero speed in the middle of normal operation. DC hold is activated by parameter *21.08 DC current control*. When both the reference and motor speed drop below a certain level (parameter *21.09 DC hold speed*), the drive will stop generating sinusoidal current and start to inject DC into the motor. The current is set by parameter *21.10 DC current reference*. When the reference exceeds parameter *21.09 DC hold speed*, normal drive operation continues.



Notes:

- DC hold is only available in speed control in DTC motor control mode (see page *22*).
- The function applies the DC current to one phase only, depending on the position of the rotor. The return current will be shared between the other phases.

Post-magnetization

This feature keeps the motor magnetized for a certain period (parameter *21.11 Post magnetization time*) after stopping. This is to prevent the machinery from moving under load, for example before a mechanical brake can be applied. Post-magnetization is activated by parameter *21.08 DC current control*. The magnetization current is set by parameter *21.10 DC current reference*.

Note: Post-magnetization is only available in speed control in DTC motor control mode (see page *22*), and only when ramping is the selected stop mode (see parameter *21.03 Stop mode*).

Continuous magnetization

A digital signal, such as a user bit in the fieldbus control word, can be selected to activate continuous magnetization. This can be especially useful in processes requiring motors to be stopped (for example, to stand by until new material is processed), then quickly started without magnetizing them first.

Note: Continuous magnetization is only available in speed control in DTC motor control mode (see page *22*), and only when ramping is the selected stop mode (see parameter *21.03 Stop mode*).

WARNING: The motor must be designed to absorb or dissipate the thermal energy generated by continuous magnetization, for example by forced ventilation.

Settings

Parameters *06.21 Drive status word 3* (page *130*), *21.01 Start mode*, *21.02 Magnetization time*, *21.08*…*21.12*, *21.14 Pre-heating input source* and *21.16 Pre-heating current* (page *197*).

Application control

Application macros

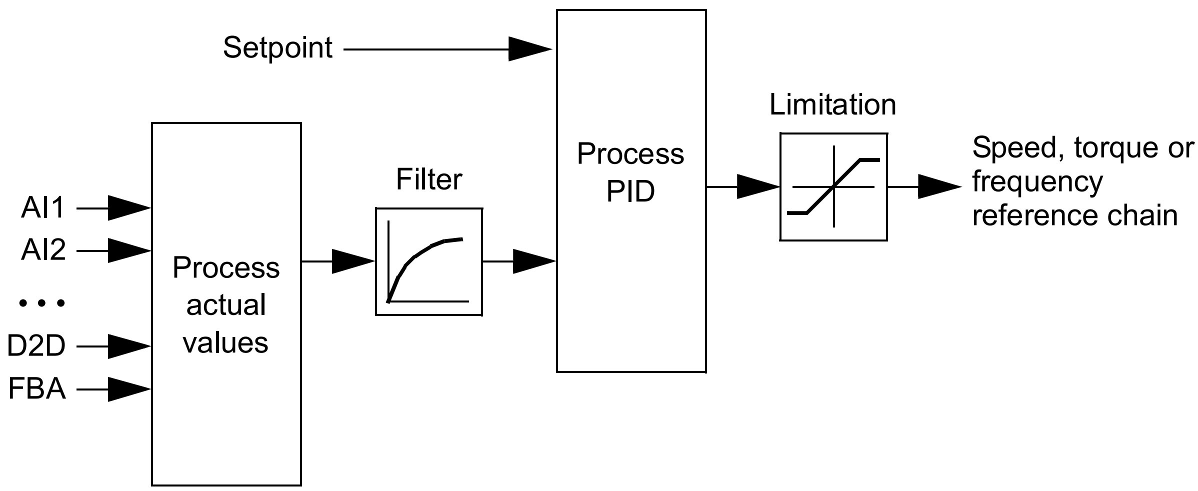
Application macros are predefined application parameter edits and I/O configurations. See chapter *Application macros* (page *93*).

Process PID control

There is a built-in process PID controller in the drive. The controller can be used to control process variables such as pressure, flow or fluid level.

In process PID control, a process reference (setpoint) is connected to the drive instead of a speed reference. An actual value (process feedback) is also brought back to the drive. The process PID control adjusts the drive speed in order to keep the measured process quantity (actual value) at the desired level (setpoint).

The simplified block diagram below illustrates the process PID control. For a more detailed block diagram, see page *564*.



The control program contains two complete sets of process PID controller settings that can be alternated whenever necessary; see parameter *40.57 PID set1/set2 selection*.

Note: Process PID control is only available in external control; see section *Local control vs. external control* (page *20*).

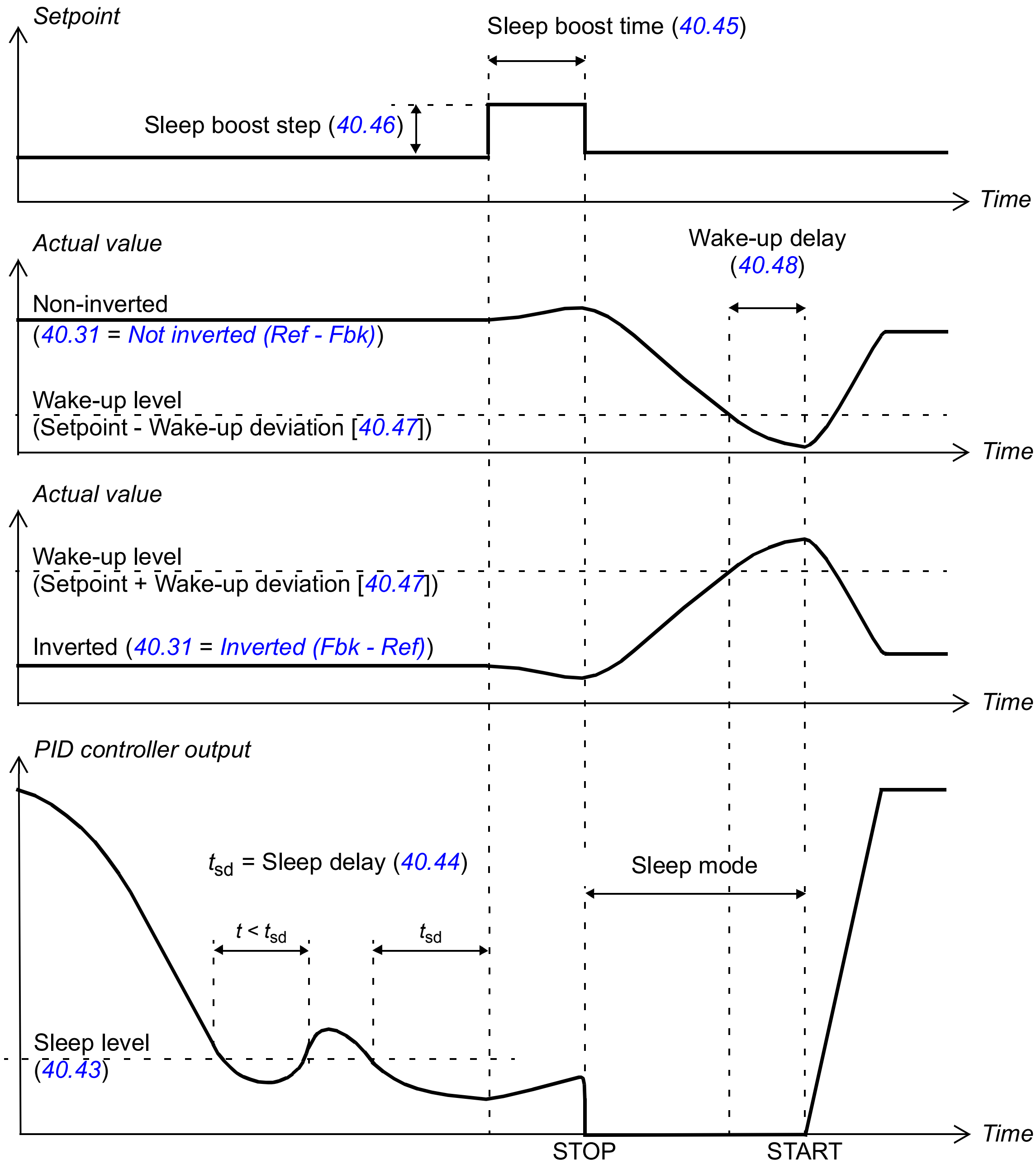
Quick configuration of the process PID controller

1. Activate the process PID controller (parameter *40.07 Set 1 PID operation mode*).
2. Select a feedback source (parameters *40.08*…*40.11*).
3. Select a setpoint source (parameters *40.16*…*40.25*).
4. Set the gain, integration time, derivation time, and the PID output levels (*40.32 Set 1 gain*, *40.33 Set 1 integration time*, *40.34 Set 1 derivation time*, *40.36 Set 1 output min* and *40.37 Set 1 output max*).
5. The PID controller output is shown by parameter *40.01 Process PID output actual*. Select it as the source of, for example, *22.11 Speed ref1 source*.

Sleep function for process PID control

The sleep function can be used in PID control applications that involve relatively long periods of low demand (for example, a tank is at level), During such periods, the sleep function saves energy by stopping the motor completely, instead of running the motor slowly below the efficient operating range of the system. When the feedback changes, the PID controller wakes the drive up.

Example: The drive controls a pressure boost pump. The water consumption falls at night. As a consequence, the process PID controller decreases the motor speed. However, due to natural losses in the pipes and the low efficiency of the centrifugal pump at low speeds, the motor would never stop rotating. The sleep function detects the slow rotation and stops unnecessary pumping after the sleep delay has passed. The drive shifts into sleep mode, still monitoring the pressure. The pumping resumes when the pressure falls under the wake-up level (setpoint - wake-up deviation) and the wake-up delay has passed.



Tracking

In tracking mode, the PID block output is set directly to the value of parameter *40.50* (or *41.50*) *Set 1 tracking ref selection*. The internal I term of the PID controller is set so that no transient is allowed to pass on to the output, so when the tracking mode is left, normal process control operation can be resumed without a significant bump.

Settings

- Parameter *96.04 Macro select* (macro selection)
- Parameter groups *40 Process PID set 1* (page *293*) and *41 Process PID set 2* (page *305*).

Motor potentiometer

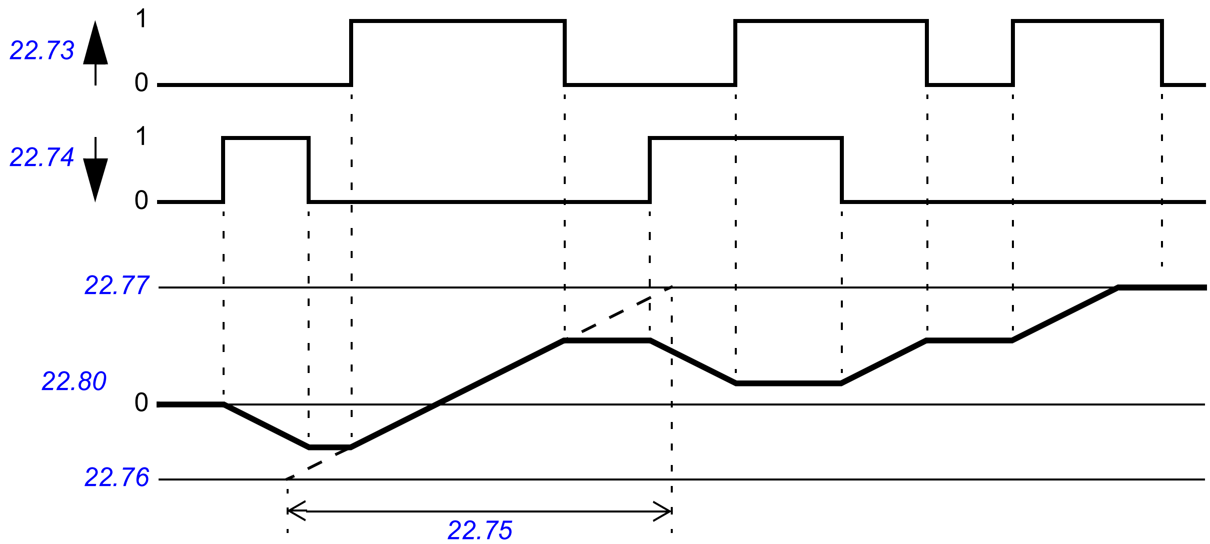
The motor potentiometer is, in effect, a counter whose value can be adjusted up and down using two digital signals selected by parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source*. Note that these signals have no effect when the drive is stopped.

When enabled by *22.71 Motor potentiometer function*, the motor potentiometer assumes the value set by *22.72 Motor potentiometer initial value*. Depending on the mode selected in *22.71*, the motor potentiometer value is either retained or reset over a stop or a power cycle.

The change rate is defined in *22.75 Motor potentiometer ramp time* as the time it would take for the value to change from the minimum (*22.76 Motor potentiometer min value*) to the maximum (*22.77 Motor potentiometer max value*) or vice versa. If the up and down signals are simultaneously on, the motor potentiometer value does not change.

The output of the function is shown by *22.80 Motor potentiometer ref act*, which can directly be set as the source of any selector parameter such as *22.11 Speed ref1 source*.

The following example shows the behavior of the motor potentiometer value.



Settings

Parameters *22.71*…*22.80* (page *209*).

Mechanical brake control

A mechanical brake can be used for holding the motor and driven machinery at zero speed when the drive is stopped, or not powered. The brake control logic observes the settings of parameter group *44 Mechanical brake control* as well as several external signals, and moves between the states presented in the diagram on page *70*. The tables below the state diagram detail the states and transitions. The timing diagram on page *72* shows an example of a close-open-close sequence.

Inputs of the brake control logic

The start command of the drive (bit 5 of *06.16 Drive status word 1*) is the main control source of the brake control logic. An optional external open/close signal can be selected by *44.12 Brake close request*. The two signals interact as follows:

- Start command = 1 **AND** signal selected by *44.12 Brake close request* = 0
  → Request brake to **open**
- Start command = 0 **OR** signal selected by *44.12 Brake close request* = 1
  → Request brake to **close**

Another external signal – for example, from a higher-level control system – can be connected via parameter *44.11 Keep brake closed* to prevent the brake from opening.

Other signals that affect the state of the control logic are

- brake status acknowledgement (optional, defined by *44.07 Brake acknowledge selection*),
- bit 2 of *06.11 Main status word* (indicates whether the drive is ready to follow the given reference or not),
- bit 6 of *06.16 Drive status word 1* (indicates whether the drive is modulating or not),
- optional FSO-xx safety functions module.

Outputs of the brake control logic

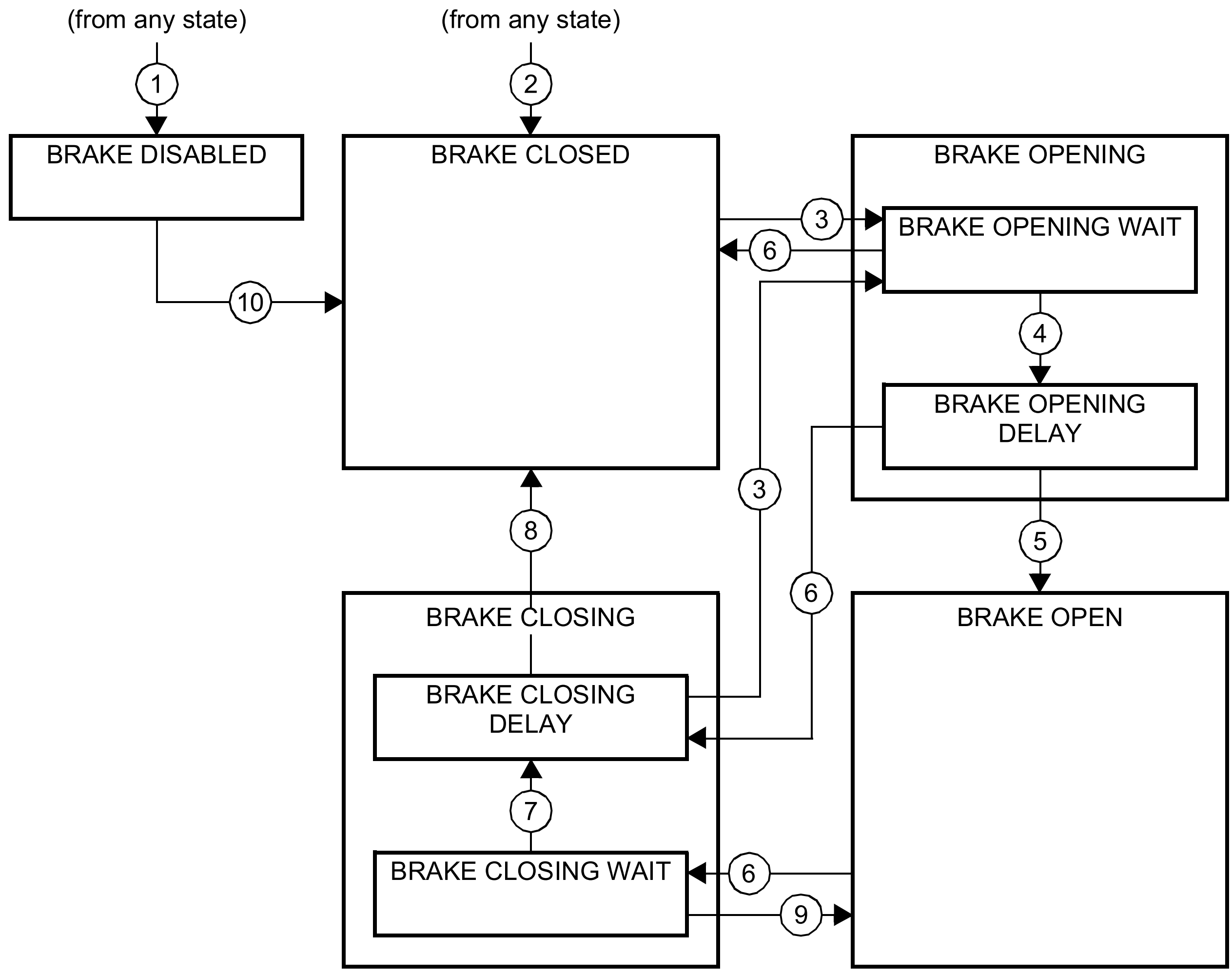
The mechanical brake is to be controlled by bit 0 of parameter *44.01 Brake control status*. This bit should be selected as the source of a relay output (or a digital input/output in output mode) which is then wired to the brake actuator through a relay. See the wiring example on page *73*.

The brake control logic, in various states, will request the drive control logic to hold the motor, increase the torque, or ramp down the speed. These requests are visible in parameter *44.01 Brake control status*.

Settings

Parameter group *44 Mechanical brake control* (page *309*).

Brake state diagram



State descriptions

State name	Description
BRAKE DISABLED	Brake control is disabled (parameter *44.06 Brake control enable* = 0, and *44.01 Brake control status* b4 = 0). The brake is closed (*44.01 Brake control status* b0 = 0).
BRAKE OPENING:	
BRAKE OPENING WAIT	Brake has been requested to open. The drive logic is requested to increase the torque up to opening torque to hold the load in place (*44.01 Brake control status* b1 = 1 and b2 = 1). The state of *44.11 Keep brake closed* is checked; if it is not 0 within a reasonable time, the drive trips on a *71A5 Mechanical brake opening not allowed* fault*.
BRAKE OPENING DELAY	Opening conditions have been met and open signal activated (*44.01 Brake control status* b0 is set). The opening torque request is removed (*44.01 Brake control status* b1 → 0). The load is held in place by the speed control of the drive until *44.08 Brake open delay* elapses. At this point, if *44.07 Brake acknowledge selection* is set to *No acknowledge*, the logic proceeds to *BRAKE OPEN* state. If an acknowledgement signal source has been selected, its state is checked; if the state is not "brake open", the drive trips on a *71A3 Mechanical brake opening failed* fault*.
BRAKE OPEN	The brake is open (*44.01 Brake control status* b0 = 1). Hold request is removed (*44.01 Brake control status* b2 = 0), and the drive is allowed to follow the reference.

State name	Description
BRAKE CLOSING:	
BRAKE CLOSING WAIT	Brake has been requested to close. The drive logic is requested to ramp down the speed to a stop (*44.01 Brake control status* b3 = 1). The open signal is kept active (*44.01 Brake control status* b0 = 1). The brake logic will remain in this state until the motor speed has remained below *44.14 Brake close level* for the time defined by *44.15 Brake close level delay*.
BRAKE CLOSING DELAY	Closing conditions have been met. The open signal is deactivated (*44.01 Brake control status* b0 → 0) and the closing torque written into *44.02 Brake torque memory*. The ramp-down request is maintained (*44.01 Brake control status* b3 = 1). The brake logic will remain in this state until *44.13 Brake close delay* has elapsed. At this point, if *44.07 Brake acknowledge selection* is set to *No acknowledge*, the logic proceeds to *BRAKE CLOSED* state. If an acknowledgement signal source has been selected, its state is checked; if the state is not "brake closed", the drive generates an *A7A1 Mechanical brake closing failed* warning. If *44.17 Brake fault function* = *Fault*, the drive will trip on a *71A2 Mechanical brake closing failed* fault after *44.18 Brake fault delay*.
BRAKE CLOSED	The brake is closed (*44.01 Brake control status* b0 = 0). The drive is not necessarily modulating. **Note concerning open-loop (encoderless) applications:** If the brake is kept closed by a brake close request (either from parameter *44.12* or an FSO-xx safety functions module) against a modulating drive for longer than 5 seconds, the brake is forced to closed state and the drive trips on a fault, *71A5 Mechanical brake opening not allowed*.
*A warning can alternatively be selected by *44.17 Brake fault function*; if so, the drive will keep modulating and remain in this state.	

State change conditions (n)

1 Brake control disabled (parameter *44.06 Brake control enable* → 0).

2 *06.11 Main status word*, bit 2 = 0 or brake is forced to close by optional FSO-xx safety functions module.

3 Brake has been requested to open and *44.16 Brake reopen delay* has expired.

4 Brake open conditions (such as *44.10 Brake open torque*) fulfilled and *44.11 Keep brake closed* = 0.

5 *44.08 Brake open delay* has elapsed and brake open acknowledgement (if chosen by *44.07 Brake acknowledge selection*) has been received.

6 Brake has been requested to close.

7 Motor speed has remained below closing speed *44.14 Brake close level* for the duration of *44.15 Brake close level delay*.

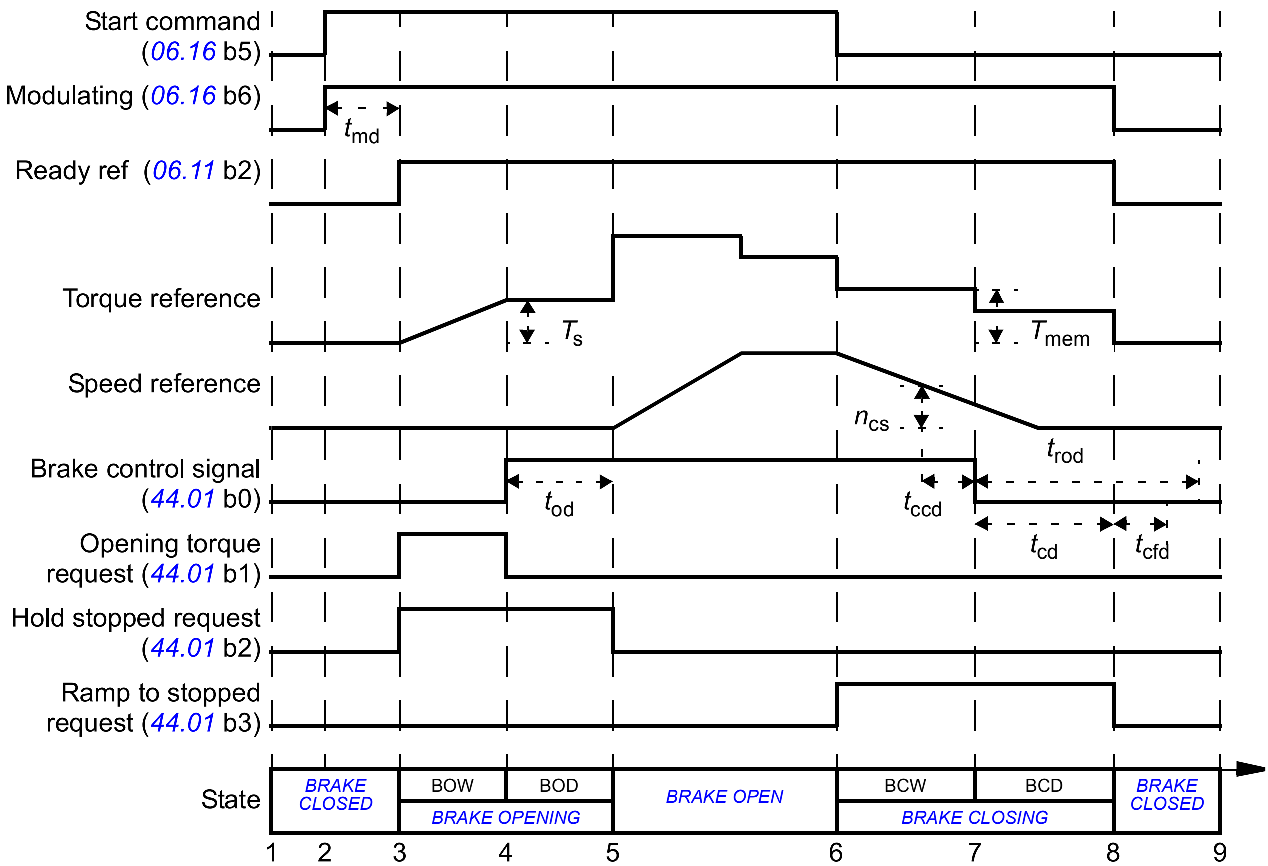
8 *44.13 Brake close delay* has elapsed and brake close acknowledgement (if chosen by *44.07 Brake acknowledge selection*) has been received.

9 Brake has been requested to open.

10 Brake control enabled (parameter *44.06 Brake control enable* → 1).

Timing diagram

The simplified timing diagram below illustrates the operation of the brake control function. Refer to the state diagram above.



T_s	Start torque at brake open (parameter *44.03 Brake open torque reference*)
T_{mem}	Stored torque value at brake close (*44.02 Brake torque memory*)
t_{md}	Motor magnetization delay
t_{od}	Brake open delay (parameter *44.08 Brake open delay*)
n_{cs}	Brake close speed (parameter *44.14 Brake close level*)
t_{ccd}	Brake close command delay (parameter *44.15 Brake close level delay*)
t_{cd}	Brake close delay (parameter *44.13 Brake close delay*)
t_{cfd}	Brake close fault delay (parameter *44.18 Brake fault delay*)
t_{rod}	Brake reopen delay (parameter *44.16 Brake reopen delay*)
BOW	*BRAKE OPENING WAIT*
BOD	*BRAKE OPENING DELAY*
BCW	*BRAKE CLOSING WAIT*
BCD	*BRAKE CLOSING DELAY*

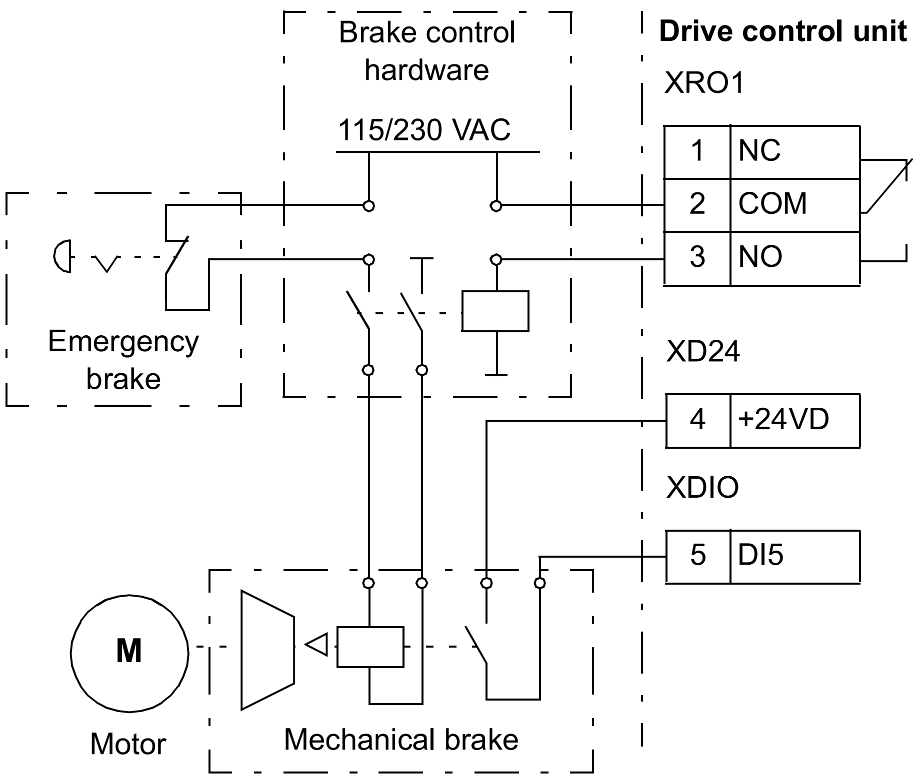
Wiring example

The figure below shows a brake control wiring example. The brake control hardware and wiring is to be sourced and installed by the customer.

WARNING! Make sure that the machinery into which the drive with brake control function is integrated fulfils the personnel safety regulations. Note that the frequency converter (a Complete Drive Module or a Basic Drive Module, as defined in IEC 61800-2), is not considered as a safety device mentioned in the European Machinery Directive and related harmonised standards. Thus, the personnel safety of the complete machinery must not be based on a specific frequency converter feature (such as the brake control function), but it has to be implemented as defined in the application specific regulations.

The brake is controlled by bit 0 of parameter *44.01 Brake control status*. The source of brake acknowledge (status supervision) is selected by parameter *44.07 Brake acknowledge selection*. In this example,

- parameter *10.24 RO1 source* is set to *Open brake command* (ie. bit 0 of *44.01 Brake control status*), and
- parameter *44.07 Brake acknowledge selection* is set to *DI5*.



DC voltage control

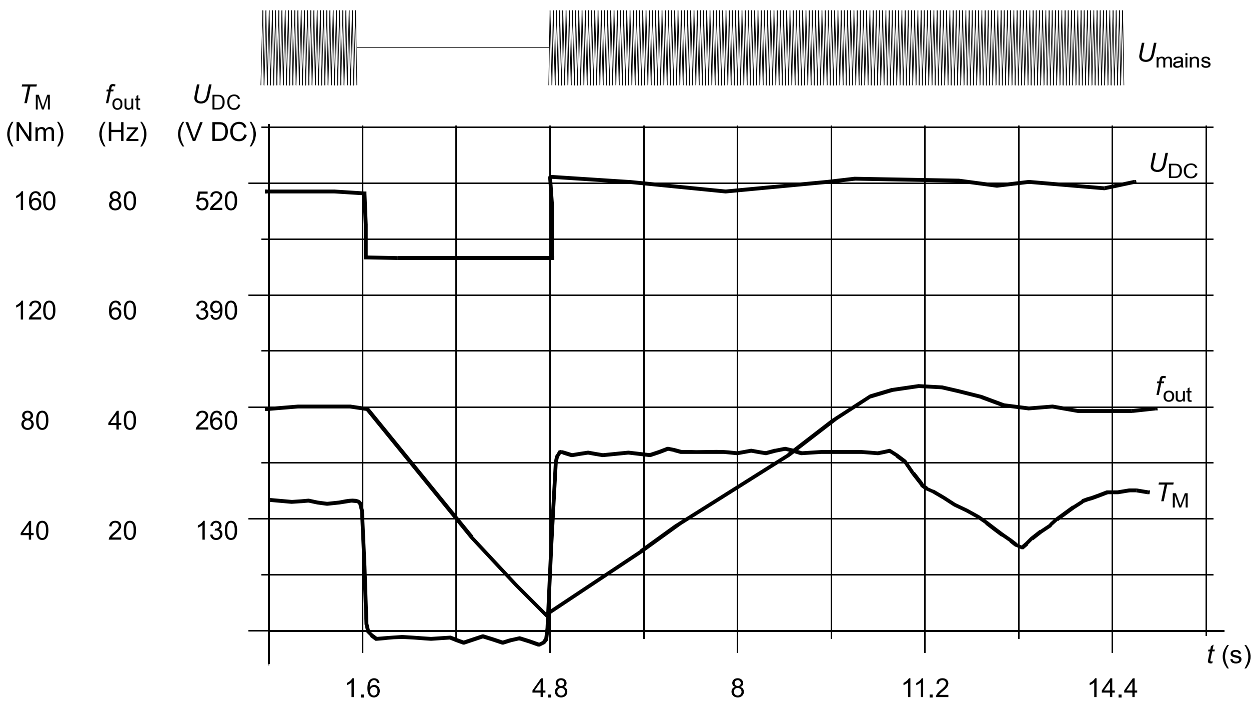
Overvoltage control

Overvoltage control of the intermediate DC link is typically needed when the motor is in generating mode. The motor can generate when it decelerates or when the load overhauls the motor shaft, causing the shaft to turn faster than the applied speed or frequency. To prevent the DC voltage from exceeding the overvoltage control limit, the overvoltage controller automatically decreases the generating torque when the limit is reached. The overvoltage controller also increases any programmed deceleration times if the limit is reached; to achieve shorter deceleration times, a brake chopper and resistor may be required.

Undervoltage control (power loss ride-through)

If the incoming supply voltage is cut off, the drive will continue to operate by utilizing the kinetic energy of the rotating motor. The drive will be fully operational as long as the motor rotates and generates energy to the drive. The drive can continue operation after the break if the main contactor (if present) remained closed.

Note: Units equipped with a main contactor must be equipped with a hold circuit (e.g. UPS) to keep the contactor control circuit closed during a short supply break.



U_{DC}= intermediate circuit voltage of the drive, f_{out} = output frequency of the drive, T_M = motor torque
Loss of supply voltage at nominal load (f_{out} = 40 Hz). The intermediate circuit DC voltage drops to the minimum limit. The controller keeps the voltage steady as long as the mains is switched off. The drive runs the motor in generator mode. The motor speed falls but the drive is operational as long as the motor has enough kinetic energy.

Automatic restart

It is possible to restart the drive automatically after a short (max. 5 seconds) power supply failure by using the Automatic restart function provided that the drive is allowed to run for 5 seconds without the cooling fans operating.

When enabled, the function takes the following actions upon a supply failure to enable a successful restart:

- The undervoltage fault is suppressed (but a warning is generated)
- Modulation and cooling is stopped to conserve any remaining energy
- DC circuit pre-charging is enabled.

If the DC voltage is restored before the expiration of the period defined by parameter *21.18 Auto restart time* and the start signal is still on, normal operation will continue. However, if the DC voltage remains too low at that point, the drive trips on a fault, *3280 Standby timeout*.

WARNING! Before you activate the function, make sure that no dangerous situations can occur. The function restarts the drive automatically and continues operation after a supply break.

Voltage control and trip limits

The control and trip limits of the intermediate DC voltage regulator are relative to the supply voltage as well as drive/inverter type. The DC voltage is approximately 1.35 times the line-to-line supply voltage, and is displayed by parameter *01.11 DC voltage*.

All levels are relative to the supply voltage range selected in parameter *95.01 Supply voltage*. The following table shows the values of selected DC voltage levels in volts and in percent of U_{DCmax} (the DC voltage at the upper bound of the supply voltage range).

	Supply voltage range [V AC] (see *95.01 Supply voltage*)					
Level [V DC (% of U_{DCmax})]	**208…240**	**380…415**	**440…480**	**500**	**525…600**	**660…690**
Overvoltage fault limit	489/440*	800	878	880	1113	1218
Overvoltage control limit	405 (125)	700 (125)	810 (125)	810 (120)	1013 (125)	1167 (125)
Internal brake chopper at 100% pulse width	403 (124)	697 (124)	806 (124)	806 (119)	1008 (124)	1159 (124)
Internal brake chopper at 0% pulse width	375 (116)	648 (116)	749 (116)	780 (116)	936 (116)	1077 (116)
Overvoltage warning limit	373 (115)	644 (115)	745 (115)	776 (115)	932 (115)	1071 (115)
U_{DCmax} = DC voltage at upper bound of supply voltage range	324 (100)	560 (100)	648 (100)	675 (100)	810 (100)	932 (100)
DC voltage at lower bound of supply voltage range	281	513	594	675	709	891
Undervoltage control and warning limit	239 (85)	436 (85)	505 (85)	574 (85)	602 (85)	757 (85)
Charging activation/standby limit	225 (80)	410 (80)	475 (80)	540 (80)	567 (80)	713 (80)
Undervoltage fault limit	168 (60)	308 (60)	356 (60)	405 (60)	425 (60)	535 (60)

*489 V with frames R1…R3, 440 V with frames R4…R8.

Settings

Parameters *01.11 DC voltage* (page 113), *30.30 Overvoltage control* (page 255), *30.31 Undervoltage control* (page 255), *95.01 Supply voltage* (page 391), and *95.02 Adaptive voltage limits* (page 392).

Brake chopper

A brake chopper can be used to handle the energy generated by a decelerating motor. When the DC voltage rises high enough, the chopper connects the DC circuit to an external brake resistor. The chopper operates on the pulse width modulation principle.

The internal brake choppers of ACS880 drives start conducting when the DC link voltage reaches 1.156 × U_{DCmax}. 100% pulse width is reached at approximately 1.2 × U_{DCmax}, depending on supply voltage range – see table under *Voltage control and trip limits* above. (U_{DCmax} is the DC voltage corresponding to the maximum of the AC supply voltage range.) For information on external brake choppers, refer to their documentation.

Note: For runtime braking, overvoltage control (parameter *30.30 Overvoltage control*) needs to be disabled for the chopper to operate.

Settings

Parameters *01.11 DC voltage* (page 113) and *30.30 Overvoltage control* (page 255); parameter group *43 Brake chopper* (page 307).

Safety and protections

Emergency stop

The emergency stop signal is connected to the input selected by parameter *21.05 Emergency stop source*. An emergency stop can also be generated through fieldbus (parameter *06.01 Main control word*, bits 0…2).

The mode of the emergency stop is selected by parameter *21.04 Emergency stop mode*. The following modes are available:

- Off1: Stop along the standard deceleration ramp defined for the particular reference type in use
- Off2: Stop by coasting
- Off3: Stop by the emergency stop ramp defined by parameter *23.23 Emergency stop time*.

With Off1 or Off3 emergency stop modes, the ramp-down of the motor speed can be supervised by parameters *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*.

Notes:

- For SIL 3 / PL e-level emergency stop functions, the drive can be fitted with a TÜV-certified FSO-xx safety options module. The module can then be incorporated into certified safety systems.
- The installer of the equipment is responsible for installing the emergency stop devices and all additional devices needed for the emergency stop function to fulfill the required emergency stop categories. For more information, contact your local ABB representative.
- After an emergency stop signal is detected, the emergency stop function cannot be canceled even though the signal is canceled.
- If the minimum (or maximum) torque limit is set to 0%, the emergency stop function may not be able to stop the drive.
- Speed and torque reference additives (parameters *22.15*, *22.17*, *26.16*, *26.25* and *26.41*) and reference ramp shapes (*23.16*…*23.19*) are ignored in case of emergency ramp stops.

Settings

Parameters *06.17 Drive status word 2* (page *127*), *06.18 Start inhibit status word* (page *128*), *21.04 Emergency stop mode* (page *199*), *21.05 Emergency stop source* (page *199*), *23.23 Emergency stop time* (page *215*), *25.13 Min torq sp ctrl em stop* (page *229*), *25.14 Max torq sp ctrl em stop* (page *229*), *25.15 Proportional gain em stop* (page *229*), *31.32 Emergency ramp supervision* (page *262*) and *31.33 Emergency ramp supervision delay* (page *263*).

Motor thermal protection

The control program features two separate motor temperature monitoring functions. The temperature data sources and warning/trip limits can be set up independently for each function.

The motor temperature can be monitored using

- the motor thermal protection model (estimated temperature derived internally inside the drive), or
- sensors installed in the windings. This will result in a more accurate motor model.

In addition to temperature monitoring, a protection function is available for ‘Ex’ motors installed in a potentially explosive atmosphere.

Motor thermal protection model

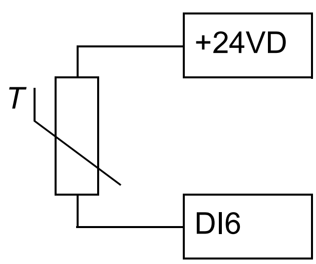
The drive calculates the temperature of the motor on the basis of the following assumptions:

1. When power is applied to the drive for the first time, the motor is assumed to be at ambient temperature (defined by parameter *35.50 Motor ambient temperature*). After this, when power is applied to the drive, the motor is assumed to be at the estimated temperature.
2. Motor temperature is calculated using the user-adjustable motor thermal time and motor load curve. The load curve should be adjusted in case the ambient temperature exceeds 30 °C.

Note: The motor thermal model can be used when only one motor is connected to the inverter.

Temperature monitoring using PTC sensors

One PTC sensor can be connected to digital input DI6.

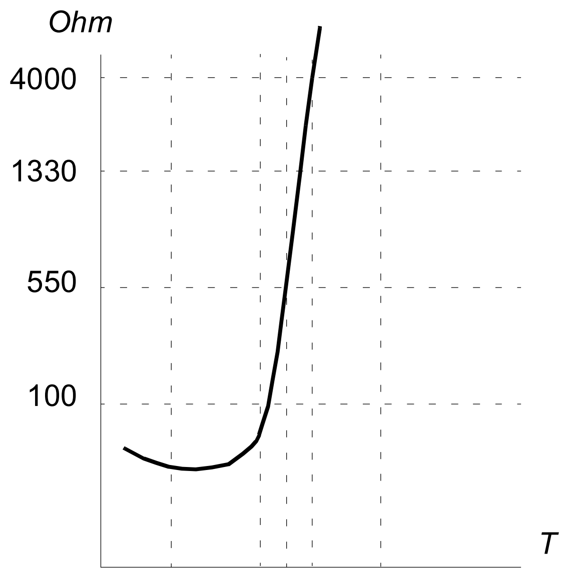


The resistance of the PTC sensor increases when its temperature rises. The increasing resistance of the sensor decreases the voltage at the input, and eventually its state switches from 1 to 0, indicating overtemperature.

1…3 PTC sensors can also be connected in series to an analog input and an analog output. The analog output feeds a constant excitation current of 1.6 mA through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function calculates the resistance of the sensor and generates an indication if overtemperature is detected.

For wiring of the sensor, refer to the *Hardware Manual* of the drive.

The figure below shows typical PTC sensor resistance values as a function of temperature.



In addition to the above, optional FEN-xx encoder interfaces, and FPTC-xx modules have connections for PTC sensors. Refer to the module-specific documentation for more information.

Temperature monitoring using Pt100 or Pt1000 sensors

1…3 Pt100 or Pt1000 sensors can be connected in series to an analog input and an analog output.

The analog output feeds a constant excitation current of 9.1 mA (Pt100) or 1 mA (Pt1000) through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function reads the voltage through the analog input and converts it into degrees Celsius.

The warning and fault limits can be adjusted by parameters.

For the wiring of the sensor, refer to the *Hardware Manual* of the drive.

Temperature monitoring using KTY84 sensors

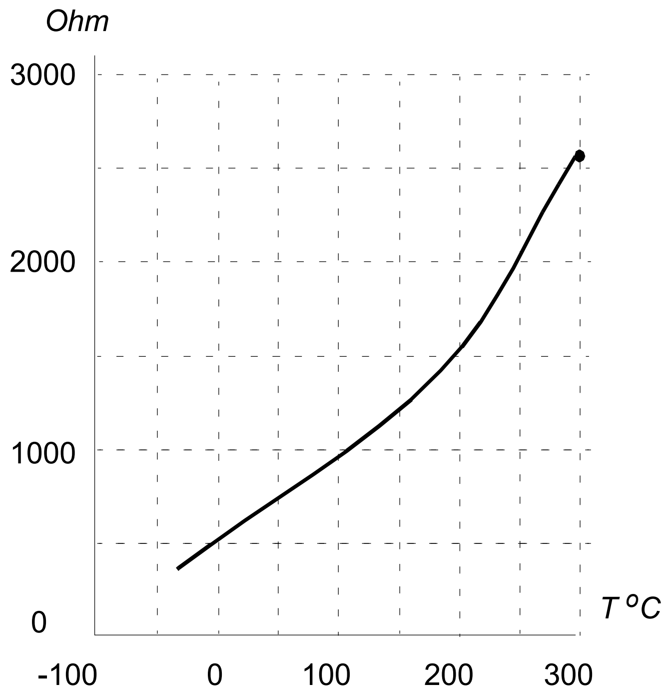
One KTY84 sensor can be connected to an analog input and an analog output on the control unit.

The analog output feeds a constant excitation current of 2.0 mA through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function reads the voltage through the analog input and converts it into degrees Celsius.

FEN-xx encoder interfaces (optional) also have a connection for one KTY84 sensor.

The figure and table below show typical KTY84 sensor resistance values as a function of the motor operating temperature.

KTY84 scaling
90 °C = 936 ohm
110 °C = 1063 ohm
130 °C = 1197 ohm
150 °C = 1340 ohm



The warning and fault limits can be adjusted by parameters.

For the wiring of the sensor, refer to the *Hardware Manual* of the drive.

Motor fan control logic (parameters *35.100*…*35.106*)

If the motor has an external cooling fan, it is possible to use a drive signal (for example, running/stopped) to control the starter of the fan via a relay or digital output. A digital input can be selected for fan feedback. A loss of the feedback signal will optionally cause a warning or a fault.

Start and stop delays can be defined for the fan. In addition, a feedback delay can be set to define the time within which feedback must be received after the fan starts.

Ex motor support (parameter *95.15*, bit 0)

The control program has a temperature protection function for Ex motors located in a potentially explosive atmosphere. The protection is enabled by setting bit 0 of parameter *95.15 Special HW settings*.

Settings

Parameter groups *35 Motor thermal protection* (page *276*) and *91 Encoder module settings* (page *379*); parameter *95.15 Special HW settings* (page *394*).

Thermal protection of motor cable

The control program contains a thermal protection function for the motor cable. This function should be used, for example, when the nominal current of the drive exceeds the current-carrying capacity of the motor cable.

The program calculates the temperature of the cable on the basis of the following data:

- Measured output current (parameter *01.07 Motor current*)
- Nominal continuous current rating of the cable, specified by *35.61 Cable nominal current*, and
- Thermal time constant of the cable, specified by *35.62 Cable thermal rise time*.

When the calculated temperature of the cable reaches 102% of the rated maximum, a warning (*A480 Motor cable overload*) is given. The drive trips on a fault (*4000 Motor cable overload*) when 106% is reached.

Settings

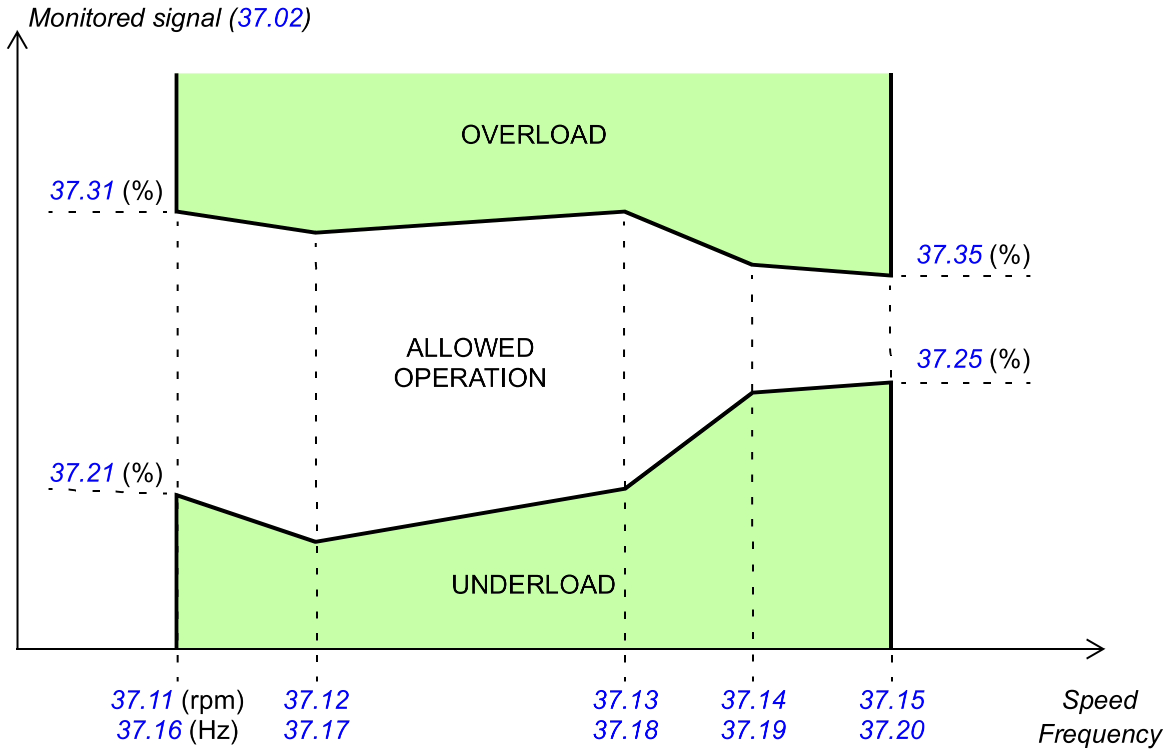
Parameters *35.60*…*35.62* (page *284*).

User load curve

The user load curve provides a function that monitors an input signal (eg. motor torque or motor current) as a function of drive output speed or frequency. The function includes both high limit (overload) and low limit (underload) monitoring. Overload monitoring can, for example, be used to detect a pump becoming clogged or a saw blade hitting a knot. Underload monitoring can detect the load being lost, for example because of the snapping of a transmission belt.

The monitoring is effective within a motor speed and/or frequency range. The frequency range is used with a frequency reference in scalar motor control mode; otherwise, the speed range is used. The range is defined by five speed (parameters *37.11*…*37.15*) or frequency (*37.16*…*37.20*) values. The values are positive, but the monitoring is symmetrically active in the negative direction as the sign of the monitored signal is ignored. Outside the speed/frequency range, the monitoring is disabled.

An underload (*37.21*…*37.25*) and overload (*37.31*…*37.35*) limit is set for each of the five speed or frequency points. Between these points, the limits are interpolated linearly to form overload and underload curves.



The action (none, warning or fault) taken when the signal exits the allowed operation area can be selected separately for overload and underload conditions (parameters *37.03* and *37.04* respectively). Each condition also has an optional timer to delay the selected action (*37.41* and *37.42*).

Settings

Parameter group *37 User load curve* (page *290*).

Automatic fault resets

The drive can automatically reset itself after overcurrent, overvoltage, undervoltage and external faults. The user can also specify a fault (excluding Safe torque off related faults) to be reset automatically.

By default, automatic resets are off and must be specifically activated by the user.

WARNING! Before you activate the function, make sure that no dangerous situations can occur. The function resets the drive automatically and continues operation after a fault.

Settings

Parameters *31.12*…*31.16* (page *257*).

Other programmable protection functions

External events (parameters *31.01*…*31.10*)

Five different event signals from the process can be connected to selectable inputs to generate trips and warnings for the driven equipment. When the signal is lost, an external event (fault, warning, or a mere log entry) is generated. The contents of the messages can be edited on the control panel by selecting **Menu - Settings** - **Edit texts**.

Motor phase loss detection (parameter *31.19*)

The parameter selects how the drive reacts whenever a motor phase loss is detected.

Earth (Ground) fault detection (parameter *31.20*)

The earth fault detection function is based on sum current measurement. Note that

- an earth fault in the supply cable does not activate the protection
- in a grounded supply, the protection activates within 2 milliseconds
- in an ungrounded supply, the supply capacitance must be 1 microfarad or more
- the capacitive currents caused by shielded motor cables up to 300 meters will not activate the protection
- the protection is deactivated when the drive is stopped.

Supply phase loss detection (parameter *31.21*)

The parameter selects how the drive reacts whenever a supply phase loss is detected.

Safe torque off detection (parameter *31.22*)

The drive monitors the status of the Safe torque off input, and this parameter selects which indications are given when the signals are lost. (The parameter does not affect the operation of the Safe torque off function itself). For more information on the Safe torque off function, see the *Hardware manual*.

Swapped supply and motor cabling (parameter *31.23*)

The drive can detect if the supply and motor cables have accidentally been swapped (for example, if the supply is connected to the motor connection of the drive). The parameter selects if a fault is generated or not. Note that the protection should be disabled in drive/inverter hardware supplied from a common DC bus.

Stall protection (parameters *31.24*…*31.28*)

The drive protects the motor in a stall situation. It is possible to adjust the supervision limits (current, frequency and time) and choose how the drive reacts to a motor stall condition.

Overspeed protection (parameter *31.30*)

The user can set overspeed limits by specifying a margin that is added to the currently-used maximum and minimum speed limits.

Ramp stop supervision (parameters *31.32*, *31.33*, *31.37* and *31.38*)

The control program has a supervision function for both the normal and emergency stop ramps. The user can either define a maximum time for stopping, or a maximum deviation from the expected deceleration rate. If the drive fails to stop in the expected manner, a fault is generated and the drive coasts to a stop.

Main cooling fan supervision (parameter *31.35*)

The parameter selects how the drive reacts to a loss of the main cooling fan.

With an inverter unit consisting of frame R8i inverter modules, it may be possible to continue operation even if a cooling fan of an inverter module stops. See the description of the parameter.

Custom motor current fault limit (parameter *31.42*)

The control program sets a motor current limit based on drive hardware. In most cases, the default value is appropriate. However, a lower limit can be manually set by the user, for example, to protect a permanent magnet motor from demagnetization.

Local control loss detection (parameter *49.05*)

The parameter selects how the drive reacts to a control panel or PC tool communication break.

Diagnostics

Fault and warning messages, data logging

See chapter *Fault tracing* (page *473*).

Signal supervision

Three signals can be selected to be supervised by this function. Whenever a supervised signal exceeds or falls below predefined limits, a bit in *32.01 Supervision status* is activated, and a warning or fault generated. The contents of the message can be edited on the control panel by selecting **Menu - Settings** - **Edit texts**.

The supervised signal is low-pass filtered.

Settings

Parameter group *32 Supervision* (page *265*).

Maintenance timers and counters

The program has six different maintenance timers or counters that can be configured to generate a warning when a pre-defined limit is reached. The contents of the message can be edited on the control panel by selecting **Menu - Settings** - **Edit texts**.

The timer/counter can be set to monitor any parameter. This feature is especially useful as a service reminder.

There are three types of counters:

- On-time timers. Measures the time a binary source (for example, a bit in a status word) is on.
- Signal edge counters. The counter is incremented whenever the monitored binary source changes state.
- Value counters. The counter measures, by integration, the monitored parameter. A warning is given when the calculated area below the signal peak exceeds a user-defined limit.

Settings

Parameter group *33 Generic timer & counter* (page *268*).

Energy saving calculators

This feature consists of the following functionalities:

- An energy optimizer that adjusts the motor flux in such a way that the total system efficiency is maximized
- A counter that monitors used and saved energy by the motor and displays them in kWh, currency or volume of CO_2 emissions, and
- A load analyzer showing the load profile of the drive (see separate section on page *86*).

Note: The accuracy of the energy savings calculation is directly dependent on the accuracy of the reference motor power given in parameter *45.19 Comparison power*.

Settings

Parameter group *45 Energy efficiency* (page *313*).

Load analyzer

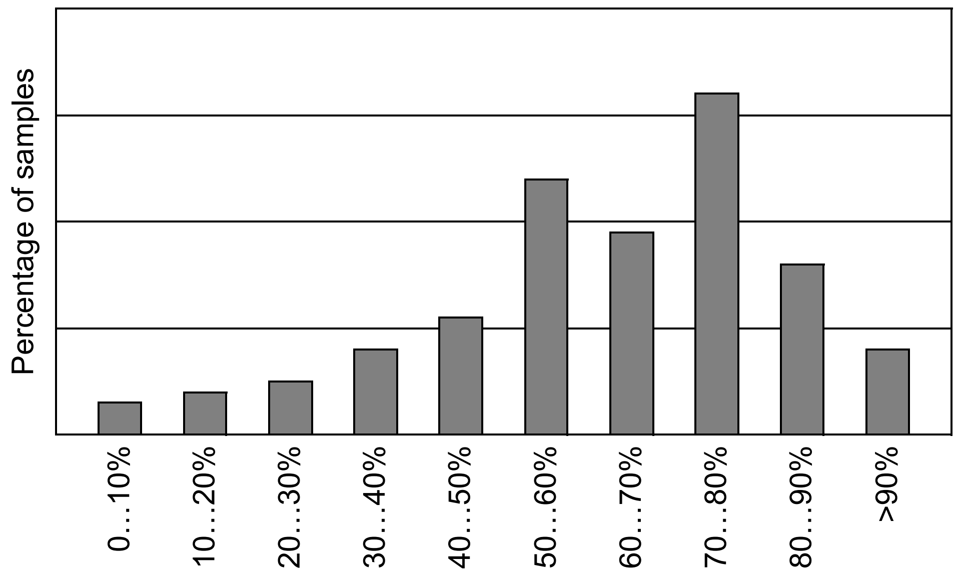
Peak value logger

The user can select a signal to be monitored by a peak value logger. The logger records the peak value of the signal along with the time the peak occurred, as well as motor current, DC voltage and motor speed at the time of the peak. The peak value is sampled at 2 ms intervals.

Amplitude loggers

The control program has two amplitude loggers.

For amplitude logger 2, the user can select a signal to be sampled at 200 ms intervals, and specify a value that corresponds to 100%. The collected samples are sorted into 10 read-only parameters according to their amplitude. Each parameter represents an amplitude range 10 percentage points wide, and displays the percentage of the collected samples that have fallen within that range.



Amplitude ranges
(parameters *36.40*…*36.49*)

Amplitude logger 1 is fixed to monitor motor current, and cannot be reset. With amplitude logger 1, 100% corresponds to the maximum output current of the drive (I_{max}, as given in the hardware manual). The measured current is logged continuously. The distribution of samples is shown by parameters *36.20*…*36.29*.

Settings

Parameter group *36 Load analyzer* (page *286*).

Miscellaneous

User parameter sets

The drive supports four user parameter sets that can be saved to the permanent memory and recalled using drive parameters. It is also possible to use digital inputs to switch between user parameter sets.

A user parameter set contains all editable values in parameter groups 10…99 except

- forced I/O values such as parameters *10.03 DI force selection* and *10.04 DI force data*
- I/O extension module settings (groups 14…16)
- fieldbus communication settings (groups 51…56 and 58)
- encoder configuration settings (groups 92…93), and
- parameter *95.01 Supply voltage*.

As the motor settings are included in the user parameter sets, make sure the settings correspond to the motor used in the application before recalling a user set. In an application where different motors are used with the drive, the motor ID run needs to be performed with each motor and the results saved to different user sets. The appropriate set can then be recalled when the motor is switched.

Settings

Parameters *96.10*…*96.13* (page *399*).

Parameter checksum calculation

A parameter checksum can be calculated from a user-definable set of parameters to monitor changes in the drive configuration. The calculated checksum is compared to 1…4 reference checksums; in case of a mismatch, an event (a pure event, warning or fault) is generated.

By default, the set of parameters included in the calculation contain most parameters with the exception of

- actual signals
- parameter group *47 Data storage*
- parameters that are activated to validate new settings (such as *51.27* and *96.07*)
- parameters that are not saved to the flash memory (such as *96.24…96.26*)
- parameters that are internally calculated from others (such as *98.09*…*98.14*).
- dynamic parameters (eg. parameters that vary according to hardware), and
- application program parameters.

The default set can be edited using the Drive customizer PC tool.

Settings

Parameters *96.53*…*96.59* (page *402*).

User lock

For better cybersecurity, it is highly recommended that you set a master pass code to prevent eg. the changing of parameter values and/or the loading of firmware and other files.

WARNING! ABB will not be liable for damages or losses caused by the failure to activate the user lock using a new pass code. See *Cybersecurity disclaimer* (page *15*).

To activate the user lock for the first time, enter the default pass code, 10000000, into *96.02 Pass code*. This will make parameters *96.100*…*96.102* visible. Then enter a new pass code into *96.100 Change user pass code*, and confirm the code in *96.101 Confirm user pass code*. In *96.102 User lock functionality*, define the actions that you want to prevent (we recommend you select all the actions unless otherwise required by the application).

To close the user lock, enter an invalid pass code into *96.02 Pass code*, activate *96.08 Control board boot*, or cycle the power. With the lock closed, parameters *96.100*…*96.102* are hidden.

To reopen the lock, enter your pass code into *96.02 Pass code*. This will again make parameters *96.100*…*96.102* visible.

Settings

Parameters *96.02* (page *397*) and *96.100*…*96.102* (page *405*).

Data storage parameters

Twenty-four (sixteen 32-bit, eight 16-bit) parameters are reserved for data storage. These parameters are unconnected by default and can be used for eg. linking, testing and commissioning purposes. They can be written to and read from using other parameters’ source or target selections.

Note that “*Analog src*” type parameters (see page *419*) expect a 32-bit real (floating point) source – in other words, parameters *47.01*…*47.08* can be used as a value source of other parameters while *47.11*…*47.28* cannot.

To use a 16-bit integer (received in DDCS data sets) as the source of another parameter, write the value into one of the “real32” type storage parameters (*47.01*…*47.08*). Select the storage parameter as the source, and define a suitable scaling method between the 16-bit and 32-bit values in parameters *47.31*…*47.38*.

Settings

Parameter group *47 Data storage* (page *320*).

Reduced run function

A “reduced run” function is available for inverter units consisting of parallel-connected inverter modules. The function makes it possible to continue operation with limited current even if one (or more) module is out of service, for example, because of maintenance work. In principle, reduced run is possible with only one module, but the physical requirements of operating the motor still apply; for example, the modules remaining in use must be able to provide the motor with enough magnetizing current.

Activation of the reduced run function

Note: For cabinet-built drives, the wiring accessories and the air baffle needed during the procedure are available from ABB, and are included in the delivery.

WARNING! Follow the safety instructions provided for the drive or inverter unit in question.

---

1. Disconnect the supply voltage and all auxiliary voltages from the drive/inverter unit.
2. If the inverter control unit is powered from the faulty module, install an extension to the wiring and connect it to one of the remaining modules.
3. Remove the module to be serviced from its bay. See the appropriate hardware manual for instructions.
4. If the Safe torque off (STO) function is in use, install jumpering in the STO wiring in place of the missing module (unless the module was the last on the chain).
5. Install an air baffle to the top module guide to block the airflow through the empty module bay.
6. In case the inverter unit has a DC switch with a charging circuit, disable the appropriate channel on the xSFC-xx charging controller.
7. Switch on the power to the drive/inverter unit.
8. Enter the number of inverter modules present into parameter *95.13 Reduced run mode*.
9. Reset all faults and start the drive/inverter unit. The maximum current is now automatically limited according to the new inverter configuration. A mismatch between the number of detected modules (*95.14*) and the value set in *95.13* will generate a fault.

After all modules have been reinstalled, parameter *95.13 Reduced run mode* must be reset to 0 to disable the reduced run function. In case the inverter is equipped with a charging circuit, the charging monitoring must be reactivated for all modules. If the Safe torque off (STO) function is in use, an acceptance test must be performed (see the hardware manual of the drive/inverter unit for instructions).

Settings

Parameters *06.17* (page *127*) and *95.13*…*95.14* (page *394*).

du/dt filter support

With an external du/dt filter connected to the output of the drive, bit 13 of *95.20 HW options word 1* must be switched on. The setting limits the output switching frequency, and forces the drive/inverter module fan to full speed. Note that the setting is not to be activated with inverter modules with internal du/dt filters.

Settings

Parameter *95.20 HW options word 1* (page *395*).

Sine filter support

The control program has a setting that enables the use of ABB sine filters (available separately). With a sine filter connected to the output of the drive, bit 1 of *95.15 Special HW settings* must be switched on. The setting forces the drive to use the scalar motor control mode, and limits the switching and output frequencies to

- prevent the drive from operating at filter resonance frequencies, and
- protect the filter from overheating.

Please contact your local ABB representative before connecting a sine filter from another manufacturer.

Settings

Parameter *95.15 Special HW settings* (page *394*).

5

Application macros

What this chapter contains

This chapter describes the intended use, operation and default control connections of the application macros.

More information on the connectivity of the control unit is given in the *Hardware manual* of the drive.

General

Application macros are sets of default parameter values suitable for the application in question. When starting up the drive, the user typically selects the best-suited application macro as a starting point, then makes any necessary changes to tailor the settings to the application. This usually results in a much lower number of user edits compared to the traditional way of programming a drive.

Application macros can be selected by parameter *96.04 Macro select*. User parameter sets are managed by the parameters in group *96 System*.

Factory macro

The Factory macro is suited to relatively straightforward speed control applications such as conveyors, pumps and fans, and test benches.

The drive is speed-controlled with the reference signal connected to analog input AI1. The start/stop commands are given through digital input DI1; running direction is determined by DI2. This macro uses control location EXT1.

Faults are reset through digital input DI3.

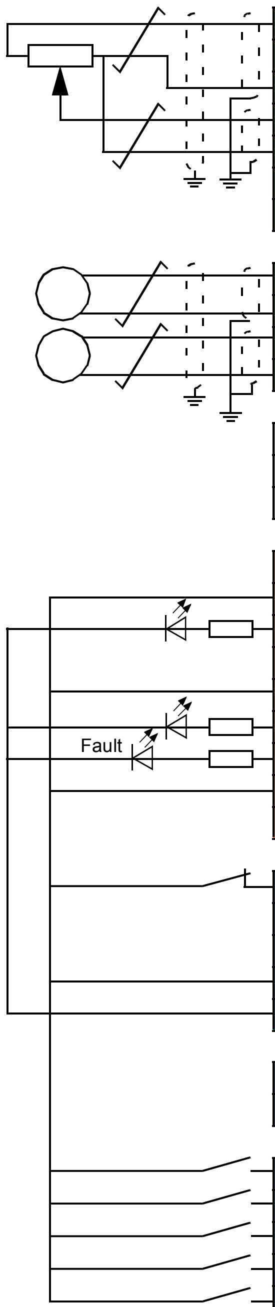
DI4 switches between acceleration/deceleration time sets 1 and 2. The acceleration and deceleration times, as well as ramp shapes, are defined by parameters *23.12*…*23.19*.

DI5 activates constant speed 1.

Default parameter settings for the Factory macro

The default parameter settings for the Factory macro are listed under *Parameter listing* (page *113*).

Default control connections for the Factory macro



XPOW	External power input	
1	+24VI	24 V DC, 2 A
2	GND	
XAI	Reference voltage and analog inputs	
1	+VREF	10 V DC, R_L 1…10 kohm
2	-VREF	-10 V DC, R_L 1…10 kohm
3	AGND	Ground
4	AI1+	**Speed reference**
5	AI1-	0(2)…10 V, R_{in} > 200 kohm
6	AI2+	By default not in use.
7	AI2-	0(4)…20 mA, R_{in} = 100 ohm
XAO	Analog outputs	
1	AO1	**Motor speed rpm**
2	AGND	0…20 mA, R_L < 500 ohm
3	AO2	**Motor current**
4	AGND	0…20 mA, R_L < 500 ohm
XD2D	Drive-to-drive link	
1	B	Master/follower, drive-to-drive or embedded fieldbus interface connection
2	A	
3	BGND	
XRO1, XRO2, XRO3	Relay outputs	
1	NC	***Ready run***
2	COM	250 V AC / 30 V DC
3	NO	2 A
1	NC	***Running***
2	COM	250 V AC / 30 V DC
3	NO	2 A
1	NC	***Fault (-1)***
2	COM	250 V AC / 30 V DC
3	NO	2 A
XD24	Digital interlock	
1	DIIL	Run enable
2	+24VD	+24 V DC 200 mA
3	DICOM	Digital input ground
4	+24VD	+24 V DC 200 mA
5	DIOGND	Digital input/output ground
XDIO	Digital input/outputs	
1	DIO1	*Output*: *Ready run*
2	DIO2	*Output*: *Running*
XDI	Digital inputs	
1	DI1	Stop (0) / Start (1)
2	DI2	Forward (0) / Reverse (1)
3	DI3	Reset
4	DI4	Acc/Dec time set 1 (0) / set 2 (1)
5	DI5	Constant speed 1 (1 = On)
6	DI6	By default, not in use.
XSTO	Safe torque off circuits must be closed for the drive to start. See *Hardware manual* of drive.	
X12	Safety options connection	
X13	Control panel connection	
X205	Memory unit connection	

Hand/Auto macro

The Hand/Auto macro is suited to speed control applications where two external control devices are used.

The drive is speed-controlled from the external control locations EXT1 (Hand control) and EXT2 (Auto control). The selection between the control locations is done through digital input DI3.

The start/stop signal for EXT1 is connected to DI1 while running direction is determined by DI2. For EXT2, start/stop commands are given through DI6, the direction through DI5.

The reference signals for EXT1 and EXT2 are connected to analog inputs AI1 and AI2 respectively.

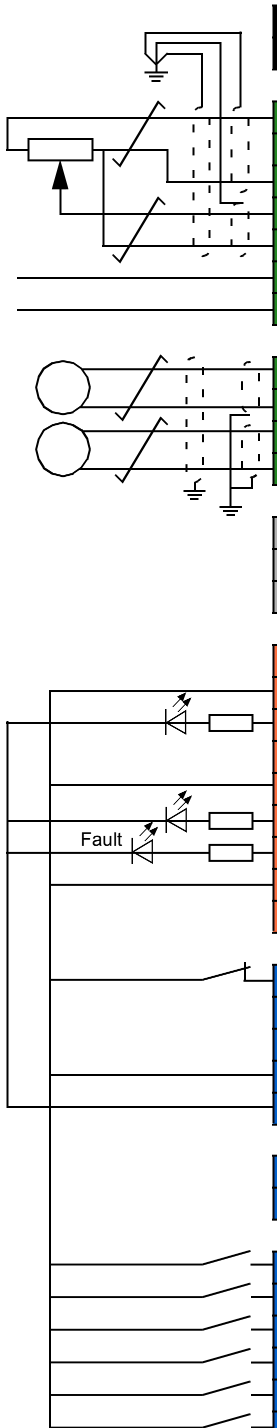
A constant speed (by default, 300 rpm) can be activated through DI4.

Default parameter settings for the Hand/Auto macro

Below is a listing of default parameter values that differ from those listed for the Factory macro in *Parameter listing* (page *113*).

Parameter		Hand/Auto macro default
No.	**Name**	
12.30	*AI2 scaled at AI2 max*	1500.000
19.11	*Ext1/Ext2 selection*	*DI3*
20.06	*Ext2 commands*	*In1 Start; In2 Dir*
20.08	*Ext2 in1 source*	*DI6*
20.09	*Ext2 in2 source*	*DI5*
20.12	*Run enable 1 source*	*DIIL*
22.12	*Speed ref2 source*	*AI2 scaled*
22.14	*Speed ref1/2 selection*	*Follow Ext1/Ext2 selection*
22.22	*Constant speed sel1*	*DI4*
23.11	*Ramp set selection*	*Acc/Dec time 1*
31.11	*Fault reset selection*	*Not selected*

Default control connections for the Hand/Auto macro



XPOW	External power input	
1	+24VI	24 V DC, 2 A
2	GND	
XAI	Reference voltage and analog inputs	
1	+VREF	10 V DC, R_L 1…10 kohm
2	-VREF	-10 V DC, R_L 1…10 kohm
3	AGND	Ground
4	AI1+	**Speed reference (Hand)**
5	AI1-	0(2)…10 V, R_{in} > 200 kohm
6	AI2+	**Speed reference (Auto)**
7	AI2-	0(4)…20 mA, R_{in} = 100 ohm
XAO	Analog outputs	
1	AO1	**Motor speed rpm**
2	AGND	0…20 mA, R_L < 500 ohm
3	AO2	**Motor current**
4	AGND	0…20 mA, R_L < 500 ohm
XD2D	Drive-to-drive link	
1	B	Master/follower, drive-to-drive or embedded fieldbus interface connection
2	A	
3	BGND	
XRO1, XRO2, XRO3	Relay outputs	
1	NC	***Ready run***
2	COM	250 V AC / 30 V DC
3	NO	2 A
1	NC	***Running***
2	COM	250 V AC / 30 V DC
3	NO	2 A
1	NC	***Fault (-1)***
2	COM	250 V AC / 30 V DC
3	NO	2 A
XD24	Digital interlock	
1	DIIL	Run enable
2	+24VD	+24 V DC 200 mA
3	DICOM	Digital input ground
4	+24VD	+24 V DC 200 mA
5	DIOGND	Digital input/output ground
XDIO	Digital input/outputs	
1	DIO1	*Output*: *Ready run*
2	DIO2	*Output*: *Running*
XDI	Digital inputs	
1	DI1	Stop (0) / Start (1) – Hand
2	DI2	Forward (0) / Reverse (1) – Hand
3	DI3	Hand (0) / Auto (1)
4	DI4	Constant speed 1 (1 = On)
5	DI5	Forward (0) / Reverse (1) – Auto
6	DI6	Stop (0) / Start (1) – Auto
XSTO	Safe torque off circuits must be closed for the drive to start. See *Hardware manual* of drive.	
X12	Safety options connection	
X13	Control panel connection	
X205	Memory unit connection	

PID control macro

The PID control macro is suitable for process control applications, for example closed-loop pressure, level or flow control systems such as

- pressure boost pumps of municipal water supply systems
- level-controlling pumps of water reservoirs
- pressure boost pumps of district heating systems
- material flow control on a conveyor line.

The process reference signal is connected to analog input AI1 and the process feedback signal to AI2. Alternatively, a direct speed reference can be given to the drive through AI1. Then the PID controller is bypassed and the drive no longer controls the process variable.

Selection between direct speed control (control location EXT1) and process variable control (EXT2) is done through digital input DI3.

The stop/start signals for EXT1 and EXT2 are connected to DI1 and DI6 respectively.

A constant speed (by default, 300 rpm) can be activated through DI4.

Note: When commissioning the PID loop, it is useful to run the motor in speed control first using EXT1; this allows testing of the PID feedback polarity and scaling. Once the feedback has been proven, the PID loop can be “closed” by switching to EXT2.

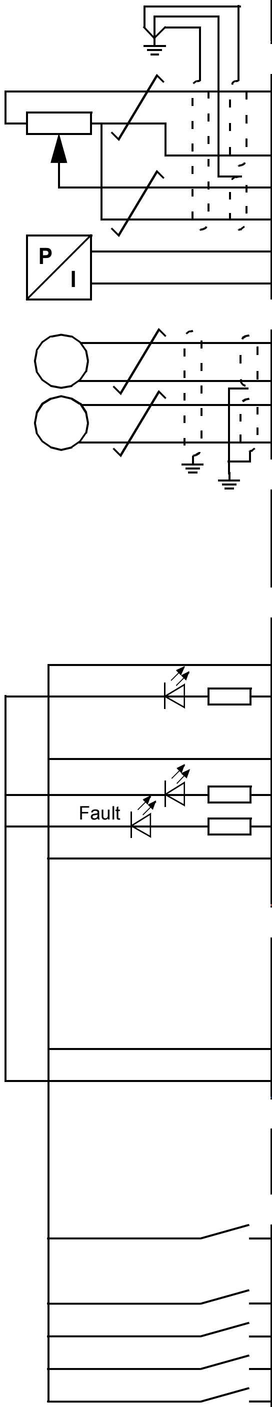
Default parameter settings for the PID control macro

Below is a listing of default parameter values that differ from those listed for the Factory macro in *Parameter listing* (page *113*).

Parameter		PID control macro default
No.	**Name**	
12.27	*AI2 min*	4.000
19.11	*Ext1/Ext2 selection*	*DI3*
20.01	*Ext1 commands*	*In1 Start*
20.04	*Ext1 in2 source*	*Not selected*
20.06	*Ext2 commands*	*In1 Start*
20.08	*Ext2 in1 source*	*DI6*
20.12	*Run enable 1 source*	*DI5*
22.12	*Speed ref2 source*	*PID*
22.22	*Constant speed sel1*	*DI4*
23.11	*Ramp set selection*	*Acc/Dec time 1*
31.11	*Fault reset selection*	*Not selected*
40.07	*Set 1 PID operation mode*	*On when drive running*
40.08	*Set 1 feedback 1 source*	*AI2 scaled*
40.11	*Set 1 feedback filter time*	0.040 s
40.35	*Set 1 derivation filter time*	1.0 s
40.60	*Set 1 PID activation source*	*Follow Ext1/Ext2 selection*

Note: The macro selection does not affect parameter group *41 Process PID set 2*.

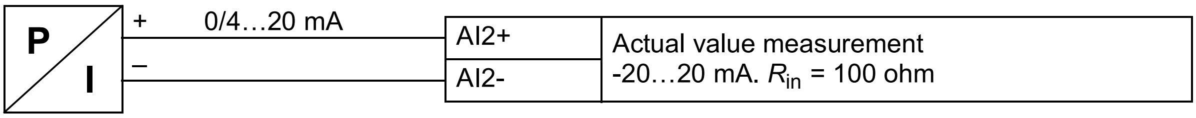
Default control connections for the PID control macro



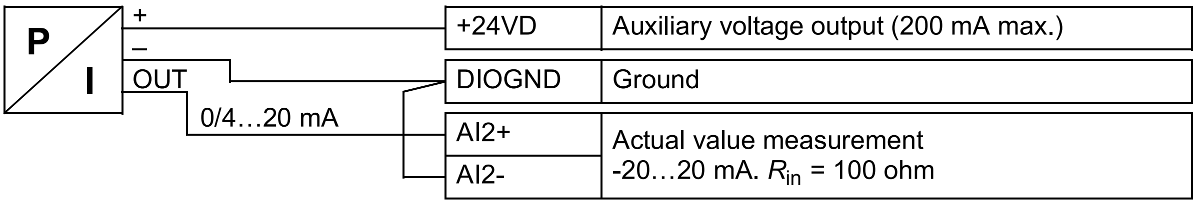
XPOW	External power input	
1	+24VI	24 V DC, 2 A
2	GND	
XAI	Reference voltage and analog inputs	
1	+VREF	10 V DC, R_L 1…10 kohm
2	-VREF	-10 V DC, R_L 1…10 kohm
3	AGND	Ground
4	AI1+	**Speed reference**
5	AI1-	0(2)…10 V, R_{in} > 200 kohm
6	AI2+	**Process feedback***
7	AI2-	0(4)…20 mA, R_{in} = 100 ohm
XAO	Analog outputs	
1	AO1	**Motor speed rpm**
2	AGND	0…20 mA, R_L < 500 ohm
3	AO2	**Motor current**
4	AGND	0…20 mA, R_L < 500 ohm
XD2D	Drive-to-drive link	
1	B	Master/follower, drive-to-drive or embedded fieldbus interface connection
2	A	
3	BGND	
XRO1, XRO2, XRO3	Relay outputs	
1	NC	***Ready run***
2	COM	250 V AC / 30 V DC
3	NO	2 A
1	NC	***Running***
2	COM	250 V AC / 30 V DC
3	NO	2 A
1	NC	***Fault (-1)***
2	COM	250 V AC / 30 V DC
3	NO	2 A
XD24	Digital interlock	
1	DIIL	Digital interlock. By default, not in use.
2	+24VD	+24 V DC 200 mA
3	DICOM	Digital input ground
4	+24VD	+24 V DC 200 mA
5	DIOGND	Digital input/output ground
XDIO	Digital input/outputs	
1	DIO1	*Output*: *Ready run*
2	DIO2	*Output*: *Running*
XDI	Digital inputs	
1	DI1	Stop (0) / Start (1) – Speed control
2	DI2	By default, not in use.
3	DI3	Speed control (0) / Process control (1)
4	DI4	Constant speed 1 (1 = On)
5	DI5	Run enable (1 = On)
6	DI6	Stop (0) / Start (1) – Process control
XSTO	Safe torque off circuits must be closed for the drive to start. See *Hardware manual* of drive.	
X12	Safety options connection	
X13	Control panel connection	
X205	Memory unit connection	

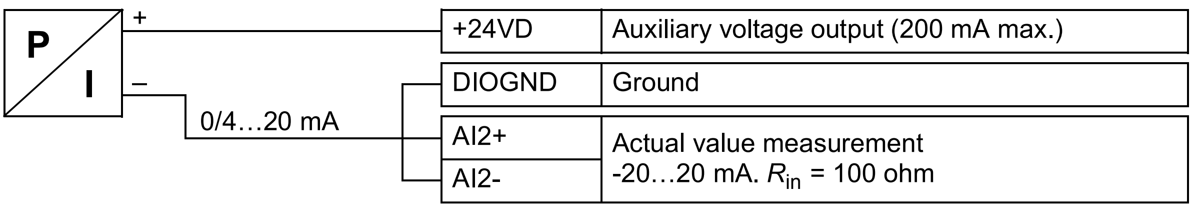
*For sensor connection examples, see page 101.

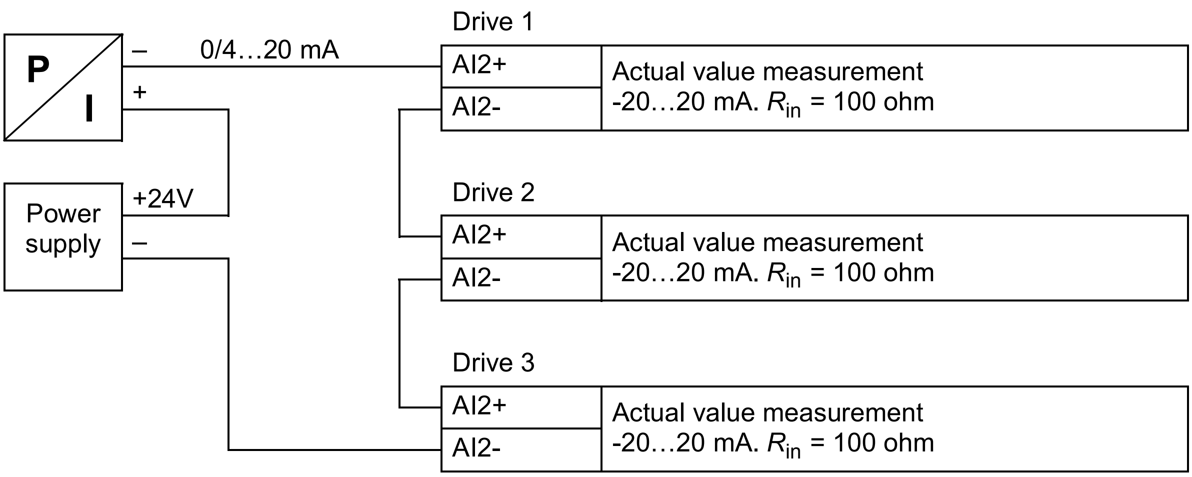
Sensor connection examples for the PID control macro



Note: The sensor must be powered externally.







Torque control macro

This macro is used in applications in which torque control of the motor is required. These are typically tension applications, where a particular tension needs to be maintained in the mechanical system.

Torque reference is given through analog input AI2, typically as a current signal in the range of 0…20 mA (corresponding to 0…100% of rated motor torque).

The start/stop signal is connected to digital input DI1. The direction is determined by DI2. Through digital input DI3, it is possible to select speed control (EXT1) instead of torque control (EXT2). As with the PID control macro, speed control can be used for commissioning the system and checking the motor direction.

It is also possible to change the control to local (control panel or PC tool) by pressing the Loc/Rem key. By default, the local reference is speed; if a torque reference is required, the value of parameter *19.16 Local control mode* should be changed to *Torque*.

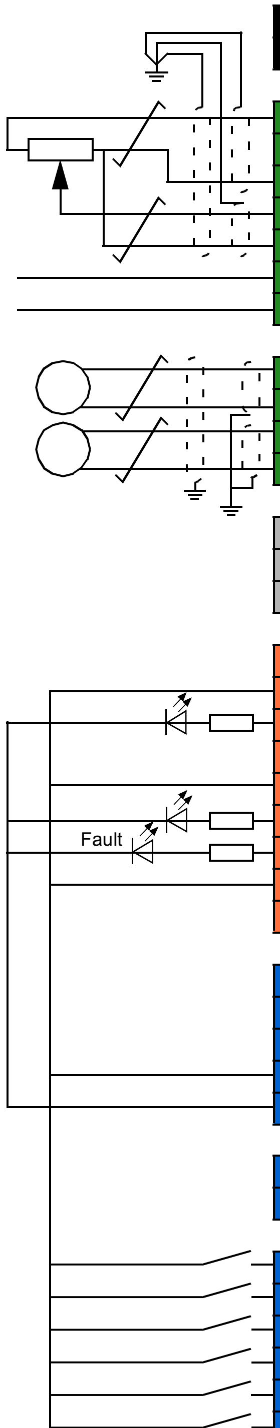
A constant speed (by default, 300 rpm) can be activated through DI4. DI5 switches between acceleration/deceleration time sets 1 and 2. The acceleration and deceleration times, as well as ramp shapes, are defined by parameters *23.12*…*23.19*.

Default parameter settings for the Torque control macro

Below is a listing of default parameter values that differ from those listed for the Factory macro in *Parameter listing* (page *113*).

Parameter		**Torque control macro default**
No.	**Name**	
19.11	*Ext1/Ext2 selection*	*DI3*
19.14	*Ext2 control mode*	*Torque*
20.02	*Ext1 start trigger type*	*Level*
20.06	*Ext2 commands*	*In1 Start; In2 Dir*
20.07	*Ext2 start trigger type*	*Level*
20.08	*Ext2 in1 source*	*DI1*
20.09	*Ext2 in2 source*	*DI2*
20.12	*Run enable 1 source*	*DI6*
22.22	*Constant speed sel1*	*DI4*
23.11	*Ramp set selection*	*DI5*
26.11	*Torque ref1 source*	*AI2 scaled*
31.11	*Fault reset selection*	*Not selected*

Default control connections for the Torque control macro



XPOW	External power input	
1	+24VI	24 V DC, 2 A
2	GND	
XAI	Reference voltage and analog inputs	
1	+VREF	10 V DC, R_L 1…10 kohm
2	-VREF	-10 V DC, R_L 1…10 kohm
3	AGND	Ground
4	AI1+	**Speed reference**
5	AI1-	0(2)…10 V, R_{in} > 200 kohm
6	AI2+	**Torque reference**
7	AI2-	0(4)…20 mA, R_{in} = 100 ohm
XAO	Analog outputs	
1	AO1	**Motor speed rpm**
2	AGND	0…20 mA, R_L < 500 ohm
3	AO2	**Motor current**
4	AGND	0…20 mA, R_L < 500 ohm
XD2D	Drive-to-drive link	
1	B	Master/follower, drive-to-drive or embedded fieldbus interface connection
2	A	
3	BGND	
XRO1, XRO2, XRO3	Relay outputs	
1	NC	***Ready run***
2	COM	250 V AC / 30 V DC
3	NO	2 A
1	NC	***Running***
2	COM	250 V AC / 30 V DC
3	NO	2 A
1	NC	***Fault (-1)***
2	COM	250 V AC / 30 V DC
3	NO	2 A
XD24	Digital interlock	
1	DIIL	Digital interlock. By default, not in use.
2	+24VD	+24 V DC 200 mA
3	DICOM	Digital input ground
4	+24VD	+24 V DC 200 mA
5	DIOGND	Digital input/output ground
XDIO	Digital input/outputs	
1	DIO1	*Output*: *Ready run*
2	DIO2	*Output*: *Running*
XDI	Digital inputs	
1	DI1	Stop (0) / Start (1)
2	DI2	Forward (0) / Reverse (1)
3	DI3	Speed control (0) / Torque control (1)
4	DI4	Constant speed 1 (1 = On)
5	DI5	Acc/Dec time set 1 (0) / set 2 (1)
6	DI6	Run enable (1 = On)
XSTO	Safe torque off circuits must be closed for the drive to start. See *Hardware manual* of drive.	
X12	Safety options connection	
X13	Control panel connection	
X205	Memory unit connection	

Sequential control macro

The Sequential control macro is suited for speed control applications in which a speed reference, multiple constant speeds, and two acceleration and deceleration ramps can be used.

Only EXT1 is used in this macro.

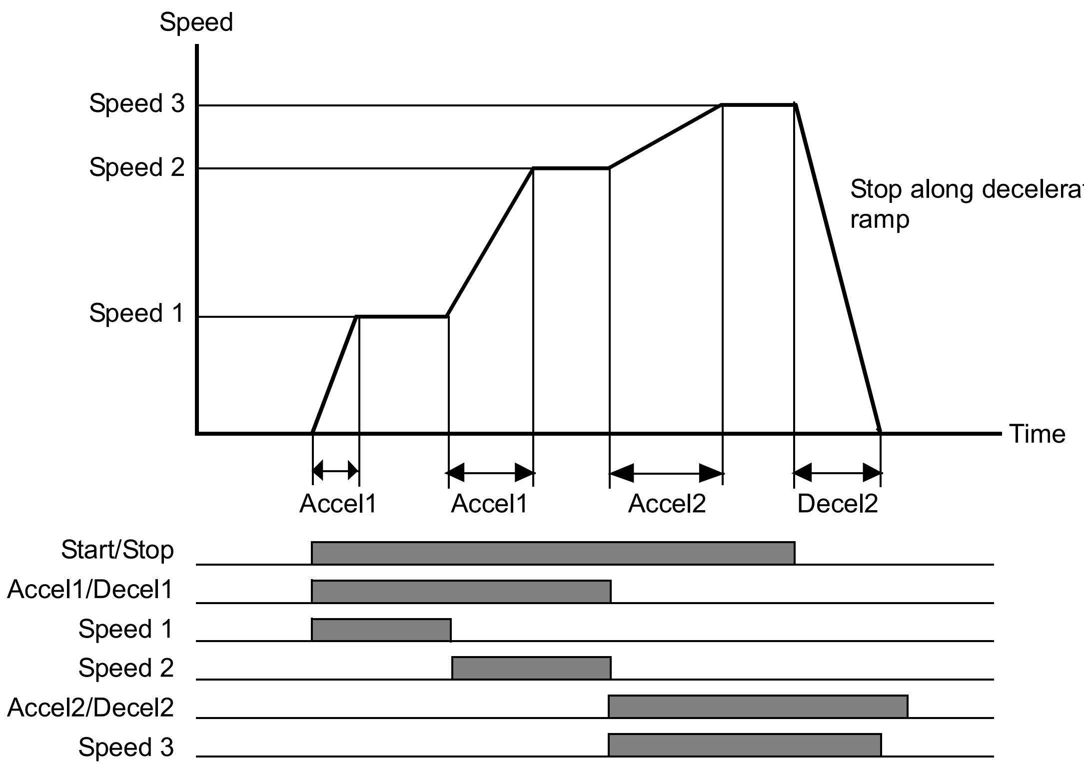
The macro offers seven preset constant speeds which can be activated by digital inputs DI4…DI6 (see parameter *22.21 Constant speed function*). An external speed reference can be given through analog input AI1. The reference is active only when no constant speed is activated (digital inputs DI4…DI6 are all off). Operational commands can also be given from the control panel.

The start/stop commands are given through digital input DI1; running direction is determined by DI2.

Two acceleration/deceleration ramps are selectable through DI3. The acceleration and deceleration times, as well as ramp shapes, are defined by parameters *23.12*…*23.19*.

Operation diagram

The figure below shows an example of the use of the macro.



Selection of constant speeds

By default, constant speeds 1…7 are selected using digital inputs DI4…DI6 as follows:

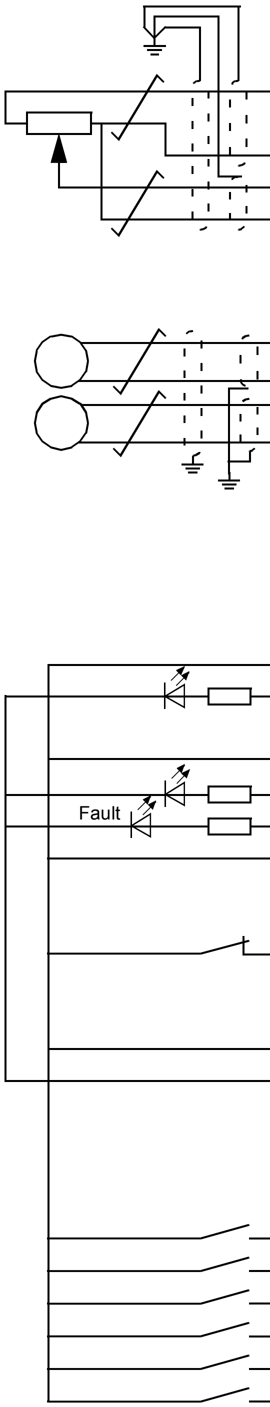
DI4	DI5	DI6	Constant speed active
0	0	0	None (External speed reference used)
1	0	0	Constant speed 1
0	1	0	Constant speed 2
1	1	0	Constant speed 3
0	0	1	Constant speed 4
1	0	1	Constant speed 5
0	1	1	Constant speed 6
1	1	1	Constant speed 7

Default parameter settings for the Sequential control macro

Below is a listing of default parameter values that differ from those listed for the Factory macro in *Parameter listing* (page *113*).

Parameter		Sequential control macro default
No.	**Name**	
20.12	*Run enable 1 source*	*DIIL*
21.03	*Stop mode*	*Ramp*
22.21	*Constant speed function*	01b (Bit 0 = Packed)
22.22	*Constant speed sel1*	*DI4*
22.23	*Constant speed sel2*	*DI5*
22.24	*Constant speed sel3*	*DI6*
22.27	*Constant speed 2*	600.00 rpm
22.28	*Constant speed 3*	900.00 rpm
22.29	*Constant speed 4*	1200.00 rpm
22.30	*Constant speed 5*	1500.00 rpm
22.31	*Constant speed 6*	2400.00 rpm
22.32	*Constant speed 7*	3000.00 rpm
23.11	*Ramp set selection*	*DI3*
25.06	*Acc comp derivation time*	0.12 s
31.11	*Fault reset selection*	*Not selected*

Default control connections for the Sequential control macro



XPOW	External power input	
1	+24VI	24 V DC, 2 A
2	GND	
XAI	Reference voltage and analog inputs	
1	+VREF	10 V DC, R_L 1…10 kohm
2	-VREF	-10 V DC, R_L 1…10 kohm
3	AGND	Ground
4	AI1+	**Speed reference**
5	AI1-	0(2)…10 V, R_{in} > 200 kohm
6	AI2+	By default, not in use.
7	AI2-	0(4)…20 mA, R_{in} = 100 ohm
XAO	Analog outputs	
1	AO1	**Motor speed rpm**
2	AGND	0…20 mA, R_L < 500 ohm
3	AO2	**Motor current**
4	AGND	0…20 mA, R_L < 500 ohm
XD2D	Drive-to-drive link	
1	B	Master/follower, drive-to-drive or embedded fieldbus interface connection
2	A	
3	BGND	
XRO1, XRO2, XRO3	Relay outputs	
1	NC	***Ready run***
2	COM	250 V AC / 30 V DC
3	NO	2 A
1	NC	***Running***
2	COM	250 V AC / 30 V DC
3	NO	2 A
1	NC	***Fault (-1)***
2	COM	250 V AC / 30 V DC
3	NO	2 A
XD24	Digital interlock	
1	DIIL	Run enable
2	+24VD	+24 V DC 200 mA
3	DICOM	Digital input ground
4	+24VD	+24 V DC 200 mA
5	DIOGND	Digital input/output ground
XDIO	Digital input/outputs	
1	DIO1	*Output*: *Ready run*
2	DIO2	*Output*: *Running*
XDI	Digital inputs	
1	DI1	Stop (0) / Start (1)
2	DI2	Forward (0) / Reverse (1)
3	DI3	Acc/Dec time set 1 (0) / set 2 (1)
4	DI4	Constant speed selection (see page 105)
5	DI5	
6	DI6	
XSTO	Safe torque off circuits must be closed for the drive to start. See *Hardware manual* of drive.	
X12	Safety options connection	
X13	Control panel connection	
X205	Memory unit connection	

Fieldbus control macro

This application macro is not supported by the current firmware version.

6

Parameters

What this chapter contains

The chapter describes the parameters, including actual signals, of the control program.

Terms and abbreviations

Term	Definition
Actual signal	Type of *parameter* that is the result of a measurement or calculation by the drive, or contains status information. Most actual signals are read-only, but some (especially counter-type actual signals) can be reset.
Def	(In the following table, shown on the same row as the parameter name) The default value of a *parameter* when used in the Factory macro. For information on other macro-specific parameter values, see chapter *Application macros* (page *93*). **Note:** Certain configurations or optional equipment may require specific default values. These are labelled as follows: (*95.20* bx) = Default changed or write-protected by parameter *95.20*, bit x.
FbEq16	(In the following table, shown on the same row as the parameter range, or for each selection) 16-bit fieldbus equivalent: The scaling between the value shown on the panel and the integer used in communication when a 16-bit value is selected for transmission to an external system. A dash (-) indicates that the parameter is not accessible in 16-bit format. The corresponding 32-bit scalings are listed in chapter *Additional parameter data* (page *419*).
Other	The value is taken from another parameter. Choosing “Other” displays a parameter list in which the user can specify the source parameter. **Note:** The source parameter must be a 32-bit real (floating point) number. To use a 16-bit integer (for example, received from an external device in data sets) as the source, data storage parameters *47.01*…*47.08* (page *320*) can be used.
Other [bit]	The value is taken from a specific bit in another parameter. Choosing “Other” displays a parameter list in which the user can specify the source parameter and bit.
Parameter	Either a user-adjustable operating instruction for the drive, or an *actual signal*.
p.u.	Per unit

Summary of parameter groups

Parameter listing

No.	Name/Value	Description	*Def/FbEq16*
01 Actual values		Basic signals for monitoring the drive. All parameters in this group are read-only unless otherwise noted.	
01.01	*Motor speed used*	Measured or estimated motor speed depending on which type of feedback is used (see parameter *90.41 Motor feedback selection*). A filter time constant for this signal can be defined by parameter *46.11 Filter time motor speed*.	-
	-30000.00 … 30000.00 rpm	Measured or estimated motor speed.	See par. *46.01*
01.02	*Motor speed estimated*	Estimated motor speed in rpm. A filter time constant for this signal can be defined by parameter *46.11 Filter time motor speed*.	-
	-30000.00 … 30000.00 rpm	Estimated motor speed.	See par. *46.01*
01.03	*Motor speed %*	Shows the value of *01.01 Motor speed used* in percent of the synchronous speed of the motor.	10 = 1%
	-1000.00 … 1000.00%	Measured or estimated motor speed.	See par. *46.01*
01.04	*Encoder 1 speed filtered*	Speed of encoder 1 in rpm. A filter time constant for this signal can be defined by parameter *46.11 Filter time motor speed*.	-
	-30000.00 … 30000.00 rpm	Encoder 1 speed.	See par. *46.01*
01.05	*Encoder 2 speed filtered*	Speed of encoder 2 in rpm. A filter time constant for this signal can be defined by parameter *46.11 Filter time motor speed*.	-
	-30000.00 … 30000.00 rpm	Encoder 2 speed.	See par. *46.01*
01.06	*Output frequency*	Estimated drive output frequency in Hz. A filter time constant for this signal can be defined by parameter *46.12 Filter time output frequency*.	-
	-500.00 … 500.00 Hz	Estimated output frequency.	See par. *46.02*
01.07	*Motor current*	Measured (absolute) motor current in A.	-
	0.00 … 30000.00 A	Motor current.	See par. *46.05*
01.08	*Motor current % of motor nom*	Motor current (drive output current) in percent of the nominal motor current.	-
	0.0 … 1000.0%	Motor current.	1 = 1%
01.10	*Motor torque*	Motor torque in percent of the nominal motor torque. See also parameter *01.30 Nominal torque scale*. A filter time constant for this signal can be defined by parameter *46.13 Filter time motor torque*.	-
	-1600.0 … 1600.0%	Motor torque.	See par. *46.03*
01.11	*DC voltage*	Measured DC link voltage.	-
	0.00 … 2000.00 V	DC link voltage.	10 = 1 V

No.	Name/Value	Description	Def/FbEq16
01.13	Output voltage	Calculated motor voltage in V AC.	-
	0…2000 V	Motor voltage.	1 = 1 V
01.14	Output power	Drive output power. The unit is selected by parameter 96.16 Unit selection. A filter time constant for this signal can be defined by parameter 46.14 Filter time power out.	-
	-32768.00 … 32767.00 kW or hp	Output power.	1 = 1 unit
01.15	Output power % of motor nom	Shows the value of 01.14 Output power in percent of the nominal power of the motor.	-
	-300.00 … 300.00%	Output power.	1 = 1%
01.17	Motor shaft power	Estimated mechanical power at motor shaft. The unit is selected by parameter 96.16 Unit selection. A filter time constant for this signal can be defined by parameter 46.14 Filter time power out.	-
	-32768.00 … 32767.00 kW or hp	Motor shaft power.	1 = 1 unit
01.18	Inverter GWh motoring	Amount of energy that has passed through the drive (towards the motor) in full gigawatt-hours. The minimum value is zero.	-
	0…32767 GWh	Motoring energy in GWh.	1 = 1 GWh
01.19	Inverter MWh motoring	Amount of energy that has passed through the drive (towards the motor) in full megawatt-hours. Whenever the counter rolls over, 01.18 Inverter GWh motoring is incremented.The minimum value is zero.	-
	0…999 MWh	Motoring energy in MWh.	1 = 1 MWh
01.20	Inverter kWh motoring	Amount of energy that has passed through the drive (towards the motor) in full kilowatt-hours. Whenever the counter rolls over, 01.19 Inverter MWh motoring is incremented.The minimum value is zero.	-
	0…999 kWh	Motoring energy in kWh.	10 = 1 kWh
01.21	U-phase current	Measured U-phase current.	-
	-30000.00 … 30000.00 A	U-phase current.	See par. 46.05
01.22	V-phase current	Measured V-phase current.	-
	-30000.00 … 30000.00 A	V-phase current.	See par. 46.05
01.23	W-phase current	Measured W-phase current.	-
	-30000.00 … 30000.00 A	W-phase current.	See par. 46.05
01.24	Flux actual %	Used flux reference in percent of nominal flux of motor.	-
	0…200%	Flux reference.	1 = 1%
01.29	Speed change rate	Rate of actual speed change. Positive values indicate acceleration, negative values indicate deceleration. See also parameters 31.32 Emergency ramp supervision, 31.33 Emergency ramp supervision delay, 31.37 Ramp stop supervision and 31.38 Ramp stop supervision delay.	-
	-15000 … 15000 rpm/s	Rate of speed change.	1 = 1 rpm/s

No.	Name/Value	Description	*Def/FbEq16*
01.30	*Nominal torque scale*	Torque that corresponds to 100% of nominal motor torque. The unit is selected by parameter *96.16 Unit selection* **Note:** This value is copied from parameter *99.12 Motor nominal torque* if entered. Otherwise the value is calculated from other motor data.	-
	0.000… N·m or lb·ft	Nominal torque.	1 = 1 unit
01.31	*Ambient temperature*	Measured temperature of incoming cooling air. The unit is selected by parameter *96.16 Unit selection*.	-
	-40 … 120 °C or °F	Cooling air temperature.	1 = 1°
01.32	*Inverter GWh regenerating*	Amount of energy that has passed through the drive (towards the supply) in full gigawatt-hours. The minimum value is zero.	-
	0…32767 GWh	Motoring energy in GWh.	1 = 1 GWh
01.33	*Inverter MWh regenerating*	Amount of energy that has passed through the drive (towards the supply) in full megawatt-hours. Whenever the counter rolls over, *01.32 Inverter GWh regenerating* is incremented.The minimum value is zero.	-
	0…999 MWh	Motoring energy in MWh.	1 = 1 MWh
01.34	*Inverter kWh regenerating*	Amount of energy that has passed through the drive (towards the supply) in full kilowatt-hours. Whenever the counter rolls over, *01.33 Inverter MWh regenerating* is incremented.The minimum value is zero.	-
	0…999 kWh	Motoring energy in kWh.	10 = 1 kWh
01.35	*Mot - regen energy GWh*	Amount of net energy (motoring energy - regenerating energy) that has passed through the drive in full gigawatt-hours.	-
	-32768…32767 GWh	Motoring energy in GWh.	1 = 1 GWh
01.36	*Mot - regen energy MWh*	Amount of net energy (motoring energy - regenerating energy) that has passed through the drive in full megawatt-hours. Whenever the counter rolls over, *01.35 Mot - regen energy GWh* is incremented or decremented.	-
	-999…999 MWh	Motoring energy in MWh.	1 = 1 MWh
01.37	*Mot - regen energy kWh*	Amount of energy (motoring energy - regenerating energy) that has passed through the drive in full kilowatt-hours. Whenever the counter rolls over, *01.36 Mot - regen energy MWh* is incremented or decremented.	-
	-999…999 kWh	Motoring energy in kWh.	10 = 1 kWh
01.61	*Abs motor speed used*	Absolute value of *01.01 Motor speed used*.	-
	0.00 … 30000.00 rpm	Measured or estimated motor speed.	See par. *46.01*
01.62	*Abs motor speed %*	Absolute value of *01.03 Motor speed %*.	-
	0.00 … 1000.00%	Measured or estimated motor speed.	10 = 1%
01.63	*Abs output frequency*	Absolute value of *01.06 Output frequency*.	-
	0.00 … 500.00 Hz	Estimated output frequency.	See par. *46.02*
01.64	*Abs motor torque*	Absolute value of *01.10 Motor torque*.	-
	0.0 … 1600.0%	Motor torque.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
01.65	Abs output power	Absolute value of 01.14 Output power.	-
	0.00 … 32767.00 kW or hp	Output power.	1 = 1 unit
01.66	Abs output power % motor nom	Absolute value of 01.15 Output power % of motor nom.	-
	0.00 … 300.00%	Output power.	10 = 1%
01.68	Abs motor shaft power	Absolute value of 01.17 Motor shaft power.	-
	0.00 … 32767.00 kW or hp	Motor shaft power.	1 = 1 unit

03 Input references		Values of references received from various sources. All parameters in this group are read-only unless otherwise noted.	
03.01	Panel reference	Local reference given from the control panel or PC tool.	-
	-100000.00 … 100000.00	Local control panel or PC tool reference.	1 = 10
03.02	Panel reference 2	Remote reference given from the control panel or PC tool.	-
	-30000.00 … 30000.00	Remote control panel or PC tool reference.	1 = 10
03.05	FB A reference 1	Reference 1 received through fieldbus adapter A. See also chapter Fieldbus control through a fieldbus adapter (page 537).	-
	-100000.00 … 100000.00	Reference 1 from fieldbus adapter A.	1 = 10
03.06	FB A reference 2	Reference 2 received through fieldbus adapter A.	-
	-100000.00 … 100000.00	Reference 2 from fieldbus adapter A.	1 = 10
03.07	FB B reference 1	Reference 1 received through fieldbus adapter B.	-
	-100000.00 … 100000.00	Reference 1 from fieldbus adapter B.	1 = 10
03.08	FB B reference 2	Reference 2 received through fieldbus adapter B.	-
	-100000.00 … 100000.00	Reference 2 from fieldbus adapter B.	1 = 10
03.09	EFB reference 1	Scaled reference 1 received through the embedded fieldbus interface. The scaling is defined by 58.26 EFB ref1 type.	1 = 10
	-30000.00 … 30000.00	Reference 1 received through the embedded fieldbus interface.	1 = 10
03.10	EFB reference 2	Scaled reference 2 received through the embedded fieldbus interface. The scaling is defined by 58.27 EFB ref2 type.	1 = 10
	-30000.00 … 30000.00	Reference 2 received through the embedded fieldbus interface.	1 = 10
03.11	DDCS controller ref 1	Reference 1 received from the external (DDCS) controller. The value has been scaled according to parameter 60.60 DDCS controller ref1 type. See also section External controller interface (page 38).	1 = 10
	-30000.00 … 30000.00	Scaled reference 1 received from external controller.	1 = 10

No.	Name/Value	Description	Def/FbEq16
03.12	*DDCS controller ref 2*	Reference 2 received from the external (DDCS) controller. The value has been scaled according to parameter *60.61 DDCS controller ref2 type*.	1 = 10
	-30000.00 … 30000.00	Scaled reference 2 received from external controller.	1 = 10
03.13	*M/F or D2D ref1*	Master/follower reference 1 received from the master. The value has been scaled according to parameter *60.10 M/F ref1 type*. See also section *Master/follower functionality* (page *31*).	1 = 10
	-30000.00 … 30000.00	Scaled reference 1 received from master.	1 = 10
03.14	*M/F or D2D ref2*	Master/follower reference 2 received from the master. The value has been scaled according to parameter *60.11 M/F ref2 type*.	1 = 10
	-30000.00 … 30000.00	Scaled reference 2 received from master.	1 = 10

04 Warnings and faults		Information on warnings and faults that occurred last. For explanations of individual warning and fault codes, see chapter *Fault tracing*. All parameters in this group are read-only unless otherwise noted.	
04.01	*Tripping fault*	Code of the 1st active fault (the fault that caused the current trip).	-
	0000h…FFFFh	1st active fault.	1 = 1
04.02	*Active fault 2*	Code of the 2nd active fault.	-
	0000h…FFFFh	2nd active fault.	1 = 1
04.03	*Active fault 3*	Code of the 3rd active fault.	-
	0000h…FFFFh	3rd active fault.	1 = 1
04.04	*Active fault 4*	Code of the 4th active fault.	-
	0000h…FFFFh	4th active fault.	1 = 1
04.05	*Active fault 5*	Code of the 5th active fault.	-
	0000h…FFFFh	5th active fault.	1 = 1
04.06	*Active warning 1*	Code of the 1st active warning.	-
	0000h…FFFFh	1st active warning.	1 = 1
04.07	*Active warning 2*	Code of the 2nd active warning.	-
	0000h…FFFFh	2nd active warning.	1 = 1
04.08	*Active warning 3*	Code of the 3rd active warning.	-
	0000h…FFFFh	3rd active warning.	1 = 1
04.09	*Active warning 4*	Code of the 4th active warning.	-
	0000h…FFFFh	4th active warning.	1 = 1
04.10	*Active warning 5*	Code of the 5th active warning.	-
	0000h…FFFFh	5th active warning.	1 = 1
04.11	*Latest fault*	Code of the 1st stored (non-active) fault.	-
	0000h…FFFFh	1st stored fault.	1 = 1

No.	Name/Value	Description	Def/FbEq16
04.12	2nd latest fault	Code of the 2nd stored (non-active) fault.	-
	0000h…FFFFh	2nd stored fault.	1 = 1
04.13	3rd latest fault	Code of the 3rd stored (non-active) fault.	-
	0000h…FFFFh	3rd stored fault.	1 = 1
04.14	4th latest fault	Code of the 4th stored (non-active) fault.	-
	0000h…FFFFh	4th stored fault.	1 = 1
04.15	5th latest fault	Code of the 5th stored (non-active) fault.	-
	0000h…FFFFh	5th stored fault.	1 = 1
04.16	Latest warning	Code of the 1st stored (non-active) warning.	-
	0000h…FFFFh	1st stored warning.	1 = 1
04.17	2nd latest warning	Code of the 2nd stored (non-active) warning.	-
	0000h…FFFFh	2nd stored warning.	1 = 1
04.18	3rd latest warning	Code of the 3rd stored (non-active) warning.	-
	0000h…FFFFh	3rd stored warning.	1 = 1
04.19	4th latest warning	Code of the 4th stored (non-active) warning.	-
	0000h…FFFFh	4th stored warning.	1 = 1
04.20	5th latest warning	Code of the 5th stored (non-active) warning.	-
	0000h…FFFFh	5th stored warning.	1 = 1

No.	Name/Value	Description	Def/FbEq16
04.21	Fault word 1	ACS800-compatible fault word 1. The bit assignments of this word correspond to FAULT WORD 1 in the ACS800. Parameter 04.120 Fault/Warning word compatibility determines whether the bit assignments are according to the ACS800 Standard or ACS800 System control program. Each bit can indicate several ACS880 events as listed below. This parameter is read-only.	-

Bit	ACS800 fault name (04.120 = ACS800 Standard ctrl program)	ACS800 fault name (04.120 = ACS800 System ctrl program)	ACS880 events indicated by this bit (see Fault tracing, page 473)
0	SHORT CIRC	SHORT CIRC	2340
1	OVERCURRENT	OVERCURRENT	2310
2	DC OVERVOLT	DC OVERVOLT	3210
3	ACS800 TEMP	ACS800 TEMP	2381, 4210, 4290, 42F1, 4310, 4380
4	EARTH FAULT	EARTH FAULT	2330, 2392, 3181
5	THERMISTOR	MOTOR TEMP M	4981
6	MOTOR TEMP	MOTOR TEMP	4982
7	SYSTEM_FAULT	SYSTEM_FAULT	6481, 6487, 64A1, 64A2, 64A3, 64B1, 64E1, 6881, 6882, 6883, 6885
8	UNDERLOAD	UNDERLOAD	-
9	OVERFREQ	OVERFREQ	7310
10	Reserved	MPROT SWITCH	9081
11	Reserved	CH2 COMM LOSS	7582
12	Reserved	SC (INU1)	2340 (XXYY YY01)
13	Reserved	SC (INU2)	2340 (XXYY YY02)
14	Reserved	SC (INU3)	2340 (XXYY YY03)
15	Reserved	SC (INU4)	2340 (XXYY YY04)

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	ACS800-compatible fault word 1.	1 = 1

No.	Name/Value	Description	Def/FbEq16
04.22	*Fault word 2*	ACS800-compatible fault word 2. The bit assignments of this word correspond to FAULT WORD 2 in the ACS800. Parameter *04.120 Fault/Warning word compatibility* determines whether the bit assignments are according to the ACS800 Standard or ACS800 System control program. Each may indicate several ACS880 events as listed below. This parameter is read-only.	-

Bit	ACS800 fault name (*04.120* = *ACS800 Standard ctrl program*)	ACS800 fault name (*04.120* = *ACS800 System ctrl program*)	**ACS880 events indicated by this bit** (see *Fault tracing*, page *473*)
0	SUPPLY PHASE	SUPPLY PHASE	*3130*
1	NO MOT DATA	NO MOTOR DATA	-
2	DC UNDERVOLT	DC UNDERVOLT	*3220*
3	Reserved	CABLE TEMP	*4000*
4	RUN ENABLE	RUN DISABLE	*AFEB*
5	ENCODER ERR	ENCODER ERR	*7301*, *7380*, *7381*, *73A0*, *73A1*
6	I/O COMM	IO COMM ERR	*7080*, *7082*
7	CTRL B TEMP	CTRL B TEMP	-
8	EXTERNAL FLT	SELECTABLE	*9082*
9	OVER SWFREQ	OVER SWFREQ	-
10	AI < MIN FUNC	AI<MIN FUNC	*80A0*
11	PPCC LINK	PPCC LINK	*5681*, *5682*, *5690*, *5691*, *5692*, *5693*, *5694*, *5695*
12	COMM MODULE	COMM MODULE	*6681*, *7510*, *7520*, *7581*
13	PANEL LOSS	PANEL LOSS	*7081*
14	MOTOR STALL	MOTOR STALL	*7121*
15	MOTOR PHASE	MOTOR PHASE	*3381*

	0000h…FFFFh	ACS800-compatible fault word 2.	1 = 1

No.	Name/Value	Description	*Def/FbEq16*
04.31	*Warning word 1*	ACS800-compatible warning (alarm) word 1. The bit assignments of this word correspond to ALARM WORD 1 in the ACS800. Parameter *04.120 Fault/Warning word compatibility* determines whether the assignments are according to the ACS800 Standard or ACS800 System control program. Each may indicate several ACS880 warnings as listed below. This parameter is read-only.	-

Bit	ACS800 alarm name		ACS880 events indicated by this bit (see *Fault tracing*, page *473*)
	(*04.120* = *ACS800 Standard ctrl program*)	(*04.120* = *ACS800 System ctrl program*)	
0	START INHIBIT	START INHIBI	*B5A0*
1	Reserved	EM STOP	*AFE1*, *AFE2*
2	THERMISTOR	MOTOR TEMP M	*A491*
3	MOTOR TEMP	MOTOR TEMP	*A492*
4	ACS800 TEMP	ACS800 TEMP	*A2BA*, *A4A1*, *A4A9*, *A4B0*, *A4B1*, *A4F6*
5	ENCODER ERR	ENCODER ERR	*A797*, *A7B0*, *A7B1*, *A7E1*
6	T MEAS ALM	T MEAS CIRC	*A490*, *A5EA*, *A782*, *A8A0*
7	Reserved	DIGITAL IO	-
8	Reserved	ANALOG IO	-
9	Reserved	EXT DIGITAL IO	-
10	Reserved	EXT ANALOG IO	*A6E5*, *A7AA*, *A7AB*
11	Reserved	CH2 COMM LOSS	*A7CB*, *AF80*
12	COMM MODULE	MPROT SWITCH	*A981*
13	Reserved	EM STOP DEC	-
14	EARTH FAULT	EARTH FAULT	*A2B3*
15	Reserved	SAFETY SWITC	*A983*

	0000h…FFFFh	ACS800-compatible warning (alarm) word 1.	1 = 1

No.	Name/Value	Description	Def/FbEq16
04.32	Warning word 2	ACS800-compatible warning (alarm) word 2. The bit assignments of this word correspond to ALARM WORD 2 in the ACS800. Parameter 04.120 Fault/Warning word compatibility determines whether the bit assignments are according to the ACS800 Standard or ACS800 System control program. Each may indicate several ACS880 warnings as listed below. This parameter is read-only.	-

Bit	ACS800 alarm name (04.120 = ACS800 Standard ctrl program)	(04.120 = ACS800 System ctrl program)	ACS880 events indicated by this bit (see Fault tracing, page 473)
0	Reserved	MOTOR FAN	A781
1	UNDERLOAD	UNDERLOAD	-
2	Reserved	INV OVERLOAD	-
3	Reserved	CABLE TEMP	A480
4	ENCODER	ENCODER A<>B	-
5	Reserved	FAN OVERTEMP	A984
6	Reserved	Reserved	-
7	POWFAIL FILE	POWFAIL FILE	-
8	ALM (OS_17)	POWDOWN FILE	-
9	MOTOR STALL	MOTOR STALL	A780
10	AI < MIN FUNC	AI<MIN FUNC	A8A0
11	Reserved	COMM MODULE	A6D1, A6D2, A7C1, A7C2, A7CA, A7CE
12	Reserved	BATT FAILURE	-
13	PANEL LOSS	PANEL LOSS	A7EE
14	Reserved	DC UNDERVOLT	A3A2
15	Reserved	RESTARTED	-

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	ACS800-compatible warning (alarm) word 2.	1 = 1
04.40	Event word 1	User-defined event word. This word collects the status of the events (warnings, faults or pure events) selected by parameters 04.41…04.72. For each event, an auxiliary code can optionally be specified for filtering. This parameter is read-only.	-

Bit	Name	Description
0	User bit 0	1 = Event selected by parameters 04.41 (and 04.42) is active
1	User bit 1	1 = Event selected by parameters 04.43 (and 04.44) is active
…	…	…
15	User bit 15	1 = Event selected by parameters 04.71 (and 04.72) is active

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	User-defined event word.	1 = 1

No.	Name/Value	Description	*Def/FbEq16*
04.41	*Event word 1 bit 0 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 0 of *04.40 Event word 1*. The event codes are listed in chapter *Fault tracing* (page *473*).	0000h
	0000h…FFFFh	Code of event.	1 = 1
04.42	*Event word 1 bit 0 aux code*	Specifies an auxiliary code for the event selected by the previous parameter. The selected event is indicated by the event word only if its auxiliary code matches the value of this parameter. With a value of 0000 0000h, the event word will indicate the event regardless of the auxiliary code.	0000 0000h
	0000 0000h … FFFF FFFFh	Code of warning, fault or pure event.	1 = 1
04.43	*Event word 1 bit 1 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 1 of *04.40 Event word 1*. The event codes are listed in chapter *Fault tracing* (page *473*).	0000h
	0000h…FFFFh	Code of event.	1 = 1
04.44	*Event word 1 bit 1 aux code*	Specifies an auxiliary code for the event selected by the previous parameter. The selected event is indicated by the event word only if its auxiliary code matches the value of this parameter. With a value of 0000 0000h, the event word will indicate the event regardless of the auxiliary code.	0000 0000h
	0000 0000h … FFFF FFFFh	Code of warning, fault or pure event.	1 = 1
…	…	…	…
04.71	*Event word 1 bit 15 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 15 of *04.40 Event word 1*. The event codes are listed in chapter *Fault tracing* (page *473*).	0000h
	0000h…FFFFh	Code of event.	1 = 1
04.72	*Event word 1 bit 15 aux code*	Specifies an auxiliary code for the event selected by the previous parameter. The selected event is indicated by the event word only if its auxiliary code matches the value of this parameter. With a value of 0000 0000h, the event word will indicate the event regardless of the auxiliary code.	0000 0000h
	0000 0000h … FFFF FFFFh	Code of warning, fault or pure event.	1 = 1
04.120	*Fault/Warning word compatibility*	Selects whether the bit assignments of parameters *04.21…04.32* correspond to the ACS800 Standard control program or the ACS800 System control program.	*False*
	ACS800 Standard ctrl program	The bit assignments of parameters *04.21…04.32* correspond to the ACS800 Standard control program as follows: *04.21 Fault word 1*: 03.05 FAULT WORD 1 *04.22 Fault word 2*: 03.06 FAULT WORD 2 *04.31 Warning word 1*: 03.08 ALARM WORD 1 *04.32 Warning word 2*: 03.09 ALARM WORD 2	0

No.	Name/Value	Description	Def/FbEq16
	ACS800 System ctrl program	The bit assignments of parameters 04.21…04.32 correspond to the ACS800 System control program as follows: 04.21 Fault word 1: 09.01 FAULT WORD 1 04.22 Fault word 2: 09.02 FAULT WORD 2 04.31 Warning word 1: 09.04 ALARM WORD 1 04.32 Warning word 2: 09.05 ALARM WORD 2	1
05 Diagnostics		Various run-time-type counters and measurements related to drive maintenance. All parameters in this group are read-only unless otherwise noted.	
05.01	On-time counter	On-time counter. The counter runs when the drive is powered.	-
	0…65535 d	On-time counter.	1 = 1 d
05.02	Run-time counter	Motor run-time counter. The counter runs when the inverter modulates.	-
	0…65535 d	Motor run-time counter.	1 = 1 d
05.04	Fan on-time counter	Running time of the drive cooling fan. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…65535 d	Cooling fan run-time counter.	1 = 1 d
05.11	Inverter temperature	Estimated drive temperature in percent of fault limit. The actual trip temperature varies according to the type of the drive. 0.0% = 0 °C (32 °F) 94% approx. = Warning limit 100.0% = Fault limit	-
	-40.0 … 160.0%	Drive temperature in percent.	1 = 1%
05.22	Diagnostic word 3	Diagnostic word 3.	-

Bit	Name	Value
0…10	Reserved	
11	Fan command	1 = Drive fan is rotating above idle speed
12	Fan service counter	1 = Drive fan service counter has reached its limit
13…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Diagnostic word 3.	1 = 1
05.41	Main fan service counter	Displays the age of the main cooling fan as a percentage of its estimated lifetime. The estimate is based on the duty, operating conditions and other operating parameters of the fan. When the counter reaches 100%, a warning (A8C0 Fan service counter) is generated. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…150%	Main cooling fan age.	1 = 1%

No.	Name/Value	Description	*Def/FbEq16*
05.42	*Aux. fan service counter*	Displays the age of the auxiliary cooling fan as a percentage of its estimated lifetime. The estimate is based on the duty, operating conditions and other operating parameters of the fan. When the counter reaches 100%, a warning (*A8C0 Fan service counter*) is generated. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…150%	Auxiliary cooling fan age.	1 = 1%
06 Control and status words		Drive control and status words.	
06.01	*Main control word*	The main control word of the drive. This parameter shows the control signals as received from the selected sources (such as digital inputs, the fieldbus interfaces and the application program). The bit assignments of the word are as described on page *543*. The related status word and state diagram are presented on pages *544* and *545* respectively. **Note:** Bits 12…15 can be used to carry additional control data, and used as a signal source by any binary-source selector parameter. This parameter is read-only.	-
	0000h…FFFFh	Main control word.	1 = 1
06.02	*Application control word*	The drive control word received from the application program (if any). The bit assignments are described on page *543*. This parameter is read-only.	-
	0000h…FFFFh	Application program control word.	1 = 1
06.03	*FBA A transparent control word*	Displays the unaltered control word received from the PLC through fieldbus adapter A when a transparent communication profile is selected eg. by parameter group *51 FBA A settings*. See section *Control word and Status word* (page *540*). This parameter is read-only.	-
	00000000h … FFFFFFFFh	Control word received through fieldbus adapter A.	-
06.04	*FBA B transparent control word*	Displays the unaltered control word received from the PLC through fieldbus adapter B when a transparent communication profile is selected eg. by parameter group *54 FBA B settings*. See section *Control word and Status word* (page *540*). This parameter is read-only.	-
	00000000h … FFFFFFFFh	Control word received through fieldbus adapter B.	1 = 1
06.05	*EFB transparent control word*	Displays the unaltered control word received from the PLC through the embedded fieldbus interface when a transparent communication profile is selected in parameter *58.25 Control profile*. See section *The Transparent profile* (page *530*). This parameter is read-only.	-
	00000000h … FFFFFFFFh	Control word received through the embedded fieldbus interface.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.11	Main status word	Main status word of the drive. The bit assignments are described on page 544. The related control word and state diagram are presented on pages 543 and 545 respectively. This parameter is read-only.	-
	0000h…FFFFh	Main status word.	1 = 1
06.16	Drive status word 1	Drive status word 1. This parameter is read-only.	-

Bit	Name	Description
0	Enabled	1 = Both run enable (see par. 20.12) and start enable (20.19) signals are present, and Safe torque off has not been activated. **Notes:** • In I/O or local control, clearing this bit makes the drive enter the SWITCH-ON INHIBITED state (see page 544). • This bit is not affected by the presence of a fault.
1	Inhibited	1 = Start inhibited. See parameters 06.18 and 06.25 for the source of the inhibiting signal.
2	DC charged	1 = DC circuit has been charged. If present, the DC switch is closed, and charging switch is open. 0 = Charging not complete. If the inverter unit is not equipped with a DC switch (option +F286), check setting of 95.09.
3	Ready to start	1 = Drive is ready to receive a start command
4	Following reference	1 = Drive is ready to follow given reference
5	Started	1 = Drive has been started
6	Modulating	1 = Drive is modulating (output stage is being controlled)
7	Limiting	1 = Any operating limit (speed, torque, etc.) is active
8	Local control	1 = Drive is in local control
9	Network ctrl	1 = Drive is in *network control* (see page 15)
10	Ext1 active	1 = Control location EXT1 active
11	Ext2 active	1 = Control location EXT2 active
12	Reserved	
13	Start request	1 = Start requested
14…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Drive status word 1.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.17	Drive status word 2	Drive status word 2. This parameter is read-only.	-

Bit	Name	Description
0	Identification run done	1 = Motor identification (ID) run has been performed
1	Magnetized	1 = The motor has been magnetized
2	Torque control	1 = Torque control mode active
3	Speed control	1 = Speed control mode active
4	Power control	1 = Power control mode active
5	Safe reference active	1 = A “safe” reference is being applied by functions such as parameters 49.05 and 50.02
6	Last speed active	1 = A “last speed” reference is being applied by functions such as parameters 49.05 and 50.02
7	Loss of reference	1 = Reference signal lost
8	Emergency stop failed	1 = Emergency stop failed (see parameters 31.32 and 31.33)
9	Jogging active	1 = Jogging enable signal is on
10	Above limit	1 = Actual speed, frequency or torque equals or exceeds limit (defined by parameters 46.31…46.33). Valid in both directions of rotation.
11	Emergency stop active	1 = An emergency stop command signal is active, or the drive is stopping after receiving an emergency stop command.
12	Reduced run	1 = Reduced run active (see section Reduced run function on page 90)
13	Reserved	
14	Stop failed	1 = Stopping failed (see parameters 31.37 and 31.38)
15	Reserved	

	0000h…FFFFh	Drive status word 2.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.18	*Start inhibit status word*	Start inhibit status word. This word specifies the source of the inhibiting signal that is preventing the drive from starting. The conditions marked with an asterisk (*) only require that the start command is cycled. In all other instances, the inhibiting condition must be removed first. See also parameter *06.25 Drive inhibit status word 2*, and *06.16 Drive status word 1*, bit 1. This parameter is read-only.	-

Bit	Name	Description
0	Not ready run	1 = DC voltage is missing or drive has not been parametrized correctly. Check the parameters in groups 95 and 99.
1	Ctrl location changed	* 1 = Control location has changed
2	SSW inhibit	1 = Control program is keeping itself in inhibited state
3	Fault reset	* 1 = A fault has been reset
4	Lost start enable	1 = Start enable signal missing
5	Lost run enable	1 = Run enable signal missing
6	FSO inhibit	1 = Operation prevented by FSO-xx safety functions module
7	STO	1 = Safe torque off active
8	Current calibration ended	* 1 = Current calibration routine has finished
9	ID run ended	* 1 = Motor identification run has finished
10	Auto phase ended	* 1 = Autophasing routine has finished
11	Em Off1	1 = Emergency stop signal (mode Off1)
12	Em Off2	1 = Emergency stop signal (mode Off2)
13	Em Off3	1 = Emergency stop signal (mode Off3)
14	Auto reset inhibit	1 = The autoreset function is inhibiting operation
15	Jogging active	1 = The jogging enable signal is inhibiting operation

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Start inhibit status word.	1 = 1

No.	Name/Value	Description	*Def/FbEq16*
06.19	*Speed control status word*	Speed control status word. This parameter is read-only.	-

Bit	Name	Description
0	Zero speed	1 = Drive is running at zero speed, ie. the absolute value of par. *90.01 Motor speed for control* has remained below *21.06 Zero speed limit* for longer than *21.07 Zero speed delay*. **Notes:** • This bit is not updated when mechanical brake control is enabled by par. *44.06* and the drive is modulating. • During a ramp stop when the drive is running forward, the delay count runs whenever [*90.01*] < [*21.06*]. From the reverse direction, the delay count runs whenever *90.01* > -[*21.06*].
1	Forward	1 = Drive is running in forward direction above zero speed limit, ie. [*90.01*] > +[*21.06*].
2	Reverse	1 = Drive is running in reverse direction above zero speed limit, ie. [*90.01*] < -[*21.06*].
3	Out of window	1 = Speed error window control active (see par. *24.41*)
4	Internal speed feedback	1 = Estimated speed feedback used in motor control, ie. estimated speed is selected by par. *90.41* or *90.46*, or selected encoder has faulted (par. *90.45*) 0 = Encoder 1 or 2 used for speed feedback
5	Encoder 1 feedback	1 = Encoder 1 used for speed feedback in motor control 0 = Encoder 1 faulted or not selected as source of speed feedback (see par. *90.41* and *90.46*)
6	Encoder 2 feedback	1 = Encoder 2 used for speed feedback in motor control 0 = Encoder 2 faulted or not selected as source of speed feedback (see par. *90.41* and *90.46*)
7	Any constant speed request	1 = A constant speed or frequency has been selected; see par. *06.20*.
8	Follower speed corr min lim	1 = Minimum limit of speed correction (in a speed-controlled follower) has been reached (see par. *23.39*…*23.41*).
9	Follower speed corr max lim	1 = Maximum limit of speed correction (in a speed-controlled follower) has been reached (see par. *23.39*…*23.41*).
10…15	Reserved	

	0000h…FFFFh	Speed control status word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.20	*Constant speed status word*	Constant speed/frequency status word. Indicates which constant speed or frequency is active (if any). See also parameter *06.19 Speed control status word*, bit 7, and section *Constant speeds/frequencies* (page 43). This parameter is read-only.	-

Bit	Name	Description
0	Constant speed 1	1 = Constant speed or frequency 1 selected
1	Constant speed 2	1 = Constant speed or frequency 2 selected
2	Constant speed 3	1 = Constant speed or frequency 3 selected
3	Constant speed 4	1 = Constant speed or frequency 4 selected
4	Constant speed 5	1 = Constant speed or frequency 5 selected
5	Constant speed 6	1 = Constant speed or frequency 6 selected
6	Constant speed 7	1 = Constant speed or frequency 7 selected
7…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Constant speed/frequency status word.	1 = 1
06.21	*Drive status word 3*	Drive status word 3. This parameter is read-only.	-

Bit	Name	Description
0	DC hold active	1 = DC hold is active (see par. *21.08*)
1	Post-magnetizing active	1 = Post-magnetizing is active (see par. *21.08*)
2	Motor pre-heating active	1 = Motor pre-heating is active (see par. *21.14*)
3	Smooth start active	Reserved.
4	Rotor position known	1 = Rotor position has been determined (autophasing not needed). See section *Autophasing* (page 59).
5…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Drive status word 3.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.25	*Drive inhibit status word 2*	Drive inhibit status word 2. This word specifies the source of the inhibiting signal that is preventing the drive from starting. See also parameter *06.18 Start inhibit status word*, and *06.16 Drive status word 1*, bit 1. This parameter is read-only.	-

Bit	Name	Description
0	Follower drive	1 = A follower is preventing the master from starting.
1	Application	1 = The application program is preventing the drive from starting.
2	Aux. power failure	1 = A control unit auxiliary power failure is preventing the drive from starting.
3	Encoder feedback	1 = The encoder feedback configuration is preventing the drive from starting.
4	Ref source parametrization	1 = A reference source parametrization conflict is preventing the drive from starting. See warning *A6DA Reference source parametrization* (page *484*).
5…15	Reserved	

	0000h…FFFFh	Start inhibit status word.	1 = 1
06.29	*MSW bit 10 sel*	Selects a binary source whose status is transmitted as bit 10 of *06.11 Main status word*.	*Above limit*
	False	0.	0
	True	1.	1
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *127*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.30	*MSW bit 11 sel*	Selects a binary source whose status is transmitted as bit 11 of *06.11 Main status word*.	*Ext ctrl loc*
	False	0.	0
	True	1.	1
	Ext ctrl loc	Bit 11 of *06.01 Main control word* (see page *125*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.31	*MSW bit 12 sel*	Selects a binary source whose status is transmitted as bit 12 of *06.11 Main status word*.	*Ext run enable*
	False	0.	0
	True	1.	1
	Ext run enable	Inverted bit 5 of *06.18 Start inhibit status word* (see page *128*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.32	*MSW bit 13 sel*	Selects a binary source whose status is transmitted as bit 13 of *06.11 Main status word*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.33	*MSW bit 14 sel*	Selects a binary source whose status is transmitted as bit 14 of *06.11 Main status word*.	*False*
	False	0.	0
	True	1.	1

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
06.36	LSU Status Word	(Only visible with a BCU control unit) Shows the status of the supply unit. See also section Control of a supply unit (LSU) (page 40), and parameter group 60 DDCS communication. This parameter is read-only.	-

Bit	Name	Description
0	Ready on	1 = Ready to switch on
1	Ready run	1 = Ready to operate, DC link charged
2	Ready ref	1 = Operation enabled
3	Tripped	1 = A fault is active
4…6	Reserved	
7	Warning	1 = A warning is active
8	Modulating	1 = The supply unit is modulating
9	Remote	1 = Remote control (EXT1 or EXT2) 0 = Local control
10	Net ok	1 = Supply network voltage OK
11…12	Reserved	
13	Charging or ready run	1 = Bit 1 or bit 14 active
14	Charging	1 = Charging contactor closed 0 = Charging contactor open
15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Supply unit status word.	1 = 1
06.39	Internal state machine LSU CW	(Only visible with a BCU control unit) Shows the control word sent to the supply unit from the INU-LSU (inverter unit/supply unit) state machine. This parameter is read-only.	-

Bit	Name	Description
0	ON/OFF	1 = Start charging 0 = Open main contactor (switch power off)
1	OFF 2	0 = Emergency stop (Off2)
2	OFF 3	0 = Emergency stop (Off3)
3	START	1 = Start modulating 0 = Stop modulating
4…6	Reserved	
7	RESET	0 -> 1 = Reset an active fault. A fresh start command is required after reset.
8…11	Reserved	
12	USER BIT 0	See parameter 06.40 LSU CW user bit 0 selection.
13	USER BIT 1	See parameter 06.41 LSU CW user bit 1 selection.
14	USER BIT 2	See parameter 06.42 LSU CW user bit 2 selection.
15	USER BIT 3	See parameter 06.43 LSU CW user bit 3 selection.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Supply unit control word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.40	LSU CW user bit 0 selection	(Only visible with a BCU control unit) Selects a binary source whose status is transmitted as bit 12 of 06.39 Internal state machine LSU CW to the supply unit.	MCW user bit 0
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of 06.01 Main control word (see page 125).	2
	MCW user bit 1	Bit 13 of 06.01 Main control word (see page 125).	3
	MCW user bit 2	Bit 14 of 06.01 Main control word (see page 125).	4
	MCW user bit 3	Bit 15 of 06.01 Main control word (see page 125).	5
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
06.41	LSU CW user bit 1 selection	(Only visible with a BCU control unit) Selects a binary source whose status is transmitted as bit 13 of 06.39 Internal state machine LSU CW to the supply unit.	MCW user bit 1
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of 06.01 Main control word (see page 125).	2
	MCW user bit 1	Bit 13 of 06.01 Main control word (see page 125).	3
	MCW user bit 2	Bit 14 of 06.01 Main control word (see page 125).	4
	MCW user bit 3	Bit 15 of 06.01 Main control word (see page 125).	5
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
06.42	LSU CW user bit 2 selection	(Only visible with a BCU control unit) Selects a binary source whose status is transmitted as bit 14 of 06.39 Internal state machine LSU CW to the supply unit.	MCW user bit 2
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of 06.01 Main control word (see page 125).	2
	MCW user bit 1	Bit 13 of 06.01 Main control word (see page 125).	3
	MCW user bit 2	Bit 14 of 06.01 Main control word (see page 125).	4
	MCW user bit 3	Bit 15 of 06.01 Main control word (see page 125).	5
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
06.43	LSU CW user bit 3 selection	(Only visible with a BCU control unit) Selects a binary source whose status is transmitted as bit 15 of 06.39 Internal state machine LSU CW to the supply unit.	MCW user bit 3
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of 06.01 Main control word (see page 125).	2
	MCW user bit 1	Bit 13 of 06.01 Main control word (see page 125).	3
	MCW user bit 2	Bit 14 of 06.01 Main control word (see page 125).	4
	MCW user bit 3	Bit 15 of 06.01 Main control word (see page 125).	5
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-

No.	Name/Value	Description	Def/FbEq16
06.45	*Follower CW user bit 0 selection*	Selects a binary source whose status is transmitted as bit 12 of the Follower control word to follower drives. (Bits 0…11 of the Follower control word are taken from *06.01 Main control word*.) See also section *Master/follower functionality* (page *31*).	*MCW user bit 0*
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of *06.01 Main control word* (see page *125*).	2
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *125*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *125*).	4
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *125*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.46	*Follower CW user bit 1 selection*	Selects a binary source whose status is transmitted as bit 13 of the Follower control word to follower drives. (Bits 0…11 of the Follower control word are taken from *06.01 Main control word*.)	*MCW user bit 1*
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of *06.01 Main control word* (see page *125*).	2
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *125*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *125*).	4
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *125*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.47	*Follower CW user bit 2 selection*	Selects a binary source whose status is transmitted as bit 14 of the Follower control word to follower drives. (Bits 0…11 of the Follower control word are taken from *06.01 Main control word*.)	*MCW user bit 2*
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of *06.01 Main control word* (see page *125*).	2
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *125*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *125*).	4
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *125*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.48	*Follower CW user bit 3 selection*	Selects a binary source whose status is transmitted as bit 15 of the Follower control word to follower drives. (Bits 0…11 of the Follower control word are taken from *06.01 Main control word*.)	*MCW user bit 3*
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of *06.01 Main control word* (see page *125*).	2
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *125*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *125*).	4
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *125*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-

No.	Name/Value	Description	*DeflFbEq16*
06.50	*User status word 1*	User-defined status word. This word shows the status of the binary sources selected by parameters *06.60*…*06.75*. This parameter is read-only.	-

Bit	Name	Description
0	User status bit 0	Status of source selected by parameter *06.60*
1	User status bit 1	Status of source selected by parameter *06.61*
…	…	…
15	User status bit 15	Status of source selected by parameter *06.75*

No.	Name/Value	Description	*DeflFbEq16*
	0000h…FFFFh	User-defined status word.	1 = 1
06.60	*User status word 1 bit 0 sel*	Selects a binary source whose status is shown as bit 0 of *06.50 User status word 1*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.61	*User status word 1 bit 1 sel*	Selects a binary source whose status is shown as bit 1 of *06.50 User status word 1*.	*Out of window*
	False	0.	0
	True	1.	1
	Out of window	Bit 3 of *06.19 Speed control status word* (see page *129*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.62	*User status word 1 bit 2 sel*	Selects a binary source whose status is shown as bit 2 of *06.50 User status word 1*.	*Emergency stop failed*
	False	0.	0
	True	1.	1
	Emergency stop failed	Bit 8 of *06.17 Drive status word 2* (see page *127*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.63	*User status word 1 bit 3 sel*	Selects a binary source whose status is shown as bit 3 of *06.50 User status word 1*.	*Magnetized*
	False	0.	0
	True	1.	1
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *127*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.64	*User status word 1 bit 4 sel*	Selects a binary source whose status is shown as bit 4 of *06.50 User status word 1*.	*Run disable*
	False	0.	0
	True	1.	1
	Run disable	Bit 5 of *06.18 Start inhibit status word* (see page *128*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.65	*User status word 1 bit 5 sel*	Selects a binary source whose status is shown as bit 5 of *06.50 User status word 1*.	*False*
	False	0.	0
	True	1.	1

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.66	*User status word 1 bit 6 sel*	Selects a binary source whose status is shown as bit 6 of *06.50 User status word 1*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.67	*User status word 1 bit 7 sel*	Selects a binary source whose status is shown as bit 7 of *06.50 User status word 1*.	*Identification run done*
	False	0.	0
	True	1.	1
	Identification run done	Bit 0 of *06.17 Drive status word 2* (see page *127*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.68	*User status word 1 bit 8 sel*	Selects a binary source whose status is shown as bit 8 of *06.50 User status word 1*.	*Start inhibition*
	False	0.	0
	True	1.	1
	Start inhibition	Bit 7 of *06.18 Start inhibit status word* (see page *128*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.69	*User status word 1 bit 9 sel*	Selects a binary source whose status is shown as bit 9 of *06.50 User status word 1*.	*Limiting*
	False	0.	0
	True	1.	1
	Limiting	Bit 7 of *06.16 Drive status word 1* (see page *126*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.70	*User status word 1 bit 10 sel*	Selects a binary source whose status is shown as bit 10 of *06.50 User status word 1*.	*Torque control*
	False	0.	0
	True	1.	1
	Torque control	Bit 2 of *06.17 Drive status word 2* (see page *127*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.71	*User status word 1 bit 11 sel*	Selects a binary source whose status is shown as bit 11 of *06.50 User status word 1*.	*Zero speed*
	False	0.	0
	True	1.	1
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *129*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.72	*User status word 1 bit 12 sel*	Selects a binary source whose status is shown as bit 12 of *06.50 User status word 1*.	*Internal speed feedback*
	False	0.	0
	True	1.	1
	Internal speed feedback	Bit 4 of *06.19 Speed control status word* (see page *129*).	2

No.	Name/Value	Description	*DefFbEq16*
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.73	*User status word 1 bit 13 sel*	Selects a binary source whose status is shown as bit 13 of *06.50 User status word 1*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.74	*User status word 1 bit 14 sel*	Selects a binary source whose status is shown as bit 14 of *06.50 User status word 1*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.75	*User status word 1 bit 15 sel*	Selects a binary source whose status is shown as bit 15 of *06.50 User status word 1*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
06.100	*User control word 1*	User-defined control word 1.	-

Bit	Name	Description
0	User control word 1 bit 0	User-defined bit.
1	User control word 1 bit 1	User-defined bit.
…	…	…
15	User control word 1 bit 15	User-defined bit.

	0000h…FFFFh	User-defined control word 1.	1 = 1
06.101	*User control word 2*	User-defined control word 2.	-

Bit	Name	Description
0	User control word 2 bit 0	User-defined bit.
1	User control word 2 bit 1	User-defined bit.
…	…	…
15	User control word 2 bit 15	User-defined bit.

	0000h…FFFFh	User-defined control word 2.	1 = 1

07 System info		Information on drive hardware, firmware and application program. All parameters in this group are read-only.	
07.03	*Drive rating id*	Type of the drive/inverter unit.	-
07.04	*Firmware name*	Firmware identification. The format is AINFX, where X denotes the control unit type (2 = BCU-x2, 6 = ZCU-12/14).	-
07.05	*Firmware version*	Version number of the firmware. The format is A.BB.C.D, where A = major version, B = minor version, C = patch (ie. firmware variant code), D = 0.	-

No.	Name/Value	Description	Def/FbEq16
07.06	Loading package name	Name of the firmware loading package. The format is AINLX, where X denotes the control unit type (2 = BCU-x2, 6 = ZCU-12/14).	-
07.07	Loading package version	Version number of the firmware loading package. See parameter 07.05.	-
07.08	Bootloader version	Version number of the firmware bootloader.	-
07.11	Cpu usage	Microprocessor load in percent.	-
	0…100%	Microprocessor load.	1 = 1%
07.13	PU logic version number	Version number of the power unit logic. The value of FFFF indicates that the version numbers of parallel-connected power units are different. See the drive information on the control panel.	-
07.21	Application environment status 1	Shows which tasks of the application program are running. See the *Drive (IEC 61131-3) application programming manual* (3AUA0000127808 [English]).	-

Bit	Name	Description
0	Pre task	1 = Pre-task running.
1	Appl task1	1 = Task 1 running.
2	Appl task2	1 = Task 2 running.
3	Appl task3	1 = Task 3 running.
4…14	Reserved	
15	Task monitoring	1 = Task monitoring enabled.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Application program task status.	1 = 1
07.22	Application environment status 2	Shows the status of the openings in the application program. See the *Drive (IEC 61131-3) application programming manual* (3AUA0000127808 [English]).	-

Bit	Name	Description
0	Opening1	Status of opening 1 in the application program.
1	Opening2	Status of opening 2 in the application program.
…	…	…
15	Opening16	Status of opening 16 in the application program.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Application program opening status.	1 = 1
07.23	Application name	First five ASCII letters of the name given to the application program in the programming tool. The full name is visible under System info on the control panel or the Drive composer PC tool. _N/A_ = None.	-
07.24	Application version	Application program version number given to the application program in the programming tool. Also visible under System info on the control panel or the Drive composer PC tool.	-
07.25	Customization package name	First five ASCII letters of the name given to the customization package. The full name is visible under System info on the control panel or the Drive composer PC tool. _N/A_ = None.	-

No.	Name/Value	Description	*DefFbEq16*
07.26	*Customization package version*	Customization package version number. Also visible under System info on the control panel or the Drive composer PC tool.	-
07.30	*Adaptive program status*	Shows the status of the adaptive program. See section *Adaptive programming* (page *27*).	-

Bit	Name	Description
0	Initialized	1 = Adaptive program initialized
1	Editing	1 = Adaptive program is being edited
2	Edit done	1 = Editing of adaptive program finished
3	Running	1 = Adaptive program running
4…13	Reserved	
14	State changing	1 = State change in progress in adaptive programming engine
15	Faulted	1 = Error in adaptive program

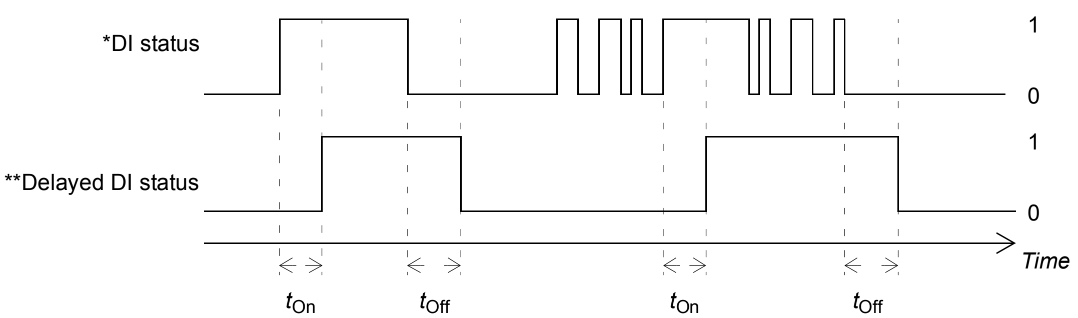
	0000h…FFFFh	Adaptive program status.	1 = 1
07.40	*IEC application Cpu usage peak*	Displays the peak loading of the microprocessor caused by the application program. This parameter can, for example, be used to check the effect of a given application program functionality on the CPU load. The value is in percent of an internally-defined quota. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0.0 … 100.0%	Peak microprocessor loading caused by application program.	10 = 1%
07.41	*IEC application Cpu load average*	Displays the average loading of the microprocessor caused by the application program. The value is in percent of an internally-defined quota.	-
	0.0 … 100.0%	Average microprocessor loading caused by application program.	10 = 1%

10 Standard DI, RO		Configuration of digital inputs and relay outputs.	
10.01	*DI status*	Displays the electrical status of digital inputs DIIL and DI6…DI1. The activation/deactivation delays of the inputs (if any are specified) are ignored. A filtering time can be defined by parameter *10.51 DI filter time*. Bits 0…5 reflect the status of DI1…DI6; bit 15 reflects the status of the DIIL input. **Example:** 1000000000010011b = DIIL, DI5, DI2 and DI1 are on, DI3, DI4 and DI6 are off. This parameter is read-only.	-
	0000h…FFFFh	Status of digital inputs.	1 = 1
10.02	*DI delayed status*	Displays the status of digital inputs DIIL and DI6…DI1. This word is updated only after activation/deactivation delays (if any are specified). Bits 0…5 reflect the delayed status of DI1…DI6; bit 15 reflects the delayed status of the DIIL input. This parameter is read-only.	-
	0000h…FFFFh	Delayed status of digital inputs.	1 = 1

No.	Name/Value	Description	Def/FbEq16
10.03	DI force selection	The electrical statuses of the digital inputs can be overridden for eg. testing purposes. A bit in parameter 10.04 DI force data is provided for each digital input, and its value is applied whenever the corresponding bit in this parameter is 1.	0000h

Bit	Value
0	1 = Force DI1 to value of bit 0 of parameter 10.04 DI force data.
1	1 = Force DI2 to value of bit 1 of parameter 10.04 DI force data.
2	1 = Force DI3 to value of bit 2 of parameter 10.04 DI force data.
3	1 = Force DI4 to value of bit 3 of parameter 10.04 DI force data.
4	1 = Force DI5 to value of bit 4 of parameter 10.04 DI force data.
5	1 = Force DI6 to value of bit 5 of parameter 10.04 DI force data.
6…14	Reserved
15	1 = Force DIIL to value of bit 15 of parameter 10.04 DI force data.

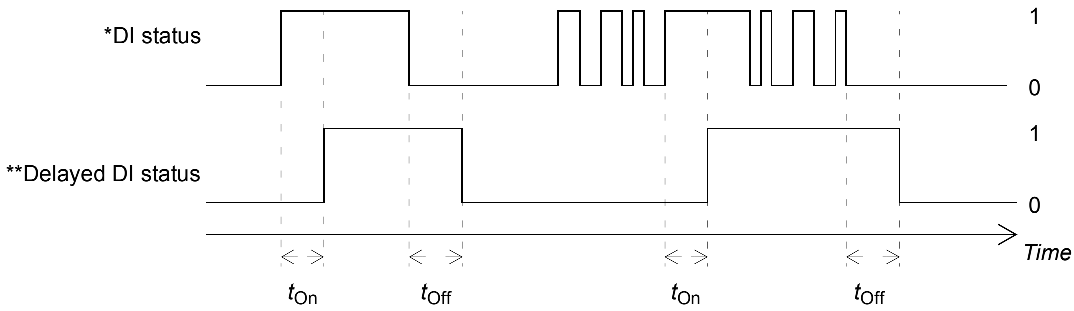
No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Override selection for digital inputs.	1 = 1
10.04	DI force data	Contains the values that the digital inputs are forced to when selected by 10.03 DI force selection. Bit 0 is the forced value for DI1; bit 15 is the forced value for the DIIL input.	0000h
	0000h…FFFFh	Forced values of digital inputs.	1 = 1
10.05	DI1 ON delay	Defines the activation delay for digital input DI1.	0.0 s



t_{On} = 10.05 DI1 ON delay
t_{Off} = 10.06 DI1 OFF delay
*Electrical status of digital input. Indicated by 10.01 DI status.
**Indicated by 10.02 DI delayed status.

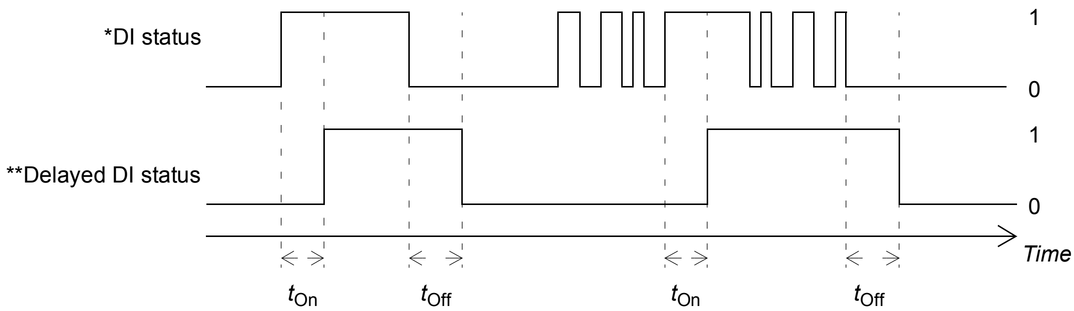
No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for DI1.	10 = 1 s
10.06	DI1 OFF delay	Defines the deactivation delay for digital input DI1. See parameter 10.05 DI1 ON delay.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI1.	10 = 1 s

No.	Name/Value	Description	*DeflFbEq16*
10.07	*DI2 ON delay*	Defines the activation delay for digital input DI2.	0.0 s



t_{On} = *10.07 DI2 ON delay*
t_{Off} = *10.08 DI2 OFF delay*
*Electrical status of digital input. Indicated by *10.01 DI status*.
**Indicated by *10.02 DI delayed status*.

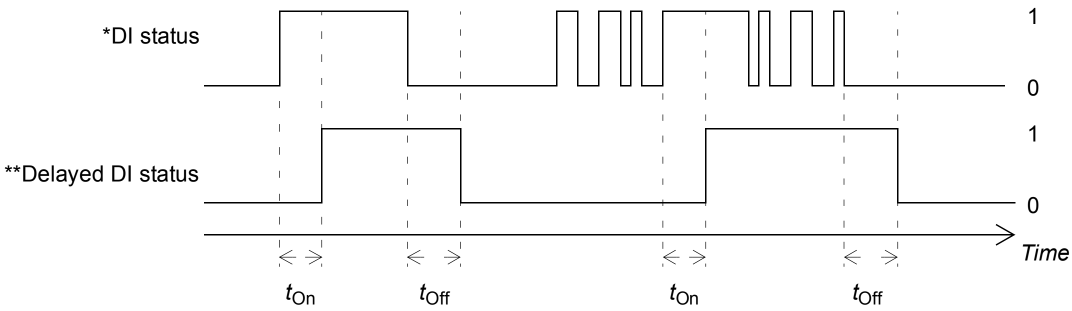
	0.0 … 3000.0 s	Activation delay for DI2.	10 = 1 s
10.08	*DI2 OFF delay*	Defines the deactivation delay for digital input DI2. See parameter *10.07 DI2 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI2.	10 = 1 s
10.09	*DI3 ON delay*	Defines the activation delay for digital input DI3.	0.0 s



t_{On} = *10.09 DI3 ON delay*
t_{Off} = *10.10 DI3 OFF delay*
*Electrical status of digital input. Indicated by *10.01 DI status*.
**Indicated by *10.02 DI delayed status*.

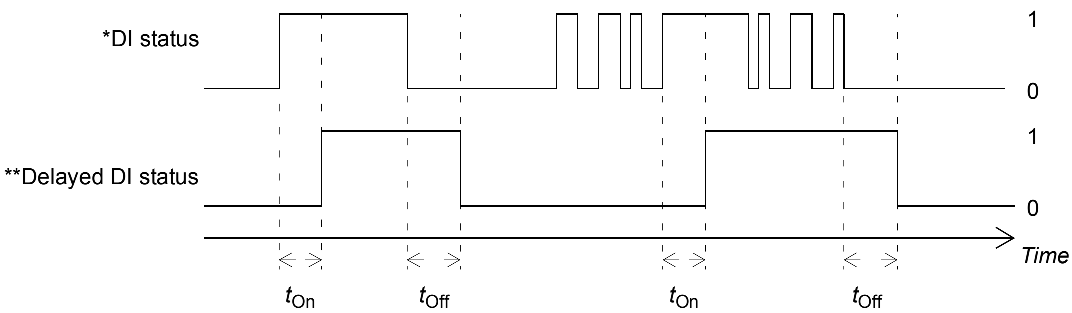
	0.0 … 3000.0 s	Activation delay for DI3.	10 = 1 s
10.10	*DI3 OFF delay*	Defines the deactivation delay for digital input DI3. See parameter *10.09 DI3 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI3.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
10.11	DI4 ON delay	Defines the activation delay for digital input DI4.	0.0 s



t_{On} = *10.11 DI4 ON delay*
t_{Off} = *10.12 DI4 OFF delay*
*Electrical status of digital input. Indicated by *10.01 DI status*.
**Indicated by *10.02 DI delayed status*.

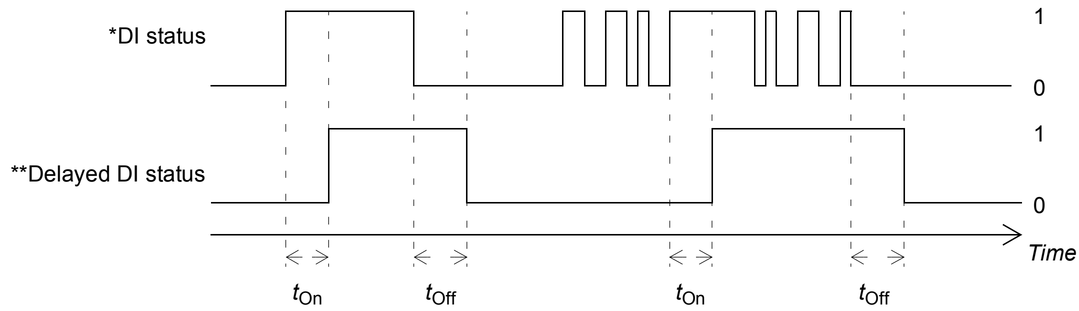
No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for DI4.	10 = 1 s
10.12	DI4 OFF delay	Defines the deactivation delay for digital input DI4. See parameter *10.11 DI4 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI4.	10 = 1 s
10.13	DI5 ON delay	Defines the activation delay for digital input DI5.	0.0 s



t_{On} = *10.13 DI5 ON delay*
t_{Off} = *10.14 DI5 OFF delay*
*Electrical status of digital input. Indicated by *10.01 DI status*.
**Indicated by *10.02 DI delayed status*.

No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for DI5.	10 = 1 s
10.14	DI5 OFF delay	Defines the deactivation delay for digital input DI5. See parameter *10.13 DI5 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI5.	10 = 1 s

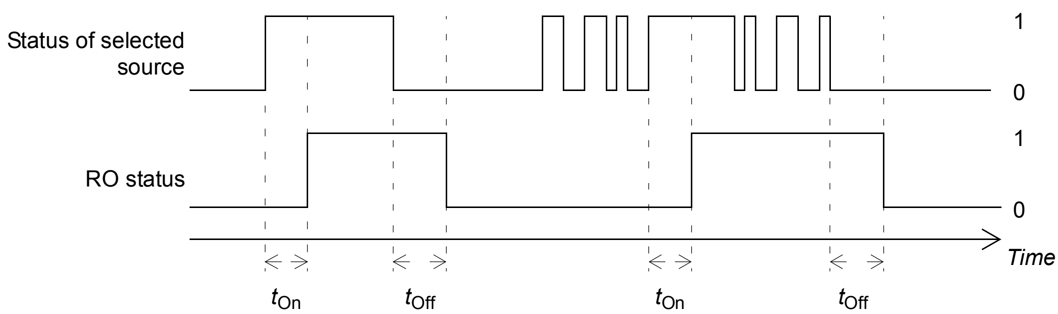
No.	Name/Value	Description	*DeflFbEq16*
10.15	*DI6 ON delay*	Defines the activation delay for digital input DI6.	0.0 s



t_{On} = *10.15 DI6 ON delay*
t_{Off} = *10.16 DI6 OFF delay*
*Electrical status of digital input. Indicated by *10.01 DI status*.
**Indicated by *10.02 DI delayed status*.

No.	Name/Value	Description	*DeflFbEq16*
	0.0 … 3000.0 s	Activation delay for DI6.	10 = 1 s
10.16	*DI6 OFF delay*	Defines the deactivation delay for digital input DI6. See parameter *10.15 DI6 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI6.	10 = 1 s
10.21	*RO status*	Status of relay outputs RO8…RO1. **Example:** 00000001b = RO1 is energized, RO2…RO8 are de-energized.	-
	0000h…FFFFh	Status of relay outputs.	1 = 1
10.24	*RO1 source*	Selects a drive signal to be connected to relay output RO1.	*Ready run*; *10.01* b3 (-1) (*95.20* b2); *35.105* b1 (*95.20* b6); *06.16* b6 (*95.20* b9)
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *126*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *126*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *126*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *127*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *126*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *126*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *126*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *129*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *129*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *127*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *126*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *126*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *126*).	15
	Open brake command	Bit 0 of *44.01 Brake control status* (see page *309*).	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *126*).	23

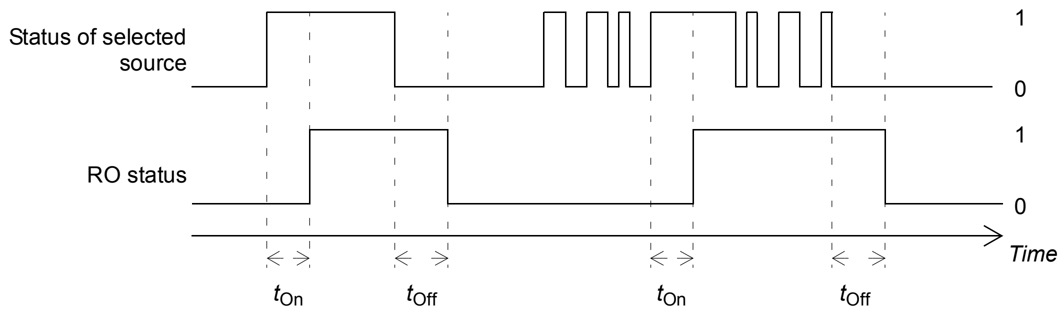
No.	Name/Value	Description	*Def/FbEq16*
	Remote control	Bit 9 of *06.11 Main status word* (see page *126*).	24
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *265*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *265*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *265*).	35
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *146*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *146*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *146*).	42
	RO/DIO control word bit8	Bit 8 of *10.99 RO/DIO control word* (see page *146*).	43
	RO/DIO control word bit9	Bit 9 of *10.99 RO/DIO control word* (see page *146*).	44
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
10.25	*RO1 ON delay*	Defines the activation delay for relay output RO1.	0.0 s



t_{On} = *10.25 RO1 ON delay*
t_{Off} = *10.26 RO1 OFF delay*

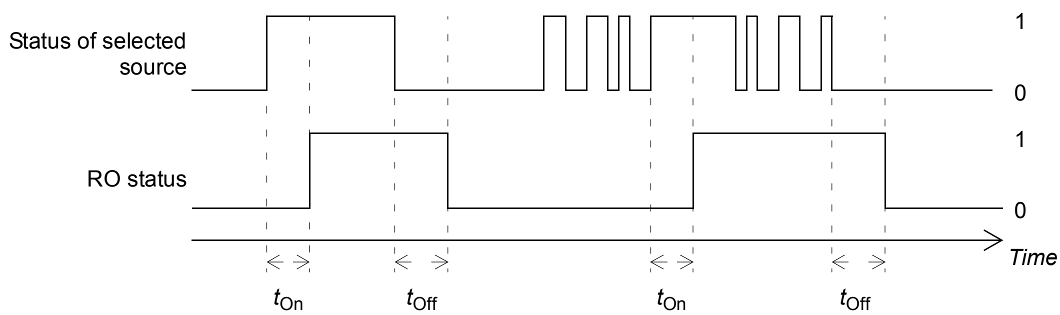
No.	Name/Value	Description	*Def/FbEq16*
	0.0 … 3000.0 s	Activation delay for RO1.	10 = 1 s
10.26	*RO1 OFF delay*	Defines the deactivation delay for relay output RO1. See parameter *10.25 RO1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO1.	10 = 1 s
10.27	*RO2 source*	Selects a drive signal to be connected to relay output RO2. For the available selections, see parameter *10.24 RO1 source*.	*Running* (*95.20* b3)

No.	Name/Value	Description	Def/FbEq16
10.28	*RO2 ON delay*	Defines the activation delay for relay output RO2.	0.0 s (*95.20* b3)



t_{On} = *10.28 RO2 ON delay*
t_{Off} = *10.29 RO2 OFF delay*

No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for RO2.	10 = 1 s
10.29	*RO2 OFF delay*	Defines the deactivation delay for relay output RO2. See parameter *10.28 RO2 ON delay*.	0.0 s (*95.20* b3)
	0.0 … 3000.0 s	Deactivation delay for RO2.	10 = 1 s
10.30	*RO3 source*	Selects a drive signal to be connected to relay output RO3. For the available selections, see parameter *10.24 RO1 source*.	*Fault (-1)*
10.31	*RO3 ON delay*	Defines the activation delay for relay output RO3.	0.0 s



t_{On} = *10.31 RO3 ON delay*
t_{Off} = *10.32 RO3 OFF delay*

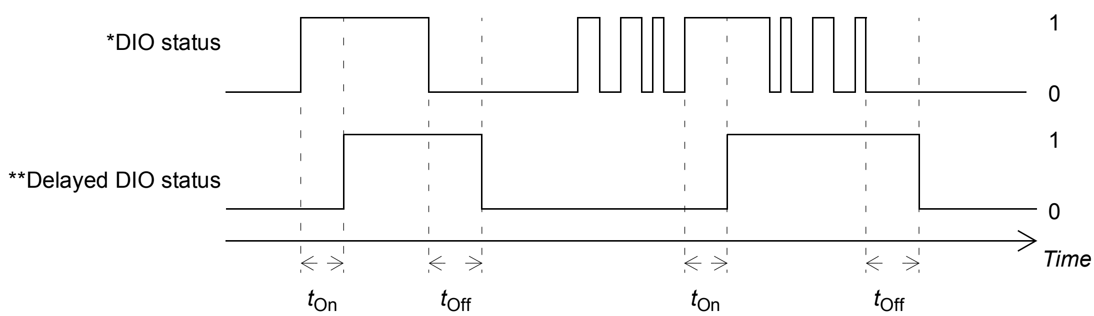
No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for RO3.	10 = 1 s
10.32	*RO3 OFF delay*	Defines the deactivation delay for relay output RO3. See parameter *10.31 RO3 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO3.	10 = 1 s
10.51	*DI filter time*	Defines a filtering time for parameter *10.01 DI status*.	10.0 ms
	0.3 … 100.0 ms	Filtering time for *10.01*.	10 = 1 ms

No.	Name/Value	Description	Def/FbEq16
10.99	*RO/DIO control word*	Storage parameter for controlling the relay outputs and digital input/outputs eg. through the embedded fieldbus interface. To control the relay outputs (RO) and the digital input/outputs (DIO) of the drive, send a control word with the bit assignments shown below as Modbus I/O data. Set the target selection parameter of that particular data (*58.101*…*58.124*) to *RO/DIO control word*. In the source selection parameter of the desired output, select the appropriate bit of this word.	0000h

Bit	Name	Description
0	RO1	Source bits for relay outputs RO1…RO3 (see parameters *10.24*, *10.27* and *10.30*).
1	RO2	
2	RO3	
3…7	Reserved	
8	DIO1	Source bits for digital input/outputs DIO1…DIO3 (see parameters *11.06* and *11.10*).
9	DIO2	
10…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	RO/DIO control word.	1 = 1
11 Standard DIO, FI, FO		Configuration of digital input/outputs and frequency inputs/outputs.	
11.01	*DIO status*	Displays the status of digital input/outputs DIO2 and DIO1. The activation/deactivation delays (if any are specified) are ignored. A filtering time (for input mode) can be defined by parameter *10.51 DI filter time*. **Example:** 0010 = DIO2 is on, DIO1 is off. This parameter is read-only.	-
	0000b…0011b	Status of digital input/outputs.	1 = 1
11.02	*DIO delayed status*	Displays the delayed status of digital input/outputs DIO2 and DIO1. This word is updated only after activation/deactivation delays (if any are specified). **Example:** 0010 = DIO2 is on, DIO1 is off. This parameter is read-only.	-
	0000b…0011b	Delayed status of digital input/outputs.	1 = 1
11.05	*DIO1 function*	Selects whether DIO1 is used as a digital output or input, or a frequency input.	*Output*
	Output	DIO1 is used as a digital output.	0
	Input	DIO1 is used as a digital input.	1
	Frequency	DIO1 is used as a frequency input.	2
11.06	*DIO1 output source*	Selects a drive signal to be connected to digital input/output DIO1 when parameter *11.05 DIO1 function* is set to *Output*.	*Ready run*
	Not energized	Output is off.	0
	Energized	Output is on.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *126*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *126*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *126*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *127*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *126*).	7

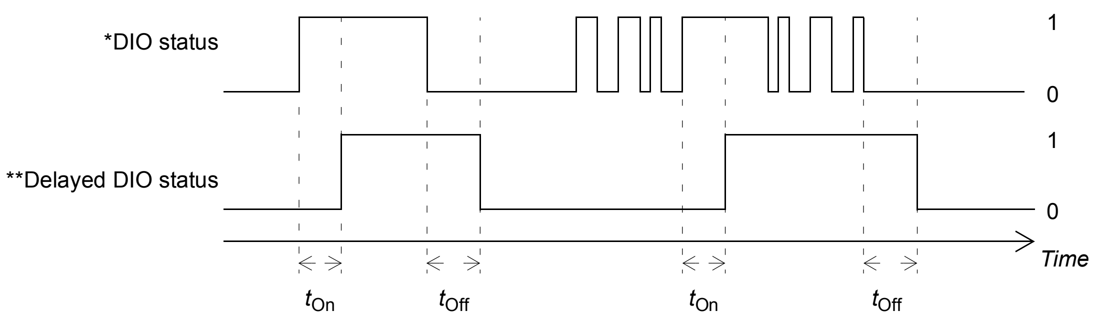
No.	Name/Value	Description	*DefFbEq16*
	Ready ref	Bit 2 of *06.11 Main status word* (see page *126*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *126*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *129*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *129*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *127*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *126*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *126*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *126*).	15
	Open brake command	Bit 0 of *44.01 Brake control status* (see page *309*).	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *126*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *126*).	24
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *265*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *265*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *265*).	35
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *146*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *146*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *146*).	42
	RO/DIO control word bit8	Bit 8 of *10.99 RO/DIO control word* (see page *146*).	43
	RO/DIO control word bit9	Bit 9 of *10.99 RO/DIO control word* (see page *146*).	44
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
11.07	*DIO1 ON delay*	Defines the activation delay for digital input/output DIO1 (when used as a digital output or digital input).	0.0 s



t_{On} = *11.07 DIO1 ON delay*
t_{Off} = *11.08 DIO1 OFF delay*
*Electrical status of DIO (in input mode) or status of selected source (in output mode). Indicated by *11.01 DIO status*.
**Indicated by *11.02 DIO delayed status*.

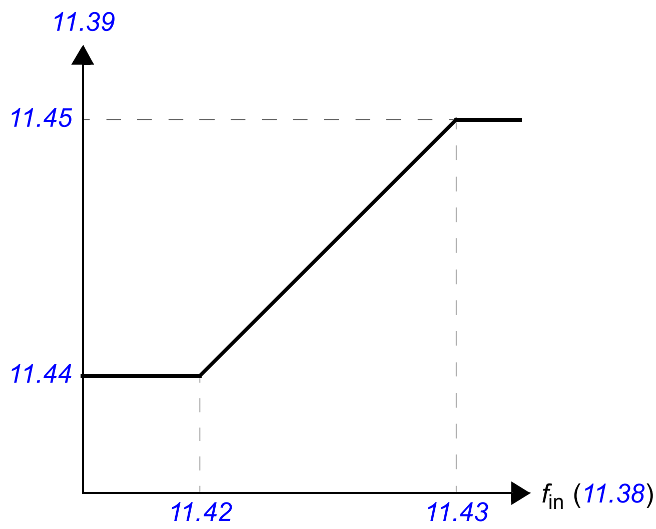
	0.0 … 3000.0 s	Activation delay for DIO1.	10 = 1 s
11.08	*DIO1 OFF delay*	Defines the deactivation delay for digital input/output DIO1 (when used as a digital output or digital input). See parameter *11.07 DIO1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DIO1.	10 = 1 s

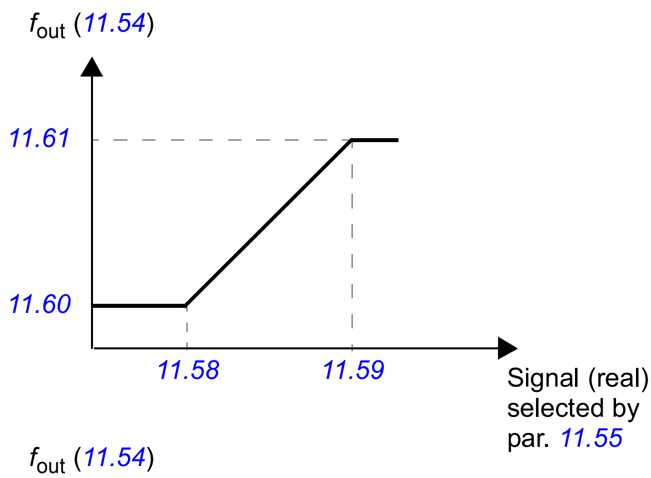
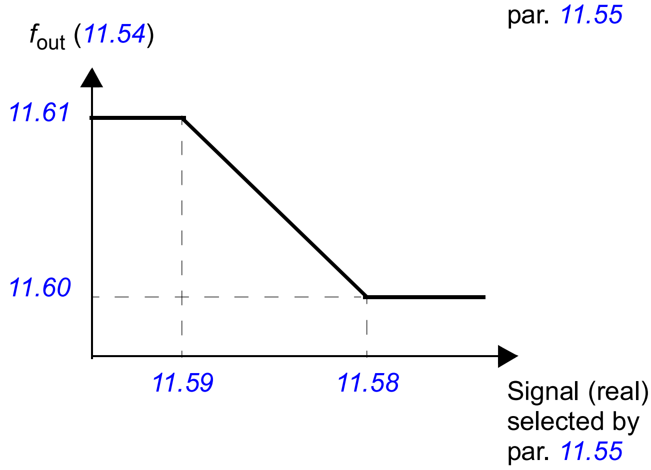
No.	Name/Value	Description	*Def/FbEq16*
11.09	*DIO2 function*	Selects whether DIO2 is used as a digital output or input, or a frequency output.	*Output*
	Output	DIO2 is used as a digital output.	0
	Input	DIO2 is used as a digital input.	1
	Frequency	DIO2 is used as a frequency output.	2
11.10	*DIO2 output source*	Selects a drive signal to be connected to digital input/output DIO2 when parameter *11.09 DIO2 function* is set to *Output*. For the available selections, see parameter *11.06 DIO1 output source*.	*Running*
11.11	*DIO2 ON delay*	Defines the activation delay for digital input/output DIO2 (when used as a digital output or digital input).	0.0 s



t_{On} = *11.11 DIO2 ON delay*
t_{Off} = *11.12 DIO2 OFF delay*
*Electrical status of DIO (in input mode) or status of selected source (in output mode). Indicated by *11.01 DIO status*.
**Indicated by *11.02 DIO delayed status*.

No.	Name/Value	Description	*Def/FbEq16*
	0.0 … 3000.0 s	Activation delay for DIO2.	10 = 1 s
11.12	*DIO2 OFF delay*	Defines the deactivation delay for digital input/output DIO2 (when used as a digital output or digital input). See parameter *11.11 DIO2 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DIO2.	10 = 1 s
11.38	*Freq in 1 actual value*	Displays the value of frequency input 1 (via DIO1 when it is used as a frequency input) before scaling. See parameter *11.42 Freq in 1 min*. This parameter is read-only.	-
	0 … 16000 Hz	Unscaled value of frequency input 1.	1 = 1 Hz
11.39	*Freq in 1 scaled*	Displays the value of frequency input 1 (via DIO1 when it is used as a frequency input) after scaling. See parameter *11.42 Freq in 1 min*. This parameter is read-only.	-
	-32768.000 … 32767.000	Scaled value of frequency input 1.	1 = 1

No.	**Name/Value**	**Description**	***Def/FbEq16***
11.42	*Freq in 1 min*	Defines the minimum for the frequency actually arriving at frequency input 1 (DIO1 when it is used as a frequency input). The incoming frequency signal (*11.38 Freq in 1 actual value*) is scaled into an internal signal (*11.39 Freq in 1 scaled*) by parameters *11.42*…*11.45* as follows:  	0 Hz
	0 … 16000 Hz	Minimum frequency of frequency input 1 (DIO1).	1 = 1 Hz
11.43	*Freq in 1 max*	Defines the maximum for the frequency actually arriving at frequency input 1 (DIO1 when it is used as a frequency input). See parameter *11.42 Freq in 1 min*.	16000 Hz
	0 … 16000 Hz	Maximum frequency for frequency input 1 (DIO1).	1 = 1 Hz
11.44	*Freq in 1 at scaled min*	Defines the value that is required to correspond internally to the minimum input frequency defined by parameter *11.42 Freq in 1 min*. See diagram at parameter *11.42 Freq in 1 min*.	0.000
	-32768.000 … 32767.000	Value corresponding to minimum of frequency input 1.	1 = 1
11.45	*Freq in 1 at scaled max*	Defines the value that is required to correspond internally to the maximum input frequency defined by parameter *11.43 Freq in 1 max*. See diagram at parameter *11.42 Freq in 1 min*.	1500.000; 1800.000 (*95.20* b0)
	-32768.000 … 32767.000	Value corresponding to maximum of frequency input 1.	1 = 1
11.54	*Freq out 1 actual value*	Displays the value of frequency output 1 after scaling. See parameter *11.58 Freq out 1 src min*. This parameter is read-only.	-
	0 … 16000 Hz	Value of frequency output 1.	1 = 1
11.55	*Freq out 1 source*	Selects a signal to be connected to frequency output 1.	*Motor speed used*
	Zero	None.	0
	Motor speed used	*01.01 Motor speed used* (page *113*).	1
	Output frequency	*01.06 Output frequency* (page *113*).	3
	Motor current	*01.07 Motor current* (page *113*).	4
	Motor torque	*01.10 Motor torque* (page *113*).	6
	DC voltage	*01.11 DC voltage* (page *113*).	7
	Power inu out	*01.14 Output power* (page *114*).	8

No.	Name/Value	Description	Def/FbEq16
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *212*).	10
	Speed ref ramped	*23.02 Speed ref ramp output* (page *212*).	11
	Speed ref used	*24.01 Used speed reference* (page *218*).	12
	Torq ref used	*26.02 Torque reference used* (page *234*).	13
	Freq ref used	*28.02 Frequency ref ramp output* (page *240*).	14
	Process PID out	*40.01 Process PID output actual* (page *293*).	16
	Process PID fbk	*40.02 Process PID feedback actual* (page *293*).	17
	Process PID act	*40.03 Process PID setpoint actual* (page *293*).	18
	Process PID dev	*40.04 Process PID deviation actual* (page *293*).	19
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
11.58	*Freq out 1 src min*	Defines the real value of the signal (selected by parameter *11.55 Freq out 1 source* and shown by parameter *11.54 Freq out 1 actual value*) that corresponds to the minimum value of frequency output 1 (defined by parameter *11.60 Freq out 1 at src min*).   	0.000
	-32768.000 … 32767.000	Real signal value corresponding to minimum value of frequency output 1.	1 = 1
11.59	*Freq out 1 src max*	Defines the real value of the signal (selected by parameter *11.55 Freq out 1 source* and shown by parameter *11.54 Freq out 1 actual value*) that corresponds to the maximum value of frequency output 1 (defined by parameter *11.61 Freq out 1 at src max*). See parameter *11.58 Freq out 1 src min*.	1500.000; 1800.000 (*95.20* b0)
	-32768.000 … 32767.000	Real signal value corresponding to maximum value of frequency output 1.	1 = 1

No.	Name/Value	Description	DeflFbEq16
11.60	*Freq out 1 at src min*	Defines the minimum value of frequency output 1. See diagrams at parameter *11.58 Freq out 1 src min*.	0 Hz
	0…16000 Hz	Minimum value of frequency output 1.	1 = 1 Hz
11.61	*Freq out 1 at src max*	Defines the maximum value of frequency output 1. See diagrams at parameter *11.58 Freq out 1 src min*.	16000 Hz
	0…16000 Hz	Maximum value of frequency output 1.	1 = 1 Hz
11.81	*DIO filter time*	Defines a filtering time for parameter *11.01 DIO status*. The filtering time will only affect the DIOs that are in input mode.	10.0 ms
	0.3 … 100.0 ms	Filtering time for *11.01*.	10 = 1 ms

12 Standard AI		Configuration of standard analog inputs.	
12.01	*AI tune*	Triggers the analog input tuning function. Connect the signal to the input and select the appropriate tuning function.	
	No action	AI tune is not activated.	0
	AI1 min tune	Current analog input AI1 signal value is set as minimum value of AI1 into parameter *12.17 AI1 min*. The value reverts back to *No action* automatically.	1
	AI1 max tune	Current analog input AI1 signal value is set as maximum value of AI1 into parameter *12.18 AI1 max*. The value reverts back to *No action* automatically.	2
	AI2 min tune	Current analog input AI2 signal value is set as minimum value of AI2 into parameter *12.27 AI2 min*. The value reverts back to *No action* automatically.	3
	AI2 max tune	Current analog input AI2 signal value is set as maximum value of AI2 into parameter *12.28 AI2 max*. The value reverts back to *No action* automatically.	4
12.03	*AI supervision function*	Selects how the drive reacts when an analog input signal moves out of the minimum and/or maximum limits specified for the input. The supervision applies a margin of 0.5 V or 1.0 mA to the limits. For example, if the maximum limit for the input is 7.000 V, the maximum limit supervision activates at 7.500 V. The inputs and the limits to be observed are selected by parameter *12.04 AI supervision selection*. **Note:** Analog input signal supervision is only active when • the analog input is set as the source (using the *AI1 scaled* or *AI2 scaled* selection) in parameter *22.11*, *22.12*, *22.15*, *22.17*, *23.42*, *26.11*, *26.12*, *26.16*, *26.25*, *28.11*, *28.12*, *30.21*, *30.22*, *40.16*, *40.17*, *40.50*, *41.16*, *41.17*, *41.50* or *44.09*, and is being used as the active source, or • supervision is forced using parameter *12.05 AI supervision force*.	*No action*
	No action	No action taken.	0
	Fault	Drive trips on *80A0 AI supervision*.	1
	Warning	Drive generates an *A8A0 AI supervision* warning.	2
	Last speed	Drive generates a warning (*A8A0 AI supervision*) and freezes the speed (or frequency) to the level the drive was operating at. The speed/frequency is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3

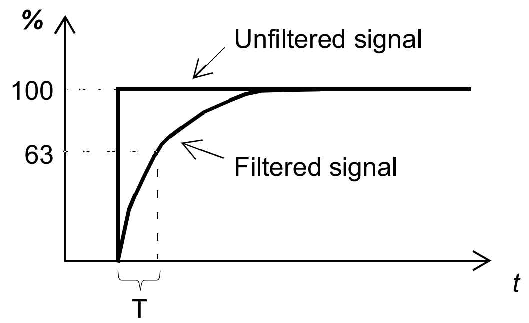
No.	Name/Value	Description	Def/FbEq16
	Speed ref safe	Drive generates a warning (*A8A0 AI supervision*) and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	4
12.04	*AI supervision selection*	Specifies the analog input limits to be supervised. See parameter *12.03 AI supervision function*.	0000b

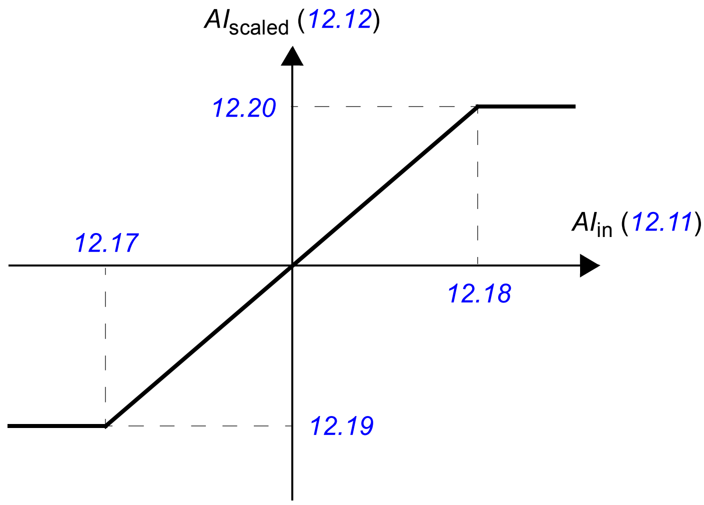
Bit	Name	Description
0	AI1 < MIN	1 = Minimum limit supervision of AI1 active.
1	AI1 > MAX	1 = Maximum limit supervision of AI1 active.
2	AI2 < MIN	1 = Minimum limit supervision of AI2 active.
3	AI2 > MAX	1 = Maximum limit supervision of AI2 active.
4…15	Reserved	

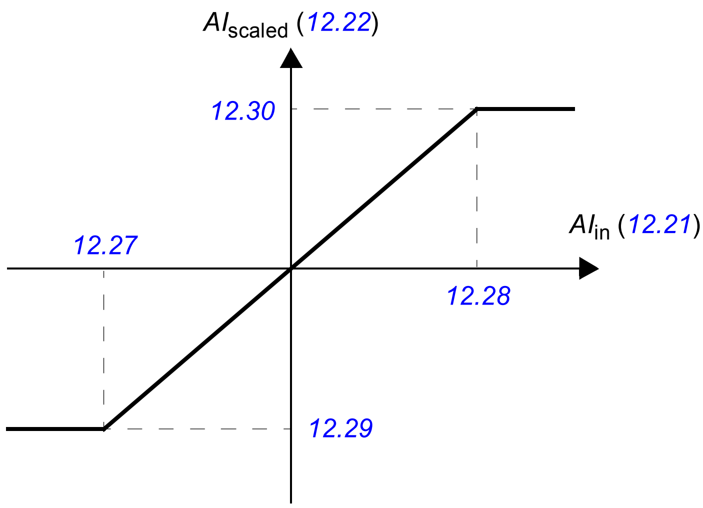
No.	Name/Value	Description	Def/FbEq16
	0000b…1111b	Activation of analog input supervision.	1 = 1
12.05	*AI supervision force*	Activates analog input supervision separately for each control location (see section *Local control vs. external control* on page *20*). The parameter is primarily intended for analog input supervision when the input is connected to the application program and not selected as a control source by drive parameters.	0000 0000b

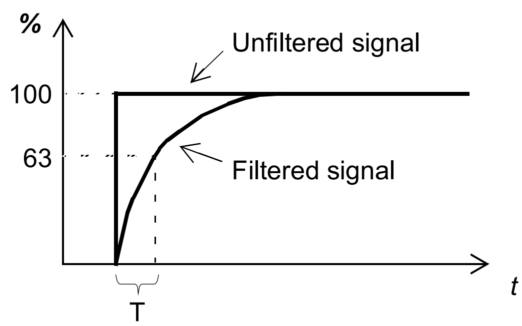
Bit	Name	Description
0	AI1 Ext1	1 = AI1 supervision active when EXT1 is being used.
1	AI1 Ext2	1 = AI1 supervision active when EXT2 is being used.
2	AI1 Local	1 = AI1 supervision active when local control is being used.
3	Reserved	
4	AI2 Ext1	1 = AI2 supervision active when EXT1 is being used.
5	AI2 Ext2	1 = AI2 supervision active when EXT2 is being used.
6	AI2 Local	1 = AI2 supervision active when local control is being used.
7…15	Reserved	

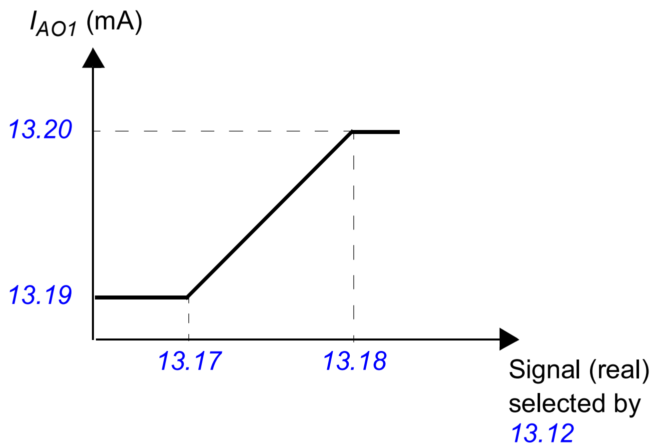
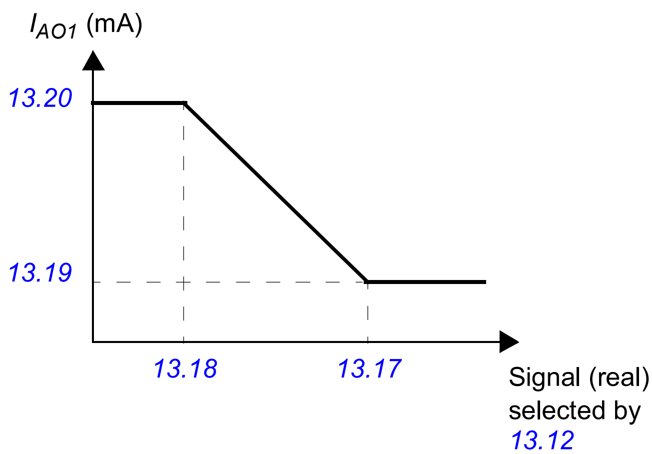
No.	Name/Value	Description	Def/FbEq16
	0000 0000b … 0111 0111b	Analog input supervision selection.	1 = 1
12.11	*AI1 actual value*	Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). This parameter is read-only.	-
	-22.000 … 22.000 mA or V	Value of analog input AI1.	1000 = 1 mA or V
12.12	*AI1 scaled value*	Displays the value of analog input AI1 after scaling. See parameters *12.19 AI1 scaled at AI1 min* and *12.20 AI1 scaled at AI1 max*. This parameter is read-only.	-
	-32768.000 … 32767.000	Scaled value of analog input AI1.	1 = 1

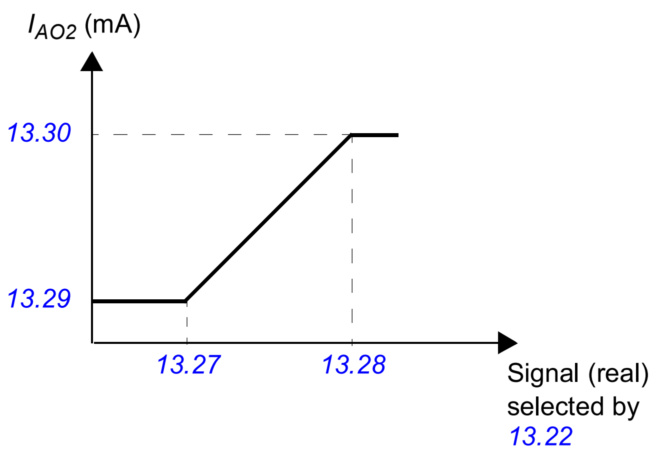
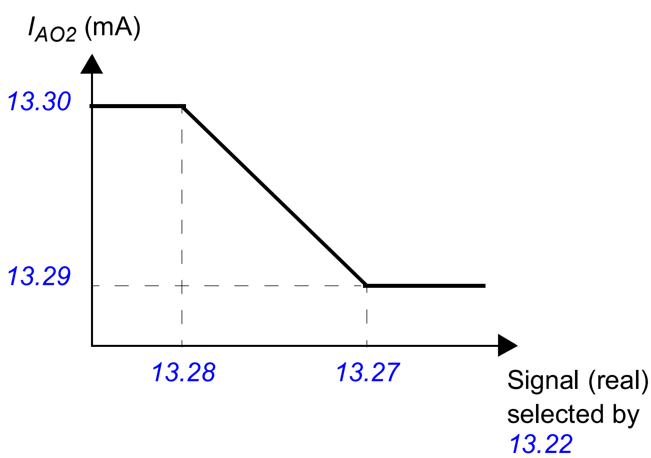
No.	Name/Value	Description	*Def/FbEq16*
12.15	*AI1 unit selection*	Selects the unit for readings and settings related to analog input AI1. **Note:** This setting must match the corresponding hardware setting on the drive control unit (see the hardware manual of the drive). Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.	*V*
	V	Volts.	2
	mA	Milliamperes.	10
12.16	*AI1 filter time*	Defines the filter time constant for analog input AI1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant **Note:** The signal is also filtered due to the signal interface hardware (approximately 0.25 ms time constant). This cannot be changed by any parameter.	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s
12.17	*AI1 min*	Defines the minimum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting. See also parameter *12.01 AI tune*.	0.000 mA or V
	-22.000 … 22.000 mA or V	Minimum value of AI1.	1000 = 1 mA or V
12.18	*AI1 max*	Defines the maximum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting. See also parameter *12.01 AI tune*.	20.000 mA or 10.000 V
	-22.000 … 22.000 mA or V	Maximum value of AI1.	1000 = 1 mA or V

No.	Name/Value	Description	Def/FbEq16
12.19	*AI1 scaled at AI1 min*	Defines the real internal value that corresponds to the minimum analog input AI1 value defined by parameter *12.17 AI1 min*. (Changing the polarity settings of *12.19* and *12.20* can effectively invert the analog input.)  	0.000
	-32768.000 … 32767.000	Real value corresponding to minimum AI1 value.	1 = 1
12.20	*AI1 scaled at AI1 max*	Defines the real internal value that corresponds to the maximum analog input AI1 value defined by parameter *12.18 AI1 max*. See the drawing at parameter *12.19 AI1 scaled at AI1 min*.	1500.000; 1800.000 (*95.20* b0)
	-32768.000 … 32767.000	Real value corresponding to maximum AI1 value.	1 = 1
12.21	*AI2 actual value*	Displays the value of analog input AI2 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). This parameter is read-only.	-
	-22.000 … 22.000 mA or V	Value of analog input AI2.	1000 = 1 mA or V
12.22	*AI2 scaled value*	Displays the value of analog input AI2 after scaling. See parameters *12.29 AI2 scaled at AI2 min* and *12.30 AI2 scaled at AI2 max*. This parameter is read-only.	-
	-32768.000 … 32767.000	Scaled value of analog input AI2.	1 = 1
12.25	*AI2 unit selection*	Selects the unit for readings and settings related to analog input AI2. **Note:** This setting must match the corresponding hardware setting on the drive control unit (see the hardware manual of the drive). Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.	*mA*
	V	Volts.	2
	mA	Milliamperes.	10
12.26	*AI2 filter time*	Defines the filter time constant for analog input AI2. See parameter *12.16 AI1 filter time*.	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

No.	Name/Value	Description	*DefIFbEq16*
12.27	*AI2 min*	Defines the minimum site value for analog input AI2. Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting. See also parameter *12.01 AI tune*.	0.000 mA or V
	-22.000 … 22.000 mA or V	Minimum value of AI2.	1000 = 1 mA or V
12.28	*AI2 max*	Defines the maximum site value for analog input AI2. Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting. See also parameter *12.01 AI tune*.	20.000 mA or 10.000 V
	-22.000 … 22.000 mA or V	Maximum value of AI2.	1000 = 1 mA or V
12.29	*AI2 scaled at AI2 min*	Defines the real value that corresponds to the minimum analog input AI2 value defined by parameter *12.27 AI2 min*. (Changing the polarity settings of *12.29* and *12.30* can effectively invert the analog input.) 	0.000
	-32768.000 … 32767.000	Real value corresponding to minimum AI2 value.	1 = 1
12.30	*AI2 scaled at AI2 max*	Defines the real value that corresponds to the maximum analog input AI2 value defined by parameter *12.28 AI2 max*. See the drawing at parameter *12.29 AI2 scaled at AI2 min*.	100.000
	-32768.000 … 32767.000	Real value corresponding to maximum AI2 value.	1 = 1
13 Standard AO		Configuration of standard analog outputs.	
13.11	*AO1 actual value*	Displays the value of AO1 in mA. This parameter is read-only.	-
	0.000 … 22.000 mA	Value of AO1.	1000 = 1 mA
13.12	*AO1 source*	Selects a signal to be connected to analog output AO1. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor.	*Motor speed used*
	Zero	None.	0
	Motor speed used	*01.01 Motor speed used* (page *113*).	1
	Output frequency	*01.06 Output frequency* (page *113*).	3
	Motor current	*01.07 Motor current* (page *113*).	4

No.	Name/Value	Description	Def/FbEq16
	Motor torque	*01.10 Motor torque* (page *113*).	6
	DC voltage	*01.11 DC voltage* (page *113*).	7
	Power inu out	*01.14 Output power* (page *114*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *212*).	10
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *212*).	11
	Speed ref used	*24.01 Used speed reference* (page *218*).	12
	Torq ref used	*26.02 Torque reference used* (page *234*).	13
	Freq ref used	*28.02 Frequency ref ramp output* (page *240*).	14
	Process PID out	*40.01 Process PID output actual* (page *293*).	16
	Process PID fbk	*40.02 Process PID feedback actual* (page *293*).	17
	Process PID act	*40.03 Process PID setpoint actual* (page *293*).	18
	Process PID dev	*40.04 Process PID deviation actual* (page *293*).	19
	Force Pt100 excitation	The output is used to feed an excitation current to 1…3 Pt100 sensors. See section *Motor thermal protection* (page *78*).	20
	Force KTY84 excitation	The output is used to feed an excitation current to a KTY84 sensor. See section *Motor thermal protection* (page *78*).	21
	Force PTC excitation	The output is used to feed an excitation current to 1…3 PTC sensors. See section *Motor thermal protection* (page *78*).	22
	Force Pt1000 excitation	The output is used to feed an excitation current to 1…3 Pt1000 sensors. See section *Motor thermal protection* (page *78*).	23
	AO1 data storage	*13.91 AO1 data storage* (page *159*).	37
	AO2 data storage	*13.92 AO2 data storage* (page *159*).	38
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
13.16	*AO1 filter time*	Defines the filtering time constant for analog output AO1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

No.	Name/Value	Description	*DeflFbEq16*
13.17	*AO1 source min*	Defines the real minimum value of the signal (selected by parameter *13.12 AO1 source*) that corresponds to the minimum required AO1 output value (defined by parameter *13.19 AO1 out at AO1 src min*).  Programming *13.17* as the maximum value and *13.18* as the minimum value inverts the output.  	0.0
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO1 output value.	1 = 1
13.18	*AO1 source max*	Defines the real maximum value of the signal (selected by parameter *13.12 AO1 source*) that corresponds to the maximum required AO1 output value (defined by parameter *13.20 AO1 out at AO1 src max*). See parameter *13.17 AO1 source min*.	1500.0; 1800.0 (*95.20* b0)
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO1 output value.	1 = 1
13.19	*AO1 out at AO1 src min*	Defines the minimum output value for analog output AO1. See also drawing at parameter *13.17 AO1 source min*.	0.000 mA
	0.000 … 22.000 mA	Minimum AO1 output value.	1000 = 1 mA
13.20	*AO1 out at AO1 src max*	Defines the maximum output value for analog output AO1. See also drawing at parameter *13.17 AO1 source min*.	20.000 mA
	0.000 … 22.000 mA	Maximum AO1 output value.	1000 = 1 mA

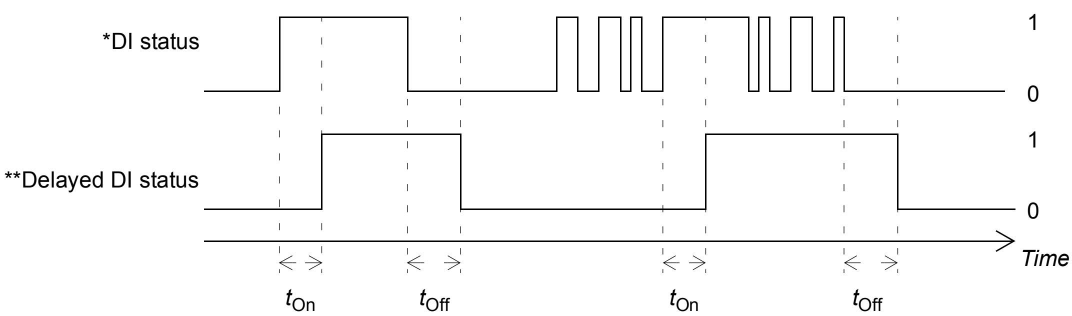
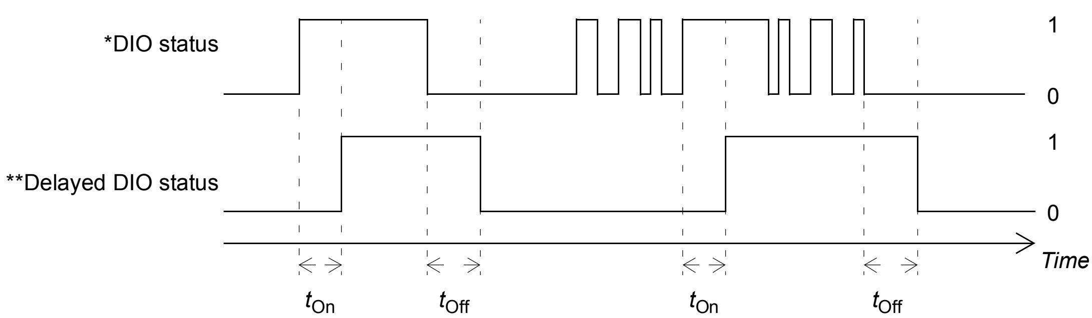
No.	Name/Value	Description	Def/FbEq16
13.21	AO2 actual value	Displays the value of AO2 in mA. This parameter is read-only.	-
	0.000 … 22.000 mA	Value of AO2.	1000 = 1 mA
13.22	AO2 source	Selects a signal to be connected to analog output AO2. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor. For the selections, see parameter 13.12 AO1 source.	Motor current
13.26	AO2 filter time	Defines the filtering time constant for analog output AO2. See parameter 13.16 AO1 filter time.	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s
13.27	AO2 source min	Defines the real minimum value of the signal (selected by parameter 13.22 AO2 source) that corresponds to the minimum required AO2 output value (defined by parameter 13.29 AO2 out at AO2 src min).  Programming 13.27 as the maximum value and 13.28 as the minimum value inverts the output. 	0.0
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO2 output value.	1 = 1

No.	Name/Value	Description	*Def/FbEq16*
13.28	*AO2 source max*	Defines the real maximum value of the signal (selected by parameter *13.22 AO2 source*) that corresponds to the maximum required AO2 output value (defined by parameter *13.30 AO2 out at AO2 src max*). See parameter *13.27 AO2 source min*.	100.0
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO2 output value.	1 = 1
13.29	*AO2 out at AO2 src min*	Defines the minimum output value for analog output AO2. See also drawing at parameter *13.27 AO2 source min*.	0.000 mA
	0.000 … 22.000 mA	Minimum AO2 output value.	1000 = 1 mA
13.30	*AO2 out at AO2 src max*	Defines the maximum output value for analog output AO2. See also drawing at parameter *13.27 AO2 source min*.	20.000 mA
	0.000 … 22.000 mA	Maximum AO2 output value.	1000 = 1 mA
13.91	*AO1 data storage*	Storage parameter for controlling analog output AO1 eg. through fieldbus. In *13.12 AO1 source*, select *AO1 data storage*. Then set this parameter as the target of the incoming value data. With the embedded fieldbus interface, simply set the target selection parameter of that particular data (*58.101*…*58.124*) to *AO1 data storage*.	0.00
	-327.68 … 327.67	Storage parameter for AO1.	100 = 1
13.92	*AO2 data storage*	Storage parameter for controlling analog output AO2 eg. through fieldbus. In *13.22 AO2 source*, select *AO2 data storage*. Then set this parameter as the target of the incoming value data. With the embedded fieldbus interface, simply set the target selection parameter of that particular data (*58.101*…*58.124*) to *AO2 data storage*.	0.00
	-327.68 … 327.67	Storage parameter for AO2.	100 = 1

14 I/O extension module 1		Configuration of I/O extension module 1. See also section *Programmable I/O extensions* (page *29*). **Note:** The contents of the parameter group vary according to the selected I/O extension module type.	
14.01	*Module 1 type*	Activates (and specifies the type of) I/O extension module 1.	*None*
	None	Inactive.	0
	FIO-01	FIO-01.	1
	FIO-11	FIO-11.	2
	FDIO-01	FDIO-01.	3
	FAIO-01	FAIO-01.	4
14.02	*Module 1 location*	Specifies the slot (1…3) on the control unit of the drive into which the I/O extension module is installed. Alternatively, specifies the node ID of the slot on an FEA-03 extension adapter.	*Slot 1*
	Slot 1	Slot 1.	1
	Slot 2	Slot 2.	2
	Slot 3	Slot 3.	3
	4…254	Node ID of the slot on the FEA-03 extension adapter.	1 = 1

No.	Name/Value	Description	Def/FbEq16
14.03	Module 1 status	Displays the status of I/O extension module 1.	No option
	No option	No module detected in the specified slot.	0
	No communication	A module has been detected but cannot be communicated with.	1
	Unknown	The module type is unknown.	2
	FIO-01	An FIO-01 module has been detected and is active.	15
	FIO-11	An FIO-11 module has been detected and is active.	20
	FAIO-01	An FAIO-01 module has been detected and is active.	24
14.05	DI status	*(Visible when 14.01 Module 1 type = FDIO-01)* Displays the status of the digital inputs on the extension module. The activation/deactivation delays (if any are specified) are ignored. A filtering time (for input mode) can be defined by parameter *14.08 DI filter time*. Bit 0 indicates the status of DI1. **Note:** The number of active bits in this parameter depends on the number of digital input/outputs on the extension module. **Example:** 0101b = DI1 and DI3 are on, remainder are off. This parameter is read-only.	-
	0000b…1111b	Status of digital inputs.	1 = 1
14.05	DIO status	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Displays the status of the digital input/outputs on the extension module. The activation/deactivation delays (if any are specified) are ignored. A filtering time (for input mode) can be defined by parameter *14.08 DIO filter time*. Bit 0 indicates the status of DIO1. **Note:** The number of active bits in this parameter depends on the number of digital input/outputs on the extension module. **Example:** 1001b = DIO1 and DIO4 are on, remainder are off. This parameter is read-only.	-
	0000b…1111b	Status of digital input/outputs.	1 = 1
14.06	DI delayed status	*(Visible when 14.01 Module 1 type = FDIO-01)* Displays the delayed status of the digital inputs on the extension module. The word is updated only after activation/deactivation delays (if any are specified). Bit 0 indicates the status of DI1. **Note:** The number of active bits in this parameter depends on the number of digital inputs on the extension module. **Example:** 0101b = DI1 and DI3 are on, remainder are off. This parameter is read-only.	-
	0000b…1111b	Delayed status of digital inputs.	1 = 1
14.06	DIO delayed status	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Displays the delayed status of the digital input/outputs on the extension module. This word is updated only after activation/deactivation delays (if any are specified). Bit 0 indicates the status of DIO1. **Note:** The number of active bits in this parameter depends on the number of digital input/outputs on the extension module. **Example:** 1001b = DIO1 and DIO4 are on, remainder are off. This parameter is read-only.	-
	0000b…1111b	Delayed status of digital input/outputs.	1 = 1

No.	Name/Value	Description	*DefFbEq16*
14.08	*DI filter time*	*(Visible when 14.01 Module 1 type = FDIO-01)* Defines a filtering time for parameter *14.05 DI status*.	10.0 ms
	0.8 … 100.0 ms	Filtering time for *14.05*.	10 = 1 ms
14.08	*DIO filter time*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines a filtering time for parameter *14.05 DIO status*. The filtering time will only affect the DIOs that are in input mode.	10.0 ms
	0.8 … 100.0 ms	Filtering time for *14.05*.	10 = 1 ms
14.09	*DIO1 function*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Selects whether DIO1 of the extension module is used as a digital input or output.	*Input*
	Output	DIO1 is used as a digital output.	0
	Input	DIO1 is used as a digital input.	1
14.11	*DIO1 output source*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Selects a drive signal to be connected to digital input/output DIO1 of the extension module when parameter *14.09 DIO1 function* is set to *Output*.	*Not energized*
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *126*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *126*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *126*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *127*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *126*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *126*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *126*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *129*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *129*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *127*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *126*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *126*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *126*).	15
	Open brake command	Bit 0 of *44.01 Brake control status* (see page *309*).	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *126*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *126*).	24
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *265*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *265*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *265*).	35
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *146*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *146*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *146*).	42

No.	Name/Value	Description	*Def*/**FbEq16**
	RO/DIO control word bit8	Bit 8 of *10.99 RO/DIO control word* (see page *146*).	43
	RO/DIO control word bit9	Bit 9 of *10.99 RO/DIO control word* (see page *146*).	44
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
14.12	*DI1 ON delay*	*(Visible when 14.01 Module 1 type = FDIO-01)* Defines the activation delay for digital input DI1.	0.00 s
	 t_{On} = *14.12 DI1 ON delay* t_{Off} = *14.13 DI1 OFF delay* *Electrical status of DI or status of selected source (in output mode). Indicated by *14.05 DI status*. **Indicated by *14.06 DI delayed status*.		
	0.00 … 3000.00 s	Activation delay for DI1.	10 = 1 s
14.12	*DIO1 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines the activation delay for digital input/output DIO1.	0.00 s
	 t_{On} = *14.12 DIO1 ON delay* t_{Off} = *14.13 DIO1 OFF delay* *Electrical status of DIO (in input mode) or status of selected source (in output mode). Indicated by *14.05 DIO status*. **Indicated by *14.06 DIO delayed status*.		
	0.00 … 3000.00 s	Activation delay for DIO1.	10 = 1 s
14.13	*DI1 OFF delay*	*(Visible when 14.01 Module 1 type = FDIO-01)* Defines the deactivation delay for digital input DI1. See parameter *14.12 DI1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DI1.	10 = 1 s
14.13	*DIO1 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines the deactivation delay for digital input/output DIO1. See parameter *14.12 DIO1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DIO1.	10 = 1 s

No.	Name/Value	Description	*Def/FbEq16*
14.14	*DIO2 function*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Selects whether DIO2 of the extension module is used as a digital input or output.	*Input*
	Output	DIO2 is used as a digital output.	0
	Input	DIO2 is used as a digital input.	1
14.16	*DIO2 output source*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Selects a drive signal to be connected to digital input/output DIO2 when parameter *14.14 DIO2 function* is set to *Output*. For the available selections, see parameter *14.11 DIO1 output source*.	*Not energized*
14.17	*DI2 ON delay*	*(Visible when 14.01 Module 1 type = FDIO-01)* Defines the activation delay for digital input DI2. See parameter *14.12 DI1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Activation delay for DI2.	10 = 1 s
14.17	*DIO2 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines the activation delay for digital input/output DIO2. See parameter *14.12 DIO1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Activation delay for DIO2.	10 = 1 s
14.18	*DI2 OFF delay*	*(Visible when 14.01 Module 1 type = FDIO-01)* Defines the deactivation delay for digital input DI2. See parameter *14.12 DI1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DI2.	10 = 1 s
14.18	*DIO2 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines the deactivation delay for digital input/output DIO2. See parameter *14.12 DIO1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DIO2.	10 = 1 s
14.19	*DIO3 function*	*(Visible when 14.01 Module 1 type = FIO-01)* Selects whether DIO3 of the extension module is used as a digital input or output.	*Input*
	Output	DIO3 is used as a digital output.	0
	Input	DIO3 is used as a digital input.	1
14.19	*AI supervision function*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Selects how the drive reacts when an analog input signal moves out of the minimum and/or maximum limits specified for the input. The inputs and the limits to be observed are selected by parameter *14.20 AI supervision selection*.	*No action*
	No action	No action taken.	0
	Fault	Drive trips on *80A0 AI supervision*.	1
	Warning	Drive generates an *A8A0 AI supervision* warning.	2
	Last speed	Drive generates a warning (*A8A0 AI supervision*) and freezes the speed (or frequency) to the level the drive was operating at. The speed/frequency is determined on the basis of actual speed using 850 ms low-pass filtering. ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3

No.	Name/Value	Description	Def/FbEq16
	Speed ref safe	Drive generates a warning (*A8A0 AI supervision*) and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	4
14.20	*AI supervision selection*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Specifies the analog input limits to be supervised. See parameter *14.19 AI supervision function*. **Note:** The number of active bits in this parameter depends on the number of inputs on the extension module.	0000 0000b

Bit	Name	Description
0	AI1 < MIN	1 = Minimum limit supervision of AI1 active.
1	AI1 > MAX	1 = Maximum limit supervision of AI1 active.
2	AI2 < MIN	1 = Minimum limit supervision of AI2 active.
3	AI2 > MAX	1 = Maximum limit supervision of AI2 active.
4	AI3 < MIN	1 = Minimum limit supervision of AI3 active (FIO-11 only).
5	AI3 > MAX	1 = Maximum limit supervision of AI3 active (FIO-11 only).
6…15	Reserved	

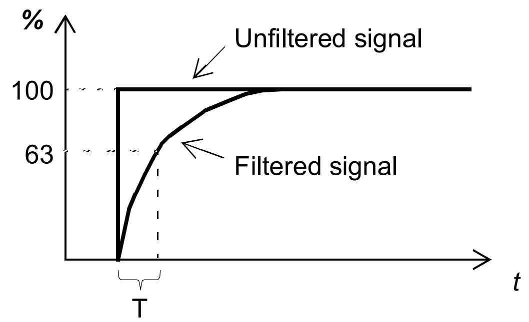
No.	Name/Value	Description	Def/FbEq16
	0000 0000b … 0011 1111b	Activation of analog input supervision.	1 = 1
14.21	*DIO3 output source*	*(Visible when 14.01 Module 1 type = FIO-01)* Selects a drive signal to be connected to digital input/output DIO3 when parameter *14.19 DIO3 function* is set to *Output*. For the available selections, see parameter *14.11 DIO1 output source*.	*Not energized*
14.21	*AI tune*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Triggers the analog input tuning function, which enables the use of actual measurements as the minimum and maximum input values instead of potentially inaccurate estimates. Apply the minimum or maximum signal to the input and select the appropriate tuning function. See also the drawing at parameter *14.35 AI1 scaled at AI1 min*.	*No action*
	No action	Tuning action completed or no action has been requested. The parameter automatically reverts to this value after any tuning action.	0
	AI1 min tune	The measured value of AI1 is set as the minimum value of AI1 into parameter *14.33 AI1 min*.	1
	AI1 max tune	The measured value of AI1 is set as the maximum value of AI1 into parameter *14.34 AI1 max*.	2
	AI2 min tune	The measured value of AI2 is set as the minimum value of AI2 into parameter *14.48 AI2 min*.	3
	AI2 max tune	The measured value of AI2 is set as the maximum value of AI2 into parameter *14.49 AI2 max*.	4
	AI3 min tune	*(Visible when 14.01 Module 1 type = FIO-11)* The measured value of AI3 is set as the minimum value of AI3 into parameter *14.63 AI3 min*.	5

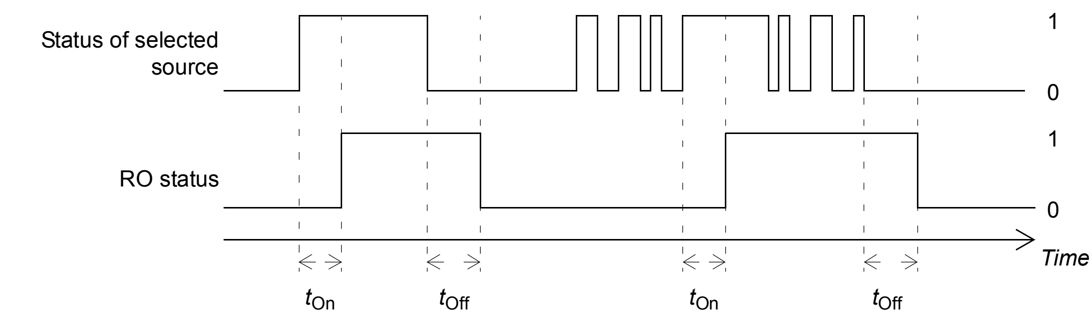
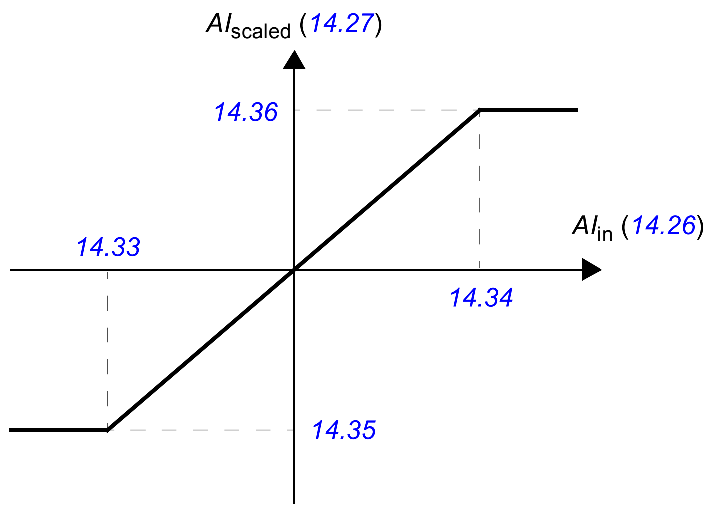
No.	Name/Value	Description	*DefIFbEq16*
	AI3 max tune	*(Visible when 14.01 Module 1 type = FIO-11)* The measured value of AI3 is set as the maximum value of AI3 into parameter *14.64 AI3 max*.	6
14.22	*DI3 ON delay*	*(Visible when 14.01 Module 1 type = FDIO-01)* Defines the activation delay for digital input DI3. See parameter *14.12 DI1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Activation delay for DI3.	10 = 1 s
14.22	*DIO3 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines the activation delay for digital input/output DIO3. See parameter *14.12 DIO1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Activation delay for DIO3.	10 = 1 s
14.22	*AI force selection*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* The true readings of the analog inputs can be overridden for eg. testing purposes. A forced value parameter is provided for each analog input, and its value is applied whenever the corresponding bit in this parameter is 1.	0000b

Bit	Name	Description
0	AI1	1 = Force mode: Force AI1 to value of parameter *14.28 AI1 force data*.
1	AI2	1 = Force mode: Force AI2 to value of parameter *14.43 AI2 force data*.
2	AI3	1 = Force mode: Force AI3 to value of parameter *14.58 AI3 force data* (FIO-11 only).
3…15	Reserved	

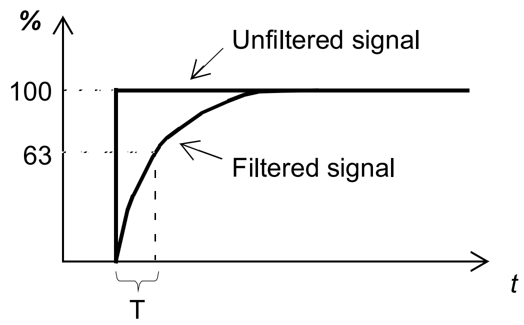
No.	Name/Value	Description	*DefIFbEq16*
	0000b…0111b	Forced values selector for analog inputs.	1 = 1
14.23	*DI3 OFF delay*	*(Visible when 14.01 Module 1 type = FDIO-01)* Defines the deactivation delay for digital input DI3. See parameter *14.12 DI1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DI3.	10 = 1 s
14.23	*DIO3 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01)* Defines the deactivation delay for digital input/output DIO3. See parameter *14.12 DIO1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DIO3.	10 = 1 s
14.24	*DIO4 function*	*(Visible when 14.01 Module 1 type = FIO-01)* Selects whether DIO4 of the extension module is used as a digital input or output.	*Input*
	Output	DIO4 is used as a digital output.	0
	Input	DIO4 is used as a digital input.	1
14.26	*DIO4 output source*	*(Visible when 14.01 Module 1 type = FIO-01)* Selects a drive signal to be connected to digital input/output DIO4 when parameter *14.24 DIO4 function* is set to *Output*. For the available selections, see parameter *14.11 DIO1 output source*.	*Not energized*
14.26	*AI1 actual value*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage). This parameter is read-only.	-
	-22.000 … 22.000 mA or V	Value of analog input AI1.	1000 = 1 mA or V

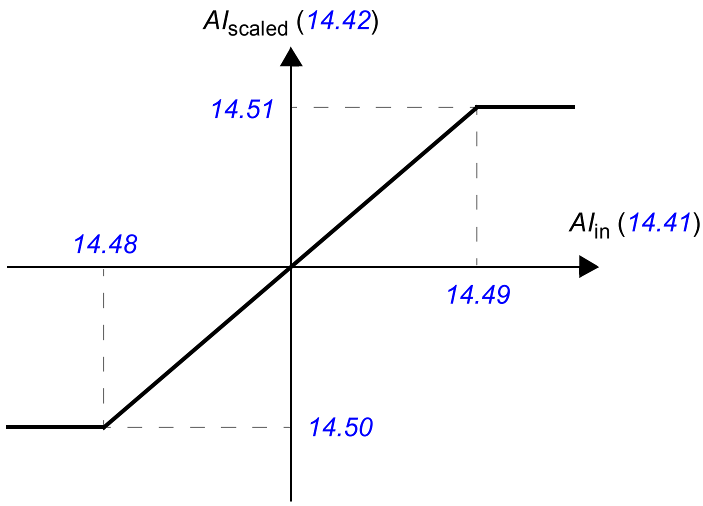
No.	Name/Value	Description	Def/FbEq16
14.27	DIO4 ON delay	(Visible when 14.01 Module 1 type = FIO-01 or FIO-11) Defines the activation delay for digital input/output DIO4. See parameter 14.12 DIO1 ON delay.	0.00 s
	0.00 … 3000.00 s	Activation delay for DIO4.	10 = 1 s
14.27	AI1 scaled value	(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01) Displays the value of analog input AI1 after scaling. See parameter 14.35 AI1 scaled at AI1 min. This parameter is read-only.	-
	-32768.000 … 32767.000	Scaled value of analog input AI1.	1 = 1
14.28	DIO4 OFF delay	(Visible when 14.01 Module 1 type = FIO-01) Defines the deactivation delay for digital input/output DIO4. See parameter 14.12 DIO1 ON delay.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DIO4.	10 = 1 s
14.28	AI1 force data	(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01) Forced value that can be used instead of the true reading of the input. See parameter 14.22 AI force selection.	0.000 mA
	-22.000 … 22.000 mA or V	Forced value of analog input AI1.	1000 = 1 mA or V
14.29	AI1 HW switch position	(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01) Shows the position of the hardware current/voltage selector on the I/O extension module. **Note:** The setting of the current/voltage selector must match the unit selection made in parameter 14.30 AI1 unit selection. I/O module reboot either by cycling the power or through parameter 96.08 Control board boot is required to validate any changes in the hardware settings.	-
	V	Volts.	2
	mA	Milliamperes.	10
14.30	AI1 unit selection	(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01) Selects the unit for readings and settings related to analog input AI1. **Note:** This setting must match the corresponding hardware setting on the I/O extension module (see the manual of the I/O extension module). The hardware setting is shown by parameter 14.29 AI1 HW switch position. I/O module reboot either by cycling the power or through parameter 96.08 Control board boot is required to validate any changes in the hardware settings.	mA
	V	Volts.	2
	mA	Milliamperes.	10
14.31	RO status	(Visible when 14.01 Module 1 type = FIO-01 or FDIO-01) Status of relay outputs on the I/O extension module. **Example:** 0001b = RO1 is energized, RO2 is de-energized.	-
	0000b…1111b	Status of relay outputs.	1 = 1
14.31	AI1 filter gain	(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01) Selects a hardware filtering time for AI1. See also parameter 14.32 AI1 filter time.	1 ms
	No filtering	No filtering.	0
	125 us	125 microseconds.	1

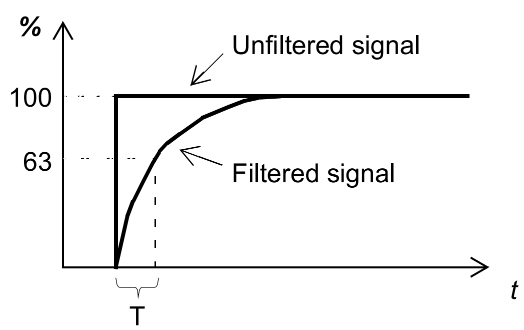
No.	Name/Value	Description	*DeflFbEq16*
	250 us	250 microseconds.	2
	500 us	500 microseconds.	3
	1 ms	1 millisecond.	4
	2 ms	2 milliseconds.	5
	4 ms	4 milliseconds.	6
	7.9375 ms	7.9375 milliseconds.	7
14.32	*AI1 filter time*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the filter time constant for analog input AI1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant **Note:** The signal is also filtered due to the signal interface hardware. See parameter *14.31 AI1 filter gain*.	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s
14.33	*AI1 min*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the minimum value for analog input AI1. See also parameter *14.21 AI tune*.	0.000 mA or V
	-22.000 … 22.000 mA or V	Minimum value of AI1.	1000 = 1 mA or V
14.34	*RO1 source*	*(Visible when 14.01 Module 1 type = FIO-01* or *FDIO-01)* Selects a drive signal to be connected to relay output RO1. For the available selections, see parameter *14.11 DIO1 output source*.	*Not energized*
14.34	*AI1 max*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the maximum value for analog input AI1. See also parameter *14.21 AI tune*.	10.000 mA or V
	-22.000 … 22.000 mA or V	Maximum value of AI1.	1000 = 1 mA or V

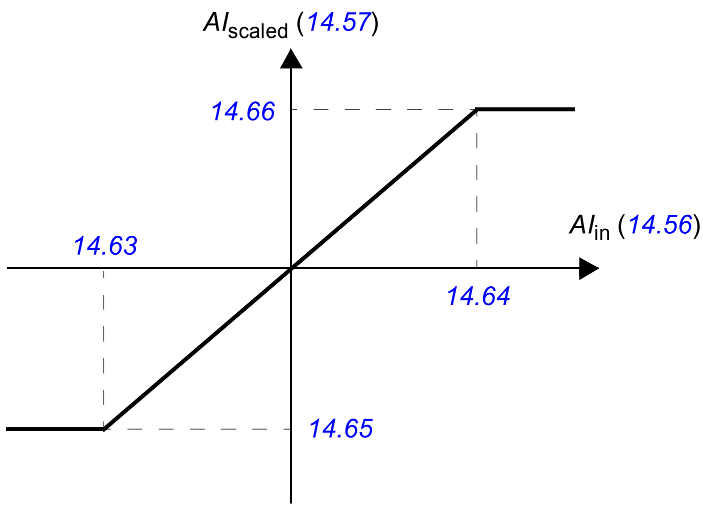
No.	Name/Value	Description	Def/FbEq16
14.35	*RO1 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01* or *FDIO-01)* Defines the activation delay for relay output RO1.	0.00 s
	 t_{On} = *14.35 RO1 ON delay* t_{Off} = *14.36 RO1 OFF delay*		
	0.00 … 3000.00 s	Activation delay for RO1.	10 = 1 s
14.35	*AI1 scaled at AI1 min*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the real value that corresponds to the minimum analog input AI1 value defined by parameter *14.33 AI1 min*. 	0.000
	-32768.000 … 32767.000	Real value corresponding to minimum AI1 value.	1 = 1
14.36	*RO1 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01* or *FDIO-01)* Defines the deactivation delay for relay output RO1. See parameter *14.35 RO1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for RO1.	10 = 1 s
14.36	*AI1 scaled at AI1 max*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the real value that corresponds to the maximum analog input AI1 value defined by parameter *14.34 AI1 max*. See the drawing at parameter *14.35 AI1 scaled at AI1 min*.	100.000
	-32768.000 … 32767.000	Real value corresponding to maximum AI1 value.	1 = 1
14.37	*RO2 source*	*(Visible when 14.01 Module 1 type = FIO-01* or *FDIO-01)* Selects a drive signal to be connected to relay output RO2. For the available selections, see parameter *14.11 DIO1 output source*.	*Not energized*

No.	Name/Value	Description	*DeflFbEq16*
14.38	*RO2 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01* or *FDIO-01)* Defines the activation delay for relay output RO2. See parameter *14.35 RO1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Activation delay for RO2.	10 = 1 s
14.39	*RO2 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01* or *FDIO-01)* Defines the deactivation delay for relay output RO2. See parameter *14.35 RO1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for RO2.	10 = 1 s
14.41	*AI2 actual value*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Displays the value of analog input AI2 in mA or V (depending on whether the input is set to current or voltage). This parameter is read-only.	-
	-22.000 … 22.000 mA or V	Value of analog input AI2.	1000 = 1 mA or V
14.42	*AI2 scaled value*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Displays the value of analog input AI2 after scaling. See parameter *14.50 AI2 scaled at AI2 min*. This parameter is read-only.	-
	-32768.000 … 32767.000	Scaled value of analog input AI2.	1 = 1
14.43	*AI2 force data*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Forced value that can be used instead of the true reading of the input. See parameter *14.22 AI force selection*.	0.000 mA
	-22.000 … 22.000 mA or V	Forced value of analog input AI2.	1000 = 1 mA or V
14.44	*AI2 HW switch position*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Shows the position of the hardware current/voltage selector on the I/O extension module. **Note:** The setting of the current/voltage selector must match the unit selection made in parameter *14.45 AI2 unit selection*. I/O module reboot either by cycling the power or through parameter *96.08 Control board boot* is required to validate any changes in the hardware settings.	-
	V	Volts.	2
	mA	Milliamperes.	10
14.45	*AI2 unit selection*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Selects the unit for readings and settings related to analog input AI2. **Note:** This setting must match the corresponding hardware setting on the I/O extension module (see the manual of the I/O extension module). The hardware setting is shown by parameter *14.44 AI2 HW switch position*. I/O module reboot either by cycling the power or through parameter *96.08 Control board boot* is required to validate any changes in the hardware settings.	*mA*
	V	Volts.	2
	mA	Milliamperes.	10
14.46	*AI2 filter gain*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Selects a hardware filtering time for AI2. See also parameter *14.47 AI2 filter time*.	*1 ms*
	No filtering	No filtering.	0

No.	Name/Value	Description	Def/FbEq16
	125 us	125 microseconds.	1
	250 us	250 microseconds.	2
	500 us	500 microseconds.	3
	1 ms	1 millisecond.	4
	2 ms	2 milliseconds.	5
	4 ms	4 milliseconds.	6
	7.9375 ms	7.9375 milliseconds.	7
14.47	*AI2 filter time*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the filter time constant for analog input AI2.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant **Note:** The signal is also filtered due to the signal interface hardware. See parameter *14.46 AI2 filter gain*.	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s
14.48	*AI2 min*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the minimum value for analog input AI2. See also parameter *14.21 AI tune*.	0.000 mA or V
	-22.000 … 22.000 mA or V	Minimum value of AI2.	1000 = 1 mA or V
14.49	*AI2 max*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the maximum value for analog input AI2. See also parameter *14.21 AI tune*.	10.000 mA or V
	-22.000 … 22.000 mA or V	Maximum value of AI2.	1000 = 1 mA or V

No.	Name/Value	Description	Def/FbEq16
14.50	*AI2 scaled at AI2 min*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the real value that corresponds to the minimum analog input AI2 value defined by parameter *14.48 AI2 min*.  	0.000
	-32768.000 … 32767.000	Real value corresponding to minimum AI2 value.	1 = 1
14.51	*AI2 scaled at AI2 max*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the real value that corresponds to the maximum analog input AI2 value defined by parameter *14.49 AI2 max*. See the drawing at parameter *14.50 AI2 scaled at AI2 min*.	100.000
	-32768.000 … 32767.000	Real value corresponding to maximum AI2 value.	1 = 1
14.56	*AI3 actual value*	*(Visible when 14.01 Module 1 type = FIO-11)* Displays the value of analog input AI3 in mA or V (depending on whether the input is set to current or voltage). This parameter is read-only.	-
	-22.000 … 22.000 mA or V	Value of analog input AI3.	1000 = 1 mA or V
14.57	*AI3 scaled value*	*(Visible when 14.01 Module 1 type = FIO-11)* Displays the value of analog input AI3 after scaling. See parameter *14.65 AI3 scaled at AI3 min*. This parameter is read-only.	-
	-32768.000 … 32767.000	Scaled value of analog input AI3.	1 = 1
14.58	*AI3 force data*	*(Visible when 14.01 Module 1 type = FIO-11)* Forced value that can be used instead of the true reading of the input. See parameter *14.22 AI force selection*.	0.000 mA
	-22.000 … 22.000 mA or V	Forced value of analog input AI3.	1000 = 1 mA or V
14.59	*AI3 HW switch position*	*(Visible when 14.01 Module 1 type = FIO-11)* Shows the position of the hardware current/voltage selector on the I/O extension module. **Note:** The setting of the current/voltage selector must match the unit selection made in parameter *14.60 AI3 unit selection*. I/O module reboot either by cycling the power or through parameter *96.08 Control board boot* is required to validate any changes in the hardware settings.	-
	V	Volts.	2

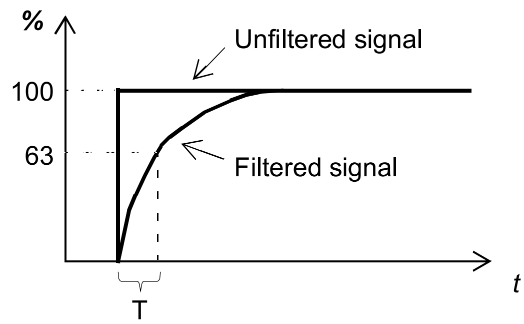
No.	Name/Value	Description	Def/FbEq16
	mA	Milliamperes.	10
14.60	*AI3 unit selection*	*(Visible when 14.01 Module 1 type = FIO-11)* Selects the unit for readings and settings related to analog input AI3. **Note:** This setting must match the corresponding hardware setting on the I/O extension module (see the manual of the I/O extension module). The hardware setting is shown by parameter *14.59 AI3 HW switch position*. I/O module reboot either by cycling the power or through parameter *96.08 Control board boot* is required to validate any changes in the hardware settings.	*mA*
	V	Volts.	2
	mA	Milliamperes.	10
14.61	*AI3 filter gain*	*(Visible when 14.01 Module 1 type = FIO-11)* Selects a hardware filtering time for AI3. See also parameter *14.62 AI3 filter time*.	*1 ms*
	No filtering	No filtering.	0
	125 us	125 microseconds.	1
	250 us	250 microseconds.	2
	500 us	500 microseconds.	3
	1 ms	1 millisecond.	4
	2 ms	2 milliseconds.	5
	4 ms	4 milliseconds.	6
	7.9375 ms	7.9375 milliseconds.	7
14.62	*AI3 filter time*	*(Visible when 14.01 Module 1 type = FIO-11)* Defines the filter time constant for analog input AI3.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant **Note:** The signal is also filtered due to the signal interface hardware. See parameter *14.61 AI3 filter gain*.	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

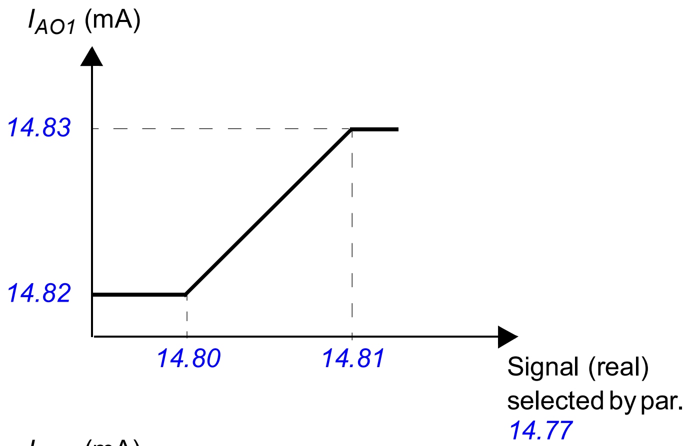
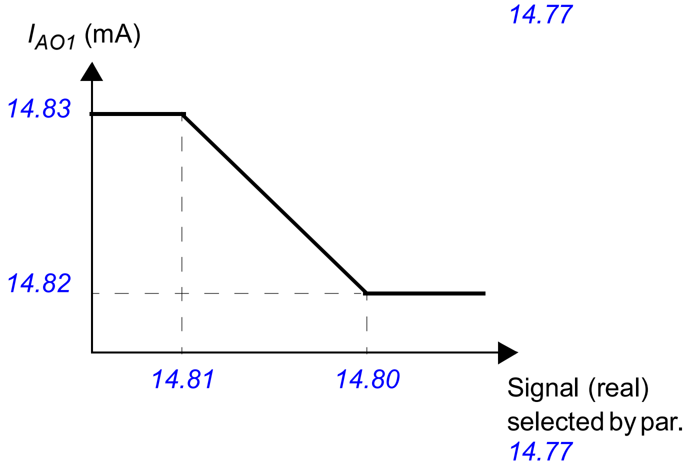
No.	Name/Value	Description	DefFbEq16
14.63	AI3 min	(Visible when 14.01 Module 1 type = FIO-11) Defines the minimum value for analog input AI3. See also parameter 14.21 AI tune.	0.000 mA or V
	-22.000 … 22.000 mA or V	Minimum value of AI3.	1000 = 1 mA or V
14.64	AI3 max	(Visible when 14.01 Module 1 type = FIO-11) Defines the maximum value for analog input AI3. See also parameter 14.21 AI tune.	10.000 mA or V
	-22.000 … 22.000 mA or V	Maximum value of AI3.	1000 = 1 mA or V
14.65	AI3 scaled at AI3 min	(Visible when 14.01 Module 1 type = FIO-11) Defines the real value that corresponds to the minimum analog input AI3 value defined by parameter 14.63 AI3 min. 	0.000
	-32768.000 … 32767.000	Real value corresponding to minimum AI3 value.	1 = 1
14.66	AI3 scaled at AI3 max	(Visible when 14.01 Module 1 type = FIO-11) Defines the real value that corresponds to the maximum analog input AI3 value defined by parameter 14.64 AI3 max. See the drawing at parameter 14.65 AI3 scaled at AI3 min.	100.000
	-32768.000 … 32767.000	Real value corresponding to maximum AI3 value.	1 = 1
14.71	AO force selection	(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01) The value of the analog output can be overridden for eg. testing purposes. A forced value parameter (14.78 AO1 force data) is provided for the analog output, and its value is applied whenever the corresponding bit in this parameter is 1.	00b

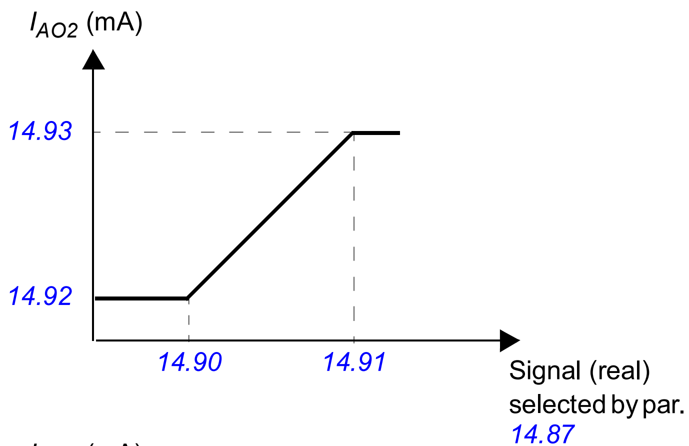
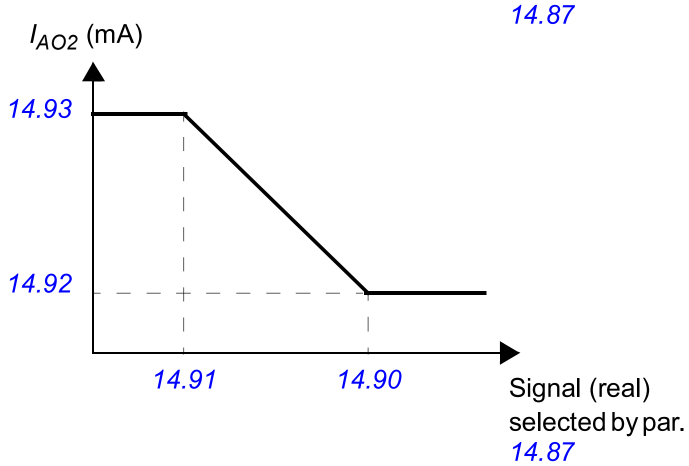
Bit	Name	Description
0	AO1	1 = Force mode: Force AO1 to value of parameter 14.78 AO1 force data.
1	AO2	1 = Force mode: Force AO2 to value of parameter 14.88 AO2 force data (FAIO-01 only).
3…15	Reserved	

	00b…11b	Forced values selector for analog outputs.	1 = 1

No.	Name/Value	Description	Def/FbEq16
14.76	AO1 actual value	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Displays the value of AO1 in mA. This parameter is read-only.	-
	0.000 … 22.000 mA	Value of AO1.	1000 = 1 mA
14.77	AO1 source	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Selects a signal to be connected to analog output AO1. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor.	Zero
	Zero	None.	0
	Motor speed used	01.01 Motor speed used (page 113).	1
	Output frequency	01.06 Output frequency (page 113).	3
	Motor current	01.07 Motor current (page 113).	4
	Motor torque	01.10 Motor torque (page 113).	6
	DC voltage	01.11 DC voltage (page 113).	7
	Power inu out	01.14 Output power (page 114).	8
	Speed ref ramp in	23.01 Speed ref ramp input (page 212).	10
	Speed ref ramp out	23.02 Speed ref ramp output (page 212).	11
	Speed ref used	24.01 Used speed reference (page 218).	12
	Torq ref used	26.02 Torque reference used (page 234).	13
	Freq ref used	28.02 Frequency ref ramp output (page 240).	14
	Process PID out	40.01 Process PID output actual (page 293).	16
	Process PID fbk	40.02 Process PID feedback actual (page 293).	17
	Process PID act	40.03 Process PID setpoint actual (page 293).	18
	Process PID dev	40.04 Process PID deviation actual (page 293).	19
	Force Pt100 excitation	The output is used to feed an excitation current to 1…3 Pt100 sensors. See section Motor thermal protection (page 78).	20
	Force KTY84 excitation	The output is used to feed an excitation current to a KTY84 sensor. See section Motor thermal protection (page 78).	21
	Force PTC excitation	The output is used to feed an excitation current to 1…3 PTC sensors. See section Motor thermal protection (page 78).	22
	Force Pt1000 excitation	The output is used to feed an excitation current to 1…3 Pt1000 sensors. See section Motor thermal protection (page 78).	23
	AO1 data storage	13.91 AO1 data storage (page 159).	37
	AO2 data storage	13.92 AO2 data storage (page 159).	38
	Other	Source selection (see Terms and abbreviations on page 110).	-
14.78	AO1 force data	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Forced value that can be used instead of the selected output signal. See parameter 14.71 AO force selection.	0.000 mA
	0.000 … 22.000 mA	Forced value of analog output AO1.	1000 = 1 mA

No.	Name/Value	Description	*Def/FbEq16*
14.79	*AO1 filter time*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the filtering time constant for analog output AO1.  O = I × $(1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

No.	Name/Value	Description	Def/FbEq16
14.80	*AO1 source min*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the real value of the signal (selected by parameter *14.77 AO1 source*) that corresponds to the minimum AO1 output value (defined by parameter *14.82 AO1 out at AO1 src min*).  	0.0
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO1 output value.	1 = 1
14.81	*AO1 source max*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the real value of the signal (selected by parameter *14.77 AO1 source*) that corresponds to the maximum AO1 output value (defined by parameter *14.83 AO1 out at AO1 src max*). See parameter *14.80 AO1 source min*.	100.0
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO1 output value.	1 = 1
14.82	*AO1 out at AO1 src min*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the minimum output value for analog output AO1. See also drawing at parameter *14.80 AO1 source min*.	0.000 mA
	0.000 … 22.000 mA	Minimum AO1 output value.	1000 = 1 mA
14.83	*AO1 out at AO1 src max*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the maximum output value for analog output AO1. See also drawing at parameter *14.80 AO1 source min*.	10.000 mA
	0.000 … 22.000 mA	Maximum AO1 output value.	1000 = 1 mA

No.	Name/Value	Description	Def/FbEq16
14.86	*AO2 actual value*	*(Visible when 14.01 Module 1 type = FAIO-01)* Displays the value of AO2 in mA. This parameter is read-only.	-
	0.000 … 22.000 mA	Value of AO2.	1000 = 1 mA
14.87	*AO2 source*	*(Visible when 14.01 Module 1 type = FAIO-01)* Selects a signal to be connected to analog output AO2. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor. For the selections, see parameter *14.77 AO1 source*.	*Zero*
14.88	*AO2 force data*	*(Visible when 14.01 Module 1 type = FAIO-01)* Forced value that can be used instead of the selected output signal. See parameter *14.71 AO force selection*.	0.000 mA
	0.000 … 22.000 mA	Forced value of analog output AO2.	1000 = 1 mA
14.89	*AO2 filter time*	*(Visible when 14.01 Module 1 type = FAIO-01)* Defines the filtering time constant for analog output AO2. See parameter *14.79 AO1 filter time.*	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s
14.90	*AO2 source min*	*(Visible when 14.01 Module 1 type = FAIO-01)* Defines the real value of the signal (selected by parameter *14.87 AO2 source*) that corresponds to the minimum AO2 output value (defined by parameter *14.92 AO2 out at AO2 src min*).  	0.0
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO2 output value.	1 = 1

No.	Name/Value	Description	Def/FbEq16
14.91	AO2 source max	*(Visible when 14.01 Module 1 type = FAIO-01)* Defines the real value of the signal (selected by parameter 14.87 AO2 source) that corresponds to the maximum AO2 output value (defined by parameter 14.93 AO2 out at AO2 src max). See parameter 14.90 AO2 source min.	100.0
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO2 output value.	1 = 1
14.92	AO2 out at AO2 src min	*(Visible when 14.01 Module 1 type = FAIO-01)* Defines the minimum output value for analog output AO2. See also drawing at parameter 14.90 AO2 source min.	0.000 mA
	0.000 … 22.000 mA	Minimum AO2 output value.	1000 = 1 mA
14.93	AO2 out at AO2 src max	*(Visible when 14.01 Module 1 type = FAIO-01)* Defines the maximum output value for analog output AO2. See also drawing at parameter 14.90 AO2 source min.	10.000 mA
	0.000 … 22.000 mA	Maximum AO2 output value.	1000 = 1 mA
15 I/O extension module 2		Configuration of I/O extension module 2. See also section Programmable I/O extensions (page 29). **Note:** The contents of the parameter group vary according to the selected I/O extension module type.	
15.01	Module 2 type	See parameter 14.01 Module 1 type.	None
15.02	Module 2 location	See parameter 14.02 Module 1 location.	Slot 1
15.03	Module 2 status	See parameter 14.03 Module 1 status.	No option
15.05	DI status	*(Visible when 15.01 Module 2 type = FDIO-01)* See parameter 14.05 DI status.	-
15.05	DIO status	*(Visible when 15.01 Module 2 type = FIO-01 or FIO-11)* See parameter 14.05 DIO status.	-
15.06	DI delayed status	*(Visible when 15.01 Module 2 type = FDIO-01)* See parameter 14.06 DI delayed status.	-
15.06	DIO delayed status	*(Visible when 15.01 Module 2 type = FIO-01 or FIO-11)* See parameter 14.06 DIO delayed status.	-
15.08	DI filter time	*(Visible when 15.01 Module 2 type = FDIO-01)* See parameter 14.08 DI filter time.	10.0 ms
15.08	DIO filter time	*(Visible when 15.01 Module 2 type = FIO-01 or FIO-11)* See parameter 14.08 DIO filter time.	10.0 ms
15.09	DIO1 function	*(Visible when 15.01 Module 2 type = FIO-01 or FIO-11)* See parameter 14.09 DIO1 function.	Input
15.11	DIO1 output source	*(Visible when 15.01 Module 2 type = FIO-01 or FIO-11)* See parameter 14.11 DIO1 output source.	Not energized
15.12	DI1 ON delay	*(Visible when 15.01 Module 2 type = FDIO-01)* See parameter 14.12 DI1 ON delay.	0.00 s
15.12	DIO1 ON delay	*(Visible when 15.01 Module 2 type = FIO-01 or FIO-11)* See parameter 14.12 DIO1 ON delay.	0.00 s
15.13	DI1 OFF delay	*(Visible when 15.01 Module 2 type = FDIO-01)* See parameter 14.13 DI1 OFF delay.	0.00 s
15.13	DIO1 OFF delay	*(Visible when 15.01 Module 2 type = FIO-01 or FIO-11)* See parameter 14.13 DIO1 OFF delay.	0.00 s

No.	Name/Value	Description	Def/FbEq16
15.14	*DIO2 function*	*(Visible when 15.01 Module 2 type = FIO-01 or FIO-11)* See parameter *14.14 DIO2 function*.	*Input*
15.16	*DIO2 output source*	*(Visible when 15.01 Module 2 type = FIO-01 or FIO-11)* See parameter *14.16 DIO2 output source*.	*Not energized*
15.17	*DI2 ON delay*	*(Visible when 15.01 Module 2 type = FDIO-01)* See parameter *14.17 DI2 ON delay*.	0.00 s
15.17	*DIO2 ON delay*	*(Visible when 15.01 Module 2 type = FIO-01 or FIO-11)* See parameter *14.17 DIO2 ON delay*.	0.00 s
15.18	*DI2 OFF delay*	*(Visible when 15.01 Module 2 type = FDIO-01)* See parameter *14.18 DI2 OFF delay*.	0.00 s
15.18	*DIO2 OFF delay*	*(Visible when 15.01 Module 2 type = FIO-01 or FIO-11)* See parameter *14.18 DIO2 OFF delay*.	0.00 s
15.19	*DIO3 function*	*(Visible when 15.01 Module 2 type = FIO-01)* See parameter *14.19 DIO3 function*.	*Input*
15.19	*AI supervision function*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.19 AI supervision function*.	*No action*
15.20	*AI supervision selection*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.20 AI supervision selection*.	0000 0000b
15.21	*DIO3 output source*	*(Visible when 15.01 Module 2 type = FIO-01)* See parameter *14.21 DIO3 output source*.	*Not energized*
15.21	*AI tune*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.21 AI tune*.	*No action*
15.22	*DI3 ON delay*	*(Visible when 15.01 Module 2 type = FDIO-01)* See parameter *14.22 DI3 ON delay*.	0.00 s
15.22	*DIO3 ON delay*	*(Visible when 15.01 Module 2 type = FIO-01)* See parameter *14.22 DIO3 ON delay*.	0.00 s
15.22	*AI force selection*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.22 AI force selection*.	0000b
15.23	*DI3 OFF delay*	*(Visible when 15.01 Module 2 type = FDIO-01)* See parameter *14.23 DI3 OFF delay*.	0.00 s
15.23	*DIO3 OFF delay*	*(Visible when 15.01 Module 2 type = FIO-01)* See parameter *14.23 DIO3 OFF delay*.	0.00 s
15.24	*DIO4 function*	*(Visible when 15.01 Module 2 type = FIO-01)* See parameter *14.24 DIO4 function*.	*Input*
15.26	*DIO4 output source*	*(Visible when 15.01 Module 2 type = FIO-01)* See parameter *14.26 DIO4 output source*.	*Not energized*
15.26	*AI1 actual value*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.26 AI1 actual value*.	-
15.27	*DIO4 ON delay*	*(Visible when 15.01 Module 2 type = FIO-01)* See parameter *14.27 DIO4 ON delay*.	0.00 s
15.27	*AI1 scaled value*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.27 AI1 scaled value*.	-
15.28	*DIO4 OFF delay*	*(Visible when 15.01 Module 2 type = FIO-01)* See parameter *14.28 DIO4 OFF delay*.	0.00 s
15.28	*AI1 force data*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.28 AI1 force data*.	0.000 mA

No.	Name/Value	Description	Def/FbEq16
15.29	AI1 HW switch position	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.29 AI1 HW switch position.	-
15.30	AI1 unit selection	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.30 AI1 unit selection.	mA
15.31	RO status	(Visible when 15.01 Module 2 type = FIO-01 or FDIO-01) See parameter 14.31 RO status.	-
15.31	AI1 filter gain	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.31 AI1 filter gain.	1 ms
15.32	AI1 filter time	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.32 AI1 filter time.	0.100 s
15.33	AI1 min	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.33 AI1 min.	0.000 mA or V
15.34	RO1 source	(Visible when 15.01 Module 2 type = FIO-01 or FDIO-01) See parameter 14.34 RO1 source.	Not energized
15.34	AI1 max	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.34 AI1 max.	10.000 mA or V
15.35	RO1 ON delay	(Visible when 15.01 Module 2 type = FIO-01 or FDIO-01) See parameter 14.35 RO1 ON delay.	0.00 s
15.35	AI1 scaled at AI1 min	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.35 AI1 scaled at AI1 min.	0.000
15.36	RO1 OFF delay	(Visible when 15.01 Module 2 type = FIO-01 or FDIO-01) See parameter 14.36 RO1 OFF delay.	0.00 s
15.36	AI1 scaled at AI1 max	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.36 AI1 scaled at AI1 max.	100.000
15.37	RO2 source	(Visible when 15.01 Module 2 type = FIO-01 or FDIO-01) See parameter 14.37 RO2 source.	Not energized
15.38	RO2 ON delay	(Visible when 15.01 Module 2 type = FIO-01 or FDIO-01) See parameter 14.38 RO2 ON delay.	0.00 s
15.39	RO2 OFF delay	(Visible when 15.01 Module 2 type = FIO-01 or FDIO-01) See parameter 14.39 RO2 OFF delay.	0.00 s
15.41	AI2 actual value	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.41 AI2 actual value.	-
15.42	AI2 scaled value	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.42 AI2 scaled value.	-
15.43	AI2 force data	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.43 AI2 force data.	0.000 mA
15.44	AI2 HW switch position	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.44 AI2 HW switch position.	-
15.45	AI2 unit selection	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.45 AI2 unit selection.	mA
15.46	AI2 filter gain	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.46 AI2 filter gain.	1 ms
15.47	AI2 filter time	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.47 AI2 filter time.	0.100 s
15.48	AI2 min	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.48 AI2 min.	0.000 mA or V

No.	Name/Value	Description	Def/FbEq16
15.49	AI2 max	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.49 AI2 max.	10.000 mA or V
15.50	AI2 scaled at AI2 min	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.50 AI2 scaled at AI2 min.	0.000
15.51	AI2 scaled at AI2 max	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.51 AI2 scaled at AI2 max.	100.000
15.56	AI3 actual value	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.56 AI3 actual value.	-
15.57	AI3 scaled value	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.57 AI3 scaled value.	-
15.58	AI3 force data	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.58 AI3 force data.	0.000 mA
15.59	AI3 HW switch position	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.59 AI3 HW switch position.	-
15.60	AI3 unit selection	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.60 AI3 unit selection.	mA
15.61	AI3 filter gain	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.61 AI3 filter gain.	1 ms
15.62	AI3 filter time	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.62 AI3 filter time.	0.100 s
15.63	AI3 min	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.63 AI3 min.	0.000 mA or V
15.64	AI3 max	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.64 AI3 max.	10.000 mA or V
15.65	AI3 scaled at AI3 min	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.65 AI3 scaled at AI3 min.	0.000
15.66	AI3 scaled at AI3 max	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.66 AI3 scaled at AI3 max.	100.000
15.71	AO force selection	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.71 AO force selection.	00b
15.76	AO1 actual value	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.76 AO1 actual value.	-
15.77	AO1 source	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.77 AO1 source.	Zero
15.78	AO1 force data	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.78 AO1 force data.	0.000 mA
15.79	AO1 filter time	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.79 AO1 filter time.	0.100 s
15.80	AO1 source min	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.80 AO1 source min.	0.0
15.81	AO1 source max	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.81 AO1 source max.	100.0
15.82	AO1 out at AO1 src min	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.82 AO1 out at AO1 src min.	0.000 mA
15.83	AO1 out at AO1 src max	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.83 AO1 out at AO1 src max.	10.000 mA

No.	Name/Value	Description	Def/FbEq16
15.86	AO2 actual value	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.86 AO2 actual value.	-
15.87	AO2 source	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.87 AO2 source.	Zero
15.88	AO2 force data	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.88 AO2 force data.	0.000 mA
15.89	AO2 filter time	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.89 AO2 filter time.	0.100 s
15.90	AO2 source min	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.90 AO2 source min.	0.0
15.91	AO2 source max	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.91 AO2 source max.	100.0
15.92	AO2 out at AO2 src min	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.92 AO2 out at AO2 src min.	0.000 mA
15.93	AO2 out at AO2 src max	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.93 AO2 out at AO2 src max.	10.000 mA
16 I/O extension module 3		Configuration of I/O extension module 3. See also section Programmable I/O extensions (page 29). **Note:** The contents of the parameter group vary according to the selected I/O extension module type.	
16.01	Module 3 type	See parameter 14.01 Module 1 type.	None
16.02	Module 3 location	See parameter 14.02 Module 1 location.	Slot 1
16.03	Module 3 status	See parameter 14.03 Module 1 status.	No option
16.05	DI status	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.05 DI status.	-
16.05	DIO status	(Visible when 16.01 Module 3 type = FIO-01 or FIO-11) See parameter 14.05 DIO status.	-
16.06	DI delayed status	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.06 DI delayed status.	-
16.06	DIO delayed status	(Visible when 16.01 Module 3 type = FIO-01 or FIO-11) See parameter 14.06 DIO delayed status.	-
16.08	DI filter time	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.08 DI filter time.	10.0 ms
16.08	DIO filter time	(Visible when 16.01 Module 3 type = FIO-01 or FIO-11) See parameter 14.08 DIO filter time.	10.0 ms
16.09	DIO1 function	(Visible when 16.01 Module 3 type = FIO-01 or FIO-11) See parameter 14.09 DIO1 function.	Input
16.11	DIO1 output source	(Visible when 16.01 Module 3 type = FIO-01 or FIO-11) See parameter 14.11 DIO1 output source.	Not energized
16.12	DI1 ON delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.12 DI1 ON delay.	0.00 s
16.12	DIO1 ON delay	(Visible when 16.01 Module 3 type = FIO-01 or FIO-11) See parameter 14.12 DIO1 ON delay.	0.00 s
16.13	DI1 OFF delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.13 DI1 OFF delay.	0.00 s

No.	Name/Value	Description	Def/FbEq16
16.13	DIO1 OFF delay	(Visible when 16.01 Module 3 type = FIO-01 or FIO-11) See parameter 14.13 DIO1 OFF delay.	0.00 s
16.14	DIO2 function	(Visible when 16.01 Module 3 type = FIO-01 or FIO-11) See parameter 14.14 DIO2 function.	Input
16.16	DIO2 output source	(Visible when 16.01 Module 3 type = FIO-01 or FIO-11) See parameter 14.16 DIO2 output source.	Not energized
16.17	DI2 ON delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.17 DI2 ON delay.	0.00 s
16.17	DIO2 ON delay	(Visible when 16.01 Module 3 type = FIO-01 or FIO-11) See parameter 14.17 DIO2 ON delay.	0.00 s
16.18	DI2 OFF delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.18 DI2 OFF delay.	0.00 s
16.18	DIO2 OFF delay	(Visible when 16.01 Module 3 type = FIO-01 or FIO-11) See parameter 14.18 DIO2 OFF delay.	0.00 s
16.19	DIO3 function	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.19 DIO3 function.	Input
16.19	AI supervision function	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.19 AI supervision function.	No action
16.20	AI supervision selection	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.20 AI supervision selection.	0000 0000b
16.21	DIO3 output source	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.21 DIO3 output source.	Not energized
16.21	AI tune	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.21 AI tune.	No action
16.22	DI3 ON delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.22 DI3 ON delay.	0.00 s
16.22	DIO3 ON delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.22 DIO3 ON delay.	0.00 s
16.22	AI force selection	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.22 AI force selection.	0000b
16.23	DI3 OFF delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.23 DI3 OFF delay.	0.00 s
16.23	DIO3 OFF delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.23 DIO3 OFF delay.	0.00 s
16.24	DIO4 function	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.24 DIO4 function.	Input
16.26	DIO4 output source	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.26 DIO4 output source.	Not energized
16.26	AI1 actual value	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.26 AI1 actual value.	-
16.27	DIO4 ON delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.27 DIO4 ON delay.	0.00 s
16.27	AI1 scaled value	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.27 AI1 scaled value.	-
16.28	DIO4 OFF delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.28 DIO4 OFF delay.	0.00 s

No.	Name/Value	Description	Def/FbEq16
16.28	AI1 force data	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.28 AI1 force data.	0.000 mA
16.29	AI1 HW switch position	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.29 AI1 HW switch position.	-
16.30	AI1 unit selection	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.30 AI1 unit selection.	mA
16.31	RO status	(Visible when 16.01 Module 3 type = FIO-11 or FDIO-01) See parameter 14.31 RO status.	-
16.31	AI1 filter gain	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.31 AI1 filter gain.	1 ms
16.32	AI1 filter time	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.32 AI1 filter time.	0.100 s
16.33	AI1 min	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.33 AI1 min.	0.000 mA or V
16.34	RO1 source	(Visible when 16.01 Module 3 type = FIO-01 or FDIO-01) See parameter 14.34 RO1 source.	Not energized
16.34	AI1 max	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.34 AI1 max.	10.000 mA or V
16.35	RO1 ON delay	(Visible when 16.01 Module 3 type = FIO-01 or FDIO-01) See parameter 14.35 RO1 ON delay.	0.00 s
16.35	AI1 scaled at AI1 min	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.35 AI1 scaled at AI1 min.	0.000
16.36	RO1 OFF delay	(Visible when 16.01 Module 3 type = FIO-01 or FDIO-01) See parameter 14.36 RO1 OFF delay.	0.00 s
16.36	AI1 scaled at AI1 max	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.36 AI1 scaled at AI1 max.	100.000
16.37	RO2 source	(Visible when 16.01 Module 3 type = FIO-01 or FDIO-01) See parameter 14.37 RO2 source.	Not energized
16.38	RO2 ON delay	(Visible when 16.01 Module 3 type = FIO-01 or FDIO-01) See parameter 14.38 RO2 ON delay.	0.00 s
16.39	RO2 OFF delay	(Visible when 16.01 Module 3 type = FIO-01 or FDIO-01) See parameter 14.39 RO2 OFF delay.	0.00 s
16.41	AI2 actual value	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.41 AI2 actual value.	-
16.42	AI2 scaled value	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.42 AI2 scaled value.	-
16.43	AI2 force data	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.43 AI2 force data.	0.000 mA
16.44	AI2 HW switch position	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.44 AI2 HW switch position.	-
16.45	AI2 unit selection	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.45 AI2 unit selection.	mA
16.46	AI2 filter gain	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.46 AI2 filter gain.	1 ms
16.47	AI2 filter time	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.47 AI2 filter time.	0.100 s

No.	Name/Value	Description	Def/FbEq16
16.48	AI2 min	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.48 AI2 min.	0.000 mA or V
16.49	AI2 max	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.49 AI2 max.	10.000 mA or V
16.50	AI2 scaled at AI2 min	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.50 AI2 scaled at AI2 min.	0.000
16.51	AI2 scaled at AI2 max	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.51 AI2 scaled at AI2 max.	100.000
16.56	AI3 actual value	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.56 AI3 actual value.	-
16.57	AI3 scaled value	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.57 AI3 scaled value.	-
16.58	AI3 force data	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.58 AI3 force data.	0.000 mA
16.59	AI3 HW switch position	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.59 AI3 HW switch position.	-
16.60	AI3 unit selection	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.60 AI3 unit selection.	mA
16.61	AI3 filter gain	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.61 AI3 filter gain.	1 ms
16.62	AI3 filter time	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.62 AI3 filter time.	0.100 s
16.63	AI3 min	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.63 AI3 min.	0.000 mA or V
16.64	AI3 max	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.64 AI3 max.	10.000 mA or V
16.65	AI3 scaled at AI3 min	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.65 AI3 scaled at AI3 min.	0.000
16.66	AI3 scaled at AI3 max	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.66 AI3 scaled at AI3 max.	100.000
16.71	AO force selection	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.71 AO force selection.	00b
16.76	AO1 actual value	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.76 AO1 actual value.	-
16.77	AO1 source	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.77 AO1 source.	Zero
16.78	AO1 force data	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.78 AO1 force data.	0.000 mA
16.79	AO1 filter time	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.79 AO1 filter time.	0.100 s
16.80	AO1 source min	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.80 AO1 source min.	0.0
16.81	AO1 source max	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.81 AO1 source max.	100.0
16.82	AO1 out at AO1 src min	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.82 AO1 out at AO1 src min.	0.000 mA

No.	Name/Value	Description	Def/FbEq16
16.83	*AO1 out at AO1 src max*	*(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01)* See parameter *14.83 AO1 out at AO1 src max*.	10.000 mA
16.86	*AO2 actual value*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.86 AO2 actual value*.	-
16.87	*AO2 source*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.87 AO2 source*.	*Zero*
16.88	*AO2 force data*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.88 AO2 force data*.	0.000 mA
16.89	*AO2 filter time*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.89 AO2 filter time*.	0.100 s
16.90	*AO2 source min*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.90 AO2 source min*.	0.0
16.91	*AO2 source max*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.91 AO2 source max*.	100.0
16.92	*AO2 out at AO2 src min*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.92 AO2 out at AO2 src min*.	0.000 mA
16.93	*AO2 out at AO2 src max*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.93 AO2 out at AO2 src max*.	10.000 mA

19 Operation mode		Selection of local and external control location sources and operating modes. See also section *Operating modes of the drive* (page *22*).	
19.01	*Actual operation mode*	Displays the operating mode currently used. See parameters *19.11*…*19.14*. This parameter is read-only.	-
	Zero	None.	1
	Speed	Speed control (in DTC motor control mode).	2
	Torque	Torque control (in DTC motor control mode).	3
	Min	The torque selector is comparing the output of the speed controller (*25.01 Torque reference speed control*) and torque reference (*26.74 Torque ref ramp out*) and the smaller of the two is used.	4
	Max	The torque selector is comparing the output of the speed controller (*25.01 Torque reference speed control*) and torque reference (*26.74 Torque ref ramp out*) and the greater of the two is used.	5
	Add	The speed controller output is added to the torque reference.	6
	Scalar (Hz)	Frequency control in scalar motor control mode.	10
	Scalar (rpm)	Speed control in scalar motor control mode.	11
	Forced magn.	Motor is in magnetizing mode.	20
19.11	*Ext1/Ext2 selection*	Selects the source for external control location EXT1/EXT2 selection. 0 = EXT1 1 = EXT2	*EXT1*
	EXT1	EXT1 (permanently selected).	0
	EXT2	EXT2 (permanently selected).	1
	FBA A MCW bit 11	Control word bit 11 received through fieldbus interface A.	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3

No.	Name/Value	Description	*Def/FbEq16*
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	11
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	12
	EFB MCW bit 11	Control word bit 11 received through the embedded fieldbus interface.	32
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
19.12	*Ext1 control mode*	Selects the operating mode for external control location EXT1.	*Speed*
	Zero	None.	1
	Speed	Speed control. The torque reference used is *25.01 Torque reference speed control* (output of the speed reference chain).	2
	Torque	Torque control. The torque reference used is *26.74 Torque ref ramp out* (output of the torque reference chain).	3
	Minimum	Combination of selections *Speed* and *Torque*: the torque selector compares the speed controller output (*25.01 Torque reference speed control*) and the torque reference (*26.74 Torque ref ramp out*) and selects the smaller of the two. If speed error becomes negative, the drive follows the speed controller output until speed error becomes positive again. This prevents the drive from accelerating uncontrollably if the load is lost in torque control.	4
	Maximum	Combination of selections *Speed* and *Torque*: the torque selector compares the speed controller output (*25.01 Torque reference speed control*) and the torque reference (*26.74 Torque ref ramp out*) and selects the greater of the two. If speed error becomes positive, the drive follows the speed controller output until speed error becomes negative again. This prevents the drive from accelerating uncontrollably if the load is lost in torque control.	5
	Add	Combination of selections *Speed* and *Torque*: Torque selector adds the speed reference chain output to the torque reference chain output.	6
19.14	*Ext2 control mode*	Selects the operating mode for external control location EXT2. For the selections, see parameter *19.12 Ext1 control mode*.	*Speed*
19.16	*Local control mode*	Selects the operating mode for local control.	*Speed*
	Speed	Speed control. The torque reference used is *25.01 Torque reference speed control* (output of the speed reference chain).	0
	Torque	Torque control. The torque reference used is *26.74 Torque ref ramp out* (output of the torque reference chain).	1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>19.17</td><td>Local control disable</td><td>Enables/disables local control (start and stop buttons on the control panel, and the local controls on the PC tool).
WARNING! Before disabling local control, ensure that the control panel is not needed for stopping the drive.</td><td>No</td></tr>
<tr><td></td><td>No</td><td>Local control enabled.</td><td>0</td></tr>
<tr><td></td><td>Yes</td><td>Local control disabled.</td><td>1</td></tr>
<tr><td>19.20</td><td>Scalar control reference unit</td><td>Selects the reference type for scalar motor control mode.
See also section Operating modes of the drive (page 22), and parameter 99.04 Motor control mode.</td><td>Rpm</td></tr>
<tr><td></td><td>Hz</td><td>Hz. The reference is taken from parameter 28.02 Frequency ref ramp output (output of the frequency control chain).</td><td>0</td></tr>
<tr><td></td><td>Rpm</td><td>Rpm. The reference is taken from parameter 23.02 Speed ref ramp output (speed reference after ramping and shaping).</td><td>1</td></tr>
<tr><td colspan="2">20 Start/stop/direction</td><td>Start/stop/direction and run/start/jog enable signal source selection; positive/negative reference enable signal source selection.
For information on control locations, see section Local control vs. external control (page 20).</td><td></td></tr>
<tr><td>20.01</td><td>Ext1 commands</td><td>Selects the source of start, stop and direction commands for external control location 1 (EXT1).
See also parameters 20.02…20.05.</td><td>In1 Start; In2 Dir</td></tr>
<tr><td></td><td>Not selected</td><td>No start or stop command sources selected.</td><td>0</td></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter 20.03 Ext1 in1 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>Command</th></tr>
<tr><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>Start</td></tr>
<tr><td>0</td><td>Stop</td></tr>
</table></td><td>1</td></tr>
<tr><td></td><td>In1 Start; In2 Dir</td><td>The source selected by 20.03 Ext1 in1 source is the start signal; the source selected by 20.04 Ext1 in2 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0</td><td>Any</td><td>Stop</td></tr>
<tr><td rowspan="2">0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>1</td><td>Start reverse</td></tr>
</table></td><td>2</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>In1 Start fwd; In2 Start rev</td><td>The source selected by 20.03 Ext1 in1 source is the forward start signal; the source selected by 20.04 Ext1 in2 source is the reverse start signal. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0</td><td>0</td><td>Stop</td></tr>
<tr><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>0</td><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>Start reverse</td></tr>
<tr><td>1</td><td>1</td><td>Stop</td></tr>
</table></td><td>3</td></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source and 20.04 Ext1 in2 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>Start</td></tr>
<tr><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Note: The start signal is always edge-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.</td><td>4</td></tr>
<tr><td></td><td>In1P Start; In2 Stop; In3 Dir</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source and 20.04 Ext1 in2 source. The source selected by 20.05 Ext1 in3 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>State of source 3 (20.05)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>0</td><td>Start forward</td></tr>
<tr><td>0 -> 1</td><td>1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>0</td><td>Any</td><td>Stop</td></tr>
</table>
Note: The start signal is always edge-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.</td><td>5</td></tr>
<tr><td></td><td>In1P Start fwd; In2P Start rev; In3 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source, 20.04 Ext1 in2 source and 20.05 Ext1 in3 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>State of source 3 (20.05)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>Any</td><td>1</td><td>Start forward</td></tr>
<tr><td>Any</td><td>0 -> 1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Note: The start signal is always edge-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.</td><td>6</td></tr>
<tr><td></td><td>Control panel</td><td>The start and stop commands are taken from the control panel.</td><td>11</td></tr>
</table>

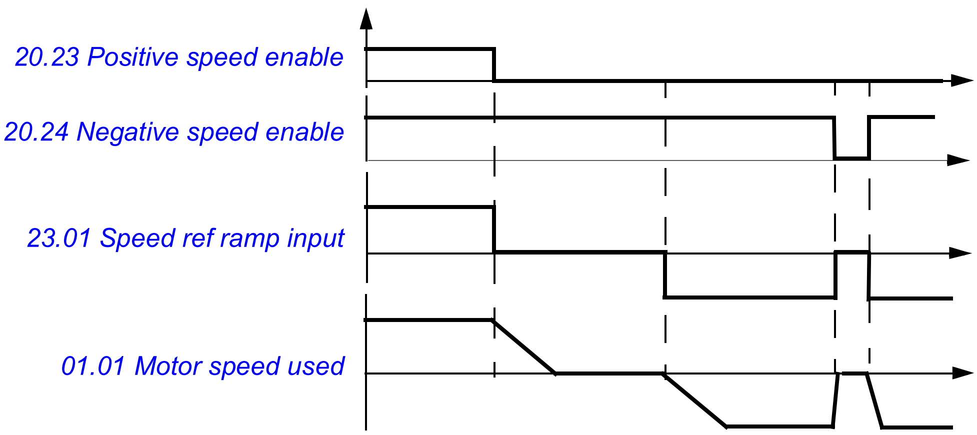
No.	Name/Value	Description	Def/FbEq16
	Fieldbus A	The start and stop commands are taken from fieldbus adapter A. **Note:** The start signal is always level-triggered with this setting regardless of parameter *20.02 Ext1 start trigger type*.	12
	Embedded fieldbus	The start and stop commands are taken from the embedded fieldbus interface. **Note:** The start signal is always level-triggered with this setting regardless of parameter *20.02 Ext1 start trigger type*.	14
	M/F link	The start and stop commands are taken from another drive through the master/follower link. **Note:** The start signal is always level-triggered with this setting regardless of parameter *20.02 Ext1 start trigger type*.	15
	Application Program	The start and stop commands are taken from the application program control word (parameter *06.02 Application control word*). **Note:** The start signal is always level-triggered with this setting regardless of parameter *20.02 Ext1 start trigger type*.	21
	ATF	Reserved.	22
	DDCS controller	The start and stop commands are taken from an external (DDCS) controller. **Note:** The start signal is always level-triggered with this setting regardless of parameter *20.02 Ext1 start trigger type*.	16
20.02	*Ext1 start trigger type*	Defines whether the start signal for external control location EXT1 is edge-triggered or level-triggered. **Note:** This parameter is only effective when parameter *20.01 Ext1 commands* is set to *In1 Start*, *In1 Start; In2 Dir*, *In1 Start fwd; In2 Start rev*, or *Control panel*.	*Edge*
	Edge	The start signal is edge-triggered.	0
	Level	The start signal is level-triggered.	1
20.03	*Ext1 in1 source*	Selects source 1 for parameter *20.01 Ext1 commands*.	*DI1*
	Not selected	0 (always off).	0
	Selected	1 (always on).	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
20.04	*Ext1 in2 source*	Selects source 2 for parameter *20.01 Ext1 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*.	*DI2*
20.05	*Ext1 in3 source*	Selects source 3 for parameter *20.01 Ext1 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*.	*Not selected*

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>DeflFbEq16</th></tr>
<tr><td>20.06</td><td>Ext2 commands</td><td>Selects the source of start, stop and direction commands for external control location 2 (EXT2).
See also parameters 20.07…20.10.</td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>No start or stop command sources selected.</td><td>0</td></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter 20.08 Ext2 in1 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>Command</th></tr>
<tr><td>0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>Start</td></tr>
<tr><td>0</td><td>Stop</td></tr>
</table></td><td>1</td></tr>
<tr><td></td><td>In1 Start; In2 Dir</td><td>The source selected by 20.08 Ext2 in1 source is the start signal; the source selected by 20.09 Ext2 in2 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>Command</th></tr>
<tr><td>0</td><td>Any</td><td>Stop</td></tr>
<tr><td rowspan="2">0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>1</td><td>Start reverse</td></tr>
</table></td><td>2</td></tr>
<tr><td></td><td>In1 Start fwd; In2 Start rev</td><td>The source selected by 20.08 Ext2 in1 source is the forward start signal; the source selected by 20.09 Ext2 in2 source is the reverse start signal. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>Command</th></tr>
<tr><td>0</td><td>0</td><td>Stop</td></tr>
<tr><td>0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>0</td><td>0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>Start reverse</td></tr>
<tr><td>1</td><td>1</td><td>Stop</td></tr>
</table></td><td>3</td></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source and 20.09 Ext2 in2 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>Start</td></tr>
<tr><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Note: The start signal is always edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>4</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>In1P Start; In2 Stop; In3 Dir</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source and 20.09 Ext2 in2 source. The source selected by 20.10 Ext2 in3 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>State of source 3 (20.10)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>0</td><td>Start forward</td></tr>
<tr><td>0 -> 1</td><td>1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>0</td><td>Any</td><td>Stop</td></tr>
</table>
Note: The start signal is always edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>5</td></tr>
<tr><td></td><td>In1P Start fwd; In2P Start rev; In3 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source, 20.09 Ext2 in2 source and 20.10 Ext2 in3 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>State of source 3 (20.10)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>Any</td><td>1</td><td>Start forward</td></tr>
<tr><td>Any</td><td>0 -> 1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Note: The start signal is always edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>6</td></tr>
<tr><td></td><td>Control panel</td><td>The start and stop commands are taken from the control panel.</td><td>11</td></tr>
<tr><td></td><td>Fieldbus A</td><td>The start and stop commands are taken from fieldbus adapter A.
Note: The start signal is always level-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>12</td></tr>
<tr><td></td><td>Embedded fieldbus</td><td>The start and stop commands are taken from the embedded fieldbus interface.
Note: The start signal is always level-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>14</td></tr>
<tr><td></td><td>M/F link</td><td>The start and stop commands are taken from another drive through the master/follower link.
Note: The start signal is always level-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>15</td></tr>
<tr><td></td><td>Application Program</td><td>The start and stop commands are taken from the application program control word (parameter 06.02 Application control word).
Note: The start signal is always level-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>21</td></tr>
<tr><td></td><td>ATF</td><td>Reserved.</td><td>22</td></tr>
<tr><td></td><td>DDCS controller</td><td>The start and stop commands are taken from an external (DDCS) controller.
Note: The start signal is always level-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>16</td></tr>
</table>

No.	Name/Value	Description	*Def/FbEq16*
20.07	*Ext2 start trigger type*	Defines whether the start signal for external control location EXT2 is edge-triggered or level-triggered. **Note:** This parameter is only effective when parameter *20.06 Ext2 commands* is set to *In1 Start*, *In1 Start; In2 Dir*, *In1 Start fwd; In2 Start rev*, or *Control panel*.	*Edge*
	Edge	The start signal is edge-triggered.	0
	Level	The start signal is level-triggered.	1
20.08	*Ext2 in1 source*	Selects source 1 for parameter *20.06 Ext2 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*.	*Not selected*
20.09	*Ext2 in2 source*	Selects source 2 for parameter *20.06 Ext2 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*.	*Not selected*
20.10	*Ext2 in3 source*	Selects source 3 for parameter *20.06 Ext2 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*.	*Not selected*
20.11	*Run enable stop mode*	Selects the way the motor is stopped when the run enable signal switches off. The source of the run enable signal is selected by parameter *20.12 Run enable 1 source*.	*Coast* (*95.20* b10)
	Coast	Stop by switching off the output semiconductors of the drive. The motor coasts to a stop. ⚠ **WARNING!** If a mechanical brake is used, ensure it is safe to stop the drive by coasting.	0
	Ramp	Stop along the active deceleration ramp. See parameter group *23 Speed reference ramp* on page *212*.	1
	Torque limit	Stop according to torque limits (parameters *30.19* and *30.20*).	2
20.12	*Run enable 1 source*	Selects the source of the external run enable signal. If the run enable signal is switched off, the drive will not start. If already running, the drive will stop according to the setting of parameter *20.11 Run enable stop mode*. 1 = Run enable signal on. **Note:** The warning that indicates a missing signal can be suppressed using parameter *20.30 Enable signals warning function*. See also parameter *20.19 Enable start command*.	*DIIL* (*95.20* b10); *Selected* (*95.20* b5); *DI5* (*95.20* b9)
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	FBA A MCW bit 3	Control word bit 3 received through fieldbus interface A.	30
	EFB MCW bit 3	Control word bit 3 received through the embedded fieldbus interface.	32

No.	Name/Value	Description	*Def*/*FbEq16*
	DIIL	DIIL input (*10.02 DI delayed status*, bit 15).	33
	Active control source MCW bit 3	Control word bit 3 received from the active control source. **Notes:** • If the drive is running in fieldbus control, switching bit 3 off effectively removes both the start and run enable signals. In this case, the stop mode is determined by either *20.11 Run enable stop mode* or *21.03 Stop mode*, whichever mode has higher priority. The order of stop modes from highest to lowest priority is *Coast* – *Torque limit* – *Ramp*. • In case the active source is the control panel, PC tool or drive I/O, the run enable signal is always on.	34
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
20.19	*Enable start command*	Selects the source for the start enable signal. 1 = Start enable. With the signal switched off, any drive start command is inhibited. (Switching the signal off while the drive is running will not stop the drive.) **Notes:** • If a level-triggered start command is on when the start enable signal switches on, the drive will start. (An edge-triggered start signal must be cycled for the drive to start.) See parameters *20.02 Ext1 start trigger type* and *20.07 Ext2 start trigger type*. • The warning that indicates a missing signal can be suppressed using parameter *20.30 Enable signals warning function*. See also parameter *20.12 Run enable 1 source*.	*Selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	DIIL	DIIL input (*10.02 DI delayed status*, bit 15).	30
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-

No.	Name/Value	Description	DeflFbEq16
20.23	*Positive speed enable*	Selects the source of the positive speed enable command. 1 = Positive speed enabled. 0 = Positive speed interpreted as zero speed reference. In the figure below, *23.01 Speed ref ramp input* is set to zero after the positive speed enable signal has cleared. Actions in different control modes: Speed control: Speed reference is set to zero and the motor is stopped along the currently active deceleration ramp. The rush controller prevents additional torque terms from running the motor in the positive direction. Torque control: The rush controller monitors the rotation direction of the motor.  **Example:** The motor is rotating in the forward direction. To stop the motor, the positive speed enable signal is deactivated by a hardware limit switch (e.g. via digital input). If the positive speed enable signal remains deactivated and the negative speed enable signal is active, only reverse rotation of the motor is allowed.	*Selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
20.24	*Negative speed enable*	Selects the source of the negative speed reference enable command. See parameter *20.23 Positive speed enable*.	*Selected*

No.	Name/Value	Description	Def/FbEq16
20.25	Jogging enable	Selects the source for a jog enable signal. (The sources for jogging activation signals are selected by parameters 20.26 Jogging 1 start source and 20.27 Jogging 2 start source.) 1 = Jogging is enabled. 0 = Jogging is disabled. **Note:** Jogging can be enabled only when no start command from an external control location is active. On the other hand, if jogging is already enabled, the drive cannot be started from an external control location (apart from inching commands through fieldbus). See section Jogging (page 55).	Not selected
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
20.26	Jogging 1 start source	If enabled by parameter 20.25 Jogging enable, selects the source for the activation of jogging function 1. (Jogging function 1 can also be activated through fieldbus regardless of parameter 20.25.) 1 = Jogging 1 active. **Note:** If both jogging 1 and 2 are activated, the one that was activated first has priority.	Not selected
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-

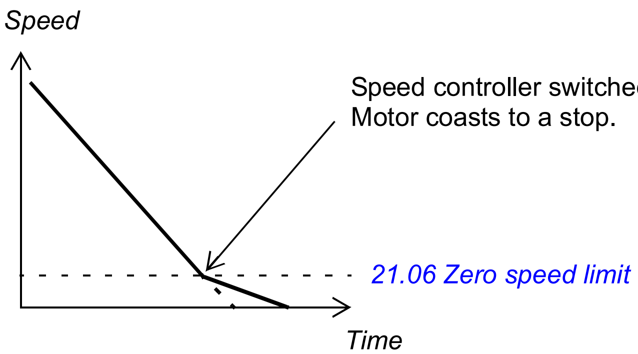
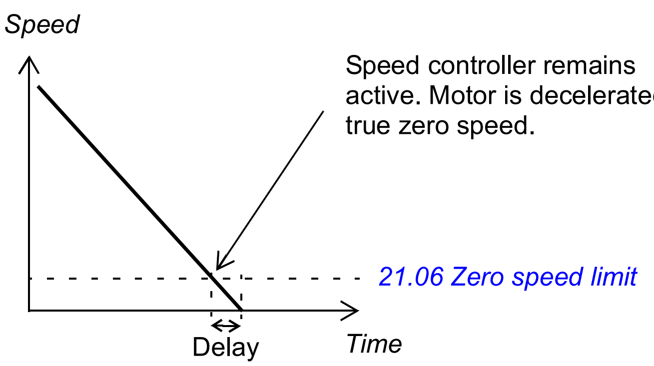
No.	Name/Value	Description	Def/FbEq16
20.27	Jogging 2 start source	If enabled by parameter 20.25 Jogging enable, selects the source for the activation of jogging function 2. (Jogging function 2 can also be activated through fieldbus regardless of parameter 20.25.) 1 = Jogging 2 active. For the selections, see parameter 20.26 Jogging 1 start source. **Note:** If both jogging 1 and 2 are activated, the one that was activated first has priority.	Not selected
20.30	Enable signals warning function	Selects enable signal (eg. run enable, start enable) warnings to be suppressed. This parameter can be used to prevent these warnings from flooding the event log. Whenever a bit of this parameter is set to 1, the corresponding warning is suppressed, ie. no warning is generated even if the signal is switched off. The bits of this binary number correspond to the following warnings:	00b

Bit	Name	Warning
0	Enable Start	AFEA Enable start signal missing
1	Run enable 1	AFEB Run enable missing
2…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	00b…11b	Suppression of "enable signal missing" warnings.	1 = 1
21 Start/stop mode		Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings; autophasing mode selection.	
21.01	Start mode	Selects the motor start function for the DTC motor control mode, ie. when 99.04 Motor control mode is set to DTC. **Notes**: • The start function for the scalar motor control mode is selected by parameter 21.19 Scalar start mode. • Starting into a rotating motor is not possible when DC magnetizing is selected (Fast or Constant time). • With permanent magnet motors and synchronous reluctance motors, Automatic start mode must be used. • This parameter cannot be changed while the drive is running. See also section DC magnetization (page 62).	Automatic
	Fast	The drive pre-magnetizes the motor before start. The pre-magnetizing time is determined automatically, being typically 200 ms to 2 s depending on motor size. This mode should be selected if a high break-away torque is required.	0

No.	Name/Value	Description	Def/FbEq16
	Constant time	The drive pre-magnetizes the motor before start. The pre-magnetizing time is defined by parameter *21.02 Magnetization time*. This mode should be selected if constant pre-magnetizing time is required (e.g. if the motor start must be synchronized with the release of a mechanical brake). This setting also guarantees the highest possible break-away torque when the pre-magnetizing time is set long enough. ⚠ **WARNING!** The drive will start after the set magnetizing time has passed even if motor magnetization is not completed. In applications where a full break-away torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.	1
	Automatic	Automatic start guarantees optimal motor start in most cases. It includes the flying start function (starting into a rotating motor) and the automatic restart function (a stopped motor can be restarted immediately without waiting the motor flux to die away). The drive motor control program identifies the flux as well as the mechanical state of the motor and starts the motor instantly under all conditions.	2
	Flying start	This method is intended for asynchronous motors only, and is optimized for applications where the drive must be started into a rotating motor at high frequencies (above 150 Hz).	3
21.02	*Magnetization time*	Defines the pre-magnetization time when • parameter *21.01 Start mode* is set to *Constant time* (in DTC motor control mode), or • parameter *21.19 Scalar start mode* is set to *Const time* (in scalar motor control mode). After the start command, the drive automatically premagnetizes the motor for the set time. To ensure full magnetizing, set this parameter to the same value as, or higher than, the rotor time constant. If not known, use the rule-of-thumb value given in the table below: **Motor rated power** — **Constant magnetizing time** < 1 kW — ≥ 50 to 100 ms 1 to 10 kW — ≥ 100 to 200 ms 10 to 200 kW — ≥ 200 to 1000 ms 200 to 1000 kW — ≥ 1000 to 2000 ms **Note:** This parameter cannot be changed while the drive is running.	500 ms
	0 … 10000 ms	Constant DC magnetizing time.	1 = 1 ms
21.03	*Stop mode*	Selects the way the motor is stopped when a stop command is received. Additional braking is possible by selecting flux braking (see parameter *97.05 Flux braking*). **Note:** This parameter has no effect in a follower drive in a master/follower configuration.	*Coast*
	Coast	Stop by switching off the output semiconductors of the drive. The motor coasts to a stop. ⚠ **WARNING!** If a mechanical brake is used, ensure it is safe to stop the drive by coasting.	0

No.	Name/Value	Description	*Def/FbEq16*
	Ramp	Stop along the active deceleration ramp. See parameter group *23 Speed reference ramp* on page *212*.	1
	Torque limit	Stop according to torque limits (parameters *30.19* and *30.20*).	2
21.04	*Emergency stop mode*	Selects the way the motor is stopped when an emergency stop command is received. The source of the emergency stop signal is selected by parameter *21.05 Emergency stop source*.	*Ramp stop (Off1)*; *Coast stop (Off2)* (*95.20* b1); *Eme ramp stop (Off3)* (*95.20* b2)
	Ramp stop (Off1)	With the drive running: • 1 = Normal operation. • 0 = Normal stop along the standard deceleration ramp defined for the particular reference type (see section *Reference ramping* [page *42*]). After the drive has stopped, it can be restarted by removing the emergency stop signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed. 0 = Starting not allowed.	0
	Coast stop (Off2)	With the drive running: • 1 = Normal operation. • 0 = Stop by coasting. The drive can be restarted by restoring the start interlock signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed. • 0 = Starting not allowed.	1
	Eme ramp stop (Off3)	With the drive running: • 1 = Normal operation. • 0 = Stop by ramping along emergency stop ramp defined by parameter *23.23 Emergency stop time*. After the drive has stopped, it can be restarted by removing the emergency stop signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed. 0 = Starting not allowed.	2
21.05	*Emergency stop source*	Selects the source of the emergency stop signal. The stop mode is selected by parameter *21.04 Emergency stop mode*. 0 = Emergency stop active 1 = Normal operation **Note:** This parameter cannot be changed while the drive is running.	*Inactive (true)*; *DI4* (*95.20* b1, *95.20* b2)
	Active (false)	0.	0
	Inactive (true)	1.	1
	DIIL	DIIL input (*10.02 DI delayed status*, bit 15).	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7

No.	Name/Value	Description	Def/FbEq16
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	11
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	12
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
21.06	*Zero speed limit*	Defines the zero speed limit. The motor is stopped along a speed ramp (when ramped stop is selected) until the defined zero speed limit is reached. After the zero speed delay, the motor coasts to a stop.	30.00 rpm
	0.00 … 30000.00 rpm	Zero speed limit.	See par. *46.01*
21.07	*Zero speed delay*	Defines the delay for the zero speed delay function. The function is useful in applications where a smooth and quick restarting is essential. During the delay, the drive knows the rotor position accurately. Without zero speed delay: The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter *21.06 Zero speed limit*, inverter modulation is stopped and the motor coasts to a standstill.  With zero speed delay: The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter *21.06 Zero speed limit*, the zero speed delay function activates. During the delay the function keeps the speed controller live: the inverter modulates, motor is magnetized and the drive is ready for a quick restart. Zero speed delay can be used e.g. with the jogging function.  	0 ms
	0 … 30000 ms	Zero speed delay.	1 = 1 ms

No.	Name/Value	Description	*Def/FbEq16*
21.08	*DC current control*	Activates/deactivates the DC hold and post-magnetization functions. See section *DC magnetization* (page *62*). **Notes:** • These functions are only available in speed control in DTC motor control mode (see page *22*). • DC magnetization causes the motor to heat up. In applications where long DC magnetization times are required, externally ventilated motors should be used. If the DC magnetization period is long, DC magnetization cannot prevent the motor shaft from rotating if a constant load is applied to the motor.	0000b

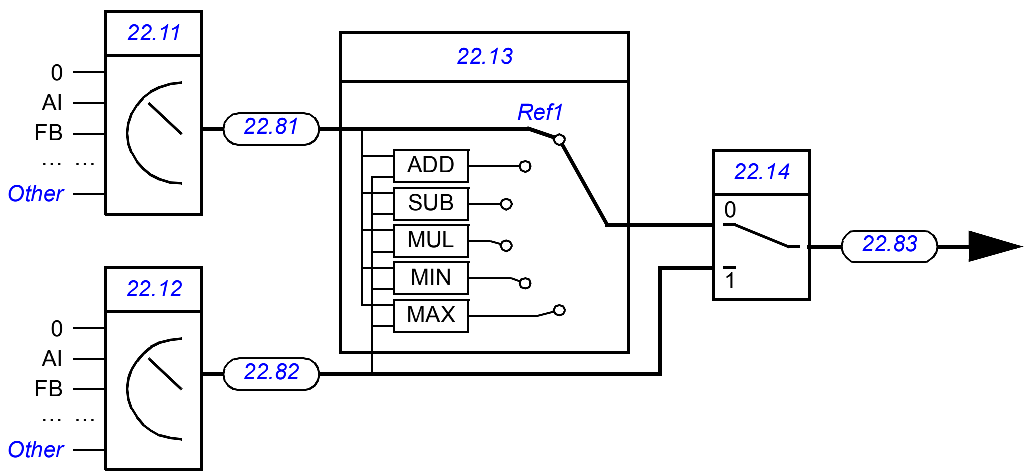
Bit	Value
0	1 = Enable DC hold. See section *DC hold* (page *63*). **Note:** The DC hold function has no effect if the start signal is switched off.
1	1 = Enable post-magnetization. See section *Post-magnetization* (page *63*). **Note:** Post-magnetization is only available when ramping is the selected stop mode (see parameter *21.03 Stop mode*).
2…15	Reserved

No.	Name/Value	Description	*Def/FbEq16*
	0000b…0011b	DC magnetization selection.	1 = 1
21.09	*DC hold speed*	Defines the DC hold speed. See parameter *21.08 DC current control*, and section *DC hold* (page *63*).	5.00 rpm
	0.00 … 1000.00 rpm	DC hold speed.	See par. *46.01*
21.10	*DC current reference*	Defines the DC hold current in percent of the motor nominal current. See parameter *21.08 DC current control*, and section *DC magnetization* (page *62*).	30.0%
	0.0 … 100.0%	DC hold current.	1 = 1%
21.11	*Post magnetization time*	Defines the length of time for which post-magnetization is active after stopping the motor. The magnetization current is defined by parameter *21.10 DC current reference*. See parameter *21.08 DC current control*.	0 s
	0…3000 s	Post-magnetization time.	1 = 1 s
21.12	*Continuous magnetization command*	Activates/deactivates (or selects a source that activates/deactivates) continuous magnetization. See section *Continuous magnetization* (page *64*). The magnetization current is calculated on the basis of flux reference (see parameter group *97 Motor control*). **Notes:** • This function is only available when ramping is the selected stop mode (see parameter *21.03 Stop mode*), and only in speed control in DTC motor control mode (see page *22*). • Continuous magnetization causes the motor to heat up. In applications where long magnetization times are required, externally ventilated motors should be used. • Continuous magnetization may not be able to prevent the motor shaft from rotating during a long period if a constant load is applied to the motor. 0 = Normal operation 1 = Magnetization active	*Off*
	Off	0.	0

No.	Name/Value	Description	Def/FbEq16
	On	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
21.13	*Autophasing mode*	Selects the way autophasing is performed. See section *Autophasing* on page *59*.	*Turning*
	Turning	This mode gives the most accurate autophasing result. This mode can be used, and is recommended, if the motor is allowed to rotate and the start-up is not time-critical. **Note:** This mode will cause the motor to rotate. The load torque must be less than 5%.	0
	Standstill 1	Faster than the *Turning* mode, but not as accurate. The motor will not rotate.	1
	Standstill 2	An alternative standstill autophasing mode that can be used if the *Turning* mode cannot be used, and the *Standstill 1* mode gives erratic results. However, this mode is considerably slower than *Standstill 1*.	2
	Turning with Z-pulse	This mode should be used if the zero pulse signal of the pulse encoder is to be observed, and other modes do not give a result. The motor will turn until a zero pulse is detected.	3
21.14	*Pre-heating input source*	Selects the source of the motor pre-heat on/off command. See section *Pre-heating* (page *62*). **Note:** The pre-heating function will not activate if • the Safe torque off function is active, • a fault is active, • less than one minute has elapsed after stopping, or • PID sleep function is active. Pre-heating is deactivated when the drive is started, and overridden by pre-magnetization, post-magnetization or continuous magnetization. 0 = Pre-heating inactive 1 = Pre-heating active	*Off*
	Off	0. Pre-heating is always deactivated.	0
	On	1. Pre-heating is always activated when the drive is stopped (apart from conditions stated above).	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Supervision 1	Supervision 1 active (*32.01 Supervision status*, bit 0).	8
	Supervision 2	Supervision 2 active (*32.01 Supervision status*, bit 1).	9
	Supervision 3	Supervision 3 active (*32.01 Supervision status*, bit 2).	10
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
21.16	*Pre-heating current*	Defines the motor pre-heating current that is fed into the motor when the source selected by *21.14 Pre-heating input source* is on. The value is in percent of the nominal motor current.	0.0%
	0.0 … 30.0%	Pre-heating current.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
21.18	Auto restart time	The motor can be automatically started after a short supply power failure using the automatic restart function. See section Automatic restart (page 75). When this parameter is set to 0.0 seconds, automatic restarting is disabled. Otherwise, the parameter defines the maximum duration of the power failure after which restarting is attempted. Note that this time also includes the DC pre-charging delay. **WARNING!** Before you activate the function, make sure that no dangerous situations can occur. The function restarts the drive automatically and continues operation after a supply break.	5.0 s
	0.0 s	Automatic restarting disabled.	0
	0.1 … 5.0 s	Maximum power failure duration.	1 = 1 s
21.19	Scalar start mode	Selects the motor start function for the scalar motor control mode, ie. when 99.04 Motor control mode is set to Scalar. **Notes**: • The start function for the DTC motor control mode is selected by parameter 21.01 Start mode. • With permanent magnet motors, Automatic start mode must be used. • This parameter cannot be changed while the drive is running. See also section DC magnetization (page 62).	Normal
	Normal	Immediate start from zero speed.	0
	Const time	The drive pre-magnetizes the motor before start. The pre-magnetizing time is defined by parameter 21.02 Magnetization time. This mode should be selected if constant pre-magnetizing time is required (e.g. if the motor start must be synchronized with the release of a mechanical brake). This setting also guarantees the highest possible break-away torque when the pre-magnetizing time is set long enough. **Note:** This mode cannot be used to start into a rotating motor. **WARNING!** The drive will start after the set magnetizing time has passed even if motor magnetization is not completed. In applications where a full break-away torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.	1
	Automatic	This setting should be used in applications where flying starts (ie. starting into a rotating motor) are required.	2
21.20	Follower force ramp stop	In a torque-controlled follower drive, forces (or selects a source that forces) the drive to switch to speed control upon a ramp stop (Off1 or Off3) command. This is required for an independent ramp stop of the follower. See also section Master/follower functionality (page 31). 1 = Ramp stop forces speed control	Not selected
	Not selected	0.	0
	Selected	1.	1
	DIIL	DIIL input (10.02 DI delayed status, bit 15).	2
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	3
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	4
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	5

No.	Name/Value	Description	Def/FbEq16
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	11
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	12
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
22 Speed reference selection		Speed reference selection; motor potentiometer settings. See the control chain diagrams on pages *550…552*.	
22.01	*Speed ref unlimited*	Displays the output of the speed reference selection block. See the control chain diagram on page *551*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Value of the selected speed reference.	See par. *46.01*
22.11	*Speed ref1 source*	Selects speed reference source 1. Two signal sources can be defined by this parameter and *22.12 Speed ref2 source*. A digital source selected by *22.14 Speed ref1/2 selection* can be used to switch between the two sources, or a mathematical function (*22.13 Speed ref1 function*) applied to the two signals to create the reference.	*AI1 scaled*



No.	Name/Value	Description	Def/FbEq16
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *152*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *154*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *116*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *116*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *116*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *116*).	9
	DDCS ctrl ref1	*03.11 DDCS controller ref 1* (see page *116*).	10
	DDCS ctrl ref2	*03.12 DDCS controller ref 2* (see page *117*).	11
	M/F reference 1	*03.13 M/F or D2D ref1* (see page *117*).	12
	M/F reference 2	*03.14 M/F or D2D ref2* (see page *117*).	13
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15

No.	Name/Value	Description	Def/FbEq16
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Control panel (ref saved)	Control panel reference, with initial value from last-used panel reference. See section *Using the control panel as an external control source* (page *21*).	18
	Control panel (ref copied)	Control panel reference, with initial value from previous source or actual value. See section *Using the control panel as an external control source* (page *21*).	19
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
22.12	*Speed ref2 source*	Selects speed reference source 2. For the selections, and a diagram of reference source selection, see parameter *22.11 Speed ref1 source*.	*Zero*
22.13	*Speed ref1 function*	Selects a mathematical function between the reference sources selected by parameters *22.11 Speed ref1 source* and *22.12 Speed ref2 source*. See diagram at *22.11 Speed ref1 source*.	*Ref1*
	Ref1	Signal selected by *22.11 Speed ref1 source* is used as speed reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as speed reference 1.	1
	Sub (ref1 - ref2)	The subtraction ([*22.11 Speed ref1 source*] - [*22.12 Speed ref2 source*]) of the reference sources is used as speed reference 1.	2
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as speed reference 1.	3
	Min (ref1, ref2)	The smaller of the reference sources is used as speed reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as speed reference 1.	5
22.14	*Speed ref1/2 selection*	Configures the selection between speed references 1 and 2. See diagram at *22.11 Speed ref1 source*. 0 = Speed reference 1 1 = Speed reference 2	*Follow Ext1/Ext2 selection*
	Speed reference 1	0.	0
	Speed reference 2	1.	1
	Follow Ext1/Ext2 selection	Speed reference 1 is used when external control location EXT1 is active. Speed reference 2 is used when external control location EXT2 is active. See also parameter *19.11 Ext1/Ext2 selection*.	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	11
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	12
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>22.15</td><td>Speed additive 1 source</td><td>Defines a reference to be added to the speed reference after reference selection (see page 550).
For the selections, see parameter 22.11 Speed ref1 source.
Note: For safety reasons, the additive is not applied when any of the stop functions are active.</td><td>Zero</td></tr>
<tr><td>22.16</td><td>Speed share</td><td>Defines a scaling factor for the selected speed reference (speed reference 1 or 2, multiplied by the defined value). Speed reference 1 or 2 is selected by parameter 22.14 Speed ref1/2 selection.</td><td>1.000</td></tr>
<tr><td></td><td>-8.000 …8.000</td><td>Speed reference scaling factor.</td><td>1000 = 1</td></tr>
<tr><td>22.17</td><td>Speed additive 2 source</td><td>Defines a reference to be added to the speed reference after the speed share function (see page 550).
For the selections, see parameter 22.11 Speed ref1 source.
Note: For safety reasons, the additive is not applied when any of the stop functions are active.</td><td>Zero</td></tr>
<tr><td>22.21</td><td>Constant speed function</td><td>Determines how constant speeds are selected, and whether the rotation direction signal is considered or not when applying a constant speed.</td><td>0000b</td></tr>
<tr><td colspan="4">
<table>
<tr><th>Bit</th><th>Name</th><th>Information</th></tr>
<tr><td rowspan="2">0</td><td rowspan="2">Constant speed mode</td><td>1 = Packed: 7 constant speeds are selectable using the three sources defined by parameters 22.22, 22.23 and 22.24.</td></tr>
<tr><td>0 = Separate: Constant speeds 1, 2 and 3 are separately activated by the sources defined by parameters 22.22, 22.23 and 22.24 respectively. In case of conflict, the constant speed with the smaller number takes priority.</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Direction enable</td><td>1 = Start dir: To determine running direction for a constant speed, the sign of the constant speed setting (parameters 22.26…22.32) is multiplied by the direction signal (forward: +1, reverse: -1). This effectively allows the drive to have 14 (7 forward, 7 reverse) constant speeds if all values in 22.26…22.32 are positive.
WARNING: If the direction signal is reverse and the active constant speed is negative, the drive will run in the forward direction.</td></tr>
<tr><td>0 = Accord Par: The running direction for the constant speed is determined by the sign of the constant speed setting (parameters 22.26…22.32).</td></tr>
<tr><td>2…15</td><td colspan="2">Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000b…0011b</td><td>Constant speed configuration word.</td><td>1 = 1</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
22.22	*Constant speed sel1*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 1. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.23 Constant speed sel2* and *22.24 Constant speed sel3* select three sources whose states activate constant speeds as follows:	*DI5*

Source defined by par. *22.22*	Source defined by par. *22.23*	Source defined by par. *22.24*	Constant speed active
0	0	0	None
1	0	0	Constant speed 1
0	1	0	Constant speed 2
1	1	0	Constant speed 3
0	0	1	Constant speed 4
1	0	1	Constant speed 5
0	1	1	Constant speed 6
1	1	1	Constant speed 7

No.	Name/Value	Description	Def/FbEq16
	Not selected	0 (always off).	0
	Selected	1 (always on).	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
22.23	*Constant speed sel2*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 2. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.22 Constant speed sel1* and *22.24 Constant speed sel3* select three sources that are used to activate constant speeds. See table at parameter *22.22 Constant speed sel1*. For the selections, see parameter *22.22 Constant speed sel1*.	*Not selected*
22.24	*Constant speed sel3*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 3. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.22 Constant speed sel1* and *22.23 Constant speed sel2* select three sources that are used to activate constant speeds. See table at parameter *22.22 Constant speed sel1*. For the selections, see parameter *22.22 Constant speed sel1*.	*Not selected*
22.26	*Constant speed 1*	Defines constant speed 1 (the speed the motor will turn when constant speed 1 is selected).	300.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 1.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
22.27	Constant speed 2	Defines constant speed 2.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 2.	See par. 46.01
22.28	Constant speed 3	Defines constant speed 3.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 3.	See par. 46.01
22.29	Constant speed 4	Defines constant speed 4.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 4.	See par. 46.01
22.30	Constant speed 5	Defines constant speed 5.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 5.	See par. 46.01
22.31	Constant speed 6	Defines constant speed 6.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 6.	See par. 46.01
22.32	Constant speed 7	Defines constant speed 7.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 7.	See par. 46.01
22.41	Speed ref safe	Defines a safe speed reference value that is used with supervision functions such as • 12.03 AI supervision function • 49.05 Communication loss action • 50.02 FBA A comm loss func • 50.32 FBA B comm loss func • 58.14 Communication loss action.	0.00 rpm
	-30000.00 … 30000.00 rpm	Safe speed reference.	See par. 46.01
22.42	Jogging 1 ref	Defines the speed reference for jogging function 1. For more information on jogging, see page 55.	0.00 rpm
	-30000.00 … 30000.00 rpm	Speed reference for jogging function 1.	See par. 46.01
22.43	Jogging 2 ref	Defines the speed reference for jogging function 2. For more information on jogging, see page 55.	0.00 rpm
	-30000.00 … 30000.00 rpm	Speed reference for jogging function 2.	See par. 46.01

No.	Name/Value	Description	Def/FbEq16
22.51	*Critical speed function*	Enables/disables the critical speeds function. Also determines whether the specified ranges are effective in both rotating directions or not. See also section *Critical speeds/frequencies* (page *43*).	0000b

Bit	Name	Information
0	Enable	1 = Enable: Critical speeds enabled.
		0 = Disable: Critical speeds disabled.
1	Sign mode	1 = Signed: The signs of parameters *22.52…22.57* are taken into account.
		0 = Absolute: Parameters *22.52…22.57* are handled as absolute values. Each range is effective in both directions of rotation.
2…15	Reserved	

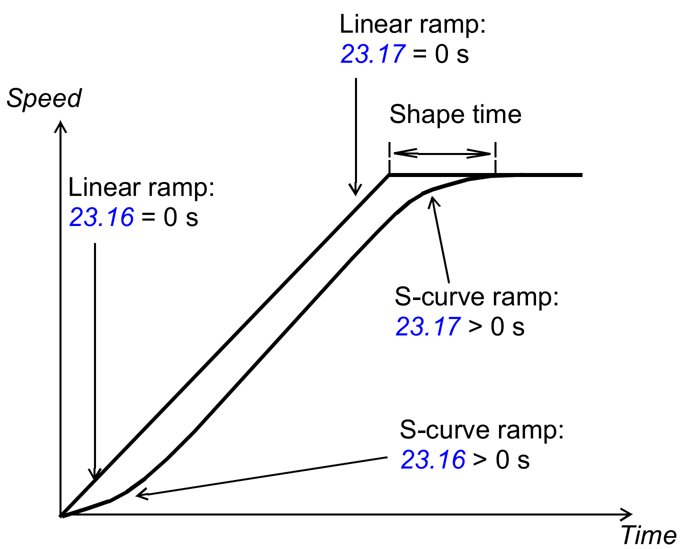
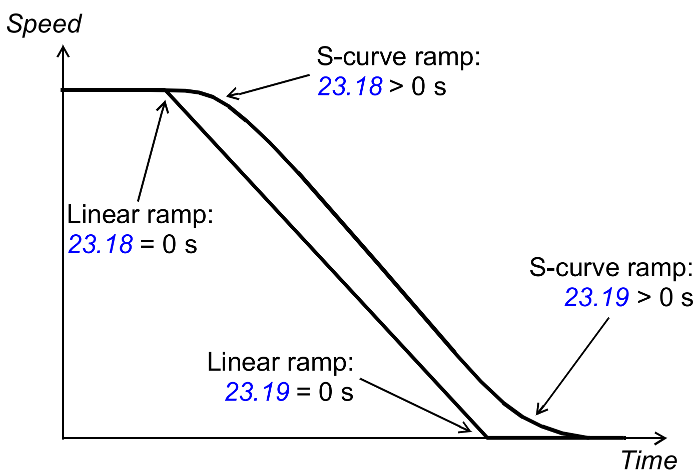
No.	Name/Value	Description	Def/FbEq16
	0000b…0011b	Critical speeds configuration word.	1 = 1
22.52	*Critical speed 1 low*	Defines the low limit for critical speed range 1. **Note:** This value must be less than or equal to the value of *22.53 Critical speed 1 high*.	0.00 rpm
	-30000.00 … 30000.00 rpm	Low limit for critical speed 1.	See par. *46.01*
22.53	*Critical speed 1 high*	Defines the high limit for critical speed range 1. **Note:** This value must be greater than or equal to the value of *22.52 Critical speed 1 low*.	0.00 rpm
	-30000.00 … 30000.00 rpm	High limit for critical speed 1.	See par. *46.01*
22.54	*Critical speed 2 low*	Defines the low limit for critical speed range 2. **Note:** This value must be less than or equal to the value of *22.55 Critical speed 2 high*.	0.00 rpm
	-30000.00 … 30000.00 rpm	Low limit for critical speed 2.	See par. *46.01*
22.55	*Critical speed 2 high*	Defines the high limit for critical speed range 2. **Note:** This value must be greater than or equal to the value of *22.54 Critical speed 2 low*.	0.00 rpm
	-30000.00 … 30000.00 rpm	High limit for critical speed 2.	See par. *46.01*
22.56	*Critical speed 3 low*	Defines the low limit for critical speed range 3. **Note:** This value must be less than or equal to the value of *22.57 Critical speed 3 high*.	0.00 rpm
	-30000.00 … 30000.00 rpm	Low limit for critical speed 3.	See par. *46.01*
22.57	*Critical speed 3 high*	Defines the high limit for critical speed range 3. **Note:** This value must be greater than or equal to the value of *22.56 Critical speed 3 low*.	0.00 rpm
	-30000.00 … 30000.00 rpm	High limit for critical speed 3.	See par. *46.01*
22.71	*Motor potentiometer function*	Activates and selects the mode of the motor potentiometer. See section *Motor potentiometer* (page *68*).	*Disabled*
	Disabled	Motor potentiometer is disabled and its value set to 0.	0

No.	Name/Value	Description	Def/FbEq16
	Enabled (init at stop/power-up)	When enabled, the motor potentiometer first adopts the value defined by parameter *22.72 Motor potentiometer initial value*. When the drive is running, the value can be adjusted from the up and down sources defined by parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source*. A stop or a power cycle will reset the motor potentiometer to the initial value (*22.72*).	1
	Enabled (resume always)	As *Enabled (init at stop/power-up)*, but the motor potentiometer value is retained over a stop or a power cycle.	2
22.72	*Motor potentiometer initial value*	Defines an initial value (starting point) for the motor potentiometer. See the selections of parameter *22.71 Motor potentiometer function*.	0.00
	-32768.00 … 32767.00	Initial value for motor potentiometer.	1 = 1
22.73	*Motor potentiometer up source*	Selects the source of motor potentiometer up signal. 0 = No change 1 = Increase motor potentiometer value. (If both the up and down sources are on, the potentiometer value will not change.)	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
22.74	*Motor potentiometer down source*	Selects the source of motor potentiometer down signal. 0 = No change 1 = Decrease motor potentiometer value. (If both the up and down sources are on, the potentiometer value will not change.) For the selections, see parameter *22.73 Motor potentiometer up source*.	*Not selected*
22.75	*Motor potentiometer ramp time*	Defines the change rate of the motor potentiometer. This parameter specifies the time required for the motor potentiometer to change from minimum (*22.76*) to maximum (*22.77*). The same change rate applies in both directions.	60.0 s
	0.0 … 3600.0 s	Motor potentiometer change time.	10 = 1 s
22.76	*Motor potentiometer min value*	Defines the minimum value of the motor potentiometer.	-1500.00
	-32768.00 … 32767.00	Motor potentiometer minimum.	1 = 1

No.	Name/Value	Description	*Def/FbEq16*
22.77	*Motor potentiometer max value*	Defines the maximum value of the motor potentiometer.	1500.00
	-32768.00 … 32767.00	Motor potentiometer maximum.	1 = 1
22.80	*Motor potentiometer ref act*	Displays the output of the motor potentiometer function. (The motor potentiometer is configured using parameters *22.71*…*22.74*.) This parameter is read-only.	-
	-32768.00 … 32767.00	Value of motor potentiometer.	1 = 1
22.81	*Speed reference act 1*	Displays the value of speed reference source 1 (selected by parameter *22.11 Speed ref1 source*). See the control chain diagram on page *550*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Value of reference source 1.	See par. *46.01*
22.82	*Speed reference act 2*	Displays the value of speed reference source 2 (selected by parameter *22.12 Speed ref2 source*). See the control chain diagram on page *550*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Value of reference source 2.	See par. *46.01*
22.83	*Speed reference act 3*	Displays the value of speed reference after the mathematical function applied by parameter *22.13 Speed ref1 function* and reference 1/2 selection (*22.14 Speed ref1/2 selection*). See the control chain diagram on page *550*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after source selection.	See par. *46.01*
22.84	*Speed reference act 4*	Displays the value of speed reference after application of 1st speed additive (*22.15 Speed additive 1 source*). See the control chain diagram on page *550*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after additive 1.	See par. *46.01*
22.85	*Speed reference act 5*	Displays the value of speed reference after the application of the speed share scaling factor (*22.16 Speed share*). See the control chain diagram on page *550*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after speed share scaling.	See par. *46.01*
22.86	*Speed reference act 6*	Displays the value of speed reference after application of 2nd speed additive (*22.17 Speed additive 2 source*). See the control chain diagram on page *550*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after additive 2.	See par. *46.01*

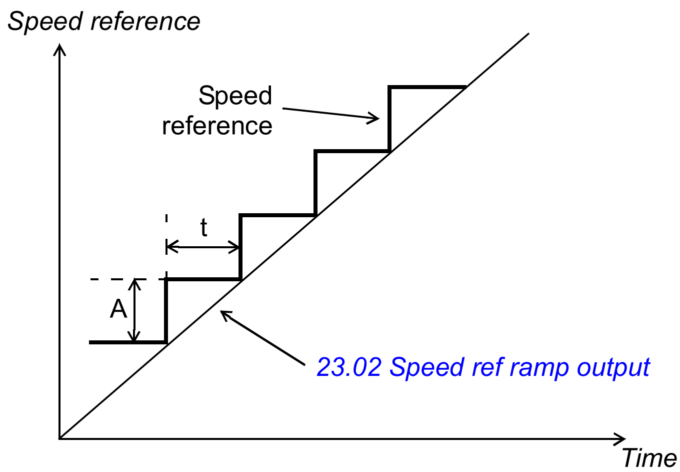
No.	Name/Value	Description	Def/FbEq16
22.87	Speed reference act 7	Displays the value of speed reference before application of critical speeds. See the control chain diagram on page 551. The value is received from 22.86 Speed reference act 6 unless overridden by • any constant speed • a jogging reference • network control reference • control panel reference • safe speed reference. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference before application of critical speeds.	See par. 46.01
23 Speed reference ramp		Speed reference ramp settings (programming of the acceleration and deceleration rates for the drive). See the control chain diagram on page 552.	
23.01	Speed ref ramp input	Displays the used speed reference (in rpm) before it enters the ramping and shaping functions. See the control chain diagram on page 552. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference before ramping and shaping.	See par. 46.01
23.02	Speed ref ramp output	Displays the ramped and shaped speed reference in rpm. See the control chain diagram on page 552. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after ramping and shaping.	See par. 46.01
23.11	Ramp set selection	Selects the source that switches between the two sets of acceleration/deceleration ramp times defined by parameters 23.12…23.15. 0 = Acceleration time 1 and deceleration time 1 are active 1 = Acceleration time 2 and deceleration time 2 are active	DI4; Acc/Dec time 2 (95.20 b1)
	Acc/Dec time 1	0.	0
	Acc/Dec time 2	1.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-

No.	Name/Value	Description	*DeflFbEq16*
23.12	*Acceleration time 1*	Defines acceleration time 1 as the time required for the speed to change from zero to the speed defined by parameter *46.01 Speed scaling* (**not** to parameter *30.12 Maximum speed*). If the speed reference increases faster than the set acceleration rate, the motor speed will follow the acceleration rate. If the speed reference increases slower than the set acceleration rate, the motor speed will follow the reference. If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits.	20.000 s
	0.000 …1800.000 s	Acceleration time 1.	10 = 1 s
23.13	*Deceleration time 1*	Defines deceleration time 1 as the time required for the speed to change from the speed defined by parameter *46.01 Speed scaling* (**not** from parameter *30.12 Maximum speed*) to zero. If the speed reference decreases slower than the set deceleration rate, the motor speed will follow the reference. If the reference changes faster than the set deceleration rate, the motor speed will follow the deceleration rate. If the deceleration rate is set too short, the drive will automatically prolong the deceleration in order not to exceed drive torque limits (or not to exceed a safe DC link voltage). If there is any doubt about the deceleration time being too short, ensure that DC overvoltage control is on (parameter *30.30 Overvoltage control*). **Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with braking equipment such as a brake chopper and brake resistor.	20.000 s
	0.000 …1800.000 s	Deceleration time 1.	10 = 1 s
23.14	*Acceleration time 2*	Defines acceleration time 2. See parameter *23.12 Acceleration time 1*.	60.000 s
	0.000 …1800.000 s	Acceleration time 2.	10 = 1 s
23.15	*Deceleration time 2*	Defines deceleration time 2. See parameter *23.13 Deceleration time 1*.	60.000 s
	0.000 …1800.000 s	Deceleration time 2.	10 = 1 s

No.	Name/Value	Description	*Def/FbEq16*
23.16	*Shape time acc 1*	Defines the shape of the acceleration ramp at the beginning of the acceleration. 0.000 s: Linear ramp. Suitable for steady acceleration or deceleration and for slow ramps. 0.001…1000.000 s: S-curve ramp. S-curve ramps are ideal for lifting applications. The S-curve consists of symmetrical curves at both ends of the ramp and a linear part in between. **Note:** For safety reasons, shape times are not applied to emergency stop ramps. **Acceleration:**  **Deceleration:** 	0.000 s
	0.000 …1800.000 s	Ramp shape at start of acceleration.	10 = 1 s
23.17	*Shape time acc 2*	Defines the shape of the acceleration ramp at the end of the acceleration. See parameter *23.16 Shape time acc 1*.	0.000 s
	0.000 …1800.000 s	Ramp shape at end of acceleration.	10 = 1 s
23.18	*Shape time dec 1*	Defines the shape of the deceleration ramp at the beginning of the deceleration. See parameter *23.16 Shape time acc 1*.	0.000 s
	0.000 …1800.000 s	Ramp shape at start of deceleration.	10 = 1 s

No.	Name/Value	Description	*DefFbEq16*
23.19	*Shape time dec 2*	Defines the shape of the deceleration ramp at the end of the deceleration. See parameter *23.16 Shape time acc 1*.	0.000 s
	0.000 …1800.000 s	Ramp shape at end of deceleration.	10 = 1 s
23.20	*Acc time jogging*	Defines the acceleration time for the jogging function i.e. the time required for the speed to change from zero to the speed value defined by parameter *46.01 Speed scaling*. See section *Jogging* (page *55*).	60.000 s
	0.000 …1800.000 s	Acceleration time for jogging.	10 = 1 s
23.21	*Dec time jogging*	Defines the deceleration time for the jogging function i.e. the time required for the speed to change from the speed value defined by parameter *46.01 Speed scaling* to zero. See section *Jogging* (page *55*).	60.000 s
	0.000 …1800.000 s	Deceleration time for jogging.	10 = 1 s
23.23	*Emergency stop time*	In speed control mode, this parameter defines the deceleration rate for emergency stop Off3 as the time it would take for the speed to decrease from the value of parameter *46.01 Speed scaling* to zero. This also applies to torque control because the drive switches to speed control on receiving an emergency stop Off3 command. In frequency control mode, this parameter specifies the time it would take for the frequency to decrease from the value of *46.02 Frequency scaling* to zero. The emergency stop mode and activation source are selected by parameters *21.04 Emergency stop mode* and *21.05 Emergency stop source* respectively. Emergency stop can also be activated through fieldbus. **Note:** Emergency stop Off1 uses the standard deceleration ramp as defined by parameters *23.11*…*23.19* (speed and torque control) or *28.71*…*28.75* (frequency control).	3.000 s
	0.000 …1800.000 s	Emergency stop Off3 deceleration time.	10 = 1 s
23.24	*Speed ramp in zero source*	Selects a source that forces the speed reference to zero just before it enters the ramp function. 0 = Force speed reference to zero before the ramp function 1 = Speed reference continues towards the ramp function as normal	*Inactive*
	Active	0.	0
	Inactive	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-

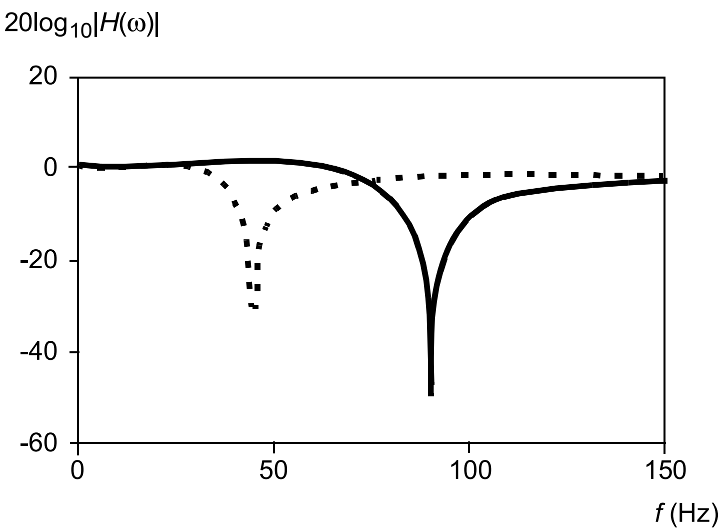
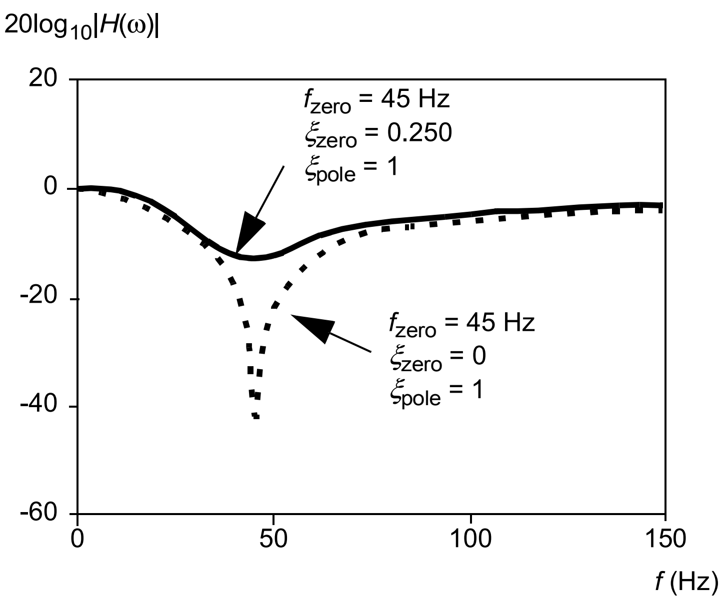
No.	Name/Value	Description	Def/FbEq16
23.26	Ramp out balancing enable	Selects the source for enabling/disabling speed reference ramp balancing. This function is used to generate a smooth transfer from a torque- or tension-controlled motor back to being speed-controlled. The balancing output would be tracking the present “line” speed of the application and when transfer is required, the speed reference can then be quickly “seeded” to the correct line speed. Balancing is also possible in the speed controller, see parameter 25.09 Speed ctrl balancing enable. See also parameter 23.27 Ramp out balancing ref. 0 = Disabled 1 = Enabled	Not selected
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
23.27	Ramp out balancing ref	Defines the reference for speed ramp balancing. The output of the ramp generator is forced to this value when balancing is enabled by parameter 23.26 Ramp out balancing enable.	0.00 rpm
	-30000.00 … 30000.00 rpm	Speed ramp balancing reference.	See par. 46.01

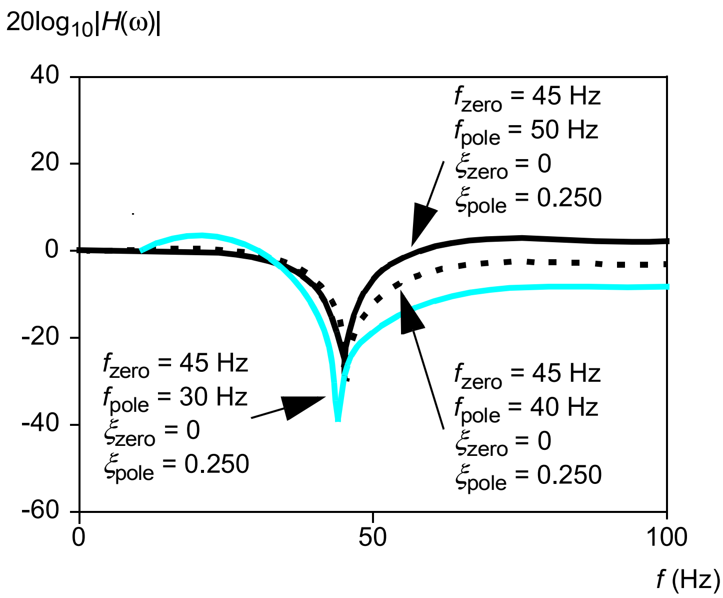
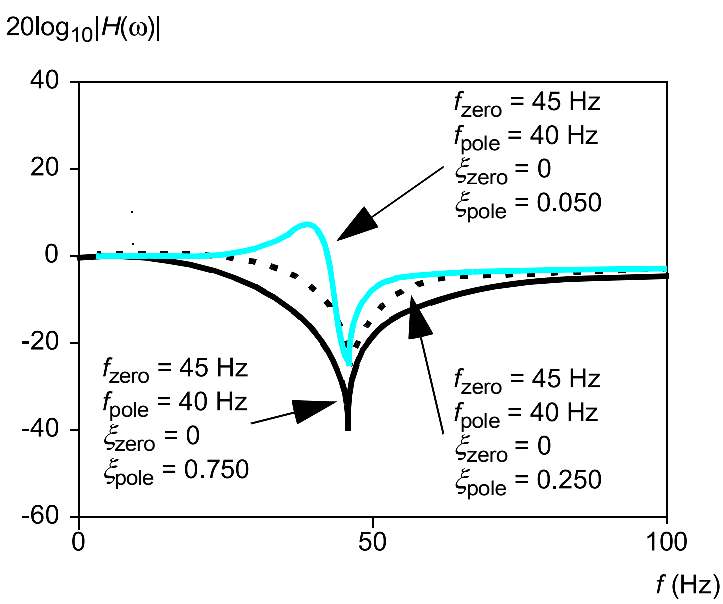
No.	Name/Value	Description	Def/FbEq16
23.28	*Variable slope enable*	Activates the variable slope function, which controls the slope of the speed ramp during a speed reference change. This allows for a constantly variable ramp rate to be generated, instead of just the standard two ramps normally available. If the update interval of the signal from an external control system and the variable slope rate (*23.29 Variable slope rate*) are equal, the resulting speed reference (*23.02 Speed ref ramp output*) is a straight line.  t = update interval of signal from external control system A = speed reference change during t This function is only active in remote control.	*Off*
	Off	Variable slope disabled.	0
	On	Variable slope enabled (not available in local control).	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
23.29	*Variable slope rate*	Defines the rate of the speed reference change when variable slope is enabled by parameter *23.28 Variable slope enable*. For the best result, enter the reference update interval into this parameter.	50 ms
	2…30000 ms	Variable slope rate.	1 = 1 ms
23.39	*Follower speed correction out*	Displays the speed correction term for the load share function with a speed-controlled follower drive. See section *Load share function with a speed-controlled follower* (page *32*). This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed correction term.	See par. *46.01*
23.40	*Follower speed correction enable*	With a speed-controlled follower, selects the source for enabling/disabling the load share function. See section *Load share function with a speed-controlled follower* (page *32*). 0 = Disabled 1 = Enabled	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3

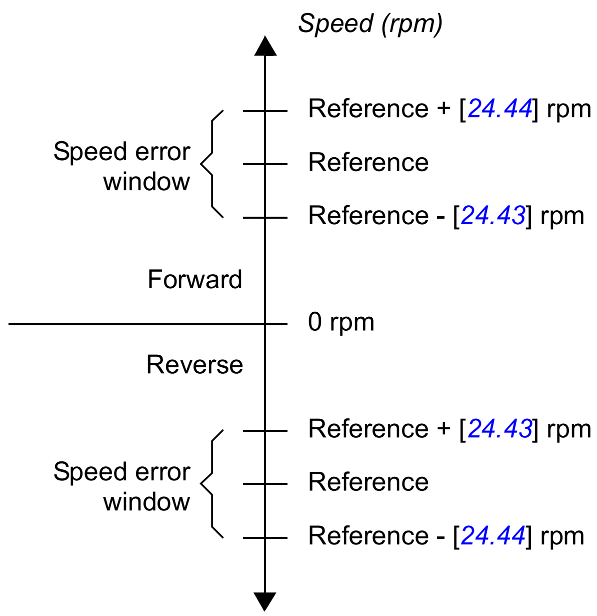
No.	Name/Value	Description	Def/FbEq16
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
23.41	*Follower speed correction gain*	Adjusts the gain of the speed correction term in a speed-controlled follower. In effect, defines how accurately the follower follows the master torque. A greater value results in a more accurate performance. See section *Load share function with a speed-controlled follower* (page *32*).	1.00%
	0.00 … 100.00%	Speed correction term adjustment.	1 = 1%
23.42	*Follower speed corr torq source*	Selects the source of the torque reference for the load share function. See section *Load share function with a speed-controlled follower* (page *32*).	*MF ref 2*
	NULL	None.	0
	MF ref 2	*03.14 M/F or D2D ref2* (page *117*).	1
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-

24 Speed reference conditioning		Speed error calculation; speed error window control configuration; speed error step. See the control chain diagrams on pages *555* and *556*.	
24.01	*Used speed reference*	Displays the ramped and corrected speed reference (before speed error calculation). See the control chain diagram on page *555*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference used for speed error calculation.	See par. *46.01*
24.02	*Used speed feedback*	Displays the speed feedback used for speed error calculation. See the control chain diagram on page *555*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed feedback used for speed error calculation.	See par. *46.01*
24.03	*Speed error filtered*	Displays the filtered speed error. See the control chain diagram on page *555*. This parameter is read-only.	-
	-30000.0 … 30000.0 rpm	Filtered speed error.	See par. *46.01*
24.04	*Speed error inverted*	Displays the inverted (unfiltered) speed error. See the control chain diagram on page *555*. This parameter is read-only.	-
	-30000.0 … 30000.0 rpm	Inverted speed error.	See par. *46.01*

No.	Name/Value	Description	*Def/FbEq16*
24.11	*Speed correction*	Defines a speed reference correction, ie. a value added to the existing reference between ramping and limitation. This is useful to trim the speed if necessary, for example to adjust draw between sections of a paper machine. **Note:** For safety reasons, the correction is not applied when an emergency stop is active. **WARNING!** If the speed reference correction exceeds *21.06 Zero speed limit*, a ramp stop may be impossible. Make sure the correction is reduced or removed when a ramp stop is required. See the control chain diagram on page *555*.	0.00 rpm
	-10000.00 … 10000.00 rpm	Speed reference correction.	See par. *46.01*
24.12	*Speed error filter time*	Defines the time constant of the speed error low-pass filter. If the used speed reference changes rapidly, the possible interferences in the speed measurement can be filtered with the speed error filter. Reducing the ripple with this filter may cause speed controller tuning problems. A long filter time constant and fast acceleration time contradict one another. A very long filter time results in unstable control.	0 ms
	0…10000 ms	Speed error filtering time constant. 0 = filtering disabled.	1 = 1 ms
24.13	*RFE speed filter*	Enables/disables resonance frequency filtering. The filtering is configured by parameters *24.13*…*24.17*. The speed error value coming to the speed controller is filtered by a common 2nd order band-elimination filter to eliminate the amplification of mechanical resonance frequencies. **Note:** Tuning the resonance frequency filter requires a basic understanding of frequency filters. Incorrect tuning can amplify mechanical oscillations and damage the drive hardware. To ensure the stability of the speed controller, stop the drive or disable the filtering before changing the parameter settings. 0 = Resonance frequency filtering disabled. 1 = Resonance frequency filtering enabled.	*Off*
	Off	0.	0
	On	1.	1

No.	Name/Value	Description	Def/FbEq16
24.14	*Frequency of zero*	Defines the zero frequency of the resonance frequency filter. The value must be set near the resonance frequency, which is filtered out before the speed controller. The drawing shows the frequency response.  	45.00 Hz
	0.50 … 500.00 Hz	Zero frequency.	1 = 1 Hz
24.15	*Damping of zero*	Defines the damping coefficient for parameter *24.14*. The value of 0 corresponds to the maximum elimination of the resonance frequency.  **Note:** To ensure that the resonance frequency band is filtered (rather than amplified), the value of *24.15* must be smaller than *24.17*.	0.000
	-1.000 … 1.000	Damping coefficient.	100 = 1

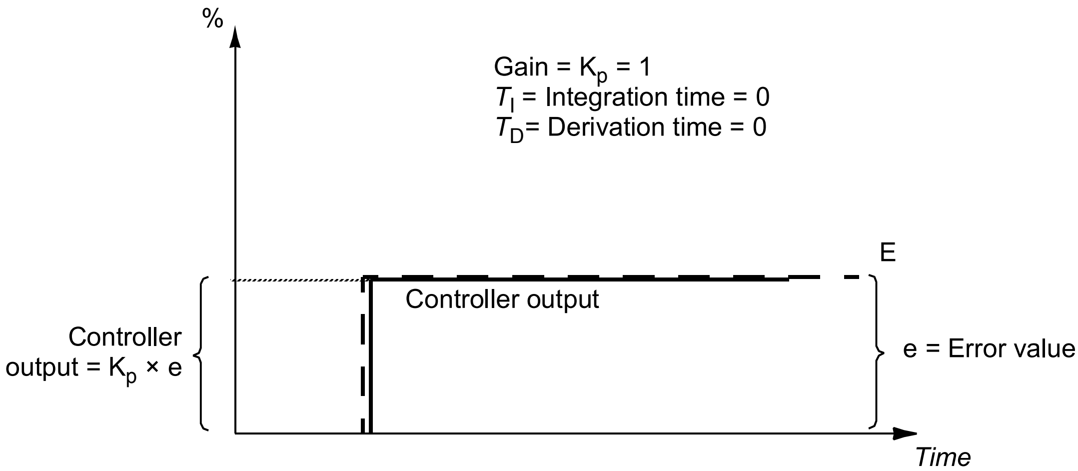
No.	Name/Value	Description	*Def*/**FbEq16**
24.16	*Frequency of pole*	Defines the frequency of pole of the resonance frequency filter.  **Note:** If this value is very different from the value of *24.14*, the frequencies near the frequency of pole are amplified, which can damage the driven machine.	40.00 Hz
	0.50 … 500.00 Hz	Frequency of pole.	1 = 1 Hz
24.17	*Damping of pole*	Defines the damping coefficient for parameter *24.16*. The coefficient shapes the frequency response of the resonance frequency filter. A narrower bandwidth results in better dynamic properties. By setting this parameter to 1, the effect of the pole is eliminated.  **Note:** To ensure that the resonance frequency band is filtered (rather than amplified), the value of *24.15* must be smaller than *24.17*.	0.250
	-1.000 … 1.000	Damping coefficient.	100 = 1

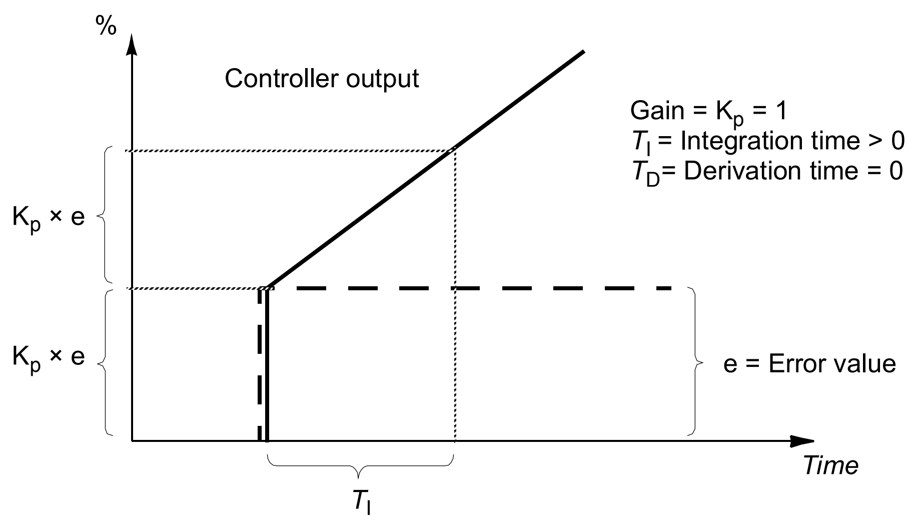
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>24.41</td><td>Speed error window control enable</td><td>
Enables/disables (or selects a source that enables/disables) speed error window control, sometimes also referred to as deadband control or strip break protection. It forms a speed supervision function for a torque-controlled drive, preventing the motor from running away if the material that is being held under tension breaks.
Note: Speed error window control is only effective when the Add operating mode is active (see parameters 19.12 and 19.14), or when the drive is a speed-controlled follower (see page 32).
In normal operation, window control keeps the speed controller input at zero so the drive stays in torque control.
If the motor load is lost, then the motor speed will rise as the torque controller tries to maintain torque. The speed error (speed reference - actual speed) will increase until it exits the speed error window. When this is detected, the exceeding part of the error value is connected to the speed controller. The speed controller produces a reference term relative to the input and gain (25.02 Speed proportional gain) which the torque selector adds to the torque reference. The result is used as the internal torque reference for the drive.
The activation of speed error window control is indicated by bit 3 of 06.19 Speed control status word.
The window boundaries are defined by 24.43 Speed error window high and 24.44 Speed error window low as follows:


Note that it is parameter 24.44 (rather than 24.43) that defines the overspeed limit in both directions of rotation. This is because the function monitors speed error (which is negative in case of overspeed, positive in case of underspeed).
0 = Speed error window control disabled
1 = Speed error window control enabled
</td><td>Disable</td></tr>
<tr><td></td><td>Disable</td><td>0.</td><td>0</td></tr>
<tr><td></td><td>Enable</td><td>1.</td><td>1</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations on page 110).</td><td>-</td></tr>
</table>

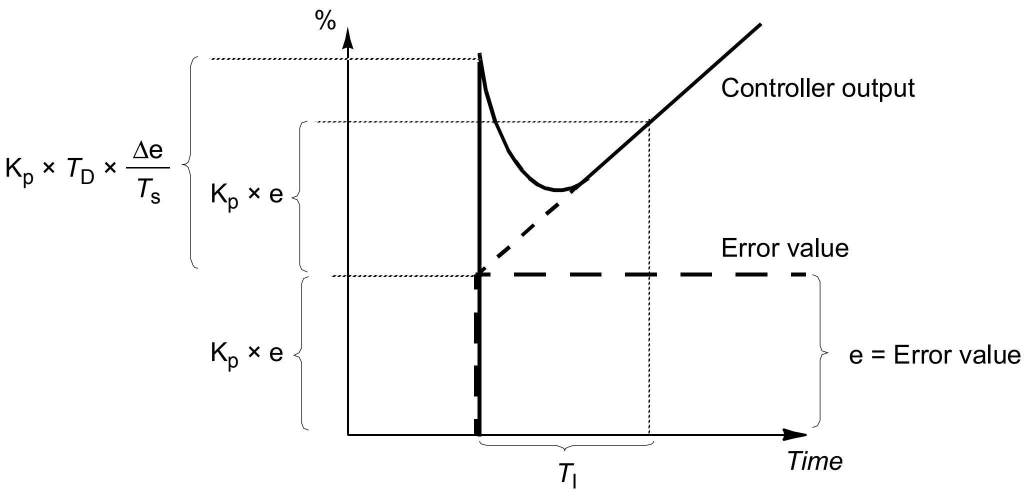
No.	Name/Value	Description	*Def/FbEq16*
24.42	*Speed window control mode*	When speed error window control (see parameter *24.41 Speed error window control enable*) is enabled, this parameter determines whether the speed controller only observes the proportional term instead of all three (P, I and D) terms.	*Normal speed control*
	Normal speed control	All three terms (parameters *25.02*, *25.03* and *25.04*) are observed by the speed controller.	0
	P-control	Only the proportional term (*25.02*) is observed by the speed controller. The integral and derivative terms are internally forced to zero.	1
24.43	*Speed error window high*	Defines the upper boundary of the speed error window. See parameter *24.41 Speed error window control enable*.	0.00 rpm
	0.00 … 3000.00 rpm	Upper boundary of speed error window.	See par. *46.01*
24.44	*Speed error window low*	Defines the lower boundary of the speed error window. See parameter *24.41 Speed error window control enable*.	0.00 rpm
	0.00 … 3000.00 rpm	Lower boundary of speed error window.	See par. *46.01*
24.46	*Speed error step*	Defines an additional speed error step given to the input of the speed controller (and added to the speed error value). This can be used in large drive systems for dynamic speed normalizing. **WARNING!** Make sure the error step value is removed when a stop command is given.	0.00 rpm
	-3000.00 … 3000.00 rpm	Speed error step.	See par. *46.01*

25 Speed control		Speed controller settings. See the control chain diagrams on pages *555* and *556*.	
25.01	*Torque reference speed control*	Displays the speed controller output that is transferred to the torque controller. See the control chain diagram on page *556*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Limited speed controller output torque.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
25.02	*Speed proportional gain*	Defines the proportional gain (K_p) of the speed controller. Too high a gain may cause speed oscillation. The figure below shows the speed controller output after an error step when the error remains constant.  If gain is set to 1.00, a 10% error (reference - actual value) in the motor synchronous speed produces a proportional term of 10%. **Note:** This parameter is automatically set by the speed controller autotune function. See section *Speed controller autotune* (page *44*).	10.00; 5.00 (*95.21* b1/b2)
	0.00 …250.00	Proportional gain for speed controller.	100 = 1

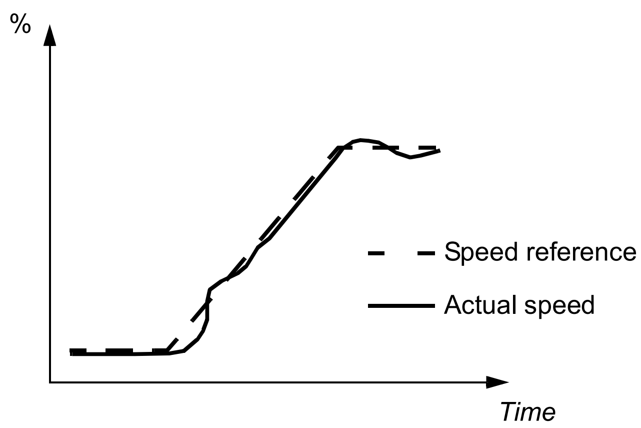
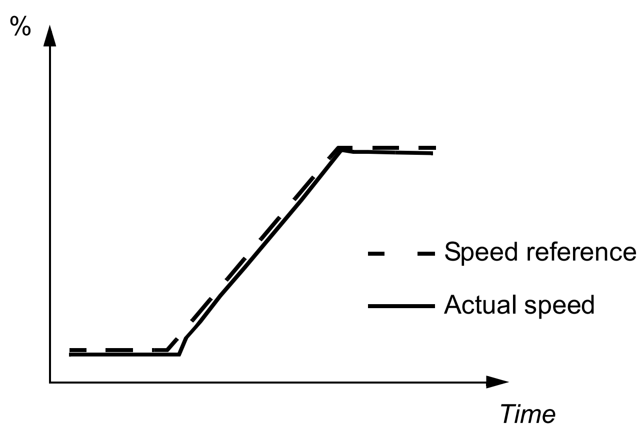
No.	Name/Value	Description	*DefFbEq16*
25.03	*Speed integration time*	Defines the integration time of the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant and the proportional gain of the speed controller is 1. The shorter the integration time, the faster the continuous error value is corrected. Setting the integration time to zero disables the I-part of the controller. This is useful to do when tuning the proportional gain; adjust the proportional gain first, then return the integration time. The integrator has anti-windup control for operation at a torque or current limit. The figure below shows the speed controller output after an error step when the error remains constant.  **Note:** This parameter is automatically set by the speed controller autotune function. See section *Speed controller autotune* (page *44*).	2.50 s; 5.00 (*95.21* b1/b2)
	0.00 … 1000.00 s	Integration time for speed controller.	10 = 1 s

No.	Name/Value	Description	*Def/FbEq16*
25.04	*Speed derivation time*	Defines the derivation time of the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted during the change. If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The derivation makes the control more responsive for disturbances. For simple applications (especially those without an encoder), derivative time is not normally required and should be left at zero. The figure below shows the speed controller output after an error step when the error remains constant. The speed error derivative must be filtered with a low pass filter to eliminate external disturbances.	0.000 s



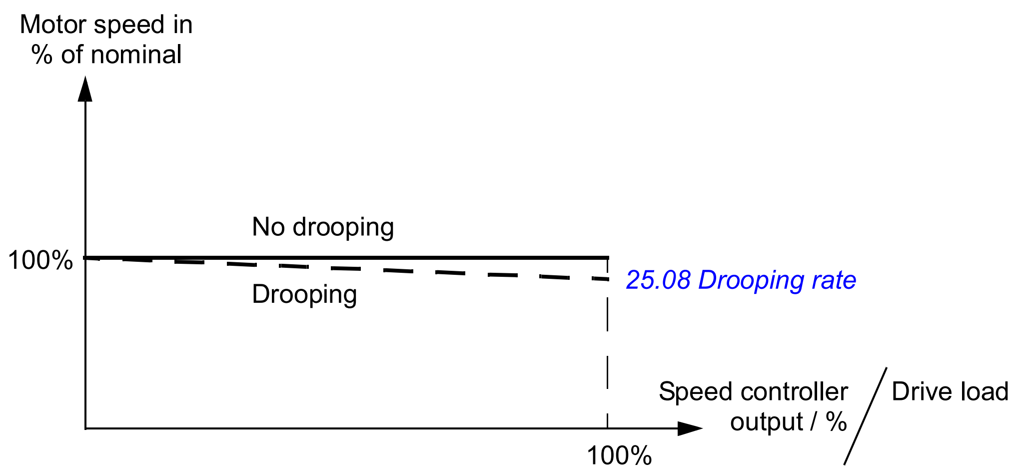
Gain = K_p = 1
T_I = Integration time > 0
T_D= Derivation time > 0
T_s= Sample time period = 500 µs
Δe = Error value change between two samples

No.	Name/Value	Description	*Def/FbEq16*
	0.000 … 10.000 s	Derivation time for speed controller.	1000 = 1 s
25.05	*Derivation filter time*	Defines the derivation filter time constant. See parameter *25.04 Speed derivation time*.	8 ms
	0…10000 ms	Derivation filter time constant.	1 = 1 ms

No.	Name/Value	Description	*Def/FbEq16*
25.06	*Acc comp derivation time*	Defines the derivation time for acceleration(/deceleration) compensation. In order to compensate for a high inertia load during acceleration, a derivative of the reference is added to the output of the speed controller. The principle of a derivative action is described under parameter *25.04 Speed derivation time*. **Note:** As a general rule, set this parameter to the value between 50 and 100% of the sum of the mechanical time constants of the motor and the driven machine. The figure below shows the speed responses when a high inertia load is accelerated along a ramp. **No acceleration compensation:**  **Acceleration compensation:** 	0.00 s
	0.00 … 1000.00 s	Acceleration compensation derivation time.	10 = 1 s
25.07	*Acc comp filter time*	Defines the acceleration (or deceleration) compensation filter time constant.. See parameters *25.04 Speed derivation time* and *25.06 Acc comp derivation time*.	8.0 ms
	0.0 … 1000.0 ms	Acceleration/deceleration compensation filter time.	1 = 1 ms

No.	Name/Value	Description	Def/FbEq16
25.08	*Drooping rate*	Defines the droop rate in percent of the nominal motor speed. Drooping decreases the drive speed slightly as the drive load increases. The actual speed decrease at a certain operating point depends on the droop rate setting and the drive load (= torque reference / speed controller output). At 100% speed controller output, drooping is at its nominal level, i.e. equal to the value of this parameter. The drooping effect decreases linearly to zero along with the decreasing load. The droop rate can be used e.g. to adjust the load sharing in a Master/Follower application run by several drives. In a Master/Follower application the motor shafts are coupled to each other. The correct droop rate for a process must be found out case by case in practice.	0.00%

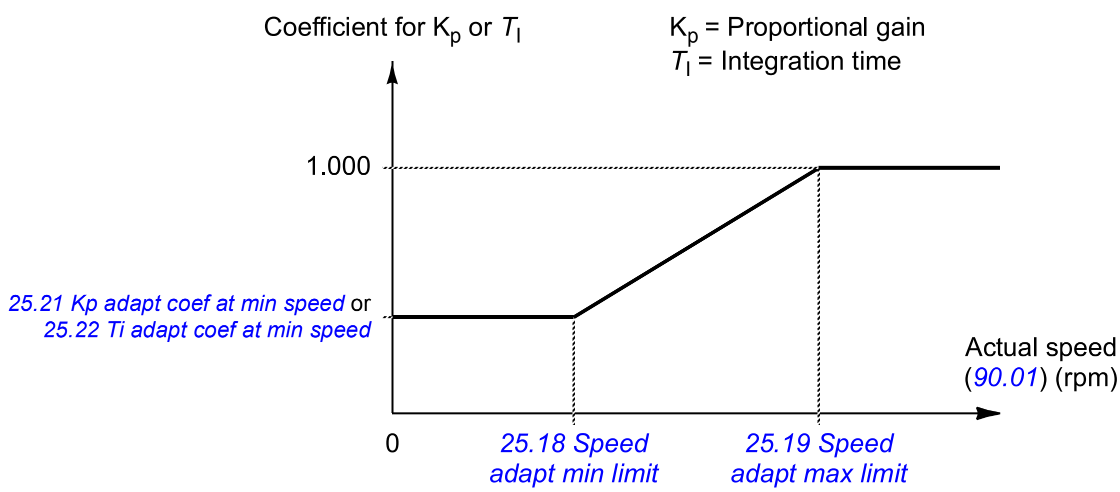
Speed decrease = Speed controller output × Drooping × Nominal speed
Example: Speed controller output is 50%, droop rate is 1%, nominal speed of the drive is 1500 rpm.
Speed decrease = 0.50 × 0.01 × 1500 rpm = 7.5 rpm.



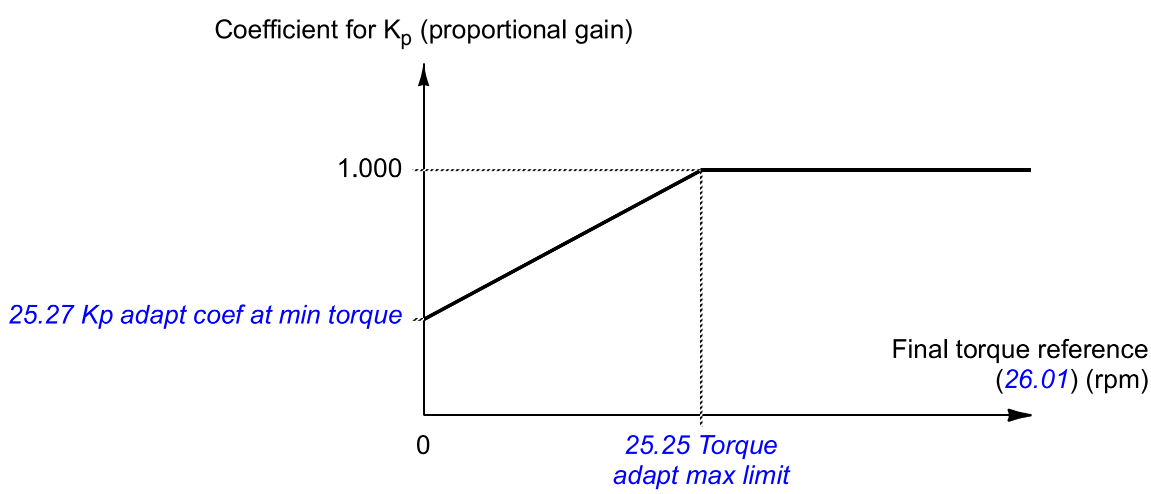
	0.00 … 100.00%	Droop rate.	100 = 1%
25.09	*Speed ctrl balancing enable*	Selects the source for enabling/disabling speed controller output balancing. This function is used to generate a smooth, “bumpless” transfer from a torque- or tension-controlled motor back to being speed-controlled. When balancing is enabled, the output of the speed controller is forced to the value of *25.10 Speed ctrl balancing ref*. Balancing is also possible in the ramp generator (see parameter *23.26 Ramp out balancing enable*). 0 = Disabled 1 = Enabled	*Not selected*
	Not selected	0.	1
	Selected	1.	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6

No.	Name/Value	Description	*Def/FbEq16*
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
25.10	*Speed ctrl balancing ref*	Defines the reference used in speed controller output balancing. The output of the speed controller is forced to this value when balancing is enabled by parameter *25.09 Speed ctrl balancing enable*.	0.0%
	-300.0 … 300.0%	Speed control output balancing reference.	See par. *46.03*
25.11	*Speed control min torque*	Defines the minimum speed controller output torque.	-300.0%
	-1600.0 … 0.0%	Minimum speed controller output torque.	See par. *46.03*
25.12	*Speed control max torque*	Defines the maximum speed controller output torque.	300.0%
	0.0 … 1600.0%	Maximum speed controller output torque.	See par. *46.03*
25.13	*Min torq sp ctrl em stop*	Defines the minimum speed controller output torque during a ramped emergency stop (Off1 or Off3).	-400.0%
	-1600.0 … 0.0%	Minimum speed controller output torque for ramped emergency stop.	See par. *46.03*
25.14	*Max torq sp ctrl em stop*	Defines the maximum speed controller output torque during a ramped emergency stop (Off1 or Off3).	400.0%
	0.0 … 1600.0%	Maximum speed controller output torque for ramped emergency stop.	See par. *46.03*
25.15	*Proportional gain em stop*	Defines the proportional gain for the speed controller when an emergency stop is active. See parameter *25.02 Speed proportional gain*.	10.00; 5.00 (*95.21* b1/b2)
	1.00 … 250.00	Proportional gain upon an emergency stop.	100 = 1

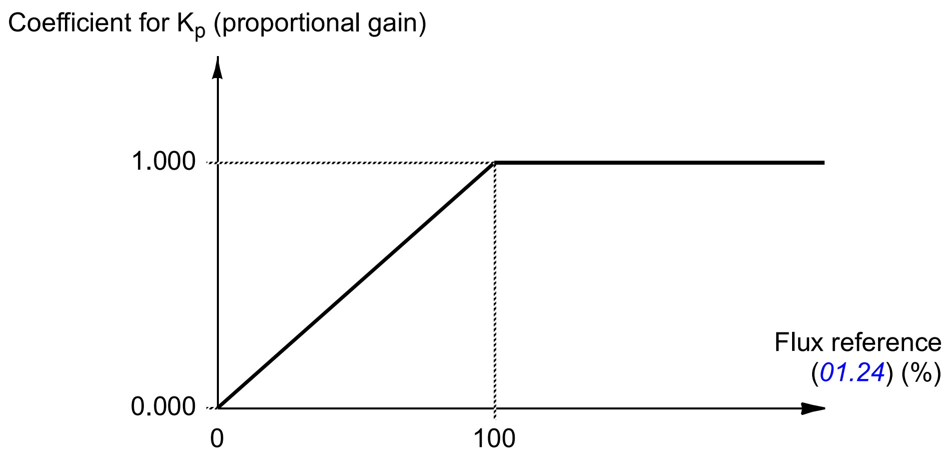
No.	Name/Value	Description	Def/FbEq16
25.18	*Speed adapt min limit*	Minimum actual speed for speed controller adaptation. Speed controller gain and integration time can be adapted according to actual speed (*90.01 Motor speed for control*). This is done by multiplying the gain (*25.02 Speed proportional gain*) and integration time (*25.03 Speed integration time*) by coefficients at certain speeds. The coefficients are defined individually for both gain and integration time. When actual speed is below or equal to *25.18 Speed adapt min limit*, the gain and integration time are multiplied by *25.21 Kp adapt coef at min speed* and *25.22 Ti adapt coef at min speed* respectively. When actual speed is equal to or above *25.19 Speed adapt max limit*, no adaptation takes place (the coefficient is 1). When actual speed is between *25.18 Speed adapt min limit* and *25.19 Speed adapt max limit*, the coefficients for the gain and integration time are calculated linearly on the basis of the breakpoints. See also the block diagram on page *556*.	0 rpm



No.	Name/Value	Description	Def/FbEq16
	0…30000 rpm	Minimum actual speed for speed controller adaptation.	1 = 1 rpm
25.19	*Speed adapt max limit*	Maximum actual speed for speed controller adaptation. See parameter *25.18 Speed adapt min limit*.	0 rpm
	0…30000 rpm	Maximum actual speed for speed controller adaptation.	1 = 1 rpm
25.21	*Kp adapt coef at min speed*	Proportional gain coefficient at minimum actual speed. See parameter *25.18 Speed adapt min limit*.	1.000
	0.000 … 10.000	Proportional gain coefficient at minimum actual speed.	1000 = 1
25.22	*Ti adapt coef at min speed*	Integration time coefficient at minimum actual speed. See parameter *25.18 Speed adapt min limit*.	1.000
	0.000 … 10.000	Integration time coefficient at minimum actual speed.	1000 = 1

No.	Name/Value	Description	*Def/FbEq16*
25.25	*Torque adapt max limit*	Maximum torque reference for speed controller adaptation. Speed controller gain can be adapted according to the final unlimited torque reference (*26.01 Torque reference to TC*). This can be used to smooth out disturbances caused by a small load and backlashes. The functionality involves multiplying the gain (*25.02 Speed proportional gain*) by a coefficient within a certain torque range. When the torque reference is 0%, the gain is multiplied by the value of parameter *25.27 Kp adapt coef at min torque*. When the torque reference is equal to or above *25.25 Torque adapt max limit*, no adaptation takes place (the coefficient is 1). Between 0% and *25.25 Torque adapt max limit*, the coefficient for the gain is calculated linearly on the basis of the breakpoints. Filtering can be applied on the torque reference using parameter *25.26 Torque adapt filt time*. See also the block diagram on page *556*.	0.0%
			
	0.0 … 1600.0%	Maximum torque reference for speed controller adaptation.	See par. *46.03*
25.26	*Torque adapt filt time*	Defines a filter time constant for the adaptation, in effect adjusting the rate of change of the gain. See parameter *25.25 Torque adapt max limit*.	0.000 s
	0.000 … 100.000 s	Filter time for adaptation.	100 = 1 s
25.27	*Kp adapt coef at min torque*	Proportional gain coefficient at 0% torque reference. See parameter *25.25 Torque adapt max limit*.	1.000
	0.000 … 10.000	Proportional gain coefficient at 0% torque reference.	1000 = 1

No.	Name/Value	Description	Def/FbEq16
25.30	*Flux adaption enable*	Enables/disables speed controller adaptation based on motor flux reference (*01.24 Flux actual %*). The proportional gain of the speed controller is multiplied by a coefficient of 0…1 between 0…100% flux reference respectively. See also the block diagram on page *556*.	*Enable*

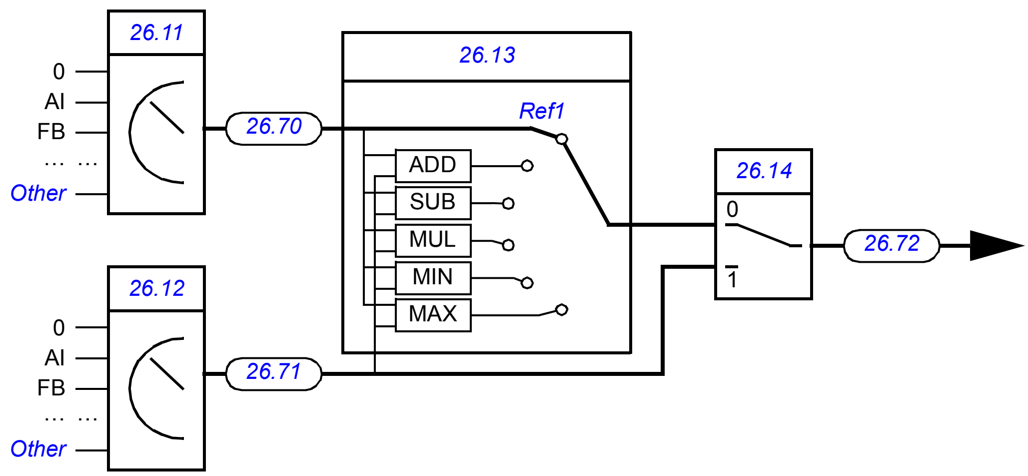


No.	Name/Value	Description	Def/FbEq16
	Disable	Speed controller adaptation based on flux reference disabled.	0
	Enable	Speed controller adaptation based on flux reference enabled.	1
25.33	*Speed controller autotune*	Activates (or selects a source that activates) the speed controller autotune function. See section *Speed controller autotune* (page *44*). The autotune will automatically set parameters *25.02 Speed proportional gain*, *25.03 Speed integration time* and *25.37 Mechanical time constant*. The prerequisites for performing the autotune routine are: • the motor identification run (ID run) has been successfully completed • the speed and torque limits (parameter group *30 Limits*) have been set • speed feedback filtering (parameter group *90 Feedback selection*), speed error filtering (*24 Speed reference conditioning*) and zero speed (*21 Start/stop mode*) have been set, and • the drive has been started and is running in speed control mode. ⚠ **WARNING!** The motor and machinery will run against the torque and speed limits during the autotune routine. MAKE SURE IT IS SAFE TO ACTIVATE THE AUTOTUNE FUNCTION! The autotune routine can be aborted by stopping the drive. 0 -> 1 = Activate speed controller autotune **Note:** The value does not revert to 0 automatically.	*Off*
	Off	0.	0
	On	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
25.34	*Speed controller autotune mode*	Defines a control preset for the speed controller autotune function. The setting affects the way the torque reference will respond to a speed reference step.	*Normal*
	Smooth	Slow but robust response.	0

No.	Name/Value	Description	*DeflFbEq16*
	Normal	Medium setting.	1
	Tight	Fast response. May produce too high a gain value for some applications.	2
25.37	*Mechanical time constant*	Mechanical time constant of the drive and the machinery as determined by the speed controller autotune function. The value can be adjusted manually.	-
	0.00 … 1000.00 s	Mechanical time constant.	10 = 1 s
25.38	*Autotune torque step*	Defines an added torque value used by the autotune function. This value is scaled to motor nominal torque. Note that the torque used by the autotune function can also be limited by the torque limits (in parameter group *30 Limits*) and nominal motor torque.	10.00%
	0.00 … 100.00%	Autotune torque step.	100 = 1%
25.39	*Autotune speed step*	Defines a speed value added to the initial speed for the autotune routine. The initial speed (speed used when autotune is activated) plus the value of this parameter is the calculated maximum speed used by the autotune routine. The maximum speed can also be limited by the speed limits (in parameter group *30 Limits*) and nominal motor speed. The value is scaled to motor nominal speed. **Note:** The motor will exceed the calculated maximum speed slightly at the end of each acceleration stage.	10.00%
	0.00 … 100.00%	Autotune speed step.	100 = 1%
25.40	*Autotune repeat times*	Determines how many acceleration/deceleration cycles are performed during the autotune routine. Increasing the value will improve the accuracy of the autotune function, and allow the use of smaller torque or speed step values.	10
	1…10	Number of cycles during autotune routine.	1 = 1
25.53	*Torque prop reference*	Displays the output of the proportional (P) part of the speed controller. See the control chain diagram on page *556*. This parameter is read-only.	-
	-30000.0 … 30000.0%	P-part output of speed controller.	See par. *46.03*
25.54	*Torque integral reference*	Displays the output of the integral (I) part of the speed controller. See the control chain diagram on page *556*. This parameter is read-only.	-
	-30000.0 … 30000.0%	I-part output of speed controller.	See par. *46.03*
25.55	*Torque deriv reference*	Displays the output of the derivative (D) part of the speed controller. See the control chain diagram on page *556*. This parameter is read-only.	-
	-30000.0 … 30000.0%	D-part output of speed controller.	See par. *46.03*
25.56	*Torque acc compensation*	Displays the output of the acceleration compensation function. See the control chain diagram on page *556*. This parameter is read-only.	-
	-30000.0 … 30000.0%	Output of acceleration compensation function.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
25.57	*Torque reference unbalanced*	Displays the acceleration-compensated output of the speed controller. See the control chain diagram on page 556. This parameter is read-only.	-
	-30000.0 … 30000.0%	Acceleration-compensated output of speed controller.	See par. 46.03
26 Torque reference chain		Settings for the torque reference chain. See the control chain diagrams on pages 557 and 559.	
26.01	*Torque reference to TC*	Displays the final torque reference given to the torque controller in percent. This reference is then acted upon by various final limiters, like power, torque, load etc. See the control chain diagrams on pages 559 and 560. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference for torque control.	See par. 46.03
26.02	*Torque reference used*	Displays the final torque reference (in percent of motor nominal torque) given to the DTC core, and comes after frequency, voltage and torque limitation. See the control chain diagram on page 560. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference for torque control.	See par. 46.03
26.08	*Minimum torque ref*	Defines the minimum torque reference. Allows for local limiting of the torque reference before it is passed on to the torque ramp controller. For absolute torque limiting, refer to parameter *30.19 Minimum torque 1*.	-300.0%
	-1000.0 … 0.0%	Minimum torque reference.	See par. 46.03
26.09	*Maximum torque ref*	Defines the maximum torque reference. Allows for local limiting of the torque reference before it is passed on to the torque ramp controller. For absolute torque limiting, refer to parameter *30.20 Maximum torque 1*.	300.0%
	0.0 … 1000.0%	Maximum torque reference.	See par. 46.03

No.	Name/Value	Description	Def/FbEq16
26.11	*Torque ref1 source*	Selects torque reference source 1. Two signal sources can be defined by this parameter and *26.12 Torque ref2 source*. A digital source selected by *26.14 Torque ref1/2 selection* can be used to switch between the two sources, or a mathematical function (*26.13 Torque ref1 function*) applied to the two signals to create the reference.	*Zero*



No.	Name/Value	Description	Def/FbEq16
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *152*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *154*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *116*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *116*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *116*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *116*).	9
	DDCS ctrl ref1	*03.11 DDCS controller ref 1* (see page *116*).	10
	DDCS ctrl ref2	*03.12 DDCS controller ref 2* (see page *117*).	11
	M/F reference 1	*03.13 M/F or D2D ref1* (see page *117*).	12
	M/F reference 2	*03.14 M/F or D2D ref2* (see page *117*).	13
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Control panel (ref saved)	Control panel reference, with initial value from last-used panel reference. See section *Using the control panel as an external control source* (page *21*).	18
	Control panel (ref copied)	Control panel reference, with initial value from previous source or actual value. See section *Using the control panel as an external control source* (page *21*).	19
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
26.12	*Torque ref2 source*	Selects torque reference source 2. For the selections, and a diagram of reference source selection, see parameter *26.11 Torque ref1 source*.	*Zero*

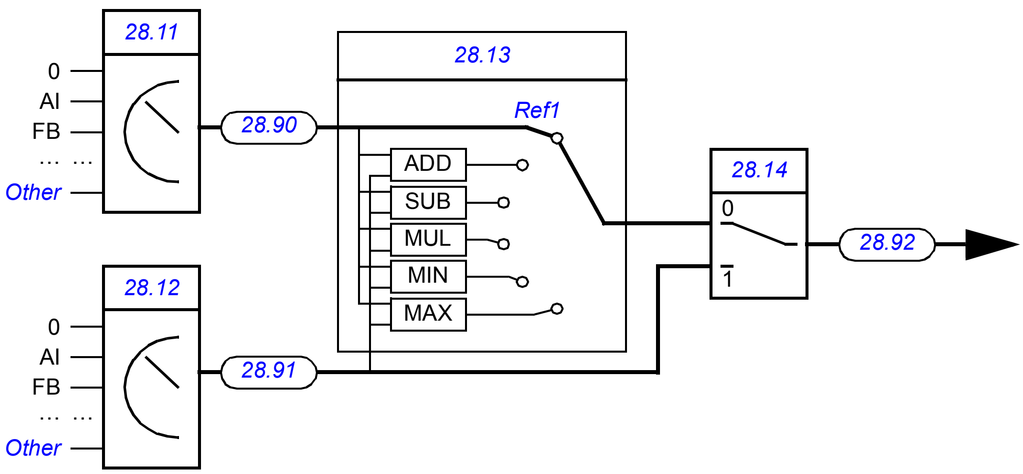
No.	Name/Value	Description	Def/FbEq16
26.13	Torque ref1 function	Selects a mathematical function between the reference sources selected by parameters 26.11 Torque ref1 source and 26.12 Torque ref2 source. See diagram at 26.11 Torque ref1 source.	Ref1
	Ref1	Signal selected by 26.11 Torque ref1 source is used as torque reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as torque reference 1.	1
	Sub (ref1 - ref2)	The subtraction ([26.11 Torque ref1 source] - [26.12 Torque ref2 source]) of the reference sources is used as torque reference 1.	2
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as torque reference 1.	3
	Min (ref1, ref2)	The smaller of the reference sources is used as torque reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as torque reference 1.	5
26.14	Torque ref1/2 selection	Configures the selection between torque references 1 and 2. See diagram at 26.11 Torque ref1 source. 0 = Torque reference 1 1 = Torque reference 2	Torque reference 1
	Torque reference 1	0.	0
	Torque reference 2	1.	1
	Follow Ext1/Ext2 selection	Torque reference 1 is used when external control location EXT1 is active. Torque reference 2 is used when external control location EXT2 is active. See also parameter 19.11 Ext1/Ext2 selection.	2
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	3
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	4
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	5
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	6
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	7
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	8
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
26.15	Load share	Defines the scaling factor for the torque reference (the torque reference is multiplied by the value). This allows drives sharing the load between two motors on the same mechanical plant to be tailored to share the correct amount each, yet use the same master torque reference.	1.000
	-8.000 … 8.000	Torque reference scaling factor.	1000 = 1
26.16	Torque additive 1 source	Selects the source of torque reference additive 1. **Note:** For safety reasons, the additive is not applied when an emergency stop is active. See the control chain diagram on page 557. For the selections, see parameter 26.11 Torque ref1 source.	Zero
26.17	Torque ref filter time	Defines a low-pass filter time constant for the torque reference.	0.000 s
	0.000 … 30.000 s	Filter time constant for torque reference.	1000 = 1 s

No.	Name/Value	Description	*Def/FbEq16*
26.18	*Torque ramp up time*	Defines the torque reference ramp-up time, ie. the time for the reference to increase from zero to nominal motor torque.	0.000 s
	0.000 … 60.000 s	Torque reference ramp-up time.	100 = 1 s
26.19	*Torque ramp down time*	Defines the torque reference ramp-down time, ie. the time for the reference to decrease from nominal motor torque to zero.	0.000 s
	0.000 … 60.000 s	Torque reference ramp-down time.	100 = 1 s
26.25	*Torque additive 2 source*	Selects the source of torque reference additive 2. The value received from the selected source is added to the torque reference after operating mode selection. Because of this, the additive can be used in speed and torque modes. **Note:** For safety reasons, the additive is not applied when an emergency stop is active. ⚠ **WARNING!** If the additive exceeds the limits set by parameters *25.11 Speed control min torque* and *25.12 Speed control max torque*, a ramp stop may be impossible. Make sure the additive is reduced or removed when a ramp stop is required eg. by using parameter *26.26 Force torque ref add 2 zero*. See the control chain diagram on page *559*. For the selections, see parameter *26.11 Torque ref1 source*.	*Zero*
26.26	*Force torque ref add 2 zero*	Selects a source that forces torque reference additive 2 (see parameter *26.25 Torque additive 2 source*) to zero. 0 = Normal operation 1 = Force torque reference additive 2 to zero.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
26.41	*Torque step*	When enabled by parameter *26.42 Torque step enable*, adds an additional step to the torque reference. **Note:** For safety reasons, the torque step is not applied when an emergency stop is active. ⚠ **WARNING!** If the torque step exceeds the limits set by parameters *25.11 Speed control min torque* and *25.12 Speed control max torque*, a ramp stop may be impossible. Make sure the torque step is reduced or removed when a ramp stop is required eg. by using parameter *26.42 Torque step enable*.	0.0%
	-300.0 … 300.0%	Torque step.	See par. *46.03*
26.42	*Torque step enable*	Enables/disables a torque step (defined by parameter *26.41 Torque step*).	*Disable*
	Disable	Torque step disabled.	0

No.	Name/Value	Description	Def/FbEq16
	Enable	Torque step enabled.	1
26.51	Oscillation damping	Parameters 26.51…26.58 configure the oscillation damping function. See section Oscillation damping (page 47), and the block diagram on page 559. This parameter enables (or selects a source that enables) the oscillation damping algorithm. 1 = Oscillation damping algorithm enabled	Not selected
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
26.52	Oscillation damping out enable	Determines (or selects a source that determines) whether the output of the oscillation damping function is applied to the torque reference or not. **Note:** Before enabling the oscillation damping output, adjust parameters 26.53…26.57. Then monitor the input signal (selected by 26.53) and the output (26.58) to make sure that the correction is safe to apply. 1 = Apply oscillation damping output to torque reference	Not selected
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
26.53	Oscillation compensation input	Selects the input signal for the oscillation damping function. **Note:** Before changing this parameter run-time, disable the oscillation damping output using parameter 26.52. Monitor the behavior of 26.58 before re-enabling the output.	Speed error
	Speed error	24.01 Used speed reference - unfiltered motor speed. **Note:** This setting is not supported in scalar motor control mode.	0
	DC voltage	01.11 DC voltage. (The value is internally filtered.)	1

No.	Name/Value	Description	*DefFbEq16*
26.55	*Oscillation damping frequency*	Defines the center frequency of the oscillation damping filter. Set the value according to the number of oscillation peaks in the monitored signal (selected by *26.53*) per second. **Note:** Before changing this parameter run-time, disable the oscillation damping output using parameter *26.52*. Monitor the behavior of *26.58* before re-enabling the output.	31.0 Hz
	0.1 … 60.0 Hz	Center frequency for oscillation damping.	10 = 1 Hz
26.56	*Oscillation damping phase*	Defines a phase shift for the output of the filter. **Note:** Before changing this parameter run-time, disable the oscillation damping output using parameter *26.52*. Monitor the behavior of *26.58* before re-enabling the output.	180 deg
	0…360 deg	Phase shift for oscillation damping function output.	10 = 1 deg
26.57	*Oscillation damping gain*	Defines a gain for the output of the oscillation damping function, ie. how much the output of the filter is amplified before it is added to the torque reference. Oscillation gain is scaled according to the speed controller gain so that changing the gain will not disturb oscillation damping. **Note:** Before changing this parameter run-time, disable the oscillation damping output using parameter *26.52*. Monitor the behavior of *26.58* before re-enabling the output.	1.0%
	0.0 … 100.0%	Gain setting for oscillation damping output.	10 = 1%
26.58	*Oscillation damping output*	Displays the output of the oscillation damping function. This value is added to the torque reference (as allowed by parameter *26.52 Oscillation damping out enable*). This parameter is read-only.	-
	-1600.000 … 1600.000%	Output of the oscillation damping function.	10 = 1%
26.70	*Torque reference act 1*	Displays the value of torque reference source 1 (selected by parameter *26.11 Torque ref1 source*). See the control chain diagram on page *557*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Value of torque reference source 1.	See par. *46.03*
26.71	*Torque reference act 2*	Displays the value of torque reference source 2 (selected by parameter *26.12 Torque ref2 source*). See the control chain diagram on page *557*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Value of torque reference source 2.	See par. *46.03*
26.72	*Torque reference act 3*	Displays the torque reference after the function applied by parameter *26.13 Torque ref1 function* (if any), and after selection (*26.14 Torque ref1/2 selection*). See the control chain diagram on page *557*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference after selection.	See par. *46.03*
26.73	*Torque reference act 4*	Displays the torque reference after application of reference additive 1. See the control chain diagram on page *557*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference after application of reference additive 1.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
26.74	*Torque ref ramp out*	Displays the torque reference after limiting and ramping. See the control chain diagram on page *557*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference after limiting and ramping.	See par. *46.03*
26.75	*Torque reference act 5*	Displays the torque reference after control mode selection. See the control chain diagram on page *559*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference after control mode selection.	See par. *46.03*
26.76	*Torque reference act 6*	Displays the torque reference after application of reference additive 2. See the control chain diagram on page *559*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference after application of reference additive 2.	See par. *46.03*
26.77	*Torque ref add A actual*	Displays the value of the source of torque reference additive 2. See the control chain diagram on page *559*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference additive 2.	See par. *46.03*
26.78	*Torque ref add B actual*	Displays the value of torque reference additive 2 before it is added to torque reference. See the control chain diagram on page *559*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference additive 2.	See par. *46.03*
26.81	*Rush control gain*	Rush controller gain term. See section *Rush control* (page *48*).	10.0
	0.0 …10000.0	Rush controller gain (0.0 = disabled).	1 = 1
26.82	*Rush control integration time*	Rush controller integration time term.	2.0 s
	0.0 … 10.0 s	Rush controller integration time (0.0 = disabled).	1 = 1 s
28 Frequency reference chain		Settings for the frequency reference chain. See the control chain diagrams on pages *562* and *563*.	
28.01	*Frequency ref ramp input*	Displays the used frequency reference before ramping. See the control chain diagram on page *563*. This parameter is read-only.	-
	-500.00 … 500.00 Hz	Frequency reference before ramping.	See par. *46.02*
28.02	*Frequency ref ramp output*	Displays the final frequency reference (after selection, limitation and ramping). See the control chain diagram on page *563*. This parameter is read-only.	-
	-500.00 … 500.00 Hz	Final frequency reference.	See par. *46.02*

No.	Name/Value	Description	Def/FbEq16
28.11	Frequency ref1 source	Selects frequency reference source 1. Two signal sources can be defined by this parameter and 28.12 Frequency ref2 source. A digital source selected by 28.14 Frequency ref1/2 selection can be used to switch between the two sources, or a mathematical function (28.13 Frequency ref1 function) applied to the two signals to create the reference.	Zero
			
	Zero	None.	0
	AI1 scaled	12.12 AI1 scaled value (see page 152).	1
	AI2 scaled	12.22 AI2 scaled value (see page 154).	2
	FB A ref1	03.05 FB A reference 1 (see page 116).	4
	FB A ref2	03.06 FB A reference 2 (see page 116).	5
	EFB ref1	03.09 EFB reference 1 (see page 116).	8
	EFB ref2	03.10 EFB reference 2 (see page 116).	9
	DDCS ctrl ref1	03.11 DDCS controller ref 1 (see page 116).	10
	DDCS ctrl ref2	03.12 DDCS controller ref 2 (see page 117).	11
	M/F reference 1	03.13 M/F or D2D ref1 (see page 117).	12
	M/F reference 2	03.14 M/F or D2D ref2 (see page 117).	13
	Motor potentiometer	22.80 Motor potentiometer ref act (output of the motor potentiometer).	15
	PID	40.01 Process PID output actual (output of the process PID controller).	16
	Control panel (ref saved)	Control panel reference, with initial value from last-used panel reference. See section Using the control panel as an external control source (page 21).	18
	Control panel (ref copied)	Control panel reference, with initial value from previous source or actual value. See section Using the control panel as an external control source (page 21).	19
	Other	Source selection (see Terms and abbreviations on page 110).	-
28.12	Frequency ref2 source	Selects frequency reference source 2. For the selections, and a diagram of reference source selection, see parameter 28.11 Frequency ref1 source.	Zero

No.	Name/Value	Description	Def/FbEq16
28.13	*Frequency ref1 function*	Selects a mathematical function between the reference sources selected by parameters *28.11 Frequency ref1 source* and *28.12 Frequency ref2 source*. See diagram at *28.11 Frequency ref1 source*.	*Ref1*
	Ref1	Signal selected by *28.11 Frequency ref1 source* is used as frequency reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as frequency reference 1.	1
	Sub (ref1 - ref2)	The subtraction ([*28.11 Frequency ref1 source*] - [*28.12 Frequency ref2 source*]) of the reference sources is used as frequency reference 1.	2
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as frequency reference 1.	3
	Min (ref1, ref2)	The smaller of the reference sources is used as frequency reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as frequency reference 1.	5
28.14	*Frequency ref1/2 selection*	Configures the selection between frequency references 1 and 2. See diagram at *28.11 Frequency ref1 source*. 0 = Frequency reference 1 1 = Frequency reference 2	*Follow Ext1/Ext2 selection*
	Frequency reference 1	0.	0
	Frequency reference 2	1.	1
	Follow Ext1/Ext2 selection	Frequency reference 1 is used when external control location EXT1 is active. Frequency reference 2 is used when external control location EXT2 is active. See also parameter *19.11 Ext1/Ext2 selection*.	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-

No.	Name/Value	Description	*DeflFbEq16*
28.21	*Constant frequency function*	Determines how constant frequencies are selected, and whether the rotation direction signal is considered or not when applying a constant frequency.	0000b

Bit	Name	Information
0	Constant freq mode	1 = Packed: 7 constant frequencies are selectable using the three sources defined by parameters *28.22*, *28.23* and *28.24*.
		0 = Separate: Constant frequencies 1, 2 and 3 are separately activated by the sources defined by parameters *28.22*, *28.23* and *28.24* respectively. In case of conflict, the constant frequency with the smaller number takes priority.
1	Direction enable	1 = Start dir: To determine running direction for a constant frequency, the sign of the constant frequency setting (parameters *28.26…28.32*) is multiplied by the direction signal (forward: +1, reverse: -1). This effectively allows the drive to have 14 (7 forward, 7 reverse) constant frequencies if all values in *28.26…28.32* are positive. **WARNING:** If the direction signal is reverse and the active constant frequency is negative, the drive will run in the forward direction.
		0 = According to Par: The running direction for the constant frequency is determined by the sign of the constant speed setting (parameters *28.26…28.32*).

	0000b…0011b	Constant frequency configuration word.	1 = 1
28.22	*Constant frequency sel1*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 1. When bit 0 of parameter *28.21 Constant frequency function* is 1 (Packed), this parameter and parameters *28.23 Constant frequency sel2* and *28.24 Constant frequency sel3* select three sources whose states activate constant frequencies as follows:	*Not selected*

Source defined by par. *28.22*	Source defined by par. *28.23*	Source defined by par. *28.24*	Constant frequency active
0	0	0	None
1	0	0	Constant frequency 1
0	1	0	Constant frequency 2
1	1	0	Constant frequency 3
0	0	1	Constant frequency 4
1	0	1	Constant frequency 5
0	1	1	Constant frequency 6
1	1	1	Constant frequency 7

	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6

No.	Name/Value	Description	Def/FbEq16
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
28.23	*Constant frequency sel2*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 2. When bit 0 of parameter *28.21 Constant frequency function* is 1 (Packed), this parameter and parameters *28.22 Constant frequency sel1* and *28.24 Constant frequency sel3* select three sources that are used to activate constant frequencies. See table at parameter *28.22 Constant frequency sel1*. For the selections, see parameter *28.22 Constant frequency sel1*.	*Not selected*
28.24	*Constant frequency sel3*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 3. When bit 0 of parameter *28.21 Constant frequency function* is 1 (Packed), this parameter and parameters *28.22 Constant frequency sel1* and *28.23 Constant frequency sel2* select three sources that are used to activate constant frequencies. See table at parameter *28.22 Constant frequency sel1*. For the selections, see parameter *28.22 Constant frequency sel1*.	*Not selected*
28.26	*Constant frequency 1*	Defines constant frequency 1 (the frequency the motor will turn when constant frequency 1 is selected).	0.00 Hz
	-500.00 … 500.00 Hz	Constant frequency 1.	See par. *46.02*
28.27	*Constant frequency 2*	Defines constant frequency 2.	0.00 Hz
	-500.00 … 500.00 Hz	Constant frequency 2.	See par. *46.02*
28.28	*Constant frequency 3*	Defines constant frequency 3.	0.00 Hz
	-500.00 … 500.00 Hz	Constant frequency 3.	See par. *46.02*
28.29	*Constant frequency 4*	Defines constant frequency 4.	0.00 Hz
	-500.00 … 500.00 Hz	Constant frequency 4.	See par. *46.02*
28.30	*Constant frequency 5*	Defines constant frequency 5.	0.00 Hz
	-500.00 … 500.00 Hz	Constant frequency 5.	See par. *46.02*
28.31	*Constant frequency 6*	Defines constant frequency 6.	0.00 Hz
	-500.00 … 500.00 Hz	Constant frequency 6.	See par. *46.02*

No.	Name/Value	Description	DefIFbEq16
28.32	*Constant frequency 7*	Defines constant frequency 7.	0.00 Hz
	-500.00 … 500.00 Hz	Constant frequency 7.	See par. *46.02*
28.41	*Frequency ref safe*	Defines a safe frequency reference value that is used with supervision functions such as • *12.03 AI supervision function* • *49.05 Communication loss action* • *50.02 FBA A comm loss func* • *50.32 FBA B comm loss func* • *58.14 Communication loss action*.	0.00 Hz
	-500.00 … 500.00 Hz	Safe frequency reference.	See par. *46.02*
28.51	*Critical frequency function*	Enables/disables the critical frequencies function. Also determines whether the specified ranges are effective in both rotating directions or not. See also section *Critical speeds/frequencies* (page *43*).	0000b

Bit	Name	Information
0	Enable	1 = Enable: Critical frequencies enabled.
		0 = Disable: Critical frequencies disabled.
1	Sign mode	1 = According to par: The signs of parameters *28.52…28.57* are taken into account.
		0 = Absolute: Parameters *28.52…28.57* are handled as absolute values. Each range is effective in both directions of rotation.

No.	Name/Value	Description	DefIFbEq16
	0000b…0011b	Critical frequencies configuration word.	1 = 1
28.52	*Critical frequency 1 low*	Defines the low limit for critical frequency 1. **Note:** This value must be less than or equal to the value of *28.53 Critical frequency 1 high*.	0.00 Hz
	-500.00 … 500.00 Hz	Low limit for critical frequency 1.	See par. *46.02*
28.53	*Critical frequency 1 high*	Defines the high limit for critical frequency 1. **Note:** This value must be greater than or equal to the value of *28.52 Critical frequency 1 low*.	0.00 Hz
	-500.00 … 500.00 Hz	High limit for critical frequency 1.	See par. *46.02*
28.54	*Critical frequency 2 low*	Defines the low limit for critical frequency 2. **Note:** This value must be less than or equal to the value of *28.55 Critical frequency 2 high*.	0.00 Hz
	-500.00 … 500.00 Hz	Low limit for critical frequency 2.	See par. *46.02*
28.55	*Critical frequency 2 high*	Defines the high limit for critical frequency 2. **Note:** This value must be greater than or equal to the value of *28.54 Critical frequency 2 low*.	0.00 Hz
	-500.00 … 500.00 Hz	High limit for critical frequency 2.	See par. *46.02*

No.	Name/Value	Description	*Def/FbEq16*
28.56	*Critical frequency 3 low*	Defines the low limit for critical frequency 3. **Note:** This value must be less than or equal to the value of *28.57 Critical frequency 3 high*.	0.00 Hz
	-500.00 … 500.00 Hz	Low limit for critical frequency 3.	See par. *46.02*
28.57	*Critical frequency 3 high*	Defines the high limit for critical frequency 3. **Note:** This value must be greater than or equal to the value of *28.56 Critical frequency 3 low*.	0.00 Hz
	-500.00 … 500.00 Hz	High limit for critical frequency 3.	See par. *46.02*
28.71	*Freq ramp set selection*	Selects a source that switches between the two sets of acceleration/deceleration times defined by parameters *28.72*…*28.75*. 0 = Acceleration time 1 and deceleration time 1 are in force 1 = Acceleration time 2 and deceleration time 2 are in force	*Acc/Dec time 1*
	Acc/Dec time 1	0.	0
	Acc/Dec time 2	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
28.72	*Freq acceleration time 1*	Defines acceleration time 1 as the time required for the frequency to change from zero to the frequency defined by parameter *46.02 Frequency scaling* (**not** to parameter *30.14 Maximum frequency*). If the reference increases faster than the set acceleration rate, the motor will follow the acceleration rate. If the reference increases slower than the set acceleration rate, the motor frequency will follow the reference. If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits.	20.000 s
	0.000 … 1800.000 s	Acceleration time 1.	10 = 1 s
28.73	*Freq deceleration time 1*	Defines deceleration time 1 as the time required for the frequency to change from the frequency defined by parameter *46.02 Frequency scaling* (**not** from parameter *30.14 Maximum frequency*) to zero. If there is any doubt about the deceleration time being too short, ensure that DC overvoltage control (*30.30 Overvoltage control*) is on. **Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with braking equipment such as a brake chopper and brake resistor.	20.000 s
	0.000 … 1800.000 s	Deceleration time 1.	10 = 1 s

No.	Name/Value	Description	*Def/FbEq16*
28.74	*Freq acceleration time 2*	Defines acceleration time 2. See parameter *28.72 Freq acceleration time 1*.	60.000 s
	0.000 … 1800.000 s	Acceleration time 2.	10 = 1 s
28.75	*Freq deceleration time 2*	Defines deceleration time 2. See parameter *28.73 Freq deceleration time 1*.	60.000 s
	0.000 … 1800.000 s	Deceleration time 2.	10 = 1 s
28.76	*Freq ramp in zero source*	Selects a source that forces the frequency reference to zero. 0 = Force frequency reference to zero 1 = Normal operation	*Inactive*
	Active	0.	0
	Inactive	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
28.77	*Freq ramp hold*	Selects a source that forces the output of the frequency ramp generator to actual frequency value. 0 = Force ramp output to actual frequency 1 = Normal operation	*Inactive*
	Active	0.	0
	Inactive	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
28.78	*Freq ramp output balancing*	Defines a reference for frequency ramp balancing. The output of the ramp generator is forced to this value when balancing is enabled by parameter *28.79 Freq ramp out balancing enable*.	0.00 Hz
	-500.00 … 500.00 Hz	Frequency ramp balancing reference.	See par. *46.02*

No.	Name/Value	Description	Def/FbEq16
28.79	Freq ramp out balancing enable	Selects the source for enabling/disabling speed ramp balancing. See parameter 28.78 Freq ramp output balancing. 0 = Disabled 1 = Enabled	Not selected
	Not selected	0.	
	Selected	1.	
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
28.90	Frequency ref act 1	Displays the value of frequency reference source 1 (selected by parameter 28.11 Frequency ref1 source). See the control chain diagram on page 562. This parameter is read-only.	-
	-500.00 … 500.00 Hz	Value of frequency reference source 1.	See par. 46.02
28.91	Frequency ref act 2	Displays the value of frequency reference source 2 (selected by parameter 28.12 Frequency ref2 source). See the control chain diagram on page 562. This parameter is read-only.	-
	-500.00 … 500.00 Hz	Value of frequency reference source 2.	See par. 46.02
28.92	Frequency ref act 3	Displays the frequency reference after the function applied by parameter 28.13 Frequency ref1 function (if any), and after selection (28.14 Frequency ref1/2 selection). See the control chain diagram on page 562. This parameter is read-only.	-
	-500.00 … 500.00 Hz	Frequency reference after selection.	See par. 46.02
28.96	Frequency ref act 7	Displays the frequency reference after application of constant frequencies, control panel reference, etc. See the control chain diagram on page 562. This parameter is read-only.	-
	-500.00 … 500.00 Hz	Frequency reference 7.	See par. 46.02
28.97	Frequency ref unlimited	Displays the frequency reference after application of critical frequencies, but before ramping and limiting. See the control chain diagram on page 563. This parameter is read-only.	-
	-500.00 … 500.00 Hz	Frequency reference before ramping and limiting.	See par. 46.02

No.	Name/Value	Description	*Def/FbEq16*
30 Limits		Drive operation limits.	
30.01	*Limit word 1*	Displays limit word 1. This parameter is read-only.	-

Bit	Name	Description
0	Torq lim	1 = Drive torque is being limited by the motor control (undervoltage control, current control, load angle control or pull-out control), or by the torque limits defined by parameters.
1	Spd ctl tlim min	1 = Speed controller output is being limited by *25.11 Speed control min torque*
2	Spd ctl tlim max	1 = Speed controller output is being limited by *25.12 Speed control max torque*
3	Torq ref max	1 = Torque reference ramp input is being limited by *26.09 Maximum torque ref*, source of *30.25 Maximum torque sel*, *30.26 Power motoring limit* or *30.27 Power generating limit*. See diagram on page *560*.
4	Torq ref min	1 = Torque reference ramp input is being limited by *26.08 Minimum torque ref*, source of *30.18 Minimum torque sel*, *30.26 Power motoring limit* or *30.27 Power generating limit*. See diagram on page *560*.
5	Tlim max speed	1 = Torque reference is being limited by the rush control because of maximum speed limit (*30.12 Maximum speed*)
6	Tlim min speed	1 = Torque reference is being limited by the rush control because of minimum speed limit (*30.11 Minimum speed*)
7	Max speed ref lim	1 = Speed reference is being limited by *30.12 Maximum speed*
8	Min speed ref lim	1 = Speed reference is being limited by *30.11 Minimum speed*
9	Max freq ref lim	1 = Frequency reference is being limited by *30.14 Maximum frequency*
10	Min freq ref lim	1 = Frequency reference is being limited by *30.13 Minimum frequency*
11	Reserved	
12	Sw freq ref lim	1 = Requested output frequency cannot be reached because of switching frequency limitation (because of eg. output filtering or ATEX-related protections)
13…15	Reserved	

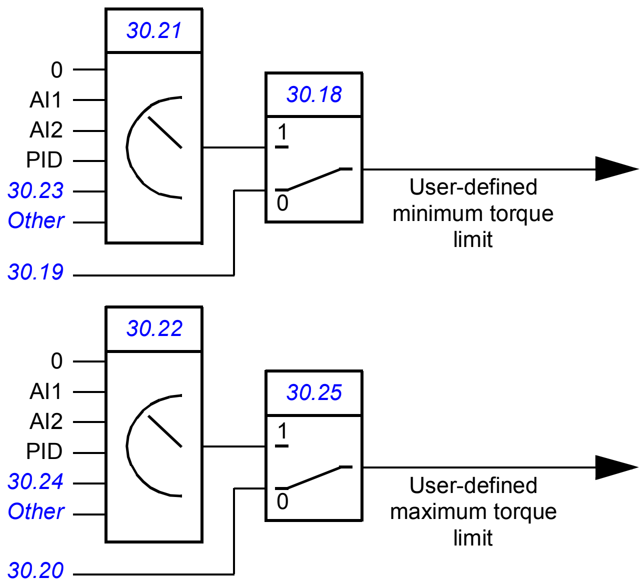
No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Limit word 1.	1 = 1

No.	Name/Value	Description	Def/FbEq16
30.02	*Torque limit status*	Displays the torque controller limitation status word. This parameter is read-only.	-

Bit	Name	Description
0	Undervoltage	*1 = Intermediate DC circuit undervoltage
1	Overvoltage	*1 = Intermediate DC circuit overvoltage
2	Minimum torque	*1 = Torque is being limited by *30.26 Power motoring limit*, *30.27 Power generating limit* or the source of *30.18 Minimum torque sel*. See diagram on page *560*.
3	Maximum torque	*1 = Torque is being limited by *30.26 Power motoring limit*, *30.27 Power generating limit* or the source of *30.25 Maximum torque sel*. See diagram on page *560*.
4	Internal current	1 = An inverter current limit (identified by bits 8…11) is active
5	Load angle	(With permanent magnet motors and synchronous reluctance motors only) 1 = Load angle limit is active, ie. the motor cannot produce any more torque
6	Motor pullout	(With asynchronous motors only) 1 = Motor pull-out limit is active, ie. the motor cannot produce any more torque
7	Reserved	
8	Thermal	1 = Input current is being limited by the main circuit thermal limit
9	Max current	*1 = Maximum output current (I_{MAX}) is being limited
10	User current	*1 = Output current is being limited by *30.17 Maximum current*
11	Thermal IGBT	*1 = Output current is being limited by a calculated thermal current value
12	IGBT overtemperature	*1 = Output current is being limited because of estimated IGBT temperature
13	IGBT overload	*1 = Output current is being limited because of IGBT junction to case temperature
14…15	Reserved	
*Only one out of bits 0…3, and one out of bits 9…13 can be on simultaneously. The bit typically indicates the limit that is exceeded first.		

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Torque limitation status word.	1 = 1
30.11	*Minimum speed*	Defines the minimum allowed speed. **WARNING!** This value must not be higher than *30.12 Maximum speed*. **WARNING!** In frequency control mode, this limit is not effective. Make sure the frequency limits (*30.13* and *30.14*) are set appropriately if frequency control is used. **WARNING!** In a master/follower configuration, do not set maximum and minimum speed limits with the same sign on a follower drive. See section *Master/follower functionality* (page *31*).	-1500.00 rpm; -1800.00 rpm (*95.20* b0)
	-30000.00 … 30000.00 rpm	Minimum allowed speed.	See par. *46.01*

No.	Name/Value	Description	*Def/FbEq16*
30.12	*Maximum speed*	Defines the maximum allowed speed. **WARNING!** This value must not be lower than *30.11 Minimum speed*. **WARNING!** In frequency control mode, this limit is not effective. Make sure the frequency limits (*30.13* and *30.14*) are set appropriately if frequency control is used. **WARNING!** In a master/follower configuration, do not set maximum and minimum speed limits with the same sign on a follower drive. See section *Master/follower functionality* (page *31*).	1500.00 rpm; 1800.00 rpm (*95.20* b0)
	-30000.00 … 30000.00 rpm	Maximum speed.	See par. *46.01*
30.13	*Minimum frequency*	Defines the minimum allowed frequency. **WARNING!** This value must not be higher than *30.14 Maximum frequency*. **WARNING!** This limit is effective in frequency control mode only.	-50.00 Hz; -60.00 Hz (*95.20* b0)
	-500.00 … 500.00 Hz	Minimum frequency.	See par. *46.02*
30.14	*Maximum frequency*	Defines the maximum allowed frequency. **WARNING!** This value must not be lower than *30.13 Minimum frequency*. **WARNING!** This limit is effective in frequency control mode only.	50.00 Hz; 60.00 Hz (*95.20* b0)
	-500.00 … 500.00 Hz	Maximum frequency.	See par. *46.02*
30.15	*Maximum start current enable*	A temporary motor current limit specifically for starting can be defined by this parameter and *30.16 Maximum start current*. When this parameter is set to *Enable*, the drive observes the start current limit defined by *30.16 Maximum start current*. The limit is in force for 2 seconds after initial magnetization (of an asynchronous induction motor) or autophasing (of a permanent magnet motor), but not more often than once in every 7 seconds. Otherwise, the limit defined by *30.17 Maximum current* is in force. **Note:** The availability of a start current higher than the general limit depends on drive hardware.	*Disable*
	Disable	Start current limit disabled.	0
	Enable	Start current limit enabled.	1
30.16	*Maximum start current*	Defines a maximum start current when enabled by parameter *30.15 Maximum start current enable*.	-
	0.00 … 30000.00 A	Maximum start current.	1 = 1 A
30.17	*Maximum current*	Defines the maximum allowed motor current.	0.00 A
	0.00 … 30000.00 A	Maximum motor current.	1 = 1 A

No.	Name/Value	Description	*Def/FbEq16*
30.18	*Minimum torque sel*	Selects a source that switches between two different predefined minimum torque limits. 0 = Minimum torque limit defined by *30.19* is active 1 = Minimum torque limit selected by *30.21* is active The user can define two sets of torque limits, and switch between the sets using a binary source such as a digital input. The minimum limit selection (*30.18*) is independent of the maximum limit selection (*30.25*). The first set of limits is defined by parameters *30.19* and *30.20*. The second set has selector parameters for both the minimum (*30.21*) and maximum (*30.22*) limits that allows the use of a selectable analog source (such as an analog input).  **Note:** In addition to the user-defined limits, torque may be limited for other reasons (such as power limitation). Refer to the block diagram on page *560*.	*Minimum torque 1*
	Minimum torque 1	0 (minimum torque limit defined by *30.19* is active).	0
	Minimum torque 2 source	1 (minimum torque limit selected by *30.21* is active).	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-

No.	Name/Value	Description	*DefFbEq16*
30.19	*Minimum torque 1*	Defines a minimum torque limit for the drive (in percent of nominal motor torque). See diagram at parameter *30.18 Minimum torque sel*. The limit is effective when • the source selected by *30.18 Minimum torque sel* is 0, or • *30.18* is set to *Minimum torque 1*.	-300.0%
	-1600.0 … 0.0%	Minimum torque limit 1.	See par. *46.03*
30.20	*Maximum torque 1*	Defines a maximum torque limit for the drive (in percent of nominal motor torque). See diagram at parameter *30.18 Minimum torque sel*. The limit is effective when • the source selected by *30.25 Maximum torque sel* is 0, or • *30.25* is set to *Maximum torque 1*.	300.0%
	0.0 … 1600.0%	Maximum torque 1.	See par. *46.03*
30.21	*Minimum torque 2 source*	Defines the source of the minimum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter *30.18 Minimum torque sel* is 1, or • *30.18* is set to *Minimum torque 2 source*. See diagram at *30.18 Minimum torque sel*. **Note:** Any positive values received from the selected source are inverted.	*Minimum torque 2*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *152*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *154*).	2
	PID	*40.01 Process PID output actual* (output of the process PID controller).	5
	Minimum torque 2	*30.23 Minimum torque 2*.	6
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
30.22	*Maximum torque 2 source*	Defines the source of the maximum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter *30.25 Maximum torque sel* is 1, or • *30.25* is set to *Maximum torque 2 source*. See diagram at *30.18 Minimum torque sel*. **Note:** Any negative values received from the selected source are inverted.	*Maximum torque 2*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *152*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *154*).	2
	PID	*40.01 Process PID output actual* (output of the process PID controller).	5
	Maximum torque 2	*30.24 Maximum torque 2*.	6
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-

No.	Name/Value	Description	Def/FbEq16
30.23	Minimum torque 2	Defines the minimum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter 30.18 Minimum torque sel is 1, and • 30.21 is set to Minimum torque 2. See diagram at 30.18 Minimum torque sel.	-300.0%
	-1600.0 … 0.0%	Minimum torque limit 2.	See par. 46.03
30.24	Maximum torque 2	Defines the maximum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter 30.25 Maximum torque sel is 1, and • 30.22 is set to Maximum torque 2. See diagram at 30.18 Minimum torque sel.	300.0%
	0.0 … 1600.0%	Maximum torque limit 2.	See par. 46.03
30.25	Maximum torque sel	Selects a source that switches between two different maximum torque limits. 0 = Maximum torque limit 1 defined by 30.20 is active 1 = Maximum torque limit selected by 30.22 is active See also parameter 30.18 Minimum torque sel.	Maximum torque 1
	Maximum torque 1	0.	0
	Maximum torque 2 source	1.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
30.26	Power motoring limit	Defines the maximum shaft power in motoring mode, ie. when power is being transferred from the motor to the machinery. The value is given in percent of nominal motor power.	300.00%
	0.00 … 600.00%	Maximum shaft power in motoring mode.	1 = 1%
30.27	Power generating limit	Defines the maximum shaft power in generating mode, ie. when power is being transferred from the machinery to the motor. The value is given in percent of nominal motor power.	-300.00%
	-600.00 … 0.00%	Maximum shaft power in generating mode.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
30.30	Overvoltage control	Enables the overvoltage control of the intermediate DC link. Fast braking of a high inertia load causes the voltage to rise to the overvoltage control limit. To prevent the DC voltage from exceeding the limit, the overvoltage controller automatically decreases the braking torque. **Note:** If the drive is equipped with a brake chopper and resistor, or a regenerative supply unit, the controller must be disabled.	Enable
	Disable	Overvoltage control disabled.	0
	Enable	Overvoltage control enabled.	1
30.31	Undervoltage control	Enables the undervoltage control of the intermediate DC link. If the DC voltage drops due to input power cut off, the undervoltage controller will automatically decrease the motor torque in order to keep the voltage above the lower limit. By decreasing the motor torque, the inertia of the load will cause regeneration back to the drive, keeping the DC link charged and preventing an undervoltage trip until the motor coasts to a stop. This will act as a power-loss ride-through functionality in systems with high inertia, such as a centrifuge or a fan.	Enable
	Disable	Undervoltage control disabled.	0
	Enable	Undervoltage control enabled.	1
31 Fault functions		Configuration of external events; selection of behavior of the drive upon fault situations.	
31.01	External event 1 source	Defines the source of external event 1. See also parameter 31.02 External event 1 type. 0 = Trigger event 1 = Normal operation	Inactive (true); DI6 (95.20 b8)
	Active (false)	0.	0
	Inactive (true)	1.	1
	DIIL	DIIL input (10.02 DI delayed status, bit 15).	2
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	3
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	4
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	5
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	6
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	7
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	8
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	11
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	12
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
31.02	External event 1 type	Selects the type of external event 1.	Fault (95.20 b8)
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3

No.	Name/Value	Description	Def/FbEq16
31.03	*External event 2 source*	Defines the source of external event 2. See also parameter *31.04 External event 2 type*. For the selections, see parameter *31.01 External event 1 source*.	*Inactive (true)*; *DIIL* (*95.20* b5)
31.04	*External event 2 type*	Selects the type of external event 2.	
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3
31.05	*External event 3 source*	Defines the source of external event 3. See also parameter *31.06 External event 3 type*. For the selections, see parameter *31.01 External event 1 source*.	*Inactive (true)*
31.06	*External event 3 type*	Selects the type of external event 3.	
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3
31.07	*External event 4 source*	Defines the source of external event 4. See also parameter *31.08 External event 4 type*. For the selections, see parameter *31.01 External event 1 source*.	*Inactive (true)*
31.08	*External event 4 type*	Selects the type of external event 4.	
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3
31.09	*External event 5 source*	Defines the source of external event 5. See also parameter *31.10 External event 5 type*. For the selections, see parameter *31.01 External event 1 source*.	*Inactive (true)*
31.10	*External event 5 type*	Selects the type of external event 5.	
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3
31.11	*Fault reset selection*	Selects the source of an external fault reset signal. This signal will be observed even if it is not the active source in the current control location (EXT1/EXT2/Local). (A reset from the active source will be observed regardless of this parameter.) 0 –> 1 = Reset	*DI3*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2

No.	Name/Value	Description	*Def/FbEq16*
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	FBA A MCW bit 7	Control word bit 7 received through fieldbus interface A.	30
	EFB MCW bit 7	Control word bit 7 received through the embedded fieldbus interface.	32
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
31.12	*Autoreset selection*	Selects faults that are automatically reset. The parameter is a 16-bit word with each bit corresponding to a fault type. Whenever a bit is set to 1, the corresponding fault is automatically reset. The number and interval of reset attempts are defined by parameters *31.14*…*31.16*. **WARNING!** Before you activate the function, make sure that no dangerous situations can occur. The function resets the drive automatically and continues operation after a fault. **Notes:** • The autoreset function is only available in external control; see section *Local control vs. external control* (page *20*). • Faults related to the Safe torque off (STO) function cannot be automatically reset. The bits of this binary number correspond to the following faults:	0000h

Bit	Fault
0	Overcurrent
1	Overvoltage
2	Undervoltage
3	AI supervision fault
4	Supply unit
5…7	Reserved
8	Application fault 1 (defined in the application program)
9	Application fault 2 (defined in the application program)
10	Selectable fault (see parameter *31.13 User selectable fault*)
11	External fault 1 (from source selected by parameter *31.01 External event 1 source*)
12	External fault 2 (from source selected by parameter *31.03 External event 2 source*)
13	External fault 3 (from source selected by parameter *31.05 External event 3 source*)
14	External fault 4 (from source selected by parameter *31.07 External event 4 source*)
15	External fault 5 (from source selected by parameter *31.09 External event 5 source*)

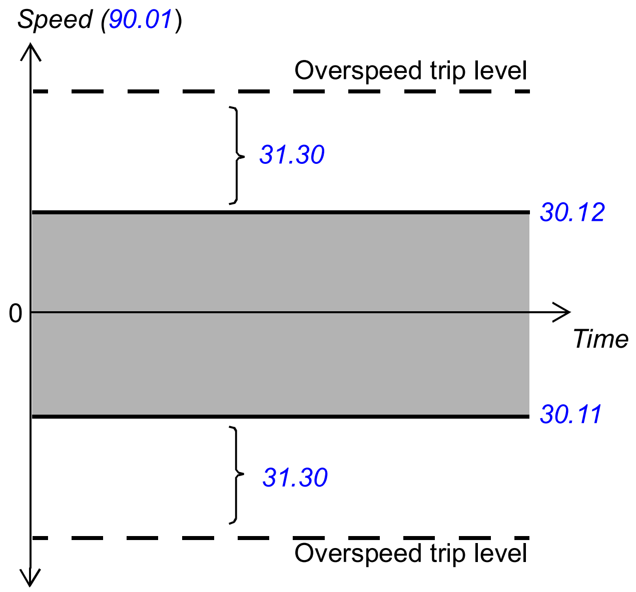
	0000h…FFFFh	Automatic reset configuration word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
31.13	User selectable fault	Defines the fault that can be automatically reset using parameter 31.12 Autoreset selection, bit 10. The faults are listed in chapter Fault tracing (page 495).	0000h
	0000h…FFFFh	Fault code.	10 = 1
31.14	Number of trials	Defines the maximum number of automatic resets that the drive is allowed to attempt within the time specified by 31.15 Total trials time. If the fault persists, subsequent reset attempts will be made at intervals defined by 31.16 Delay time. The faults to be automatically reset are defined by 31.12 Autoreset selection.	0
	0…5	Number of automatic resets.	-
31.15	Total trials time	Defines a time window for automatic fault resets. The maximum number of attempts made during any period of this length is defined by 31.14 Number of trials. **Note:** If the fault condition remains and cannot be reset, each reset attempt will generate an event and start a new time window. In practice, if the specified number of resets (31.14) at specified intervals (31.16) take longer than the value of 31.15, the drive will continue to attempt resetting the fault until the cause is eventually removed.	30.0 s
	1.0 … 600.0 s	Time for automatic resets.	10 = 1 s
31.16	Delay time	Defines the time that the drive will wait after a fault (or a previous reset attempt) before attempting an automatic reset. See parameter 31.12 Autoreset selection.	0.0 s
	0.0 … 120.0 s	Autoreset delay.	10 = 1 s
31.19	Motor phase loss	Selects how the drive reacts when a motor phase loss is detected.	Fault
	No action	No action taken.	0
	Fault	The drive trips on fault 3381 Output phase loss.	1
31.20	Earth fault	Selects how the drive reacts when an earth fault or current unbalance is detected in the motor or the motor cable.	Fault
	No action	No action taken.	0
	Warning	The drive generates an A2B3 Earth leakage warning.	1
	Fault	The drive trips on fault 2330 Earth leakage.	2
31.21	Supply phase loss	Selects how the drive reacts when a supply phase loss is detected.	Fault
	No action	No action taken.	0
	Fault	The drive trips on fault 3130 Input phase loss.	1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>31.22</td><td>STO indication run/stop</td><td>Selects which indications are given when one or both Safe torque off (STO) signals are switched off or lost. The indications also depend on whether the drive is running or stopped when this occurs.
The tables at each selection below show the indications generated with that particular setting.
Notes:
• This parameter does not affect the operation of the STO function itself. The STO function will operate regardless of the setting of this parameter: a running drive will stop upon removal of one or both STO signals, and will not start until both STO signals are restored and all faults reset.
• The loss of only one STO signal always generates a fault as it is interpreted as a malfunction.
For more information on the STO, see the Hardware manual of the drive.</td><td>Fault/Fault</td></tr>
<tr><td></td><td>Fault/Fault</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Faults 5091 Safe torque off and FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2 loss</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>0</td></tr>
<tr><td></td><td>Fault/Warning</td><td>
<table>
<tr><th colspan="2">Inputs</th><th colspan="2">Indication</th></tr>
<tr><th>IN1</th><th>IN2</th><th>Running</th><th>Stopped</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td><td>Warning A5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Faults 5091 Safe torque off and FA81 Safe torque off 1 loss</td><td>Warning A5A0 Safe torque off and fault FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2 loss</td><td>Warning A5A0 Safe torque off and fault FA82 Safe torque off 2 loss</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">(Normal operation)</td></tr>
</table>
</td><td>1</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Fault/Event</td><td>
<table>
<tr><th colspan="2">Inputs</th><th colspan="2">Indication</th></tr>
<tr><th>IN1</th><th>IN2</th><th>Running</th><th>Stopped</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td><td>Event B5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Faults 5091 Safe torque off and FA81 Safe torque off 1 loss</td><td>Event B5A0 Safe torque off and fault FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2 loss</td><td>Event B5A0 Safe torque off and fault FA82 Safe torque off 2 loss</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">(Normal operation)</td></tr>
</table>
</td><td>2</td></tr>
<tr><td></td><td>Warning/Warning</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Warning A5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Warning A5A0 Safe torque off and fault FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Warning A5A0 Safe torque off and fault FA82 Safe torque off 2 loss</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>3</td></tr>
<tr><td></td><td>Event/Event</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Event B5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Event B5A0 Safe torque off and fault FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Event B5A0 Safe torque off and fault FA82 Safe torque off 2 loss</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>4</td></tr>
<tr><td></td><td>No indication/No indication</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>None</td></tr>
<tr><td>0</td><td>1</td><td>Fault FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Fault FA82 Safe torque off 2 loss</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>5</td></tr>
<tr><td>31.23</td><td>Wiring or earth fault</td><td>Selects how the drive reacts to incorrect input power and motor cable connection (i.e. input power cable is connected to drive motor connection).
Note: The protection must be disabled with drive/inverter hardware supplied from a common DC bus.</td><td>Fault</td></tr>
<tr><td></td><td>No action</td><td>No action taken (protection disabled).</td><td>0</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault 3181 Wiring or earth fault.</td><td>1</td></tr>
</table>

No.	Name/Value	Description	*Def/FbEq16*
31.24	*Stall function*	Selects how the drive reacts to a motor stall condition. A stall condition is defined as follows: • The drive exceeds the stall current limit (*31.25 Stall current limit*), and • the output frequency is below the level set by parameter *31.27 Stall frequency limit* or the motor speed is below the level set by parameter *31.26 Stall speed limit*, and • the conditions above have been true longer than the time set by parameter *31.28 Stall time*.	*Fault*
	No action	None (stall supervision disabled).	0
	Warning	The drive generates an *A780 Motor stall* warning.	1
	Fault	The drive trips on fault *7121 Motor stall*.	2
31.25	*Stall current limit*	Stall current limit in percent of the nominal current of the motor. See parameter *31.24 Stall function*.	200.0%
	0.0 … 1600.0%	Stall current limit.	-
31.26	*Stall speed limit*	Stall speed limit in rpm. See parameter *31.24 Stall function*.	150.00 rpm; 180.00 rpm (*95.20* b0)
	0.00 … 10000.00 rpm	Stall speed limit.	See par. *46.01*
31.27	*Stall frequency limit*	Stall frequency limit. See parameter *31.24 Stall function*. **Note:** Setting the limit below 10 Hz is not recommended.	15.00 Hz; 18.00 Hz (*95.20* b0)
	0.00 … 500.00 Hz	Stall frequency limit.	See par. *46.02*
31.28	*Stall time*	Stall time. See parameter *31.24 Stall function*.	20 s
	0 … 3600 s	Stall time.	-

No.	Name/Value	Description	*Def/FbEq16*
31.30	*Overspeed trip margin*	Defines, together with *30.11 Minimum speed* and *30.12 Maximum speed*, the maximum allowed speed of the motor (overspeed protection). If *90.01 Motor speed for control* or the estimated speed exceeds the speed limit defined by parameter *30.11* or *30.12* by more than the value of this parameter, the drive trips on the *7310 Overspeed* fault. **Example:** If the maximum speed is 1420 rpm and speed trip margin is 300 rpm, the drive trips at 1720 rpm. 	500.00 rpm
	0.00 … 10000.0 rpm	Overspeed trip margin.	See par. *46.01*
31.32	*Emergency ramp supervision*	Parameters *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*, together with *01.29 Speed change rate*, provide a supervision function for emergency stop modes Off1 and Off3. The supervision is based on either • observing the time within which the motor stops, or • comparing the actual and expected deceleration rates. If this parameter is set to 0%, the maximum stop time is directly set in parameter *31.33*. Otherwise, *31.32* defines the maximum allowed deviation from the expected deceleration rate, which is calculated from parameters *23.11*…*23.19* (Off1) or *23.23 Emergency stop time* (Off3). If the actual deceleration rate (*01.29*) deviates too much from the expected rate, the drive trips on *73B0 Emergency ramp failed*, sets bit 8 of *06.17 Drive status word 2*, and coasts to a stop. If *31.32* is set to 0% and *31.33* is set to 0 s, the emergency stop ramp supervision is disabled. See also parameter *21.04 Emergency stop mode*.	0%
	0…300%	Maximum deviation from expected deceleration rate.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
31.33	*Emergency ramp supervision delay*	If parameter *31.32 Emergency ramp supervision* is set to 0%, this parameter defines the maximum time an emergency stop (mode Off1 or Off3) is allowed to take. If the motor has not stopped when the time elapses, the drive trips on *73B0 Emergency ramp failed*, sets bit 8 of *06.17 Drive status word 2*, and coasts to a stop. If *31.32* is set to a value other than 0%, this parameter defines a delay between the receipt of the emergency stop command and the activation of the supervision. It is recommended to specify a short delay to allow the speed change rate to stabilize.	0 s
	0…32767 s	Maximum ramp-down time, or supervision activation delay.	1 = 1 s
31.35	*Main fan fault function*	Selects how the drive reacts when a main cooling fan fault is detected. **Note:** With an inverter unit consisting of one or more frame R8i inverter modules with speed-controlled fans, it may be possible to continue operation even if one main fan of a module stops. When fan failure is detected, the control program will automatically • set the other fan of the module to full speed • set the fans of the other modules (if any) to full speed • decrease the switching frequency to a minimum, and • disable the supervision of temperature difference between the modules. If this parameter is set to *Fault*, the inverter unit will trip (but still carry out the actions listed above). Otherwise, the inverter will attempt to continue operation.	*Warning*
	Fault	The drive trips on fault *5080 Fan*.	0
	Warning	The drive generates an *A581 Fan* warning.	1
	No action	No action taken.	2
31.36	*Aux fan fault bypass*	*(Only visible with a ZCU control unit)* Temporarily suppresses auxiliary fan faults. Certain drive types (especially those protected to IP55) have an auxiliary fan built into the front cover as standard. If the fan is sticking or disconnected, the control program generates a fault (*5081 Auxiliary fan broken*). If it is necessary to operate the drive without the front cover (for example, during commissioning), this parameter can be activated to temporarily generate a warning (*A582 Auxiliary fan missing*) instead of the fault. **Notes:** • The parameter must be activated within 2 minutes of control unit reboot (either by cycling the power or by parameter *96.08*). • The parameter will be in effect until the auxiliary fan is reconnected and detected, or until the next control unit reboot.	*Off*
	Off	Normal operation.	0
	Temporarily bypassed	The auxiliary fan fault is temporarily replaced by a warning indication. The setting will revert automatically to *Off*.	1

No.	Name/Value	Description	Def/FbEq16
31.37	*Ramp stop supervision*	Parameters *31.37 Ramp stop supervision* and *31.38 Ramp stop supervision delay*, together with *01.29 Speed change rate*, provide a supervision function for normal (ie. non-emergency) ramp stopping. The supervision is based on either • observing the time within which the motor stops, or • comparing the actual and expected deceleration rates. If this parameter is set to 0%, the maximum stop time is directly set in parameter *31.38*. Otherwise, *31.37* defines the maximum allowed deviation from the expected deceleration rate, which is calculated from parameters *23.11*…*23.19*. If the actual deceleration rate (*01.29*) deviates too much from the expected rate, the drive trips on *73B1 Stop failed*, sets bit 14 of *06.17 Drive status word 2*, and coasts to a stop. If *31.32* is set to 0% and *31.33* is set to 0 s, the ramp stop supervision is disabled.	0%
	0…300%	Maximum deviation from expected deceleration rate.	1 = 1%
31.38	*Ramp stop supervision delay*	If parameter *31.37 Ramp stop supervision* is set to 0%, this parameter defines the maximum time a ramp stop is allowed to take. If the motor has not stopped when the time elapses, the drive trips on *73B1 Stop failed*, sets bit 14 of *06.17 Drive status word 2*, and coasts to a stop. If *31.37* is set to a value other than 0%, this parameter defines a delay between the receipt of the stop command and the activation of the supervision. It is recommended to specify a short delay to allow the speed change rate to stabilize.	0 s
	0…32767 s	Maximum ramp-down time, or supervision activation delay.	1 = 1 s
31.40	*Disable warning messages*	Selects warnings to be suppressed. The parameter is a 16-bit word with each bit corresponding to a warning. Whenever a bit is set to 1, the corresponding warning is suppressed. The bits of this binary number correspond to the following warnings:	0000b

Bit	Fault
0	Overvoltage
1	Reserved
2	Encoder 1
3	Encoder 2
4	CU (Control unit) battery
5…15	Reserved

No.	Name/Value	Description	Def/FbEq16
	0000b…1101b	Warning suppression word.	1 = 1
31.42	*Overcurrent fault limit*	Sets a custom motor current fault limit. The drive automatically sets an internal motor current limit according to the drive hardware. The internal limit is appropriate in most cases, but this parameter can be used to set a lower current limit, for example, to protect a permanent magnet motor from demagnetization. **Note:** The limit defines the maximum peak current of one phase. With this parameter at 0.0 A, only the internal limit is in force.	0.00 A
	0.00 … 30000.00 A	Custom motor current fault limit.	See par. *46.05*

No.	Name/Value	Description	Def/FbEq16
32 Supervision		Configuration of signal supervision functions 1…3. Three values can be chosen to be monitored; a warning or fault is generated whenever predefined limits are exceeded. See also section *Signal supervision* (page 85).	
32.01	*Supervision status*	Signal supervision status word. Indicates whether the values monitored by the signal supervision functions are within or outside their respective limits. **Note:** This word is independent of the drive actions defined by parameters *32.06*, *32.16* and *32.26*.	0000b

Bit	Name	Description
0	Supervision 1 active	1 = Signal selected by *32.07* is outside its limits.
1	Supervision 2 active	1 = Signal selected by *32.17* is outside its limits.
2	Supervision 3 active	1 = Signal selected by *32.27* is outside its limits.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000…0111b	Signal supervision status word.	1 = 1
32.05	*Supervision 1 function*	Selects the mode of signal supervision function 1. Determines how the monitored signal (see parameter *32.07*) is compared to its lower and upper limits (*32.09* and *32.10* respectively). The action to be taken when the condition is fulfilled is selected by *32.06*.	*Disabled*
	Disabled	Signal supervision 1 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
32.06	*Supervision 1 action*	Selects the action the drive takes when the value monitored by signal supervision 1 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No action taken.	0
	Warning	A warning (*A8B0 Signal supervision*) is generated.	1
	Fault	The drive trips on *80B0 Signal supervision*.	2
	Fault if running	If running, the drive trips on *80B0 Signal supervision*.	3
32.07	*Supervision 1 signal*	Selects the signal to be monitored by signal supervision function 1.	*Zero*
	Zero	None.	0
	Speed	*01.01 Motor speed used* (page 113).	1
	Frequency	*01.06 Output frequency* (page 113).	3

No.	Name/Value	Description	Def/FbEq16
	Current	01.07 Motor current (page 113).	4
	Torque	01.10 Motor torque (page 113).	6
	DC voltage	01.11 DC voltage (page 113).	7
	Output power	01.14 Output power (page 114).	8
	AI1	12.11 AI1 actual value (page 152).	9
	AI2	12.21 AI2 actual value (page 154).	10
	Speed ref ramp in	23.01 Speed ref ramp input (page 212).	18
	Speed ref ramp out	23.02 Speed ref ramp output (page 212).	19
	Speed ref used	24.01 Used speed reference (page 218).	20
	Torque ref used	26.02 Torque reference used (page 234).	21
	Freq ref used	28.02 Frequency ref ramp output (page 240).	22
	Process PID output	40.01 Process PID output actual (page 293).	24
	Process PID feedback	40.02 Process PID feedback actual (page 293).	25
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
32.08	*Supervision 1 filter time*	Defines a filter time constant for the signal monitored by signal supervision 1.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.09	*Supervision 1 low*	Defines the lower limit for signal supervision 1.	0.00
	-21474830.00 … 21474830.00	Low limit.	-
32.10	*Supervision 1 high*	Defines the upper limit for signal supervision 1.	0.00
	-21474830.00 … 21474830.00	Upper limit.	-
32.15	*Supervision 2 function*	Selects the mode of signal supervision function 2. Determines how the monitored signal (see parameter *32.17*) is compared to its lower and upper limits (*32.19* and *32.20* respectively). The action to be taken when the condition is fulfilled is selected by *32.16*.	*Disabled*
	Disabled	Signal supervision 2 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
32.16	*Supervision 2 action*	Selects the action the drive takes when the value monitored by signal supervision 2 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No action taken.	0

No.	Name/Value	Description	*DefFbEq16*
	Warning	A warning (*A8B1 Signal supervision 2*) is generated.	1
	Fault	The drive trips on *80B1 Signal supervision 2*.	2
	Fault if running	If running, the drive trips on *80B0 Signal supervision*.	3
32.17	*Supervision 2 signal*	Selects the signal to be monitored by signal supervision function 2. For the available selections, see parameter *32.07 Supervision 1 signal*.	*Zero*
32.18	*Supervision 2 filter time*	Defines a filter time constant for the signal monitored by signal supervision 2.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.19	*Supervision 2 low*	Defines the lower limit for signal supervision 2.	0.00
	-21474830.00 … 21474830.00	Low limit.	-
32.20	*Supervision 2 high*	Defines the upper limit for signal supervision 2.	0.00
	-21474830.00 … 21474830.00	Upper limit.	-
32.25	*Supervision 3 function*	Selects the mode of signal supervision function 3. Determines how the monitored signal (see parameter *32.27*) is compared to its lower and upper limits (*32.29* and *32.30* respectively). The action to be taken when the condition is fulfilled is selected by *32.26*.	*Disabled*
	Disabled	Signal supervision 3 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
32.26	*Supervision 3 action*	Selects the action the drive takes when the value monitored by signal supervision 3 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No action taken.	0
	Warning	A warning (*A8B2 Signal supervision 3*) is generated.	1
	Fault	The drive trips on *80B2 Signal supervision 3*.	2
	Fault if running	If running, the drive trips on *80B0 Signal supervision*.	3
32.27	*Supervision 3 signal*	Selects the signal to be monitored by signal supervision function 3. For the available selections, see parameter *32.07 Supervision 1 signal*.	*Zero*

No.	Name/Value	Description	Def/FbEq16
32.28	*Supervision 3 filter time*	Defines a filter time constant for the signal monitored by signal supervision 3.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.29	*Supervision 3 low*	Defines the lower limit for signal supervision 3.	0.00
	-21474830.00 … 21474830.00	Low limit.	-
32.30	*Supervision 3 high*	Defines the upper limit for signal supervision 3.	0.00
	-21474830.00 … 21474830.00	Upper limit.	-

33 Generic timer & counter		Configuration of maintenance timers/counters. See also section *Maintenance timers and counters* (page 85).	
33.01	*Counter status*	Displays the maintenance timer/counter status word, indicating which maintenance timers/counters have exceeded their limits. This parameter is read-only.	-

Bit	Name	Description
0	On-time1	1 = On-time timer 1 has reached its preset limit.
1	On-time2	1 = On-time timer 2 has reached its preset limit.
2	Edge 1	1 = Signal edge counter 1 has reached its preset limit.
3	Edge 2	1 = Signal edge counter 2 has reached its preset limit.
4	Value 1	1 = Value counter 1 has reached its preset limit.
5	Value 2	1 = Value counter 2 has reached its preset limit.
6…15	Reserved	

	0000 0000b … 0011 1111b	Maintenance time/counter status word.	1 = 1
33.10	*On-time 1 actual*	Displays the actual present value of on-time timer 1. The timer runs whenever the signal selected by parameter *33.13 On-time 1 source* is on. When the timer exceeds the limit set by *33.11 On-time 1 warn limit*, bit 0 of *33.01 Counter status* is set to 1. The warning specified by *33.14 On-time 1 warn message* is also given if enabled by *33.12 On-time 1 function*. The timer can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295 s	Actual present value of on-time timer 1.	-
33.11	*On-time 1 warn limit*	Sets the warning limit for on-time timer 1.	0 s
	0…4294967295 s	Warning limit for on-time timer 1.	-

No.	Name/Value	Description	Def/FbEq16
33.12	On-time 1 function	Configures on-time timer 1. **Bit** / **Function** 0 – Counter mode 0 = Loop: When the limit is reached, the counter is reset. The counter status (bit 0 of 33.01) switches to 1 for one second. The warning (if enabled) stays active for at least 10 seconds. 1 = Saturate: When the limit is reached, the counter status (bit 0 of 33.01) switches to 1, and remains so until 33.10 is reset. The warning (if enabled) also stays active until 33.10 is reset. 1 – Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning (see 33.14) is given when the limit is reached 2…15 – Reserved	0000b
	0000b…0011b	On-time timer 1 configuration word.	1 = 1
33.13	On-time 1 source	Selects the signal to be monitored by on-time timer 1.	False
	False	Constant 0 (timer disabled).	0
	True	Constant 1.	1
	RO1	Bit 0 of 10.21 RO status (page 143).	2
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
33.14	On-time 1 warn message	Selects the optional warning message for on-time timer 1.	On-time 1 exceeded
	On-time 1 exceeded	A886 On-time 1. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	0
	Clean device	A88C Device clean.	6
	Maintain additional cooling fan	A890 Additional cooling.	7
	Maintain cabinet fan	A88E Cabinet fan.	8
	Maintain DC capacitors	A88D DC capacitor.	9
	Maintain motor bearing	A880 Motor bearing.	10
33.20	On-time 2 actual	Displays the actual present value of on-time timer 2. The timer runs whenever the signal selected by parameter 33.23 On-time 2 source is on. When the timer exceeds the limit set by 33.21 On-time 2 warn limit, bit 1 of 33.01 Counter status is set to 1. The warning specified by 33.24 On-time 2 warn message is also given if enabled by 33.22 On-time 2 function. The timer can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295 s	Actual present value of on-time timer 2.	-
33.21	On-time 2 warn limit	Sets the warning limit for on-time timer 2.	0 s
	0…4294967295 s	Warning limit for on-time timer 2.	-

No.	Name/Value	Description	Def/FbEq16
33.22	*On-time 2 function*	Configures on-time timer 2.	0000b

Bit	Function
0	Counter mode 0 = Loop: When the limit is reached, the counter is reset. The counter status (bit 1 of *33.01*) switches to 1 for one second. The warning (if enabled) stays active for at least 10 seconds. 1 = Saturate: When the limit is reached, the counter status (bit 1 of *33.01*) switches to 1, and remains so until *33.20* is reset. The warning (if enabled) also stays active until *33.20* is reset.
1	Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning (see *33.24*) is given when the limit is reached
2…15	Reserved

No.	Name/Value	Description	Def/FbEq16
	0000b…0011b	On-time timer 2 configuration word.	1 = 1
33.23	*On-time 2 source*	Selects the signal to be monitored by on-time timer 2.	*False*
	False	Constant 0 (timer disabled).	0
	True	Constant 1.	1
	RO1	Bit 0 of *10.21 RO status* (page *143*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
33.24	*On-time 2 warn message*	Selects the optional warning message for on-time timer 2.	*On-time 2 exceeded*
	On-time 2 exceeded	*A887 On-time 2*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	1
	Clean device	*A88C Device clean*.	6
	Maintain additional cool fan	*A890 Additional cooling*.	7
	Maintain cabinet fan	*A88E Cabinet fan*.	8
	Maintain DC capacitors	*A88D DC capacitor*.	9
	Maintain motor bearing	*A880 Motor bearing*.	10
33.30	*Edge counter 1 actual*	Actual present value of signal edge counter 1. The counter is incremented every time the signal selected by parameter *33.33 Edge counter 1 source* switches on or off (or either, depending on the setting of *33.32 Edge counter 1 function*). A divisor may be applied to the count (see *33.34 Edge counter 1 divider*). When the counter exceeds the limit set by *33.31 Edge counter 1 warn limit*, bit 2 of *33.01 Counter status* is set to 1. The warning specified by *33.35 Edge counter 1 warn message* is also given if enabled by *33.32 Edge counter 1 function*. The counter can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Actual present value of signal edge counter 1.	-

No.	Name/Value	Description	*Def/FbEq16*
33.31	*Edge counter 1 warn limit*	Sets the warning limit for signal edge counter 1.	0
	0…4294967295	Warning limit for signal edge counter 1.	-
33.32	*Edge counter 1 function*	Configures signal edge counter 1.	0000b

Bit	Function
0	Counter mode 0 = Loop: When the limit is reached, the counter is reset. The counter status (bit 2 of *33.01*) switches to 1 and remains so until the counter is again incremented. The warning (if enabled) stays active for at least 10 seconds. 1 = Saturate: When the limit is reached, the counter status (bit 2 of *33.01*) switches to 1, and remains so until *33.30* is reset. The warning (if enabled) also stays active until *33.30* is reset.
1	Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning (see *33.35*) is given when the limit is reached
2	Count rising edges 0 = Disable: Rising edges are not counted 1 = Enable: Rising edges are counted
3	Count falling edges 0 = Disable: Falling edges are not counted 1 = Enable: Falling edges are counted
4…15	Reserved

No.	Name/Value	Description	*Def/FbEq16*
	0000b…1111b	Edge counter 1 configuration word.	1 = 1
33.33	*Edge counter 1 source*	Selects the signal to be monitored by signal edge counter 1.	*False*
	False	Constant 0.	0
	True	Constant 1.	1
	RO1	Bit 0 of *10.21 RO status* (page *143*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
33.34	*Edge counter 1 divider*	Defines a divisor for signal edge counter 1. Determines how many signal edges increment the counter by 1.	1
	1…4294967295	Divisor for signal edge counter 1.	-
33.35	*Edge counter 1 warn message*	Selects the optional warning message for signal edge counter 1.	*Edge counter 1 exceeded*
	Edge counter 1 exceeded	*A888 Edge counter 1*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	2
	Counted main contactor	*A884 Main contactor*.	11
	Counted output relay	*A881 Output relay*.	12
	Counted motor starts	*A882 Motor starts*.	13
	Counted power ups	*A883 Power ups*.	14
	Counted DC charges	*A885 DC charge*.	15

No.	Name/Value	Description	Def/FbEq16
33.40	Edge counter 2 actual	Displays the actual present value of signal edge counter 2. The counter is incremented every time the signal selected by parameter 33.43 Edge counter 2 source switches on or off (or either, depending on the setting of 33.42 Edge counter 2 function). A divisor may be applied to the count (see 33.44 Edge counter 2 divider). When the counter exceeds the limit set by 33.41 Edge counter 2 warn limit, bit 3 of 33.01 Counter status is set to 1. The warning specified by 33.45 Edge counter 2 warn message is also given if enabled by 33.42 Edge counter 2 function. The counter can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Actual present value of signal edge counter 2.	-
33.41	Edge counter 2 warn limit	Sets the warning limit for signal edge counter 2.	0
	0…4294967295	Warning limit for signal edge counter 2.	-
33.42	Edge counter 2 function	Configures signal edge counter 2.	0000b

Bit	Function
0	Counter mode 0 = Loop: When the limit is reached, the counter is reset. The counter status (bit 3 of 33.01) remains 1 until the counter is again incremented. The warning (if enabled) stays active for at least 10 seconds. 1 = Saturate: After the limit is reached, the counter status (bit 3 of 33.01) remains 1 until 33.40 is reset. The warning (if enabled) also stays active until 33.40 is reset.
1	Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning (see 33.45) is given when the limit is reached
2	Count rising edges 0 = Disable: Rising edges are not counted 1 = Enable: Rising edges are counted
3	Count falling edges 0 = Disable: Falling edges are not counted 1 = Enable: Falling edges are counted
4…15	Reserved

No.	Name/Value	Description	Def/FbEq16
	0000b…1111b	Edge counter 2 configuration word.	1 = 1
33.43	Edge counter 2 source	Selects the signal to be monitored by signal edge counter 2.	False
	False	0.	0
	True	1.	1
	RO1	Bit 0 of 10.21 RO status (page 143).	2
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
33.44	Edge counter 2 divider	Defines a divisor for signal edge counter 2. Determines how many signal edges increment the counter by 1.	1
	1…4294967295	Divisor for signal edge counter 2.	-

No.	Name/Value	Description	*Def/FbEq16*
33.45	*Edge counter 2 warn message*	Selects the optional warning message for signal edge counter 2.	*Edge counter 2 exceeded*
	Edge counter 2 exceeded	*A889 Edge counter 2*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	3
	Counted main contactor	*A884 Main contactor*.	11
	Counted output relay	*A881 Output relay*.	12
	Counted motor starts	*A882 Motor starts*.	13
	Counted power ups	*A883 Power ups*.	14
	Counted DC charges	*A885 DC charge*.	15
33.50	*Value counter 1 actual*	Displays the actual present value of value counter 1. The value of the source selected by parameter *33.53 Value counter 1 source* is read at one-second intervals and added to the counter. A divisor can be applied to the count (see *33.54 Value counter 1 divider*). When the counter exceeds the limit set by *33.51 Value counter 1 warn limit*, bit 4 of *33.01 Counter status* is set to 1. The warning specified by *33.55 Value counter 1 warn message* is also given if enabled by *33.52 Value counter 1 function*. The counter can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	-2147483008 … 2147483008	Actual present value of value counter 1.	-
33.51	*Value counter 1 warn limit*	Sets the limit for value counter 1. With a positive limit, bit 4 of *33.01 Counter status* is set to 1 (and a warning optionally generated) when the counter is equal or greater than the limit. With a negative limit, bit 4 of *33.01 Counter status* is set to 1 (and a warning optionally generated) when the counter is equal or smaller than the limit. 0 = Counter disabled.	0
	-2147483008 … 2147483008	Limit for value counter 1.	-

No.	Name/Value	Description	Def/FbEq16
33.52	*Value counter 1 function*	Configures value counter 1. **Bit** / **Function** 0 – Counter mode 0 = Loop: When the limit is reached, the counter is reset. The counter status (bit 4 of *33.01*) switches to 1 for one second. The warning (if enabled) stays active for at least 10 seconds. 1 = Saturate: When the limit is reached, the counter status (bit 4 of *33.01*) switches to 1, and remains so until *33.50* is reset. The warning (if enabled) also stays active until *33.50* is reset. 1 – Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning (see *33.55*) is given when the limit is reached 2…15 – Reserved	0000b
	0000b…0011b	Value counter 1 configuration word.	1 = 1
33.53	*Value counter 1 source*	Selects the signal to be monitored by value counter 1.	*Not selected*
	Not selected	None (counter disabled).	0
	Motor speed	*01.01 Motor speed used* (see page *113*).	1
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
33.54	*Value counter 1 divider*	Defines a divisor for value counter 1. The value of the monitored signal is divided by this value before integration.	1.000
	0.001 … 2147483.000	Divisor for value counter 1.	-
33.55	*Value counter 1 warn message*	Selects the optional warning message for value counter 1.	*Value counter 1 exceeded*
	Value counter 1 exceeded	*A88A Value counter 1*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	4
	Maintain motor bearing	*A880 Motor bearing*.	10
33.60	*Value counter 2 actual*	Displays the actual present value of value counter 2. The value of the source selected by parameter *33.63 Value counter 2 source* is read at one-second intervals and added to the counter. A divisor can be applied to the count (see *33.64 Value counter 2 divider*). When the counter exceeds the limit set by *33.61 Value counter 2 warn limit*, bit 5 of *33.01 Counter status* is set to 1. The warning specified by *33.65 Value counter 2 warn message* is also given if enabled by *33.62 Value counter 2 function*. The counter can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	-2147483008 … 2147483008	Actual present value of value counter 2.	-

No.	Name/Value	Description	*Def/FbEq16*
33.61	*Value counter 2 warn limit*	Sets the limit for value counter 2. With a positive limit, bit 5 of *33.01 Counter status* is set to 1 (and a warning optionally generated) when the counter is equal or greater than the limit. With a negative limit, bit 5 of *33.01 Counter status* is set to 1 (and a warning optionally generated) when the counter is equal or smaller than the limit. 0 = Counter disabled.	0
	-2147483008 … 2147483008	Limit for value counter 2.	-
33.62	*Value counter 2 function*	Configures value counter 2.	0000b

Bit	Function
0	Counter mode 0 = Loop: When the limit is reached, the counter is reset. The counter status (bit 5 of *33.01*) switches to 1 for one second. The warning (if enabled) stays active for at least 10 seconds. 1 = Saturate: When the limit is reached, the counter status (bit 5 of *33.01*) switches to 1, and remains so until *33.60* is reset. The warning (if enabled) also stays active until *33.60* is reset.
1	Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning (see *33.65*) is given when the limit is reached
2…15	Reserved

No.	Name/Value	Description	*Def/FbEq16*
	0000b…0011b	Value counter 2 configuration word.	1 = 1
33.63	*Value counter 2 source*	Selects the signal to be monitored by value counter 2.	*Not selected*
	Not selected	None (counter disabled).	0
	Motor speed	*01.01 Motor speed used* (see page *113*).	1
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
33.64	*Value counter 2 divider*	Defines a divisor for value counter 2. The value of the monitored signal is divided by this value before integration.	1.000
	0.001 … 2147483.000	Divisor for value counter 2.	-
33.65	*Value counter 2 warn message*	Selects the optional warning message for value counter 2.	*Value counter 2 exceeded*
	Value counter 2 exceeded	*A88B Value counter 2*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	5
	Maintain motor bearing	*A880 Motor bearing*.	10

No.	Name/Value	Description	Def/FbEq16
35 Motor thermal protection		Motor thermal protection settings such as temperature measurement configuration, load curve definition and motor fan control configuration. See also section *Motor thermal protection* (page 78).	
35.01	*Motor estimated temperature*	Displays the motor temperature as estimated by the internal motor thermal protection model (see parameters *35.50*…*35.55*). The unit is selected by parameter *96.16 Unit selection* This parameter is read-only.	-
	-60 … 1000 °C or °F	Estimated motor temperature.	1 = 1°
35.02	*Measured temperature 1*	Displays the temperature received through the source defined by parameter *35.11 Temperature 1 source*. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms. This parameter is read-only.	-
	-60 … 1000 °C, -76 … 1832 °F or 0…5000 ohm	Measured temperature 1.	1 = 1 unit
35.03	*Measured temperature 2*	Displays the temperature received through the source defined by parameter *35.21 Temperature 2 source*. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms. This parameter is read-only.	-
	-60 … 1000 °C, -76 … 1832 °F or 0…5000 ohm	Measured temperature 2.	1 = 1 unit
35.04	*FPTC status word*	Displays the status of optional FPTC-xx thermistor protection modules. The word can be used as the source of eg. external events. **Note:** The “module found” bits are updated regardless of whether the corresponding module is activated. However, the “fault active” and “warning active” bits are not updated if the module is not activated. Modules are activated by parameter *35.30 FPTC configuration word*. This parameter is read-only.	-

Bit	Name	Description
0	Module found in slot 1	1 = Yes: An FPTC-xx module has been detected in slot 1.
1	Fault active in slot 1	1 = Yes: The module in slot 1 has an active fault (*4991*).
2	Warning active in slot 1	1 = Yes: The module in slot 1 has an active warning (*A497*).
3	Module found in slot 2	1 = Yes: An FPTC-xx module has been detected in slot 2.
4	Fault active in slot 2	1 = Yes: The module in slot 2 has an active fault (*4992*).
5	Warning active in slot 2	1 = Yes: The module in slot 2 has an active warning (*A498*).
6	Module found in slot 3	1 = Yes: An FPTC-xx module has been detected in slot 3.
7	Fault active in slot 3	1 = Yes: The module in slot 3 has an active fault (*4993*).
8	Warning active in slot 3	1 = Yes: The module in slot 3 has an active warning (*A499*).
9…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	FPTC-xx status word.	1 = 1

No.	Name/Value	Description	*DefFbEq16*
35.11	*Temperature 1 source*	Selects the source from which measured temperature 1 is read. For wiring examples, see the hardware manual of the drive. Usually this source is from a sensor connected to the motor controlled by the drive, but it could be used to measure and monitor a temperature from other parts of the process as long as a suitable sensor is used as per the selection list.	*Disabled*
	Disabled	None. Temperature monitoring function 1 is disabled.	0
	Estimated temperature	Estimated motor temperature (see parameter *35.01 Motor estimated temperature*). The temperature is estimated from an internal drive calculation. It is important to set up the ambient temperature of the motor in *35.50 Motor ambient temperature*.	1
	KTY84 analog I/O	KTY84 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the unit selection parameter of the input to volt. • Set the source selection parameter of the analog output to "*Force KTY84 excitation*". • Select the analog input in parameter *35.14*. In case the input is located on an I/O extension module, use the selection *Other* to point at the actual input value parameter (for example, *14.26 AI1 actual value*). The analog output feeds a constant current through the sensor. As the resistance of the sensor changes along with its temperature, the voltage over the sensor changes. The voltage is read by the analog input and converted into degrees.	2
	KTY84 encoder module 1	KTY84 sensor connected to encoder interface 1. See also parameters *91.21 Module 1 temp sensor type* and *91.22 Module 1 temp filter time*.	3
	KTY84 encoder module 2	KTY84 sensor connected to encoder interface 2. See also parameters *91.24 Module 2 temp sensor type* and *91.25 Module 2 temp filter time*.	4
	1 × Pt100 analog I/O	Pt100 sensor connected to a standard analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force Pt100 excitation*.	5
	2 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6
	3 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	7

No.	Name/Value	Description	Def/FbEq16
	PTC DI6	PTC sensor connected to digital input DI6 (see the connection diagram on page 78). **Note:** Either 0 ohm (normal temperature) or 4000 ohm (excessive temperature) will be shown by *35.02 Measured temperature 1*. By default, an excessive temperature will generate a warning as per parameter *35.13 Temperature 1 warning limit*. If you want a fault instead, set *35.12 Temperature 1 fault limit* to 4000 ohm.	8
	PTC analog I/O	PTC sensor connected to a standard analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force PTC excitation*.	20
	PTC encoder module 1	PTC sensor connected to encoder interface 1. See also parameters *91.21 Module 1 temp sensor type* and *91.22 Module 1 temp filter time*.	9
	PTC encoder module 2	PTC sensor connected to encoder interface 2. See also parameters *91.24 Module 2 temp sensor type* and *91.25 Module 2 temp filter time*.	10
	Direct temperature	The temperature is taken from the source selected by parameter *35.14 Temperature 1 AI source*. The value of the source is assumed to be in the unit of temperature specified by *96.16 Unit selection*.	11
	1 × Pt1000 analog I/O	Pt1000 sensor connected to a standard analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force Pt1000 excitation*.	13
	2 × Pt1000 analog I/O	As selection *1 × Pt1000 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	14
	3 × Pt1000 analog I/O	As selection *1 × Pt1000 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	15
35.12	*Temperature 1 fault limit*	Defines the fault limit for temperature monitoring function 1. When measured temperature 1 exceeds the limit, the drive trips on fault *4981 External temperature 1*. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms.	130 °C, 266 °F or 4500 ohm
	-60 … 1000 °C, -76 … 1832 °F or 0…5000 ohm	Fault limit for temperature monitoring function 1.	1 = 1 unit
35.13	*Temperature 1 warning limit*	Defines the warning limit for temperature monitoring function 1. When measured temperature 1 exceeds this limit, a warning (*A491 External temperature 1*) is generated. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms.	110 °C, 230 °F or 4000 ohm
	-60 … 1000 °C, -76 … 1832 °F or 0…5000 ohm	Warning limit for temperature monitoring function 1.	1 = 1 unit

No.	Name/Value	Description	*Def/FbEq16*
35.14	*Temperature 1 AI source*	Specifies the analog input when the setting of *35.11 Temperature 1 source* requires measurement through an analog input. **Note:** If the input is located on an I/O extension module, use the selection *Other* to point to the AI actual value in group 14, 15 or 16, eg. *14.26 AI1 actual value*.	*Not selected*
	Not selected	None.	0
	AI1 actual value	Analog input AI1 on the control unit.	1
	AI2 actual value	Analog input AI2 on the control unit.	2
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
35.21	*Temperature 2 source*	Selects the source from which measured temperature 2 is read. For wiring examples, see the hardware manual of the drive. Usually this source is from a sensor connected to the motor controlled by the drive, but it could be used to measure and monitor a temperature from other parts of the process as long as a suitable sensor is used as per the selection list.	*Disabled*
	Disabled	None. Temperature monitoring function 2 is disabled.	0
	Estimated temperature	Estimated motor temperature (see parameter *35.01 Motor estimated temperature*). The temperature is estimated from an internal drive calculation. It is important to set up the ambient temperature of the motor in *35.50 Motor ambient temperature*.	1
	KTY84 analog I/O	KTY84 sensor connected to the analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the unit selection parameter of the input to volt. • Set the source selection parameter of the analog output to "*Force KTY84 excitation*". • Select the analog input in parameter *35.24*. In case the input is located on an I/O extension module, use the selection *Other* to point at the actual input value parameter (for example, *14.26 AI1 actual value*). The analog output feeds a constant current through the sensor. As the resistance of the sensor changes along with its temperature, the voltage over the sensor changes. The voltage is read by the analog input and converted into degrees.	2
	KTY84 encoder module 1	KTY84 sensor connected to encoder interface 1. See also parameters *91.21 Module 1 temp sensor type* and *91.22 Module 1 temp filter time*.	3
	KTY84 encoder module 2	KTY84 sensor connected to encoder interface 2. See also parameters *91.24 Module 2 temp sensor type* and *91.25 Module 2 temp filter time*.	4

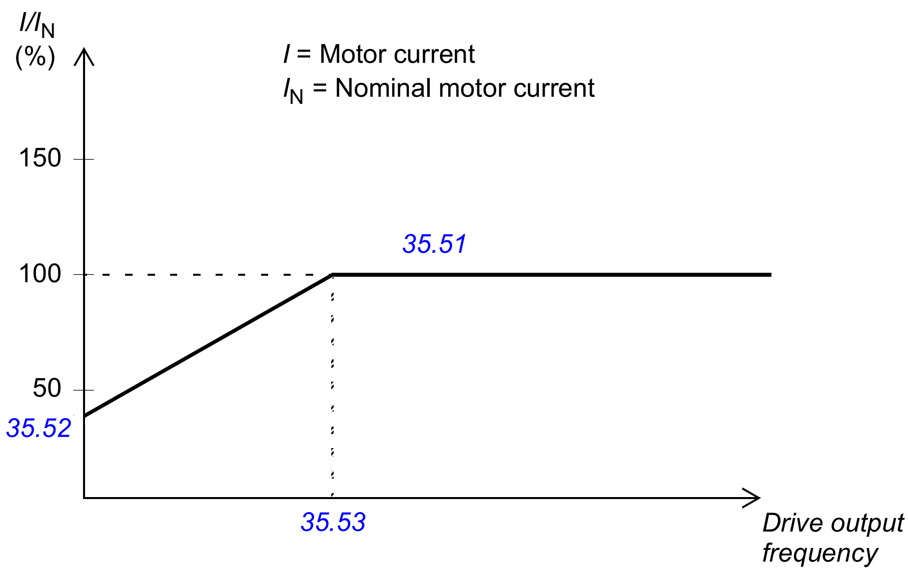
No.	Name/Value	Description	Def/FbEq16
	1 × Pt100 analog I/O	Pt100 sensor connected to a standard analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force Pt100 excitation*.	5
	2 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6
	3 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	7
	PTC DI6	PTC sensor connected to digital input DI6 (see the connection diagram on page *78*). **Note:** Either 0 ohm (normal temperature) or 4000 ohm (excessive temperature) will be shown by *35.03 Measured temperature 2*. By default, an excessive temperature will generate a warning as per parameter *35.23 Temperature 2 warning limit*. If you want a fault instead, set *35.22 Temperature 2 fault limit* to 4000 ohm.	8
	PTC analog I/O	PTC sensor connected to a standard analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force PTC excitation*.	20
	PTC encoder module 1	PTC sensor connected to encoder interface 1. See also parameters *91.21 Module 1 temp sensor type* and *91.22 Module 1 temp filter time*.	9
	PTC encoder module 2	PTC sensor connected to encoder interface 2. See also parameters *91.24 Module 2 temp sensor type* and *91.25 Module 2 temp filter time*.	10
	Direct temperature	The temperature is taken from the source selected by parameter *35.24 Temperature 2 AI source*. The value of the source is assumed to be in the unit of temperature specified by *96.16 Unit selection*.	11
	1 × Pt1000 analog I/O	Pt1000 sensor connected to a standard analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force Pt1000 excitation*.	13
	2 × Pt1000 analog I/O	As selection *1 × Pt1000 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	14
	3 × Pt1000 analog I/O	As selection *1 × Pt1000 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	15

No.	Name/Value	Description	*Def/FbEq16*
35.22	*Temperature 2 fault limit*	Defines the fault limit for temperature monitoring function 2. When measured temperature 2 exceeds the limit, the drive trips on fault *4982 External temperature 2*. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms.	130 °C, 266 °F or 4500 ohm
	-60 … 1000 °C, -76 … 1832 °F or 0…5000 ohm	Fault limit for temperature monitoring function 2.	1 = 1 unit
35.23	*Temperature 2 warning limit*	Defines the warning limit for temperature monitoring function 2. When measured temperature 2 exceeds the limit, a warning (*A492 External temperature 2*) is generated. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms.	110 °C, 230 °F or 4000 ohm
	-60 … 1000 °C, -76 … 1832 °F or 0…5000 ohm	Warning limit for temperature monitoring function 2.	1 = 1 unit
35.24	*Temperature 2 AI source*	Selects the input for parameter *35.21 Temperature 2 source*, selections *KTY84 analog I/O*, *1 × Pt100 analog I/O*, *2 × Pt100 analog I/O*, *3 × Pt100 analog I/O* and *Direct temperature*.	*Not selected*
	Not selected	None.	0
	AI1 actual value	Analog input AI1 on the control unit.	1
	AI2 actual value	Analog input AI2 on the control unit.	2
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
35.30	*FPTC configuration word*	Activates FPTC-xx thermistor protection modules installed on the control unit of the drive. Using this word, it is also possible to suppress the warnings (but not faults) from each module.	0010 1010b

Bit	Name	Description
0	Module in slot 1	1 = Yes: Module installed in slot 1.
1	Disable slot 1 warning	1 = Yes: Warnings from the module in slot 1 suppressed.
2	Module in slot 2	1 = Yes: Module installed in slot 2.
3	Disable slot 2 warning	1 = Yes: Warnings from the module in slot 2 suppressed.
4	Module in slot 3	1 = Yes: Module installed in slot 3.
5	Disable slot 3 warning	1 = Yes: Warnings from the module in slot 3 suppressed.
6…15	Reserved	

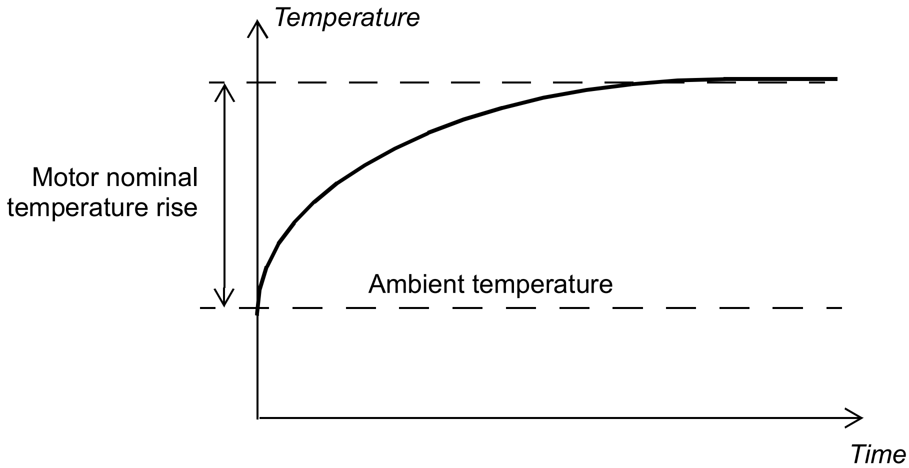
No.	Name/Value	Description	*Def/FbEq16*
	0000 0000b … 0011 1111b	FPTC-xx module configuration word.	1 = 1
35.50	*Motor ambient temperature*	Defines the ambient temperature of the motor for the motor thermal protection model. The unit is selected by parameter *96.16 Unit selection*. The motor thermal protection model estimates the motor temperature on the basis of parameters *35.50*…*35.55*. The motor temperature increases if it operates in the region above the load curve, and decreases if it operates in the region below the load curve. **WARNING!** The model cannot protect the motor if the motor does not cool properly because of dust, dirt, etc.	20 °C or 68 °F
	-60 … 100 °C or -75 … 212 °F	Ambient temperature.	1 = 1°

No.	Name/Value	Description	Def/FbEq16
35.51	Motor load curve	Defines the motor load curve together with parameters 35.52 Zero speed load and 35.53 Break point. The load curve is used by the motor thermal protection model to estimate the motor temperature. When the parameter is set to 100%, the maximum load is taken as the value of parameter 99.06 Motor nominal current (higher loads heat up the motor). The load curve level should be adjusted if the ambient temperature differs from the nominal value set in 35.50 Motor ambient temperature.	100%

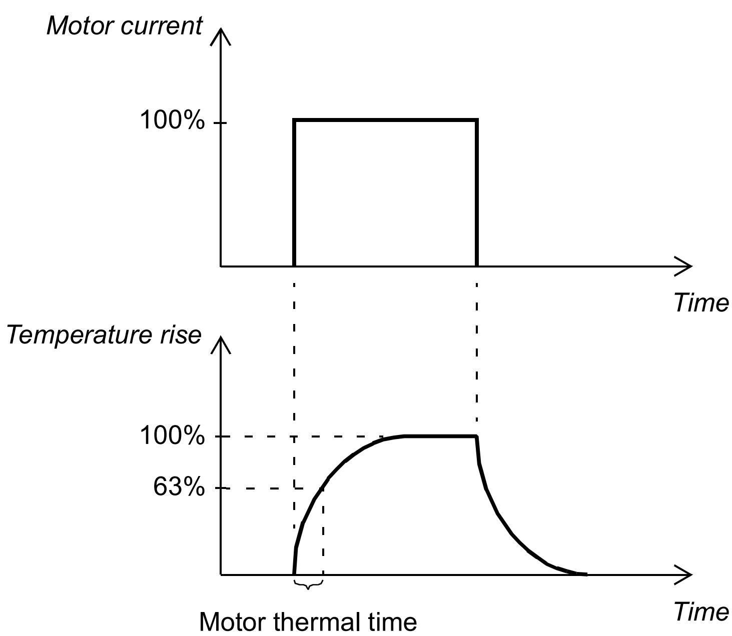


No.	Name/Value	Description	Def/FbEq16
	50 … 150%	Maximum load for the motor load curve.	1 = 1%
35.52	Zero speed load	Defines the motor load curve together with parameters 35.51 Motor load curve and 35.53 Break point. Defines the maximum motor load at zero speed of the load curve. A higher value can be used if the motor has an external motor fan to boost the cooling. See the motor manufacturer's recommendations. See parameter 35.51 Motor load curve.	100%
	50 … 150%	Zero speed load for the motor load curve.	1 = 1%
35.53	Break point	Defines the motor load curve together with parameters 35.51 Motor load curve and 35.52 Zero speed load. Defines the break point frequency of the load curve i.e. the point at which the motor load curve begins to decrease from the value of parameter 35.51 Motor load curve towards the value of parameter 35.52 Zero speed load. See parameter 35.51 Motor load curve.	45.00 Hz
	1.00 … 500.00 Hz	Break point for the motor load curve.	See par. 46.02

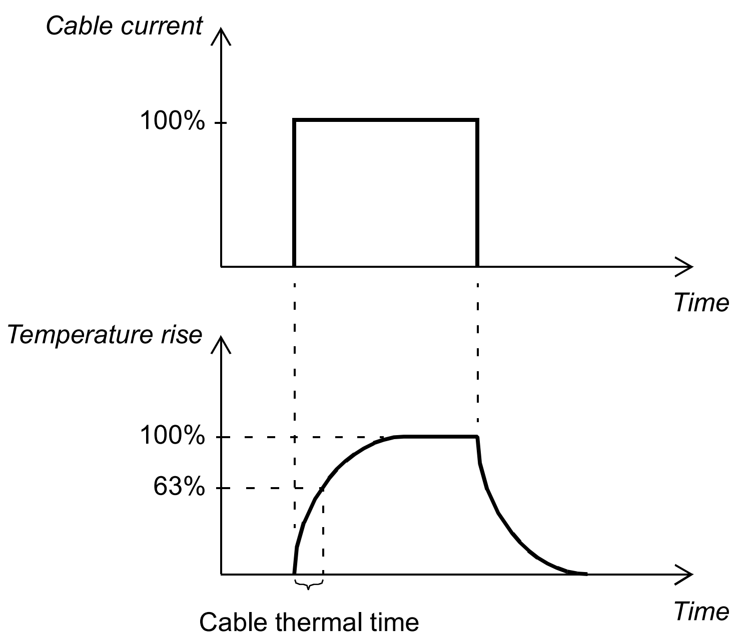
No.	Name/Value	Description	***DeflFbEq16***
35.54	*Motor nominal temperature rise*	Defines the temperature rise of the motor above ambient when the motor is loaded with nominal current. See the motor manufacturer's recommendations. The unit is selected by parameter *96.16 Unit selection*.	80 °C or 176 °F



	0…300 °C or 32…572 °F	Temperature rise.	1 = 1°
35.55	*Motor thermal time constant*	Defines the thermal time constant for use with the motor thermal protection model, defined as the time to reach 63% of the nominal motor temperature. See the motor manufacturer's recommendations.	256 s



	100 … 10000 s	Motor thermal time constant.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
35.60	*Cable temperature*	Shows the calculated temperature of the motor cable. See section *Thermal protection of motor cable* (page *81*). 102% = overtemperature warning (*A480 Motor cable overload*) 106% = overtemperature fault (*4000 Motor cable overload*) This parameter is read-only.	0.0%
	0.0 … 200.0%	Calculated temperature of motor cable.	1 = 1%
35.61	*Cable nominal current*	Specifies the continuous current of the motor cable for the thermal protection function in the control program. **WARNING!** The value entered in this parameter must be limited according to all factors affecting the loadability of the cable, such as ambient temperature, cabling arrangement, and shrouding. Refer to the technical data from the cable manufacturer.	10000.00 A
	0.00 … 10000.00 A	Continuous current-carrying capacity of motor cable.	1 = 1 A
35.62	*Cable thermal rise time*	Specifies the thermal time of the motor cable for the thermal protection function in the control program. This value is defined as the time to reach 63% of the nominal cable temperature when the cable is loaded with nominal current (parameter *35.61 Cable nominal current*). 0 s = Thermal protection of motor cable disabled Refer to the technical data from the cable manufacturer.  	1 s
	0 s	Thermal protection of motor cable disabled.	1 = 1 s
	1…50000 s	Motor cable thermal time constant.	1 = 1 s

No.	Name/Value	Description	*Def/FbEq16*
35.100	*DOL starter control source*	Parameters *35.100*…*35.106* configure a monitored start/stop control logic for external equipment such as a contactor-controlled motor cooling fan. This parameter selects the signal that starts and stops the fan. 0 = Stop 1 = Start The output controlling the fan contactor is to be connected to parameter *35.105*, bit 1. On and off delays can be set for the fan by *35.101* and *35.102* respectively. A feedback signal from the fan can be connected to an input selected by *35.103*; the loss of the feedback will optionally trigger a warning or fault (see *35.104* and *35.106*).	*Off*; *06.16* b6 (*95.20* b6)
	Off	0 (function disabled).	0
	On	1.	1
	Running	Bit 6 of *06.16 Drive status word 1* (see page *126*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
35.101	*DOL starter on delay*	Defines a start delay for the motor fan. The delay timer starts when the control source selected by parameter *35.100* switches on. After the delay, bit 1 of *35.105* switches on.	0 s
	0…42949673 s	Motor fan start delay.	1 = 1 s
35.102	*DOL starter off delay*	Defines a stop delay for the motor fan. The delay timer starts when the control source selected by parameter *35.100* switches off. After the delay, bit 1 of *35.105* switches off.	20 min
	0…715828 min	Motor fan stop delay.	1 = 1 min
35.103	*DOL starter feedback source*	Selects the input for motor fan feedback signal. 0 = Stopped 1 = Running After the fan is started (bit 1 of *35.105* switches on), feedback is expected within the time set by *35.104*.	*Not selected*; *DI5* (*95.20* b6)
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-

No.	Name/Value	Description	Def/FbEq16
35.104	*DOL starter feedback delay*	Defines a feedback delay for the motor fan. The delay timer starts when bit 1 of *35.105* switches on. If no feedback is received from the fan until the delay elapses, the action selected by *35.106* is taken. **Note:** This delay is only applied at start. If the feedback signal is lost during run, the action selected by *35.106* is taken immediately.	0 s; 5 s (*95.20* b6)
	0…42949673 s	Motor fan start delay.	1 = 1 s
35.105	*DOL starter status word*	Status of the motor fan control logic. Bit 1 is the control output for the fan, to be selected as the source of, for example, a digital or relay output. The other bits indicate the statuses of the selected control and feedback sources, and the fault status. This parameter is read-only.	-

Bit	Name	Description
0	Start command	Status of fan control source selected by *35.100*. 0 = Stop requested 1 = Start requested
1	Delayed start command	Fan control bit (delays observed). Select this bit as the source of the output controlling the fan. 0 = Stopped 1 = Started
2	DOL feedback	Status of fan feedback (source selected by *35.103*). 0 = Stopped 1 = Running
3	DOL fault (-1)	Fault status. 0 = Fault (fan feedback missing). The action taken is selected by *35.106*. 1 = No fault
4…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…1111b	Status of motor fan control logic.	1 = 1
35.106	*DOL starter event type*	Selects the action taken when missing fan feedback is detected by the motor fan control logic.	*Fault*
	No action	No action taken.	0
	Warning	The drive generates a warning (*A781 Motor fan*).	1
	Fault	Drive trips on *71B1 Motor fan*.	2
36 Load analyzer		Peak value and amplitude logger settings. See also section *Load analyzer* (page *86*).	
36.01	*PVL signal source*	Selects the signal to be monitored by the peak value logger. The signal is filtered using the filtering time specified by parameter *36.02 PVL filter time*. The peak value is stored, along with other pre-selected signals at the time, into parameters *36.10*…*36.15*. The peak value logger can be reset using parameter *36.09 Reset loggers*. The logger is also reset whenever the signal source is changed. The date and time of the last reset are stored into parameters *36.16* and *36.17* respectively.	*Power inu out*
	Zero	None (peak value logger disabled).	0
	Motor speed used	*01.01 Motor speed used* (page *113*).	1

No.	Name/Value	Description	Def/FbEq16
	Output frequency	01.06 Output frequency (page 113).	3
	Motor current	01.07 Motor current (page 113).	4
	Motor torque	01.10 Motor torque (page 113).	6
	DC voltage	01.11 DC voltage (page 113).	7
	Power inu out	01.14 Output power (page 114).	8
	Speed ref ramp in	23.01 Speed ref ramp input (page 212).	10
	Speed ref ramped	23.02 Speed ref ramp output (page 212).	11
	Speed ref used	24.01 Used speed reference (page 218).	12
	Torq ref used	26.02 Torque reference used (page 234).	13
	Freq ref used	28.02 Frequency ref ramp output (page 240).	14
	Process PID out	40.01 Process PID output actual (page 293).	16
	Process PID fbk	40.02 Process PID feedback actual (page 293).	17
	Process PID act	40.03 Process PID setpoint actual (page 293).	18
	Process PID dev	40.04 Process PID deviation actual (page 293).	19
	Other	Source selection (see Terms and abbreviations on page 110).	-
36.02	PVL filter time	Defines a filtering time for the peak value logger. See parameter 36.01 PVL signal source.	2.00 s
	0.00 … 120.00 s	Peak value logger filtering time.	100 = 1 s
36.06	AL2 signal source	Selects the signal to be monitored by amplitude logger 2. The signal is sampled at 200 ms intervals. The results are displayed by parameters 36.40…36.49. Each parameter represents an amplitude range, and shows what portion of the samples fall within that range. The signal value corresponding to 100% is defined by parameter 36.07 AL2 signal scaling. Amplitude logger 2 can be reset using parameter 36.09 Reset loggers. The logger is also reset whenever the signal source or scaling is changed. The date and time of the last reset are stored into parameters 36.50 and 36.51 respectively. For the selections, see parameter 36.01 PVL signal source.	Motor torque
36.07	AL2 signal scaling	Defines the signal value that corresponds to 100% amplitude.	100.00
	0.00 … 32767.00	Signal value corresponding to 100%.	1 = 1
36.09	Reset loggers	Resets the peak value logger and/or amplitude logger 2. (Amplitude logger 1 cannot be reset.)	Done
	Done	Reset completed or not requested (normal operation).	0
	All	Reset both the peak value logger and amplitude logger 2.	1
	PVL	Reset the peak value logger.	2
	AL2	Reset amplitude logger 2.	3
36.10	PVL peak value	Displays the peak value recorded by the peak value logger.	0.00
	-32768.00 … 32767.00	Peak value.	1 = 1
36.11	PVL peak date	Displays the date on which the peak value was recorded.	-
	-	Peak occurrence date.	-
36.12	PVL peak time	Displays the time at which the peak value was recorded.	-
	-	Peak occurrence time.	-

No.	Name/Value	Description	Def/FbEq16
36.13	PVL current at peak	Displays the motor current at the moment the peak value was recorded.	0.00 A
	-32768.00 … 32767.00 A	Motor current at peak.	1 = 1 A
36.14	PVL DC voltage at peak	Displays the voltage in the intermediate DC circuit of the drive at the moment the peak value was recorded.	0.00 V
	0.00 … 2000.00 V	DC voltage at peak.	10 = 1 V
36.15	PVL speed at peak	Displays the motor speed at the moment the peak value was recorded.	0.00 rpm
	-32768.00 … 32767.00 rpm	Motor speed at peak.	See par. 46.01
36.16	PVL reset date	Displays the date on which the peak value logger was last reset.	-
	-	Last reset date of the peak value logger.	-
36.17	PVL reset time	Displays the time at which the peak value logger was last reset.	-
	-	Last reset time of the peak value logger.	-
36.20	AL1 0 to 10%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 0 and 10%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 0 and 10%.	1 = 1%
36.21	AL1 10 to 20%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 10 and 20%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 10 and 20%.	1 = 1%
36.22	AL1 20 to 30%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 20 and 30%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 20 and 30%.	1 = 1%
36.23	AL1 30 to 40%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 30 and 40%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 30 and 40%.	1 = 1%
36.24	AL1 40 to 50%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 40 and 50%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 40 and 50%.	1 = 1%
36.25	AL1 50 to 60%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 50 and 60%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 50 and 60%.	1 = 1%
36.26	AL1 60 to 70%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 60 and 70%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 60 and 70%.	1 = 1%
36.27	AL1 70 to 80%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 70 and 80%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 70 and 80%.	1 = 1%
36.28	AL1 80 to 90%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 80 and 90%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 80 and 90%.	1 = 1%
36.29	AL1 over 90%	Displays the percentage of samples recorded by amplitude logger 1 that exceed 90%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples over 90%.	1 = 1%

No.	Name/Value	Description	*DefFbEq16*
36.40	*AL2 0 to 10%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 0 and 10%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 0 and 10%.	1 = 1%
36.41	*AL2 10 to 20%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 10 and 20%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 10 and 20%.	1 = 1%
36.42	*AL2 20 to 30%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 20 and 30%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 20 and 30%.	1 = 1%
36.43	*AL2 30 to 40%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 30 and 40%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 30 and 40%.	1 = 1%
36.44	*AL2 40 to 50%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 40 and 50%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 40 and 50%.	1 = 1%
36.45	*AL2 50 to 60%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 50 and 60%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 50 and 60%.	1 = 1%
36.46	*AL2 60 to 70%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 60 and 70%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 60 and 70%.	1 = 1%
36.47	*AL2 70 to 80%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 70 and 80%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 70 and 80%.	1 = 1%
36.48	*AL2 80 to 90%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 80 and 90%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 80 and 90%.	1 = 1%
36.49	*AL2 over 90%*	Displays the percentage of samples recorded by amplitude logger 2 that exceed 90%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples over 90%.	1 = 1%
36.50	*AL2 reset date*	Displays the date on which amplitude logger 2 was last reset.	-
	-	Last reset date of amplitude logger 2.	-
36.51	*AL2 reset time*	Displays the time at which amplitude logger 2 was last reset.	-
	-	Last reset time of amplitude logger 2.	-

No.	Name/Value	Description	Def/FbEq16
37	**User load curve**	Settings for user load curve. See also section *User load curve* (page *81*).	
37.01	ULC output status word	Displays the status of the monitored signal. (The status word is independent of the actions and delays selected by parameters *37.03*, *37.04*, *37.41* and *37.42*.) This parameter is read-only.	-

Bit	Name	Information
0	Under load limit	1 = Monitored signal is below the underload curve
1	Reserved	
2	Over load limit	1 = Monitored signal is above the overload curve
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	000b … 101b	Status of the monitored signal.	1 = 1
37.02	ULC supervision signal	Selects the signal to be monitored. The function compares the absolute value of the signal against the load curve.	Not selected
	Not selected	No signal selected (monitoring disabled).	0
	Motor current %	*01.07 Motor current* (see page *113*).	2
	Motor torque %	*01.10 Motor torque* (see page *113*).	3
	Output power % of motor nominal	*01.15 Output power % of motor nom* (see page *114*).	4
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
37.03	ULC overload actions	Selects how the drive reacts if the absolute value of the monitored signal stays above the overload curve for longer than the value of *37.41 ULC overload timer*.	Disabled
	Disabled	No action taken.	0
	Warning	The drive generates a warning (*A8BE ULC overload warning*).	1
	Fault	Drive trips on *8002 ULC overload fault*.	2
	Warning/Fault	The drive generates a warning (*A8BE ULC overload warning*) if the signal stays continuously above the overload curve for half of the time defined by *37.41 ULC overload timer*. The drive trips on *8002 ULC overload fault* if the signal stays continuously above the overload curve for the time defined by *37.41 ULC overload timer*.	3
37.04	ULC underload actions	Selects how the drive reacts if the absolute value of the monitored signal stays below the underload curve for longer than the value of *37.42 ULC underload timer*.	Disabled
	Disabled	No action taken.	0
	Warning	The drive generates a warning (*A8BF ULC underload warning*).	1
	Fault	Drive trips on *8001 ULC underload fault*.	2

No.	Name/Value	Description	*DefFbEq16*
	Warning/Fault	The drive generates a warning (*A8BF ULC underload warning*) if the signal stays continuously below the underload curve for half of the time defined by *37.42 ULC underload timer*. The drive trips on *8001 ULC underload fault* if the signal stays continuously below the underload curve for the time defined by *37.42 ULC underload timer*.	3
37.11	*ULC speed table point 1*	Defines the 1st speed point on the X-axis of the user load curve. The speed points are used in DTC motor control mode, and in scalar motor control mode when speed control is being used. The five points must be in order from lowest to highest. The points are defined as positive values, but the range is symmetrically effective also in the negative direction. The monitoring is not active outside these two areas.	150.0 rpm
	0.0 … 30000.0 rpm	Speed.	1 = 1 rpm
37.12	*ULC speed table point 2*	Defines the 2nd speed point on the X-axis of the user load curve.	750.0 rpm
	0.0 … 30000.0 rpm	Speed.	1 = 1 rpm
37.13	*ULC speed table point 3*	Defines the 3rd speed point on the X-axis of the user load curve.	1290.0 rpm
	0.0 … 30000.0 rpm	Speed.	1 = 1 rpm
37.14	*ULC speed table point 4*	Defines the 4th speed point on the X-axis of the user load curve.	1500.0 rpm
	0.0 … 30000.0 rpm	Speed.	1 = 1 rpm
37.15	*ULC speed table point 5*	Defines the 5th speed point on the X-axis of the user load curve.	1800.0 rpm
	0.0 … 30000.0 rpm	Speed.	1 = 1 rpm
37.16	*ULC frequency table point 1*	Defines the 1st frequency point on the X-axis of the user load curve. The frequency points are used in scalar motor control mode when frequency control is being used. The five points must be in order from lowest to highest. The points are defined as positive values, but the range is symmetrically effective also in the negative direction. The monitoring is not active outside these two areas.	5.0 Hz
	0.0 … 500.0 Hz	Frequency.	1 = 1 Hz
37.17	*ULC frequency table point 2*	Defines the 2nd frequency point on the X-axis of the user load curve.	25.0 Hz
	0.0 … 500.0 Hz	Frequency.	1 = 1 Hz
37.18	*ULC frequency table point 3*	Defines the 3rd frequency point on the X-axis of the user load curve.	43.0 Hz
	0.0 … 500.0 Hz	Frequency.	1 = 1 Hz
37.19	*ULC frequency table point 4*	Defines the 4th frequency point on the X-axis of the user load curve.	50.0 Hz
	0.0 … 500.0 Hz	Frequency.	1 = 1 Hz
37.20	*ULC frequency table point 5*	Defines the 5th frequency point on the X-axis of the user load curve.	60.0 Hz
	0.0 … 500.0 Hz	Frequency.	1 = 1 Hz

No.	Name/Value	Description	Def/FbEq16
37.21	ULC underload point 1	Defines the 1st point of the underload curve. Each point of the underload curve must have a lower value than the corresponding overload point.	10.0%
	0.0 … 1600.0%	Underload point.	1 = 1%
37.22	ULC underload point 2	Defines the 2nd point of the underload curve.	15.0%
	0.0 … 1600.0%	Underload point.	1 = 1%
37.23	ULC underload point 3	Defines the 3rd point of the underload curve.	25.0%
	0.0 … 1600.0%	Underload point.	1 = 1%
37.24	ULC underload point 4	Defines the 4th point of the underload curve.	30.0%
	0.0 … 1600.0%	Underload point.	1 = 1%
37.25	ULC underload point 5	Defines the 5th point of the underload curve.	30.0%
	0.0 … 1600.0%	Underload point.	1 = 1%
37.31	ULC overload point 1	Defines the 1st point of the overload curve. Each point of the overload curve must have a higher value than the corresponding underload point.	300.0%
	0.0 … 1600.0%	Overload point.	1 = 1%
37.32	ULC overload point 2	Defines the 2nd point of the overload curve.	300.0%
	0.0 … 1600.0%	Overload point.	1 = 1%
37.33	ULC overload point 3	Defines the 3rd point of the overload curve.	300.0%
	0.0 … 1600.0%	Overload point.	1 = 1%
37.34	ULC overload point 4	Defines the 4th point of the overload curve.	300.0%
	0.0 … 1600.0%	Overload point.	1 = 1%
37.35	ULC overload point 5	Defines the 5th point of the overload curve.	300.0%
	0.0 … 1600.0%	Overload point.	1 = 1%
37.41	ULC overload timer	Defines the time for which the monitored signal must continuously stay above the overload curve before the drive takes the action selected by 37.03 ULC overload actions.	20.0 s
	0.0 … 10000.0 s	Overload timer.	1 = 1 s
37.42	ULC underload timer	Defines the time for which the monitored signal must continuously stay below the underload curve before the drive takes the action selected by 37.04 ULC underload actions.	20.0 s
	0.0 … 10000.0 s	Underload timer.	1 = 1 s

No.	Name/Value	Description	*Def/FbEq16*
40 Process PID set 1		Parameter values for process PID control. The drive contains a single active PID controller for process use, however two separate complete set-ups can be programmed and stored. The first set is made up of parameters *40.07*…*40.56**, the second set is defined by the parameters in group *41 Process PID set 2*. The binary source that defines which set is used is selected by parameter *40.57 PID set1/set2 selection*. See also the control chain diagrams on pages *564* and *565*. *The remaining parameters in this group are common for both sets.	
40.01	*Process PID output actual*	Displays the output of the process PID controller. See the control chain diagram on page *565*. This parameter is read-only. The unit is selected by parameter *40.12 Set 1 unit selection*.	-
	-32768.00 … 32767.00	Process PID controller output.	1 = 1 unit
40.02	*Process PID feedback actual*	Displays the value of process feedback after source selection, mathematical function (parameter *40.10 Set 1 feedback function*), and filtering. See the control chain diagram on page *564*. This parameter is read-only. The unit is selected by parameter *40.12 Set 1 unit selection*.	-
	-32768.00 … 32767.00	Process feedback.	1 = 1 unit
40.03	*Process PID setpoint actual*	Displays the value of process PID setpoint after source selection, mathematical function (*40.18 Set 1 setpoint function*), limitation and ramping. See the control chain diagram on page *565*. This parameter is read-only. The unit is selected by parameter *40.12 Set 1 unit selection*.	-
	-32768.00 … 32767.00	Setpoint for process PID controller.	1 = 1 unit
40.04	*Process PID deviation actual*	Displays the process PID deviation. By default, this value equals setpoint - feedback, but deviation can be inverted by parameter *40.31 Set 1 deviation inversion*. See the control chain diagram on page *565*. This parameter is read-only. The unit is selected by parameter *40.12 Set 1 unit selection*.	-
	-32768.00 … 32767.00	PID deviation.	1 = 1 unit
40.05	*Process PID trim output act*	Displays the trimmed reference output. See the control chain diagram on page *565*. This parameter is read-only. The unit is selected by parameter *40.12 Set 1 unit selection*.	-
	-32768.00 … 32767.00	Trimmed reference.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
40.06	*Process PID status word*	Displays status information on process PID control. This parameter is read-only.	-

Bit	Name	Value
0	PID active	1 = Process PID control active.
1	Setpoint frozen	1 = Process PID setpoint frozen.
2	Output frozen	1 = Process PID controller output frozen.
3	PID sleep mode	1 = Sleep mode active.
4	Sleep boost	1 = Sleep boost active.
5	Trim mode	1 = Trim function active.
6	Tracking mode	1 = Tracking function active.
7	Output limit high	1 = PID output is being limited by par. *40.37*.
8	Output limit low	1 = PID output is being limited by par. *40.36*.
9	Deadband active	1 = Deadband active (see par. *40.39*)
10	PID set	0 = Parameter set 1 in use. 1 = Parameter set 2 in use.
11	Reserved	
12	Internal setpoint active	1 = Internal setpoint active (see par. *40.16*…*40.16*)
13…15	Reserved	

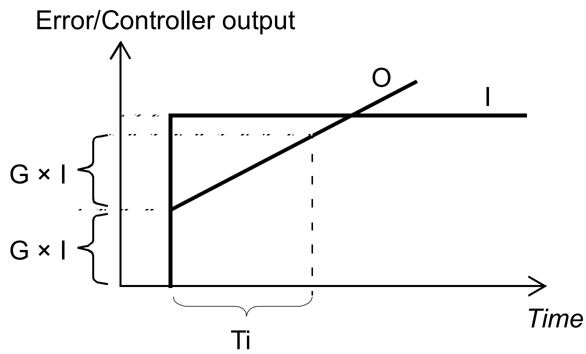
No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Process PID control status word.	1 = 1
40.07	*Set 1 PID operation mode*	Activates/deactivates process PID control. See also parameter *40.60 Set 1 PID activation source*. **Note:** Process PID control is only available in external control; see section *Local control vs. external control* (page *20*).	*Off*
	Off	Process PID control inactive.	0
	On	Process PID control active.	1
	On when drive running	Process PID control is active when the drive is running.	2
40.08	*Set 1 feedback 1 source*	Selects the first source of process feedback. See the control chain diagram on page *564*.	*AI1 scaled*
	Not selected	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *152*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *154*).	2
	Freq in scaled	*11.39 Freq in 1 scaled* (see page *148*).	3
	Motor current	*01.07 Motor current* (see page *113*).	5
	Power inu out	*01.14 Output power* (see page *114*).	6
	Motor torque	*01.10 Motor torque* (see page *113*).	7
	Feedback data storage	*40.91 Feedback data storage* (see page *305*).	10
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
40.09	*Set 1 feedback 2 source*	Selects the second source of process feedback. For the selections, see parameter *40.08 Set 1 feedback 1 source*.	*Not selected*

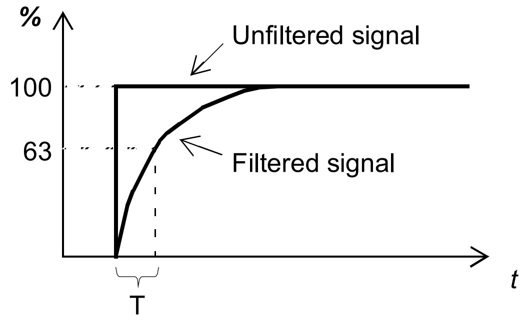
No.	Name/Value	Description	*Def/FbEq16*
40.10	*Set 1 feedback function*	Defines how process feedback is calculated from the two feedback sources selected by parameters *40.08 Set 1 feedback 1 source* and *40.09 Set 1 feedback 2 source*.	*In1*
	In1	Source 1.	0
	In1+In2	Sum of sources 1 and 2.	1
	In1-In2	Source 2 subtracted from source 1.	2
	In1*In2	Source 1 multiplied by source 2.	3
	In1/In2	Source 1 divided by source 2.	4
	MIN(In1,In2)	Smaller of the two sources.	5
	MAX(In1,In2)	Greater of the two sources.	6
	AVE(In1,In2)	Average of the two sources.	7
	sqrt(In1)	Square root of source 1.	8
	sqrt(In1-In2)	Square root of (source 1 - source 2).	9
	sqrt(In1+In2)	Square root of (source 1 + source 2).	10
	sqrt(In1)+sqrt(In2)	Square root of source 1 + square root of source 2.	11
40.11	*Set 1 feedback filter time*	Defines the filter time constant for process feedback.	0.000 s
	0.000 … 30.000 s	Feedback filter time.	1 = 1 s
40.12	*Set 1 unit selection*	Defines the unit for parameters *40.01*…*40.05*, *40.21*…*40.24* and *40.47*.	*%*
	rpm	rpm.	7
	%	%.	4
	Hz	Hz.	3
	PID user unit 1	User-definable unit 1. The name of the unit can be edited on the control panel by choosing Menu – Settings – Edit texts.	250
40.14	*Set 1 setpoint scaling*	Defines, together with parameter *40.15 Set 1 output scaling*, a general scaling factor for the process PID control chain. The scaling can be utilized when, for example, the process setpoint is input in Hz, and the output of the PID controller is used as an rpm value in speed control. In this case, this parameter might be set to 50, and parameter *40.15* to the nominal motor speed at 50 Hz. In effect, the output of the PID controller = [*40.15*] when deviation (setpoint - feedback) = [*40.14*] and [*40.32*] = 1. **Note:** The scaling is based on the ratio between *40.14* and *40.15*. For example, the values 50 and 1500 would produce the same scaling as 1 and 30.	100.00
	-32768.00 … 32767.00	Process setpoint base.	1 = 1
40.15	*Set 1 output scaling*	See parameter *40.14 Set 1 setpoint scaling*.	1500.00; 1800.00 (*95.20* b0)
	-32768.00 … 32767.00	Process PID controller output base.	1 = 1
40.16	*Set 1 setpoint 1 source*	Selects the first source of process PID setpoint. This setpoint is available in parameter *40.25 Set 1 setpoint selection* as setpoint 1. See the control chain diagram on page *564*.	*Internal setpoint*
	Not selected	None.	0

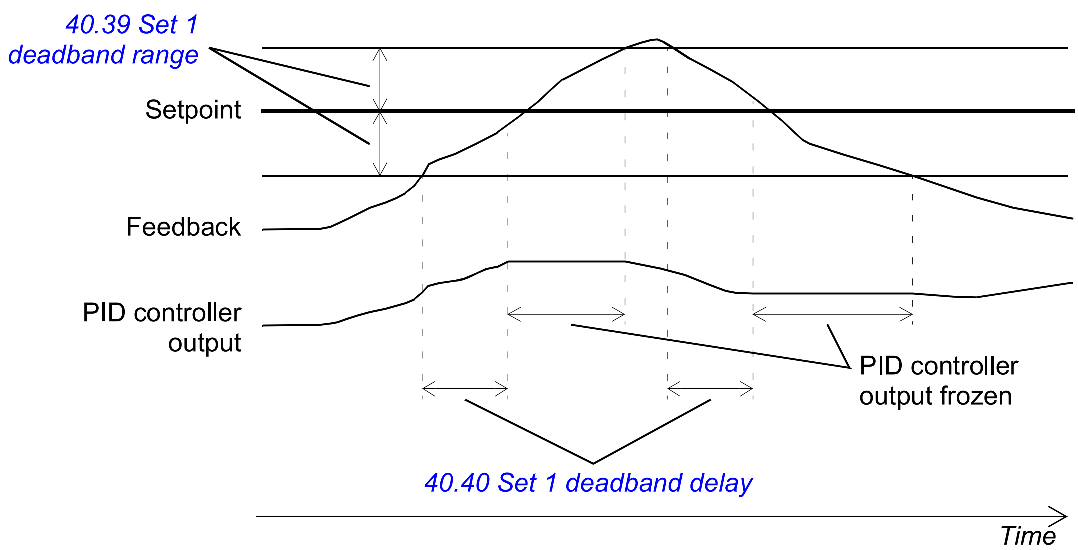
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Control panel</td><td>03.01 Panel reference (see page 116). See section Using the control panel as an external control source (page 21).</td><td>1</td></tr>
<tr><td></td><td>Internal setpoint</td><td>Internal setpoint. See parameter 40.19 Set 1 internal setpoint sel1.</td><td>2</td></tr>
<tr><td></td><td>AI1 scaled</td><td>12.12 AI1 scaled value (see page 152).</td><td>3</td></tr>
<tr><td></td><td>AI2 scaled</td><td>12.22 AI2 scaled value (see page 154).</td><td>4</td></tr>
<tr><td></td><td>Motor potentiometer</td><td>22.80 Motor potentiometer ref act (output of the motor potentiometer).</td><td>8</td></tr>
<tr><td></td><td>Freq in scaled</td><td>11.39 Freq in 1 scaled (see page 148).</td><td>10</td></tr>
<tr><td></td><td>Setpoint data storage</td><td>40.92 Setpoint data storage (see page 305).</td><td>24</td></tr>
<tr><td></td><td>Other</td><td>Source selection (see Terms and abbreviations on page 110).</td><td>-</td></tr>
<tr><td>40.17</td><td>Set 1 setpoint 2 source</td><td>Selects the second source of process setpoint. This setpoint is available in parameter 40.25 Set 1 setpoint selection as setpoint 2.
For the selections, see parameter 40.16 Set 1 setpoint 1 source.</td><td>Not selected</td></tr>
<tr><td>40.18</td><td>Set 1 setpoint function</td><td>Selects a mathematical function between the setpoint sources selected by parameters 40.16 Set 1 setpoint 1 source and 40.17 Set 1 setpoint 2 source.</td><td>In1 or In2</td></tr>
<tr><td></td><td>In1 or In2</td><td>No mathematical function applied. The source selected by parameter 40.25 Set 1 setpoint selection is used.</td><td>0</td></tr>
<tr><td></td><td>In1+In2</td><td>Sum of sources 1 and 2.</td><td>1</td></tr>
<tr><td></td><td>In1-In2</td><td>Source 2 subtracted from source 1.</td><td>2</td></tr>
<tr><td></td><td>In1*In2</td><td>Source 1 multiplied by source 2.</td><td>3</td></tr>
<tr><td></td><td>In1/In2</td><td>Source 1 divided by source 2.</td><td>4</td></tr>
<tr><td></td><td>MIN(In1,In2)</td><td>Smaller of the two sources.</td><td>5</td></tr>
<tr><td></td><td>MAX(In1,In2)</td><td>Greater of the two sources.</td><td>6</td></tr>
<tr><td></td><td>AVE(In1,In2)</td><td>Average of the two sources.</td><td>7</td></tr>
<tr><td></td><td>sqrt(In1)</td><td>Square root of source 1.</td><td>8</td></tr>
<tr><td></td><td>sqrt(In1-In2)</td><td>Square root of (source 1 - source 2).</td><td>9</td></tr>
<tr><td></td><td>sqrt(In1+In2)</td><td>Square root of (source 1 + source 2).</td><td>10</td></tr>
<tr><td></td><td>sqrt(In1)+sqrt(In2)</td><td>Square root of source 1 + square root of source 2.</td><td>11</td></tr>
<tr><td>40.19</td><td>Set 1 internal setpoint sel1</td><td>Selects, together with 40.20 Set 1 internal setpoint sel2, the internal setpoint out of the presets defined by parameters 40.21…40.24.
<table>
<tr><th>Source defined by par. 40.19</th><th>Source defined by par. 40.20</th><th>Setpoint preset active</th></tr>
<tr><td>0</td><td>0</td><td>1 (par. 40.21)</td></tr>
<tr><td>1</td><td>0</td><td>2 (par. 40.22)</td></tr>
<tr><td>0</td><td>1</td><td>3 (par. 40.23)</td></tr>
<tr><td>1</td><td>1</td><td>4 (par. 40.24)</td></tr>
</table></td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>0.</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1.</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (10.02 DI delayed status, bit 0).</td><td>2</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
40.20	*Set 1 internal setpoint sel2*	Selects, together with *40.19 Set 1 internal setpoint sel1*, the internal setpoint out of the presets defined by parameters *40.21*…*40.24*. See table at *40.19 Set 1 internal setpoint sel1*.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
40.21	*Set 1 internal setpoint 1*	Defines process setpoint preset 1. See parameter *40.19 Set 1 internal setpoint sel1*. The unit is selected by parameter *40.12 Set 1 unit selection*.	0.00
	-32768.00 … 32767.00	Process setpoint preset 1.	1 = 1 unit
40.22	*Set 1 internal setpoint 2*	Defines process setpoint preset 2. See parameter *40.19 Set 1 internal setpoint sel1*. The unit is selected by parameter *40.12 Set 1 unit selection*.	0.00
	-32768.00 … 32767.00	Process setpoint preset 2.	1 = 1 unit
40.23	*Set 1 internal setpoint 3*	Defines process setpoint preset 3. See parameter *40.19 Set 1 internal setpoint sel1*. The unit is selected by parameter *40.12 Set 1 unit selection*.	0.00
	-32768.00 … 32767.00	Process setpoint preset 3.	1 = 1 unit
40.24	*Set 1 internal setpoint 4*	Defines process setpoint preset 4. See parameter *40.19 Set 1 internal setpoint sel1*. The unit is selected by parameter *40.12 Set 1 unit selection*.	0.00
	-32768.00 … 32767.00	Process setpoint preset 4.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
40.25	Set 1 setpoint selection	Configures the selection between setpoint sources 1 (40.16) and 2 (40.17). This parameter is only effective when parameter 40.18 Set 1 setpoint function is set to In1 or In2. 0 = Setpoint source 1 1 = Setpoint source 2	Setpoint source 1
	Setpoint source 1	0.	0
	Setpoint source 2	1.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
40.26	Set 1 setpoint min	Defines a minimum limit for the process PID controller setpoint.	0.00
	-32768.00 … 32767.00	Minimum limit for process PID controller setpoint.	1 = 1
40.27	Set 1 setpoint max	Defines a maximum limit for the process PID controller setpoint.	32767.00
	-32768.00 … 32767.00	Maximum limit for process PID controller setpoint.	1 = 1
40.28	Set 1 setpoint increase time	Defines the minimum time it takes for the setpoint to increase from 0% to 100%.	0.0 s
	0.0 … 1800.0 s	Setpoint increase time.	1 = 1
40.29	Set 1 setpoint decrease time	Defines the minimum time it takes for the setpoint to decrease from 100% to 0%.	0.0 s
	0.0 … 1800.0 s	Setpoint decrease time.	1 = 1
40.30	Set 1 setpoint freeze enable	Freezes, or defines a source that can be used to freeze, the setpoint of the process PID controller. This feature is useful when the reference is based on a process feedback connected to an analog input, and the sensor must be serviced without stopping the process. 1 = Process PID controller setpoint frozen See also parameter 40.38 Set 1 output freeze enable.	Not selected
	Not selected	Process PID controller setpoint not frozen.	0
	Selected	Process PID controller setpoint frozen.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7

No.	Name/Value	Description	Def/FbEq16
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
40.31	*Set 1 deviation inversion*	Inverts the input of the process PID controller. 0 = Deviation not inverted (Deviation = Setpoint - Feedback) 1 = Deviation inverted (Deviation = Feedback - Setpoint) See also section *Sleep function for process PID control* (page *66*).	*Not inverted (Ref - Fbk)*
	Not inverted (Ref - Fbk)	0.	0
	Inverted (Fbk - Ref)	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
40.32	*Set 1 gain*	Defines the gain for the process PID controller. See parameter *40.33 Set 1 integration time*.	1.00
	0.10 … 100.00	Gain for PID controller.	100 = 1
40.33	*Set 1 integration time*	Defines the integration time for the process PID controller. This time needs to be set to the same order of magnitude as the reaction time of the process being controlled, otherwise instability will result.  I = controller input (error) O = controller output G = gain Ti = integration time **Note:** Setting this value to 0 disables the “I” part, turning the PID controller into a PD controller.	60.0 s
	0.0 … 32767.0 s	Integration time.	1 = 1 s
40.34	*Set 1 derivation time*	Defines the derivation time of the process PID controller. The derivative component at the controller output is calculated on basis of two consecutive error values (E_{K-1} and E_K) according to the following formula: PID DERIV TIME × $(E_K - E_{K-1})/T_S$, in which T_S = 2 ms sample time E = Error = Process reference - process feedback.	0.000 s
	0.000 … 10.000 s	Derivation time.	1000 = 1 s

No.	Name/Value	Description	Def/FbEq16
40.35	*Set 1 derivation filter time*	Defines the time constant of the 1-pole filter used to smooth the derivative component of the process PID controller.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant	0.0 s
	0.0 … 10.0 s	Filter time constant.	10 = 1 s
40.36	*Set 1 output min*	Defines the minimum limit for the process PID controller output. Using the minimum and maximum limits, it is possible to restrict the operation range.	0.0
	-32768.0 … 32767.0	Minimum limit for process PID controller output.	1 = 1
40.37	*Set 1 output max*	Defines the maximum limit for the process PID controller output. See parameter *40.36 Set 1 output min*.	1500.0; 1800.0 (*95.20* b0)
	-32768.0 … 32767.0	Maximum limit for process PID controller output.	1 = 1
40.38	*Set 1 output freeze enable*	Freezes (or defines a source that can be used to freeze) the output of the process PID controller, keeping the output at the value it was before freeze was enabled. This feature can be used when, for example, a sensor providing process feedback must to be serviced without stopping the process. 1 = Process PID controller output frozen See also parameter *40.30 Set 1 setpoint freeze enable*.	*Not selected*
	Not selected	Process PID controller output not frozen.	0
	Selected	Process PID controller output frozen.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-

No.	Name/Value	Description	Def/FbEq16
40.39	Set 1 deadband range	Defines a deadband around the setpoint. Whenever process feedback enters the deadband, a delay timer starts. If the feedback remains within the deadband longer than the delay (40.40 Set 1 deadband delay), the PID controller output is frozen. Normal operation resumes after the feedback value leaves the deadband.	0.0
	 		
	0.0 … 32767.0	Deadband range.	1 = 1
40.40	Set 1 deadband delay	Delay for the deadband. See parameter 40.39 Set 1 deadband range.	0.0 s
	0.0 … 3600.0 s	Delay for deadband area.	1 = 1 s
40.41	Set 1 sleep mode	Selects the mode of the sleep function. See also section Sleep function for process PID control (page 66).	Not selected
	Not selected	Sleep function disabled.	0
	Internal	The output of the PID controller is compared to the value of 40.43 Set 1 sleep level. If the PID controller output remains below the sleep level longer than the sleep delay (40.44 Set 1 sleep delay), the drive enters sleep mode. Parameters 40.44…40.48 are in force.	1
	External	The sleep function is activated by the source selected by parameter 40.42 Set 1 sleep enable. Parameters 40.44…40.46 and 40.48 are in force.	2
40.42	Set 1 sleep enable	Defines a source that is used to activate the PID sleep function when parameter 40.41 Set 1 sleep mode is set to External. 0 = Sleep function disabled 1 = Sleep function activated	Not selected
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4

No.	Name/Value	Description	Def/FbEq16
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
40.43	*Set 1 sleep level*	Defines the start limit for the sleep function when parameter *40.41 Set 1 sleep mode* is set to *Internal*.	0.0
	0.0 … 32767.0	Sleep start level.	1 = 1
40.44	*Set 1 sleep delay*	Defines a delay before the sleep function actually becomes enabled, to prevent nuisance sleeping. The delay timer starts when the sleep condition selected by parameter *40.41 Set 1 sleep mode* becomes true, and resets if the condition becomes false.	60.0 s
	0.0 … 3600.0 s	Sleep start delay.	1 = 1 s
40.45	*Set 1 sleep boost time*	Defines a boost time for the sleep boost step. See parameter *40.46 Set 1 sleep boost step*.	0.0 s
	0.0 … 3600.0 s	Sleep boost time.	1 = 1 s
40.46	*Set 1 sleep boost step*	When the drive is entering sleep mode, the process setpoint is increased by this value for the time defined by parameter *40.45 Set 1 sleep boost time*. If active, sleep boost is aborted when the drive wakes up.	0.0
	0.0 … 32767.0	Sleep boost step.	1 = 1
40.47	*Set 1 wake-up deviation*	When *40.41 Set 1 sleep mode* is set to *Internal*, this parameter defines the wake-up level as deviation between process setpoint and feedback. The unit is selected by parameter *40.12 Set 1 unit selection*. When the deviation exceeds the value of this parameter, and remains there for the duration of the wake-up delay (*40.48 Set 1 wake-up delay*), the drive wakes up. See also parameter *40.31 Set 1 deviation inversion*.	0.00 rpm, % or Hz
	-32768.00 … 32767.00 rpm, % or Hz	Wake-up level (as deviation between process setpoint and feedback).	1 = 1 unit
40.48	*Set 1 wake-up delay*	Defines a wake-up delay for the sleep function to prevent nuisance wake-ups. See parameter *40.47 Set 1 wake-up deviation*. The delay timer starts when the deviation exceeds the wake-up level (*40.47 Set 1 wake-up deviation*), and resets if the deviation falls below the wake-up level.	0.50 s
	0.00 … 60.00 s	Wake-up delay.	1 = 1 s
40.49	*Set 1 tracking mode*	Activates (or selects a source that activates) tracking mode. In tracking mode, the value selected by parameter *40.50 Set 1 tracking ref selection* is substituted for the PID controller output. See also section *Tracking* (page *67*). 1 = Tracking mode enabled	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3

No.	Name/Value	Description	*Def/FbEq16*
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
40.50	*Set 1 tracking ref selection*	Selects the value source for tracking mode. See parameter *40.49 Set 1 tracking mode*.	*Not selected*
	Not selected	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *152*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *154*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *116*).	3
	FB A ref2	*03.06 FB A reference 2* (see page *116*).	4
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
40.51	*Set 1 trim mode*	Activates the trim function and selects between direct and proportional trimming (or a combination of both). With trimming, it is possible to apply a corrective factor to the drive reference (setpoint). The output after trimming is available as parameter *40.05 Process PID trim output act*. See the control chain diagram on page *565*.	*Off*
	Off	The trim function is inactive.	0
	Direct	The trim function is active. The trimming factor is relative to the maximum speed, torque or frequency; the selection between these is made by parameter *40.52 Set 1 trim selection*.	1
	Proportional	The trim function is active. The trimming factor is relative to the reference selected by parameter *40.53 Set 1 trimmed ref pointer*.	2
	Combined	The trim function is active. The trimming factor is a combination of both *Direct* and *Proportional* modes; the proportions of each are defined by parameter *40.54 Set 1 trim mix*.	3
40.52	*Set 1 trim selection*	Selects whether trimming is used for correcting the speed, torque or frequency reference.	*Torque*
	Torque	Torque reference trimming.	1
	Speed	Speed reference trimming.	2
	Frequency	Frequency reference trimming.	3
40.53	*Set 1 trimmed ref pointer*	Selects the signal source for the trim reference.	*Not selected*
	Not selected	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *152*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *154*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *116*).	3
	FB A ref2	*03.06 FB A reference 2* (see page *116*).	4
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-

No.	Name/Value	Description	Def/FbEq16
40.54	Set 1 trim mix	When parameter 40.51 Set 1 trim mode is set to Combined, defines the effect of direct and proportional trim sources in the final trimming factor. 0.000 = 100% proportional 0.500 = 50% proportional, 50% direct 1.000 = 100% direct	0.000
	0.000 … 1.000	Trim mix.	1 = 1
40.55	Set 1 trim adjust	Defines a multiplier for the trimming factor. This value is multiplied by the result of parameter 40.51 Set 1 trim mode. Consequently, the result of the multiplication is used to multiply the result of parameter 40.56 Set 1 trim source.	1.000
	-100.000 … 100.000	Multiplier for trimming factor.	1 = 1
40.56	Set 1 trim source	Selects the reference to be trimmed.	PID ref
	PID ref	PID setpoint.	1
	PID output	PID controller output.	2
40.57	PID set1/set2 selection	Selects the source that determines whether process PID parameter set 1 (parameters 40.07…40.56) or set 2 (group 41 Process PID set 2) is used. 0 = Process PID parameter set 1 in use 1 = Process PID parameter set 2 in use	Not selected
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
40.60	Set 1 PID activation source	Selects a source that enables/disables process PID control. See also parameter 40.07 Set 1 PID operation mode. 0 = Process PID control disabled. 1 = Process PID control enabled.	On
	Off	0.	0
	On	1.	1
	Follow Ext1/Ext2 selection	Process PID control is disabled when external control location EXT1 is active, and enabled when external control location EXT2 is active. See also parameter 19.11 Ext1/Ext2 selection.	2
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	3
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	4
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	5
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	6
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	7

No.	Name/Value	Description	*Def/FbEq16*
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	11
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	12
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
40.91	*Feedback data storage*	Storage parameter for receiving a process feedback value eg. through the embedded fieldbus interface. The value can be sent to the drive as Modbus I/O data. Set the target selection parameter of that particular data (*58.101*…*58.124*) to *Feedback data storage*. In *40.08 Set 1 feedback 1 source* (or *40.09 Set 1 feedback 2 source*), select *Feedback data storage*.	-
	-327.68 … 327.67	Storage parameter for process feedback.	100 = 1
40.92	*Setpoint data storage*	Storage parameter for receiving a process setpoint value eg. through the embedded fieldbus interface. The value can be sent to the drive as Modbus I/O data. Set the target selection parameter of that particular data (*58.101*…*58.124*) to *Setpoint data storage*. In *40.16 Set 1 setpoint 1 source* (or *40.17 Set 1 setpoint 2 source*), select *Setpoint data storage*.	-
	-327.68 … 327.67	Storage parameter for process setpoint.	100 = 1

41 Process PID set 2		A second set of parameter values for process PID control. The selection between this set and first set (parameter group *40 Process PID set 1*) is made by parameter *40.57 PID set1/set2 selection*. See also parameters *40.01*…*40.06*, *40.91*, *40.92*, and the control chain diagrams on pages *564* and *565*.	
41.07	*Set 2 PID operation mode*	See parameter *40.07 Set 1 PID operation mode*.	*Off*
41.08	*Set 2 feedback 1 source*	See parameter *40.08 Set 1 feedback 1 source*.	*AI1 scaled*
41.09	*Set 2 feedback 2 source*	See parameter *40.09 Set 1 feedback 2 source*.	*Not selected*
41.10	*Set 2 feedback function*	See parameter *40.10 Set 1 feedback function*.	*In1*
41.11	*Set 2 feedback filter time*	See parameter *40.11 Set 1 feedback filter time*.	0.000 s
41.12	*Set 2 unit selection*	Defines the unit for parameters *41.21*…*41.24* and *41.47*.	*%*
	rpm	rpm.	7
	%	%.	4
	Hz	Hz.	3
	PID user unit 2	User-definable unit 2. The name of the unit can be edited on the control panel by choosing Menu – Settings – Edit texts.	249
41.14	*Set 2 setpoint scaling*	See parameter *40.14 Set 1 setpoint scaling*.	100.00
41.15	*Set 2 output scaling*	See parameter *40.15 Set 1 output scaling*.	1500.00; 1800.00 (*95.20* b0)
41.16	*Set 2 setpoint 1 source*	See parameter *40.16 Set 1 setpoint 1 source*.	*Internal setpoint*

No.	Name/Value	Description	Def/FbEq16
41.17	Set 2 setpoint 2 source	See parameter 40.17 Set 1 setpoint 2 source.	Not selected
41.18	Set 2 setpoint function	See parameter 40.18 Set 1 setpoint function.	In1 or In2
41.19	Set 2 internal setpoint sel1	See parameter 40.19 Set 1 internal setpoint sel1.	Not selected
41.20	Set 2 internal setpoint sel2	See parameter 40.20 Set 1 internal setpoint sel2.	Not selected
41.21	Set 2 internal setpoint 1	See parameter 40.21 Set 1 internal setpoint 1.	0.00
41.22	Set 2 internal setpoint 2	See parameter 40.22 Set 1 internal setpoint 2.	0.00
41.23	Set 2 internal setpoint 3	See parameter 40.23 Set 1 internal setpoint 3.	0.00
41.24	Set 2 internal setpoint 4	See parameter 40.24 Set 1 internal setpoint 4.	0.00
41.25	Set 2 setpoint selection	See parameter 40.25 Set 1 setpoint selection.	Setpoint source 1
41.26	Set 2 setpoint min	See parameter 40.26 Set 1 setpoint min.	0.00
41.27	Set 2 setpoint max	See parameter 40.27 Set 1 setpoint max.	32767.00
41.28	Set 2 setpoint increase time	See parameter 40.28 Set 1 setpoint increase time.	0.0 s
41.29	Set 2 setpoint decrease time	See parameter 40.29 Set 1 setpoint decrease time.	0.0 s
41.30	Set 2 setpoint freeze enable	See parameter 40.30 Set 1 setpoint freeze enable.	Not selected
41.31	Set 2 deviation inversion	See parameter 40.31 Set 1 deviation inversion.	Not inverted (Ref - Fbk)
41.32	Set 2 gain	See parameter 40.32 Set 1 gain.	1.00
41.33	Set 2 integration time	See parameter 40.33 Set 1 integration time.	60.0 s
41.34	Set 2 derivation time	See parameter 40.34 Set 1 derivation time.	0.000 s
41.35	Set 2 derivation filter time	See parameter 40.35 Set 1 derivation filter time.	0.0 s
41.36	Set 2 output min	See parameter 40.36 Set 1 output min.	0.0
41.37	Set 2 output max	See parameter 40.37 Set 1 output max.	1500.0; 1800.0 (95.20 b0)
41.38	Set 2 output freeze enable	See parameter 40.38 Set 1 output freeze enable.	Not selected
41.39	Set 2 deadband range	See parameter 40.39 Set 1 deadband range.	0.0
41.40	Set 2 deadband delay	See parameter 40.40 Set 1 deadband delay.	0.0 s
41.41	Set 2 sleep mode	See parameter 40.41 Set 1 sleep mode.	Not selected
41.42	Set 2 sleep enable	See parameter 40.42 Set 1 sleep enable.	Not selected
41.43	Set 2 sleep level	See parameter 40.43 Set 1 sleep level.	0.0

No.	Name/Value	Description	Def/FbEq16
41.44	*Set 2 sleep delay*	See parameter *40.44 Set 1 sleep delay*.	60.0 s
41.45	*Set 2 sleep boost time*	See parameter *40.45 Set 1 sleep boost time*.	0.0 s
41.46	*Set 2 sleep boost step*	See parameter *40.46 Set 1 sleep boost step*.	0.0
41.47	*Set 2 wake-up deviation*	See parameter *40.47 Set 1 wake-up deviation*.	0.00 rpm, % or Hz
41.48	*Set 2 wake-up delay*	See parameter *40.48 Set 1 wake-up delay*.	0.50 s
41.49	*Set 2 tracking mode*	See parameter *40.49 Set 1 tracking mode*.	*Not selected*
41.50	*Set 2 tracking ref selection*	See parameter *40.50 Set 1 tracking ref selection*.	*Not selected*
41.51	*Set 2 trim mode*	See parameter *40.51 Set 1 trim mode*.	*Off*
41.52	*Set 2 trim selection*	See parameter *40.52 Set 1 trim selection*.	*Torque*
41.53	*Set 2 trimmed ref pointer*	See parameter *40.53 Set 1 trimmed ref pointer*.	*Not selected*
41.54	*Set 2 trim mix*	See parameter *40.54 Set 1 trim mix*.	0.000
41.55	*Set 2 trim adjust*	See parameter *40.55 Set 1 trim adjust*.	1.000
41.56	*Set 2 trim source*	See parameter *40.56 Set 1 trim source*.	*PID ref*
41.60	*Set 2 PID activation source*	See parameter *40.60 Set 1 PID activation source*.	*On*

43 Brake chopper		Settings for the internal brake chopper.	
43.01	*Braking resistor temperature*	Displays the estimated temperature of the brake resistor, or how close the brake resistor is to being too hot. The value is given in percent where 100% is the eventual temperature the resistor would reach when loaded long enough with its rated maximum load capacity (*43.09 Brake resistor Pmax cont*) The temperature calculation is based on the values of parameters *43.08*, *43.09* and *43.10*, and on the assumption that the resistor is installed as instructed by the manufacturer (ie. it cools down as expected). This parameter is read-only.	-
	0.0 … 120.0%	Estimated brake resistor temperature.	1 = 1%
43.06	*Brake chopper function*	Enables brake chopper control and selects the brake resistor overload protection method (calculation or measurement). **Note:** Before enabling brake chopper control, ensure that • a brake resistor is connected, • overvoltage control is switched off (parameter *30.30 Overvoltage control*), and • the supply voltage range (parameter *95.01 Supply voltage*) has been selected correctly.	*Disabled*
	Disabled	Brake chopper control disabled.	0
	Enabled with thermal model	Brake chopper control enabled with brake resistor protection based on a thermal model. If you select this, you must also specify the values needed by the model, ie. parameters *43.08*…*43.12*. See the resistor data sheet.	1

No.	Name/Value	Description	Def/FbEq16
	Enabled without thermal model	Brake chopper control enabled without resistor overload protection based on a thermal model. This setting can be used, for example, if the resistor is equipped with a thermal circuit breaker that is wired to stop the drive if the resistor overheats. Before using this setting, ensure that overvoltage control is switched off (parameter *30.30 Overvoltage control*)	2
	Overvoltage peak protection	Brake chopper control enabled in an overvoltage condition. This setting is intended for situations where • the braking chopper is not needed for runtime operation, ie. to dissipate the inertial energy of the motor, • the motor is able to store a considerable amount of magnetic energy in its windings, and • the motor might, deliberately or inadvertently, be stopped by coasting. In such a situation, the motor would potentially discharge enough magnetic energy towards the drive to cause damage. To protect the drive, the brake chopper can be used with a small resistor dimensioned merely to handle the magnetic energy (not the inertial energy) of the motor. With this setting, the brake chopper is activated only whenever the DC voltage exceeds the overvoltage limit. During normal use, the brake chopper is not operating.	3
43.07	*Brake chopper run enable*	Selects the source for quick brake chopper on/off control. 0 = Brake chopper IGBT pulses are cut off 1 = Normal brake chopper IGBT modulation allowed. This parameter can be used to enable chopper operation only when the supply is missing from a drive with a regenerative supply unit.	*On*
	Off	0.	0
	On	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
43.08	*Brake resistor thermal tc*	Defines the thermal time constant for the brake resistor thermal model.	0 s
	0 … 10000 s	Brake resistor thermal time constant, ie. the rated time to achieve 63% temperature.	1 = 1 s
43.09	*Brake resistor Pmax cont*	Defines the maximum continuous load of the brake resistor which will eventually raise the resistor temperature to the maximum allowed value (= continuous heat dissipation capacity of the resistor in kW) but not above it. The value is used in the resistor overload protection based on the thermal model. See parameter *43.06 Brake chopper function*, and the brake resistor data sheet.	0.00 kW
	0.00 … 10000.00 kW	Maximum continuous load of the brake resistor.	1 = 1 kW
43.10	*Brake resistance*	Defines the resistance value of the brake resistor. The value is used for the brake chopper protection based on the thermal model. See parameter *43.06 Brake chopper function*.	0.0 ohm
	0.0 … 1000.0 ohm	Brake resistor resistance value.	1 = 1 ohm

No.	Name/Value	Description	Def/FbEq16
43.11	*Brake resistor fault limit*	Selects the fault limit for the brake resistor protection based on the thermal model. See parameter *43.06 Brake chopper function*. When the limit is exceeded, the drive trips on fault *7183 BR excess temperature*. The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter *43.09 Brake resistor Pmax cont*.	105%
	0 … 150%	Brake resistor temperature fault limit.	1 = 1%
43.12	*Brake resistor warning limit*	Selects the warning limit for the brake resistor protection based on the thermal model. See parameter *43.06 Brake chopper function*. When the limit is exceeded, the drive generates a *A793 BR excess temperature* warning. The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter *43.09 Brake resistor Pmax cont*.	95%
	0 … 150%	Brake resistor temperature warning limit.	1 = 1%

44 Mechanical brake control		Configuration of mechanical brake control. See also section *Mechanical brake control* (page *69*).	
44.01	*Brake control status*	Displays the mechanical brake control status word. This parameter is read-only.	-

Bit	Name	Information
0	Open command	Close/open command to brake actuator (0 = close, 1 = open). Connect this bit to desired output.
1	Opening torque request	1 = Opening torque requested from drive logic
2	Hold stopped request	1 = Hold requested from drive logic
3	Ramp to stopped	1 = Ramping down to zero speed requested from drive logic
4	Enabled	1 = Brake control is enabled
5	Closed	1 = Brake control logic in *BRAKE CLOSED* state
6	Opening	1 = Brake control logic in *BRAKE OPENING* state
7	Open	1 = Brake control logic in *BRAKE OPEN* state
8	Closing	1 = Brake control logic in *BRAKE CLOSING* state
9…15	Reserved	

	0000h…FFFFh	Mechanical brake control status word.	1 = 1
44.02	*Brake torque memory*	Displays the torque (in percent) at the instant of the previous brake close command. This value can be used as a reference for the brake open torque. See parameters *44.09 Brake open torque source* and *44.10 Brake open torque*.	-
	-1600.0 … 1600.0%	Torque at brake closure.	See par. *46.03*
44.03	*Brake open torque reference*	Displays the currently active brake open torque. See parameters *44.09 Brake open torque source* and *44.10 Brake open torque*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Currently active brake open torque.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
44.06	Brake control enable	Activates/deactivates (or selects a source that activates/deactivates) the mechanical brake control logic. 0 = Brake control inactive 1 = Brake control active	Not selected
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
44.07	Brake acknowledge selection	Activates/deactivates (and selects the source for) brake open/close status (acknowledgement) supervision. When a brake control error (unexpected state of the acknowledgement signal) is detected, the drive reacts as defined by parameter 44.17 Brake fault function. 0 = Brake closed 1 = Brake open	No acknowledge
	Off	0.	0
	On	1.	1
	No acknowledge	Brake open/closed supervision disabled.	2
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	3
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	4
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	5
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	6
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	7
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	8
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	11
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	12
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
44.08	Brake open delay	Defines the brake open delay, ie. the delay between the internal open brake command and the release of motor speed control. The delay timer starts when the drive has magnetized the motor and increased the motor torque to the level required for brake release (parameter 44.03 Brake open torque reference). Simultaneously with the timer start, the brake control logic energizes the brake control output and the brake starts to open. Set this parameter to the value of mechanical opening delay specified by the brake manufacturer.	0.00 s
	0.00 … 5.00 s	Brake open delay.	100 = 1 s

No.	Name/Value	Description	*Def/FbEq16*
44.09	*Brake open torque source*	Defines a source that is used as a brake opening torque reference if • its absolute value is greater than the setting of parameter *44.10 Brake open torque*, and • its sign is the same as the setting of *44.10 Brake open torque.* See parameter *44.10 Brake open torque*.	*Brake open torque*
	Zero	Zero.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *152*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *154*).	2
	FBA ref1	*03.05 FB A reference 1* (see page *116*).	3
	FBA ref2	*03.06 FB A reference 2* (see page *116*).	4
	Brake torque memory	Parameter *44.02 Brake torque memory.*	7
	Brake open torque	Parameter *44.10 Brake open torque*.	8
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
44.10	*Brake open torque*	Defines the sign (ie. direction of rotation) and minimum absolute value of the brake open torque (motor torque requested at brake release in percent of motor nominal torque). The value of the source selected by parameter *44.09 Brake open torque source* is used as the brake open torque only if it has the same sign as this parameter and has a greater absolute value. **Note:** This parameter is not effective in scalar motor control mode.	0.0%
	-1600.0 … 1600.0%	Minimum torque at brake release.	See par. *46.03*
44.11	*Keep brake closed*	Selects a source that prevents the brake from opening. 0 = Normal brake operation 1 = Keep brake closed **Note:** This parameter cannot be changed while the drive is running.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-

No.	Name/Value	Description	Def/FbEq16
44.12	*Brake close request*	Selects the source of an external brake close request signal. When on, the signal overrides the internal logic and closes the brake. 0 = Normal operation/No external close signal connected 1 = Close brake **Notes:** • In an open-loop (encoderless) application, if the brake is kept closed by a brake close request against a modulating drive for longer than 5 seconds, the brake is forced to close and the drive trips on a fault, *71A5 Mechanical brake opening not allowed*. • This parameter cannot be changed while the drive is running.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
44.13	*Brake close delay*	Defines a delay between a close command (that is, when the brake control output is de-energized) and when the drive stops modulating. This is to keep the motor live and under control until the brake actually closes. Set this parameter equal to the value specified by the brake manufacturer as the mechanical make-up time of the brake.	0.00 s
	0.00 … 60.00 s	Brake close delay.	100 = 1 s
44.14	*Brake close level*	Defines the brake close speed as an absolute value. After motor speed remains below this level for the duration of the brake close level delay (*44.15 Brake close level delay*), a close command is given. **Note:** Check the compatibility of this setting with *21.03 Stop mode* (and the applicable deceleration time).	10.00 rpm
	0.00 … 1000.00 rpm	Brake close speed.	See par. *46.01*
44.15	*Brake close level delay*	Defines a brake close level delay. See parameter *44.14 Brake close level*.	0.00 s
	0.00 … 10.00 s	Brake close level delay.	100 = 1 s
44.16	*Brake reopen delay*	Defines a minimum time between brake closure and a subsequent open command.	0.00 s
	0.00 … 10.00 s	Brake reopen delay.	100 = 1 s

No.	Name/Value	Description	Def/FbEq16
44.17	Brake fault function	Determines how the drive reacts upon a mechanical brake control error. **Note:** If parameter 44.07 Brake acknowledge selection is set to No acknowledge, acknowledgement status supervision is disabled altogether and will generate no warnings or faults. However, the brake open conditions are always supervised.	Fault
	Fault	The drive trips on a 71A2 Mechanical brake closing failed / 71A3 Mechanical brake opening failed fault if the status of the acknowledgement does not match the status presumed by the brake control logic. The drive trips on a 71A5 Mechanical brake opening not allowed fault if the brake open conditions cannot be fulfilled (for example, the required motor starting torque is not achieved).	0
	Warning	The drive generates a A7A1 Mechanical brake closing failed / A7A2 Mechanical brake opening failed warning if the status of the acknowledgement does not match the status presumed by the brake control logic. The drive generates a A7A5 Mechanical brake opening not allowed warning if the brake open conditions cannot be fulfilled (for example, the required motor starting torque is not achieved).	1
	Open fault	Upon closing the brake, the drive generates a A7A1 Mechanical brake closing failed warning if the status of the acknowledgement does not match the status presumed by the brake control logic. Upon opening the brake, the drive trips on a 71A3 Mechanical brake opening failed fault if the status of the acknowledgement does not match the status presumed by the brake control logic. The drive trips on a 71A5 Mechanical brake opening not allowed fault if the brake open conditions cannot be fulfilled (for example, the required motor starting torque is not achieved).	2
44.18	Brake fault delay	Defines a close fault delay, ie. time between brake closure and brake close fault trip.	0.00 s
	0.00 … 60.00 s	Brake close fault delay.	100 = 1 s

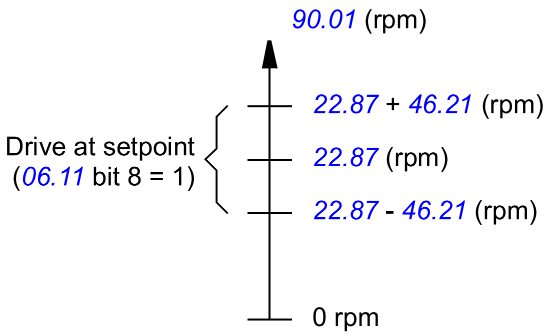
45 Energy efficiency		Settings for the energy saving calculators. See also section Energy saving calculators (page 86).	
45.01	Saved GW hours	Displays the energy saved in GWh compared to direct-on-line motor connection. This parameter is incremented when 45.02 Saved MW hours rolls over. This parameter is read-only (see parameter 45.21 Energy calculations reset).	-
	0…65535 GWh	Energy savings in GWh.	1 = 1 GWh
45.02	Saved MW hours	Displays the energy saved in MWh compared to direct-on-line motor connection. This parameter is incremented when 45.03 Saved kW hours rolls over. When this parameter rolls over, parameter 45.01 Saved GW hours is incremented. This parameter is read-only (see parameter 45.21 Energy calculations reset).	-
	0…999 MWh	Energy savings in MWh.	1 = 1 MWh

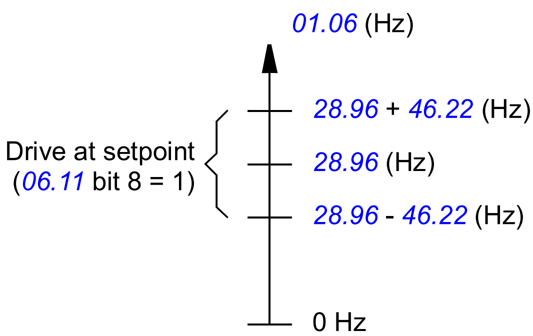
No.	Name/Value	Description	Def/FbEq16
45.03	*Saved kW hours*	Displays the energy saved in kWh compared to direct-on-line motor connection. If the internal brake chopper of the drive is enabled, all energy fed by the motor to the drive is assumed to be converted into heat, but the calculation still records savings made by controlling the speed. If the chopper is disabled, then regenerated energy from the motor is also recorded here. When this parameter rolls over, parameter *45.02 Saved MW hours* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0 … 999.9 kWh	Energy savings in kWh.	10 = 1 kWh
45.05	*Saved money x1000*	Displays the monetary savings in thousands compared to direct-on-line motor connection. This parameter is incremented when *45.06 Saved money* rolls over. The currency is defined by parameter *45.17 Tariff currency unit*. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…4294967295 thousands	Monetary savings in thousands of units.	-
45.06	*Saved money*	Displays the monetary savings compared to direct-on-line motor connection. This value is a calculated by multiplying the saved energy in kWh by the currently active energy tariff (*45.14 Tariff selection*). When this parameter rolls over, parameter *45.05 Saved money x1000* is incremented. The currency is defined by parameter *45.17 Tariff currency unit*. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.00 … 999.99 units	Monetary savings.	1 = 1 unit
45.08	*CO2 reduction in kilotons*	Displays the reduction in CO_2 emissions in metric kilotons compared to direct-on-line motor connection. This value is incremented when parameter *45.09 CO2 reduction in tons* rolls over. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…65535 metric kilotons	Reduction in CO_2 emissions in metric kilotons.	1 = 1 metric kiloton
45.09	*CO2 reduction in tons*	Displays the reduction in CO_2 emissions in metric tons compared to direct-on-line motor connection. This value is calculated by multiplying the saved energy in MWh by the value of parameter *45.18 CO2 conversion factor* (by default, 0.5 metric tons/MWh). When this parameter rolls over, parameter *45.08 CO2 reduction in kilotons* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0 … 999.9 metric tons	Reduction in CO_2 emissions in metric tons.	1 = 1 metric ton

No.	Name/Value	Description	*DeflFbEq16*
45.11	*Energy optimizer*	Enables/disables the energy optimization function. The function optimizes the motor flux so that total energy consumption and motor noise level are reduced when the drive operates below the nominal load. The total efficiency (motor and drive) can be improved by 1…20% depending on load torque and speed. **Note:** With a permanent magnet motor or a synchronous reluctance motor, energy optimization is always enabled regardless of this parameter.	*Disable*
	Disable	Energy optimization disabled.	0
	Enable	Energy optimization enabled.	1
45.12	*Energy tariff 1*	Defines energy tariff 1 (price of energy per kWh). Depending on the setting of parameter *45.14 Tariff selection*, either this value or *45.13 Energy tariff 2* is used for reference when monetary savings are calculated. The currency is defined by parameter *45.17 Tariff currency unit*. **Note:** Tariffs are read only at the instant of selection, and are not applied retroactively.	1.000 units
	0.000 … 4294967.295 units	Energy tariff 1.	-
45.13	*Energy tariff 2*	Defines energy tariff 2 (price of energy per kWh). See parameter *45.12 Energy tariff 1*.	2.000 units
	0.000 … 4294967.295 units	Energy tariff 2.	-
45.14	*Tariff selection*	Selects (or defines a source that selects) which pre-defined energy tariff is used. 0 = *45.12 Energy tariff 1* 1 = *45.13 Energy tariff 2*	*Energy tariff 1*
	Energy tariff 1	0.	0
	Energy tariff 2	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
45.17	*Tariff currency unit*	Specifies the currency used for the savings calculations.	*EUR*
	Local currency	Local currency. The name of the currency can be edited by choosing Menu - Settings - Edit texts on the control panel.	100
	EUR	Euro.	101
	USD	US dollar.	102
45.18	*CO2 conversion factor*	Defines a factor for conversion of saved energy into CO_2 emissions (kg/kWh or tn/MWh).	0.500 tn/MWh
	0.000 … 65.535 tn/MWh	Factor for conversion of saved energy into CO_2 emissions.	1 = 1 tn/MWh

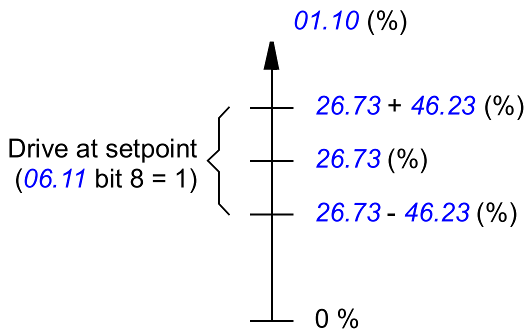
No.	Name/Value	Description	Def/FbEq16
45.19	*Comparison power*	Actual power that the motor absorbs when connected direct-on-line and operating the application. The value is used for reference when energy savings are calculated. **Note:** The accuracy of the energy savings calculation is directly dependent on the accuracy of this value. If nothing is entered here, then the nominal motor power is used by the calculation, but that may inflate the energy savings reported as many motors do not absorb nameplate power.	0.0 kW
	0.0 … 100000.0 kW	Motor power.	See par. *46.04*
45.21	*Energy calculations reset*	Resets the savings counter parameters *45.01*…*45.09*	*Done*
	Done	Reset not requested (normal operation), or reset complete.	0
	Reset	Reset the savings counter parameters. The value reverts automatically to *Done*.	1
46 Monitoring/scaling settings		Speed supervision settings; actual signal filtering; general scaling settings.	
46.01	*Speed scaling*	Defines the maximum speed value used to define the acceleration ramp rate and the initial speed value used to define the deceleration ramp rate (see parameter group *23 Speed reference ramp*). The speed acceleration and deceleration ramp times are therefore related to this value (**not** to parameter *30.12 Maximum speed*). Also defines the 16-bit scaling of speed-related parameters. The value of this parameter corresponds to 20000 in fieldbus, master/follower etc. communication.	1500.00 rpm; 1800.00 rpm (*95.20* b0)
	0.10 … 30000.00 rpm	Acceleration/deceleration terminal/initial speed.	1 = 1 rpm
46.02	*Frequency scaling*	Defines the maximum frequency value used to define the acceleration ramp rate and the initial frequency value used to define deceleration ramp rate (see parameter group *28 Frequency reference chain*). The frequency acceleration and deceleration ramp times are therefore related to this value (**not** to parameter *30.14 Maximum frequency*). Also defines the 16-bit scaling of frequency-related parameters. The value of this parameter corresponds to 20000 in fieldbus, master/follower etc. communication.	50.00 Hz; 60.00 Hz (*95.20* b0)
	0.10 … 1000.00 Hz	Acceleration/deceleration terminal/initial frequency.	10 = 1 Hz
46.03	*Torque scaling*	Defines the 16-bit scaling of torque parameters. The value of this parameter (in percent of nominal motor torque) corresponds to 10000 in fieldbus, master/follower etc. communication. See also parameter *46.42 Torque decimals*.	100.0%
	0.1 … 1000.0%	Torque corresponding to 10000 on fieldbus.	10 = 1%
46.04	*Power scaling*	Defines the output power value that corresponds to 10000 in fieldbus, master/follower etc. communication. The unit is selected by parameter *96.16 Unit selection*.	1000.00 kW or hp
	0.10 … 30000.00 kW or 0.10 … 40214.48 hp	Power corresponding to 10000 on fieldbus.	1 = 1 unit

No.	Name/Value	Description	*Def/FbEq16*
46.05	*Current scaling*	Defines the 16-bit scaling of current parameters. The value of this parameter corresponds to 10000 in fieldbus, master/follower etc. communication.	10000 A
	0…30000 A	Current corresponding to 10000 on fieldbus.	-
46.06	*Speed ref zero scaling*	Defines a speed corresponding to a zero reference received from fieldbus (either the embedded fieldbus interface, or interface FBA A or FBA B). For example, with a setting of 500, the fieldbus reference range of 0…20000 would correspond to a speed of 500…[*46.01*] rpm. **Note:** This parameter is effective only with the ABB Drives communication profile.	0.00 rpm
	0.00 … 30000.00 rpm	Speed corresponding to minimum fieldbus reference.	1 = 1 rpm
46.07	*Frequency ref zero scaling*	Defines a frequency corresponding to a zero reference received from fieldbus (either the embedded fieldbus interface, or interface FBA A or FBA B). For example, with a setting of 30, the fieldbus reference range of 0…20000 would correspond to a speed of 30…[*46.02*] Hz. **Note:** This parameter is effective only with the ABB Drives communication profile.	0.00 Hz
	0.00 … 1000.00 Hz	Frequency corresponding to minimum fieldbus reference.	10 = 1 Hz
46.11	*Filter time motor speed*	Defines a filter time for signals *01.01 Motor speed used*, *01.02 Motor speed estimated*, *01.04 Encoder 1 speed filtered* and *01.05 Encoder 2 speed filtered*.	500 ms
	0…20000 ms	Motor speed signal filter time.	1 = 1 ms
46.12	*Filter time output frequency*	Defines a filter time for signal *01.06 Output frequency*.	500 ms
	0…20000 ms	Output frequency signal filter time.	1 = 1 ms
46.13	*Filter time motor torque*	Defines a filter time for signal *01.10 Motor torque*.	100 ms
	0…20000 ms	Motor torque signal filter time.	1 = 1 ms
46.14	*Filter time power out*	Defines a filter time for signal *01.14 Output power*.	100 ms
	0…20000 ms	Output power signal filter time.	1 = 1 ms

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>46.21</td><td>At speed hysteresis</td><td>Defines the “at setpoint” limits for speed control of the drive. When the absolute difference between reference (22.87 Speed reference act 7) and actual speed (90.01 Motor speed for control) is smaller than 46.21 At speed hysteresis, the drive is considered to be “at setpoint”. This is indicated by bit 8 of 06.11 Main status word.


</td><td>100.00 rpm</td></tr>
<tr><td></td><td>0.00 … 30000.00 rpm</td><td>Limit for “at setpoint” indication in speed control.</td><td>See par. 46.01</td></tr>
<tr><td>46.22</td><td>At frequency hysteresis</td><td>Defines the “at setpoint” limits for frequency control of the drive. When the absolute difference between reference (28.96 Frequency ref ramp input) and actual frequency (01.06 Output frequency) is smaller than 46.22 At frequency hysteresis, the drive is considered to be “at setpoint”. This is indicated by bit 8 of 06.11 Main status word.


</td><td>10.00 Hz</td></tr>
<tr><td></td><td>0.00 … 1000.00 Hz</td><td>Limit for “at setpoint” indication in frequency control.</td><td>See par. 46.02</td></tr>
</table>

No.	Name/Value	Description	*Def/FbEq16*
46.23	*At torque hysteresis*	Defines the “at setpoint” limits for torque control of the drive. When the absolute difference between reference (*26.73 Torque reference act 4*) and actual torque (*01.10 Motor torque*) is smaller than *46.23 At torque hysteresis*, the drive is considered to be “at setpoint”. This is indicated by bit 8 of *06.11 Main status word*.  	10.0%
	0.0 … 300.0%	Limit for “at setpoint” indication in torque control.	See par. *46.03*
46.31	*Above speed limit*	Defines the trigger level for “above limit” indication in speed control. When actual speed exceeds the limit, bit 10 of *06.17 Drive status word 2* is set.	1500.00 rpm
	0.00 … 30000.00 rpm	“Above limit” indication trigger level for speed control.	See par. *46.01*
46.32	*Above frequency limit*	Defines the trigger level for “above limit” indication in frequency control. When actual frequency exceeds the limit, bit 10 of *06.17 Drive status word 2* is set.	50.00 Hz
	0.00 … 1000.00 Hz	“Above limit” indication trigger level for frequency control.	See par. *46.02*
46.33	*Above torque limit*	Defines the trigger level for “above limit” indication in torque control. When actual torque exceeds the limit, bit 10 of *06.17 Drive status word 2* is set.	300.0%
	0.0 … 1600.0%	“Above limit” indication trigger level for torque control.	See par. *46.03*
46.42	*Torque decimals*	Defines the number of decimal places of torque-related parameters.	1
	0…2	Number of decimal places of torque parameters.	1 = 1

No.	Name/Value	Description	Def/FbEq16
47 Data storage		Data storage parameters that can be written to and read from using other parameters' source and target settings. Note that there are different storage parameters for different data types. Integer-type storage parameters cannot be used as the source of other parameters. See also section *Data storage parameters* (page 89).	
47.01	*Data storage 1 real32*	Data storage parameter 1. Parameters *47.01*…*47.08* are real 32-bit numbers that can be used as source values of other parameters. Storage parameters *47.01*…*47.08* can be used as the target of received 16-bit data (parameter group *62 D2D and DDCS receive data*) or the source of transmitted 16-bit data (parameter group *61 D2D and DDCS transmit data*). The scaling and range are defined by parameters *47.31*…*47.38*.	0.000
	See par. *47.31*	32-bit real (floating point) number.	See par. *47.31*
47.02	*Data storage 2 real32*	Data storage parameter 2. See also parameter *47.01 Data storage 1 real32*.	0.000
	See par. *47.32*	32-bit real (floating point) number.	See par. *47.32*
47.03	*Data storage 3 real32*	Data storage parameter 3. See also parameter *47.01 Data storage 1 real32*.	0.000
	See par. *47.33*	32-bit real (floating point) number.	See par. *47.33*
47.04	*Data storage 4 real32*	Data storage parameter 4. See also parameter *47.01 Data storage 1 real32*.	0.000
	See par. *47.34*	32-bit real (floating point) number.	See par. *47.34*
47.05	*Data storage 5 real32*	Data storage parameter 5. See also parameter *47.01 Data storage 1 real32*.	0.000
	See par. *47.35*	32-bit real (floating point) number.	See par. *47.35*
47.06	*Data storage 6 real32*	Data storage parameter 6. See also parameter *47.01 Data storage 1 real32*.	0.000
	See par. *47.36*	32-bit real (floating point) number.	See par. *47.36*
47.07	*Data storage 7 real32*	Data storage parameter 7. See also parameter *47.01 Data storage 1 real32*.	0.000
	See par. *47.37*	32-bit real (floating point) number.	See par. *47.37*
47.08	*Data storage 8 real32*	Data storage parameter 8. See also parameter *47.01 Data storage 1 real32*.	0.000
	See par. *47.38*	32-bit real (floating point) number.	See par. *47.38*
47.11	*Data storage 1 int32*	Data storage parameter 9.	0
	-2147483648 … 2147483647	32-bit integer.	-

No.	Name/Value	Description	Def/FbEq16
47.12	Data storage 2 int32	Data storage parameter 10.	0
	-2147483648 … 2147483647	32-bit integer.	-
47.13	Data storage 3 int32	Data storage parameter 11.	0
	-2147483648 … 2147483647	32-bit integer.	-
47.14	Data storage 4 int32	Data storage parameter 12.	0
	-2147483648 … 2147483647	32-bit integer.	-
47.15	Data storage 5 int32	Data storage parameter 13.	0
	-2147483648 … 2147483647	32-bit integer.	-
47.16	Data storage 6 int32	Data storage parameter 14.	0
	-2147483648 … 2147483647	32-bit integer.	-
47.17	Data storage 7 int32	Data storage parameter 15.	0
	-2147483648 … 2147483647	32-bit integer.	-
47.18	Data storage 8 int32	Data storage parameter 16.	0
	-2147483648 … 2147483647	32-bit integer.	-
47.21	Data storage 1 int16	Data storage parameter 17.	0
	-32768 … 32767	16-bit integer.	1 = 1
47.22	Data storage 2 int16	Data storage parameter 18.	0
	-32768 … 32767	16-bit integer.	1 = 1
47.23	Data storage 3 int16	Data storage parameter 19.	0
	-32768 … 32767	16-bit integer.	1 = 1
47.24	Data storage 4 int16	Data storage parameter 20.	0
	-32768 … 32767	16-bit integer.	1 = 1
47.25	Data storage 5 int16	Data storage parameter 21.	0
	-32768 … 32767	16-bit integer.	1 = 1
47.26	Data storage 6 int16	Data storage parameter 22.	0
	-32768 … 32767	16-bit integer.	1 = 1

No.	Name/Value	Description	Def/FbEq16
47.27	Data storage 7 int16	Data storage parameter 23.	0
	-32768 … 32767	16-bit integer.	1 = 1
47.28	Data storage 8 int16	Data storage parameter 24.	0
	-32768 … 32767	16-bit integer.	1 = 1
47.31	Data storage 1 real32 type	Defines the scaling of parameter 47.01 Data storage 1 real32 to and from 16-bit integer format. This scaling is used when the data storage parameter is the target of received 16-bit data (defined in parameter group 62 D2D and DDCS receive data), or when the data storage parameter is the source of transmitted 16-bit data (defined in parameter group 61 D2D and DDCS transmit data). The setting also defines the visible range of the storage parameter.	Unscaled
	Unscaled	Data storage only. Range: -2147483.264 … 2147473.264.	0
	Transparent	Scaling: 1 = 1. Range: -32768 … 32767.	1
	General	Scaling: 1 = 100. Range: -327.68 … 327.67.	2
	Torque	The scaling is defined by parameter 46.03 Torque scaling. Range: -1600.0 … 1600.0.	3
	Speed	The scaling is defined by parameter 46.01 Speed scaling. Range: -30000.00 … 30000.00.	4
	Frequency	The scaling is defined by parameter 46.02 Frequency scaling. Range: -500.00 … 500.00.	5
47.32	Data storage 2 real32 type	Defines the 16-bit scaling of parameter 47.02 Data storage 2 real32. See parameter 47.31 Data storage 1 real32 type.	Unscaled
47.33	Data storage 3 real32 type	Defines the 16-bit scaling of parameter 47.03 Data storage 3 real32. See parameter 47.31 Data storage 1 real32 type.	Unscaled
47.34	Data storage 4 real32 type	Defines the 16-bit scaling of parameter 47.04 Data storage 4 real32. See parameter 47.31 Data storage 1 real32 type.	Unscaled
47.35	Data storage 5 real32 type	Defines the 16-bit scaling of parameter 47.05 Data storage 5 real32. See parameter 47.31 Data storage 1 real32 type.	Unscaled
47.36	Data storage 6 real32 type	Defines the 16-bit scaling of parameter 47.06 Data storage 6 real32. See parameter 47.31 Data storage 1 real32 type.	Unscaled
47.37	Data storage 7 real32 type	Defines the 16-bit scaling of parameter 47.07 Data storage 7 real32. See parameter 47.31 Data storage 1 real32 type.	Unscaled
47.38	Data storage 8 real32 type	Defines the 16-bit scaling of parameter 47.08 Data storage 8 real32. See parameter 47.31 Data storage 1 real32 type.	Unscaled

No.	Name/Value	Description	Def/FbEq16
49 Panel port communication		Communication settings for the control panel port on the drive.	
49.01	Node ID number	Defines the node ID of the drive. All devices connected to the network must have a unique node ID. **Note:** For networked drives, it is advisable to reserve ID 1 for spare/replacement drives.	1
	1…32	Node ID.	1 = 1
49.03	Baud rate	Defines the transfer rate of the link.	230.4 kbps
	38.4 kbps	38.4 kbit/s.	1
	57.6 kbps	57.6 kbit/s.	2
	86.4 kbps	86.4 kbit/s.	3
	115.2 kbps	115.2 kbit/s.	4
	230.4 kbps	230.4 kbit/s.	5
49.04	Communication loss time	Sets a timeout for control panel (or PC tool) communication. If a communication break lasts longer than the timeout, the action specified by parameter 49.05 Communication loss action is taken.	10.0 s
	0.3 … 3000.0 s	Panel/PC tool communication timeout.	10 = 1 s
49.05	Communication loss action	Selects how the drive reacts to a control panel (or PC tool) communication break. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 49.06 Refresh settings. See also parameters 49.07 Panel comm supervision force and 49.08 Secondary comm. loss action.	Fault
	No action	No action taken.	0
	Fault	Drive trips on 7081 Control panel loss. This only occurs if control is expected from the control panel (it is selected as source of start/stop/reference in the currently active control location), or if supervision is forced using parameter 49.07 Panel comm supervision force.	1
	Last speed	Drive generates an A7EE Control panel loss warning and freezes the speed to the level the drive was operating at. This only occurs if control is expected from the control panel, or if supervision is forced using parameter 49.07 Panel comm supervision force. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Drive generates an A7EE Control panel loss warning and sets the speed to the speed defined by parameter 22.41 Speed ref safe (or 28.41 Frequency ref safe when frequency reference is being used). This only occurs if control is expected from the control panel, or if supervision is forced using parameter 49.07 Panel comm supervision force. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3

No.	Name/Value	Description	Def/FbEq16
	Warning	Drive generates an *A7EE Control panel loss* warning. This only occurs if control is expected from the control panel, or if supervision is forced using parameter *49.07 Panel comm supervision force*. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
49.06	*Refresh settings*	Applies the settings of parameters *49.01*…*49.05*. **Note:** Refreshing may cause a communication break, so reconnecting the drive may be required.	*Done*
	Done	Refresh done or not requested.	0
	Refresh	Refresh parameters *49.01*…*49.05*. The value reverts automatically to *Done*.	1
49.07	*Panel comm supervision force*	Activates control panel communication monitoring separately for each control location (see section *Local control vs. external control* on page *20*). The parameter is primarily intended for monitoring the communication with the panel when it is connected to the application program and not selected as a control source by drive parameters.	0000b

Bit	Name	Value
0	Ext 1	1 = Communication monitoring active when Ext 1 is being used.
1	Ext 2	1 = Communication monitoring active when Ext 2 is being used.
2	Local	1 = Communication monitoring active when local control is being used.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0111b	Panel communication monitoring selection.	1 = 1
49.08	*Secondary comm. loss action*	Selects how the drive reacts to a control panel (or PC tool) communication break. This action is taken when • the panel is parametrized as an alternative control or reference source but is not currently the active source, and • communication supervision for the active control location is not forced by parameter *49.07 Panel comm supervision force*.	*No action*
	No action	No action taken.	0
	Warning	Drive generates an *A7EE Control panel loss* warning. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
49.14	*Panel speed reference unit*	Defines the unit for speed reference when given from the control panel.	*rpm*
	rpm	rpm.	0
	%	Percent of absolute value of *30.12 Maximum speed* or *30.11 Minimum speed*, whichever is greater.	1
49.15	*Minimum ext speed ref panel*	Defines a minimum limit for control panel speed reference in external control. In local control, the limits in parameter group *30 Limits* are in force. See section *Local control vs. external control* (page *20*).	-30000.00 rpm
	-30000.00 … 30000.00 rpm	Minimum speed reference.	See par. *46.01*

No.	Name/Value	Description	*Def/FbEq16*
49.16	*Maximum ext speed ref panel*	Defines a maximum limit for control panel speed reference in external control. In local control, the limits in parameter group *30 Limits* are in force. See section *Local control vs. external control* (page *20*).	30000.00 rpm
	-30000.00 … 30000.00 rpm	Maximum speed reference.	See par. *46.01*
49.17	*Minimum ext frequency ref panel*	Defines a minimum limit for control panel frequency reference in external control. In local control, the limits in parameter group *30 Limits* are in force. See section *Local control vs. external control* (page *20*).	-500.00 Hz
	-500.00 … 500.00 Hz	Minimum frequency reference.	See par. *46.02*
49.18	*Maximum ext frequency ref panel*	Defines a maximum limit for control panel frequency reference in external control. In local control, the limits in parameter group *30 Limits* are in force. See section *Local control vs. external control* (page *20*).	500.00 Hz
	-500.00 … 500.00 Hz	Maximum frequency reference.	See par. *46.02*

50 Fieldbus adapter (FBA)		Fieldbus communication configuration. See also chapter *Fieldbus control through a fieldbus adapter* (page *537*).	
50.01	*FBA A enable*	Enables/disables communication between the drive and fieldbus adapter A, and specifies the slot the adapter is installed into.	*Disable*
	Disable	Communication between drive and fieldbus adapter A disabled.	0
	Option slot 1	Communication between drive and fieldbus adapter A enabled. The adapter is in slot 1.	1
	Option slot 2	Communication between drive and fieldbus adapter A enabled. The adapter is in slot 2.	2
	Option slot 3	Communication between drive and fieldbus adapter A enabled. The adapter is in slot 3.	3
50.02	*FBA A comm loss func*	Selects how the drive reacts upon a fieldbus communication break. A time delay for the action can be defined by parameter *50.03 FBA A comm loss t out*. See also parameter *50.26 FBA A comm supervision force*.	*No action*
	No action	No action taken.	0
	Fault	Drive trips on *7510 FBA A communication*. This only occurs if control is expected from the FBA A interface (FBA A selected as source of start/stop/reference in the currently active control location), or if supervision is forced using parameter *50.26 FBA A comm supervision force*.	1

No.	Name/Value	Description	Def/FbEq16
	Last speed	Drive generates an *A7C1 FBA A communication* warning and freezes the speed to the level the drive was operating at. This only occurs if control is expected from the FBA A interface, or if supervision is forced using parameter *50.26 FBA A comm supervision force*. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Drive generates an *A7C1 FBA A communication* warning and sets the speed to the value defined by parameter *22.41 Speed ref safe* (when speed reference is being used) or *28.41 Frequency ref safe* (when frequency reference is being used). This only occurs if control is expected from the FBA A interface, or if supervision is forced using parameter *50.26 FBA A comm supervision force*. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Fault always	Drive trips on *7510 FBA A communication*. This occurs even though no control is expected from the FBA A interface.	4
	Warning	Drive generates an *A7C1 FBA A communication* warning. This only occurs if control is expected from the FBA A interface, or if supervision is forced using parameter *50.26 FBA A comm supervision force*. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
50.03	*FBA A comm loss t out*	Defines the time delay before the action defined by parameter *50.02 FBA A comm loss func* is taken. Time count starts when the communication link fails to update the message. As a rule of thumb, this parameter should be set to at least 3 times the transmit interval of the master.	0.3 s
	0.3 … 6553.5 s	Time delay.	1 = 1 s
50.04	*FBA A ref1 type*	Selects the type and scaling of reference 1 received from fieldbus adapter A. **Note:** Fieldbus-specific communication profiles may use different scalings. For more information, see the manual of the fieldbus adapter.	*Auto*
	Auto	Type and scaling are chosen automatically according to which reference chain (see settings *Torque*, *Speed*, *Frequency*) the incoming reference is connected to. If the reference is not connected to any chain, no scaling is applied (as with setting *Transparent*).	0
	Transparent	No scaling is applied.	1
	General	Generic reference with a scaling of 100 = 1 (ie. integer and two decimals).	2
	Torque	The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	The scaling is defined by parameter *46.02 Frequency scaling*.	5
50.05	*FBA A ref2 type*	Selects the type and scaling of reference 2 received from fieldbus adapter A. See parameter *50.04 FBA A ref1 type*.	*Auto*

No.	Name/Value	Description	*Def/FbEq16*
50.07	*FBA A actual 1 type*	Selects the type/source and scaling of actual value 1 transmitted to the fieldbus network through fieldbus adapter A. **Note:** Fieldbus-specific communication profiles may use different scalings. For more information, see the manual of the fieldbus adapter.	*Auto*
	Auto	Type/source and scaling follow the type of reference 1 selected by parameter *50.04 FBA A ref1 type*. See the individual settings below for the sources and scalings.	0
	Transparent	The value selected by parameter *50.10 FBA A act1 transparent source* is sent as actual value 1. No scaling is applied (the 16-bit scaling is 1 = 1 unit).	1
	General	The value selected by parameter *50.10 FBA A act1 transparent source* is sent as actual value 1 with a 16-bit scaling of 100 = 1 unit (ie. integer and two decimals).	2
	Torque	*01.10 Motor torque* is sent as actual value 1. The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	*01.01 Motor speed used* is sent as actual value 1. The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	*01.06 Output frequency* is sent as actual value 1. The scaling is defined by parameter *46.02 Frequency scaling*.	5
	Position	Motor position is sent as actual value 1. See parameter *90.06 Motor position scaled*.	6
50.08	*FBA A actual 2 type*	Selects the type/source and scaling of actual value 2 transmitted to the fieldbus network through fieldbus adapter A. See parameter *50.07 FBA A actual 1 type*.	*Auto*
50.09	*FBA A SW transparent source*	Selects the source of the fieldbus status word when the fieldbus adapter is set to a transparent communication profile eg. by its configuration parameters (group *51 FBA A settings*).	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
50.10	*FBA A act1 transparent source*	When parameter *50.07 FBA A actual 1 type* is set to *Transparent* or *General*, this parameter selects the source of actual value 1 transmitted to the fieldbus network through fieldbus adapter A.	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
50.11	*FBA A act2 transparent source*	When parameter *50.08 FBA A actual 2 type* is set to *Transparent* or *General*, this parameter selects the source of actual value 2 transmitted to the fieldbus network through fieldbus adapter A.	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
50.12	*FBA A debug mode*	Enables the display of raw (unmodified) data received from and sent to fieldbus adapter A in parameters *50.13*…*50.18*. This functionality should only be used for debugging.	*Disable*
	Disable	Display of raw data from fieldbus adapter A disabled.	0
	Fast	Display of raw data from fieldbus adapter A enabled.	1

No.	Name/Value	Description	Def/FbEq16
50.13	FBA A control word	Displays the raw (unmodified) control word sent by the master (PLC) to fieldbus adapter A if debugging is enabled by parameter 50.12 FBA A debug mode. This parameter is read-only.	-
	00000000h … FFFFFFFFh	Control word sent by master to fieldbus adapter A.	-
50.14	FBA A reference 1	Displays raw (unmodified) reference REF1 sent by the master (PLC) to fieldbus adapter A if debugging is enabled by parameter 50.12 FBA A debug mode. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw REF1 sent by master to fieldbus adapter A.	-
50.15	FBA A reference 2	Displays raw (unmodified) reference REF2 sent by the master (PLC) to fieldbus adapter A if debugging is enabled by parameter 50.12 FBA A debug mode. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw REF2 sent by master to fieldbus adapter A.	-
50.16	FBA A status word	Displays the raw (unmodified) status word sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter 50.12 FBA A debug mode. This parameter is read-only.	-
	00000000h … FFFFFFFFh	Status word sent by fieldbus adapter A to master.	-
50.17	FBA A actual value 1	Displays raw (unmodified) actual value ACT1 sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter 50.12 FBA A debug mode. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw ACT1 sent by fieldbus adapter A to master.	-
50.18	FBA A actual value 2	Displays raw (unmodified) actual value ACT2 sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter 50.12 FBA A debug mode. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw ACT2 sent by fieldbus adapter A to master.	-

No.	Name/Value	Description	Def/FbEq16
50.21	FBA A timelevel sel	Selects the communication time levels. In general, lower time levels of read/write services reduce CPU load. The table below shows the time levels of the read/write services for cyclic high and cyclic low data with each parameter setting. Selection: Monitoring – Cyclic high * 10 ms, Cyclic low ** 2 ms; Normal – 2 ms, 10 ms; Fast – 500 µs, 2 ms; Very fast – 250 µs, 2 ms * Cyclic high data consists of fieldbus Status word, Act1 and Act2. ** Cyclic low data consists of the parameter data mapped to parameter groups 52 FBA A data in and 53 FBA A data out, and acyclic data. Control word, Ref1 and Ref2 are handled as interrupts generated on receipt of cyclic high messages.	Normal
	Normal	Normal speed.	0
	Fast	Fast speed.	1
	Very fast	Very fast speed.	2
	Monitoring	Low speed. Optimized for PC tool communication and monitoring usage.	3
50.26	FBA A comm supervision force	Activates fieldbus communication monitoring separately for each control location (see section Local control vs. external control on page 20). The parameter is primarily intended for monitoring the communication with FBA A when it is connected to the application program and not selected as a control source by drive parameters.	0000b
	0000b…0111b	FBA A communication monitoring selection.	1 = 1
50.31	FBA B enable	Enables/disables communication between the drive and fieldbus adapter B, and specifies the slot the adapter is installed into.	Disable
	Disable	Communication between drive and fieldbus adapter B disabled.	0
	Option slot 1	Communication between drive and fieldbus adapter B enabled. The adapter is in slot 1.	1
	Option slot 2	Communication between drive and fieldbus adapter B enabled. The adapter is in slot 2.	2
	Option slot 3	Communication between drive and fieldbus adapter B enabled. The adapter is in slot 3.	3

Table for 50.21:

Selection	Cyclic high *	Cyclic low **
Monitoring	10 ms	2 ms
Normal	2 ms	10 ms
Fast	500 µs	2 ms
Very fast	250 µs	2 ms

Bit table for 50.26:

Bit	Name	Value
0	Ext 1	1 = Communication monitoring active when Ext 1 is being used.
1	Ext 2	1 = Communication monitoring active when Ext 2 is being used.
2	Local	1 = Communication monitoring active when local control is being used.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
50.32	*FBA B comm loss func*	Selects how the drive reacts upon a fieldbus communication break. A time delay for the action can be defined by parameter *50.33 FBA B comm loss timeout*. See also parameter *50.56 FBA B comm supervision force*.	*No action*
	No action	No action taken.	0
	Fault	Drive trips on *7520 FBA B communication*. This only occurs if control is expected from the FBA B interface (FBA B selected as source of start/stop/reference in the currently active control location), or if supervision is forced using parameter *50.56 FBA B comm supervision force*.	1
	Last speed	Drive generates an *A7C2 FBA B communication* warning and freezes the speed to the level the drive was operating at. This only occurs if control is expected from the FBA B interface, or if supervision is forced using parameter *50.56 FBA B comm supervision force*. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Drive generates an *A7C2 FBA B communication* warning and sets the speed to the value defined by parameter *22.41 Speed ref safe* (when speed reference is being used) or *28.41 Frequency ref safe* (when frequency reference is being used). This only occurs if control is expected from the FBA B interface, or if supervision is forced using parameter *50.56 FBA B comm supervision force*. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Fault always	Drive trips on *7520 FBA B communication*. This occurs even though no control is expected from the FBA B interface.	4
	Warning	Drive generates an *A7C2 FBA B communication* warning. This only occurs if control is expected from the FBA B interface, or if supervision is forced using parameter *50.56 FBA B comm supervision force*. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
50.33	*FBA B comm loss timeout*	Defines the time delay before the action defined by parameter *50.32 FBA B comm loss func* is taken. Time count starts when the communication link fails to update the message. As a rule of thumb, this parameter should be set to at least 3 times the transmit interval of the master.	0.3 s
	0.3 … 6553.5 s	Time delay.	1 = 1 s
50.34	*FBA B ref1 type*	Selects the type and scaling of reference 1 received from fieldbus adapter B. See parameter *50.04 FBA A ref1 type*.	*Auto*
50.35	*FBA B ref2 type*	Selects the type and scaling of reference 2 received from fieldbus adapter B. See parameter *50.04 FBA A ref1 type*.	*Auto*
50.37	*FBA B actual 1 type*	Selects the type/source and scaling of actual value 1 transmitted to the fieldbus network through fieldbus adapter B. See parameter *50.07 FBA A actual 1 type*.	*Auto*

No.	Name/Value	Description	Def/FbEq16
50.38	FBA B actual 2 type	Selects the type/source and scaling of actual value 2 transmitted to the fieldbus network through fieldbus adapter B. See parameter 50.08 FBA A actual 2 type.	Auto
50.39	FBA B SW transparent source	Selects the source of the fieldbus status word when the fieldbus adapter is set to a transparent communication profile eg. by its configuration parameters (group 54 FBA B settings).	Not selected
	Not selected	No source selected.	-
	Other	Source selection (see Terms and abbreviations on page 110).	-
50.40	FBA B act1 transparent source	When parameter 50.37 FBA B actual 1 type is set to Transparent or General, this parameter selects the source of actual value 1 transmitted to the fieldbus network through fieldbus adapter B.	Not selected
	Not selected	No source selected.	-
	Other	Source selection (see Terms and abbreviations on page 110).	-
50.41	FBA B act2 transparent source	When parameter 50.38 FBA B actual 2 type is set to Transparent or General, this parameter selects the source of actual value 2 transmitted to the fieldbus network through fieldbus adapter B.	Not selected
	Not selected	No source selected.	-
	Other	Source selection (see Terms and abbreviations on page 110).	-
50.42	FBA B debug mode	Enables the display of raw (unmodified) data received from and sent to fieldbus adapter B in parameters 50.43…50.48. This functionality should only be used for debugging.	Disable
	Disable	Display of raw data from fieldbus adapter B disabled.	0
	Fast	Display of raw data from fieldbus adapter B enabled.	1
50.43	FBA B control word	Displays the raw (unmodified) control word sent by the master (PLC) to fieldbus adapter B if debugging is enabled by parameter 50.42 FBA B debug mode. This parameter is read-only.	-
	00000000h … FFFFFFFFh	Control word sent by master to fieldbus adapter B.	-
50.44	FBA B reference 1	Displays raw (unmodified) reference REF1 sent by the master (PLC) to fieldbus adapter B if debugging is enabled by parameter 50.42 FBA B debug mode. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw REF1 sent by master to fieldbus adapter B.	-
50.45	FBA B reference 2	Displays raw (unmodified) reference REF2 sent by the master (PLC) to fieldbus adapter B if debugging is enabled by parameter 50.42 FBA B debug mode. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw REF2 sent by master to fieldbus adapter B.	-
50.46	FBA B status word	Displays the raw (unmodified) status word sent by fieldbus adapter B to the master (PLC) if debugging is enabled by parameter 50.42 FBA B debug mode. This parameter is read-only.	-
	00000000h … FFFFFFFFh	Status word sent by fieldbus adapter B to master.	-

No.	Name/Value	Description	Def/FbEq16
50.47	*FBA B actual value 1*	Displays raw (unmodified) actual value ACT1 sent by fieldbus adapter B to the master (PLC) if debugging is enabled by parameter *50.42 FBA B debug mode*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw ACT1 sent by fieldbus adapter B to master.	-
50.48	*FBA B actual value 2*	Displays raw (unmodified) actual value ACT2 sent by fieldbus adapter B to the master (PLC) if debugging is enabled by parameter *50.42 FBA B debug mode*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw ACT2 sent by fieldbus adapter B to master.	-
50.51	*FBA B timelevel sel*	Selects the communication time levels. In general, lower time levels of read/write services reduce CPU load. The table below shows the time levels of the read/write services for cyclic high and cyclic low data with each parameter setting. **Selection** / **Cyclic high *** / **Cyclic low **** *Monitoring* / 10 ms / 2 ms *Normal* / 2 ms / 10 ms *Fast* / 500 µs / 2 ms *Very fast* / 250 µs / 2 ms * Cyclic high data consists of fieldbus Status word, Act1 and Act2. ** Cyclic low data consists of the parameter data mapped to parameter groups *55 FBA B data in* and *56 FBA B data out*, and acyclic data. Control word, Ref1 and Ref2 are handled as interrupts generated on receipt of cyclic high messages.	*Normal*
	Normal	Normal speed.	0
	Fast	Fast speed.	1
	Very fast	Very fast speed.	2
	Monitoring	Low speed. Optimized for PC tool communication and monitoring usage.	3

No.	Name/Value	Description	Def/FbEq16
50.56	FBA B comm supervision force	Activates fieldbus communication monitoring separately for each control location (see section Local control vs. external control on page 20). The parameter is primarily intended for monitoring the communication with FBA B when it is connected to the application program and not selected as a control source by drive parameters.	0000b

Bit	Name	Value
0	Ext 1	1 = Communication monitoring active when Ext 1 is being used.
1	Ext 2	1 = Communication monitoring active when Ext 2 is being used.
2	Local	1 = Communication monitoring active when local control is being used.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0111b	FBA B communication monitoring selection.	1 = 1
51 FBA A settings		Fieldbus adapter A configuration.	
51.01	FBA A type	Displays the type of the connected fieldbus adapter module. **0** = Module is not found or is not properly connected, or is disabled by parameter 50.01 FBA A enable; **1** = FPBA; **32** = FCAN; **37** = FDNA; **101** = FCNA, **128** = FENA-11/21; **135** = FECA; **136** = FEPL; **485** = FSCA. This parameter is read-only.	-
51.02	FBA A Par2	Parameters 51.02…51.26 are adapter module-specific. For more information, see the documentation of the fieldbus adapter module. Note that not all of these parameters are necessarily in use.	-
	0…65535	Fieldbus adapter configuration parameter.	1 = 1
…	…	…	…
51.26	FBA A Par26	See parameter 51.02 FBA A Par2.	-
	0…65535	Fieldbus adapter configuration parameter.	1 = 1
51.27	FBA A par refresh	Validates any changed fieldbus adapter module configuration settings. After refreshing, the value reverts automatically to Done. **Note:** This parameter cannot be changed while the drive is running.	Done
	Done	Refreshing done.	0
	Refresh	Refreshing.	1
51.28	FBA A par table ver	Displays the parameter table revision of the fieldbus adapter module mapping file (stored in the memory of the drive). In format axyz, where ax = major table revision number; yz = minor table revision number. This parameter is read-only.	-
		Parameter table revision of adapter module.	-
51.29	FBA A drive type code	Displays the drive type code in the fieldbus adapter module mapping file (stored in the memory of the drive). This parameter is read-only.	-
	0…65535	Drive type code stored in the mapping file.	1 = 1

No.	Name/Value	Description	Def/FbEq16
51.30	FBA A mapping file ver	Displays the fieldbus adapter module mapping file revision stored in the memory of the drive in decimal format. This parameter is read-only.	-
	0…65535	Mapping file revision.	1 = 1
51.31	D2FBA A comm status	Displays the status of the fieldbus adapter module communication.	-
	Not configured	Adapter is not configured.	0
	Initializing	Adapter is initializing.	1
	Time out	A timeout has occurred in the communication between the adapter and the drive.	2
	Configuration error	Adapter configuration error: mapping file not found in the file system of the drive, or mapping file upload has failed more than three times.	3
	Off-line	Fieldbus communication is off-line.	4
	On-line	Fieldbus communication is on-line, or fieldbus adapter has been configured not to detect a communication break. For more information, see the documentation of the fieldbus adapter.	5
	Reset	Adapter is performing a hardware reset.	6
51.32	FBA A comm SW ver	Displays the patch and build versions of the adapter module firmware in format xxyy, where xx = patch version number, yy = build version number. Example: C802 = 200.02 (patch version 200, build version 2).	
		Patch and build versions of adapter module firmware.	-
51.33	FBA A appl SW ver	Displays the major and minor versions of the adapter module firmware in format xyy, where x = major revision number, yy = minor revision number. Example: 300 = 3.00 (major version 3, minor version 00).	
		Major and minor versions of adapter module firmware.	-

52 FBA A data in		Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter A. **Note:** 32-bit values require two consecutive parameters. Whenever a 32-bit value is selected in a data parameter, the next parameter is automatically reserved.	
52.01	FBA A data in1	Parameters 52.01…52.12 select data to be transferred from the drive to the fieldbus controller through fieldbus adapter A.	None
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits)	5
	Act2 16bit	Actual value ACT2 (16 bits)	6
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	SW 32bit	Status Word (32 bits)	14

No.	Name/Value	Description	*Def/FbEq16*
	Act1 32bit	Actual value ACT1 (32 bits)	15
	Act2 32bit	Actual value ACT2 (32 bits)	16
	SW2 16bit	Status Word 2 (16 bits)	24
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
…	…	…	…
52.12	*FBA A data in12*	See parameter *52.01 FBA A data in1*.	*None*
53 FBA A data out		Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter A. **Note:** 32-bit values require two consecutive parameters. Whenever a 32-bit value is selected in a data parameter, the next parameter is automatically reserved.	
53.01	*FBA A data out1*	Parameters *53.01*…*53.12* select data to be transferred from the fieldbus controller to the drive through fieldbus adapter A.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	CW2 16bit	Control Word 2 (16 bits)	21
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
…	…	…	…
53.12	*FBA A data out12*	See parameter *53.01 FBA A data out1*.	*None*
54 FBA B settings		Fieldbus adapter B configuration.	
54.01	*FBA B type*	Displays the type of the connected fieldbus adapter module. **0** = Module is not found or is not properly connected, or is disabled by parameter *50.31 FBA B enable*; **1** = FPBA; **32** = FCAN; **37** = FDNA; **101** = FCNA, **128** = FENA-11/21; **135** = FECA; **136** = FEPL; **485** = FSCA. This parameter is read-only.	-
54.02	*FBA B Par2*	Parameters *54.02*…*54.26* are adapter module-specific. For more information, see the documentation of the fieldbus adapter module. Note that not all of these parameters are necessarily in use.	-
	0…65535	Fieldbus adapter configuration parameter.	1 = 1
…	…	…	…
54.26	*FBA B Par26*	See parameter *54.02 FBA B Par2*.	-
	0…65535	Fieldbus adapter configuration parameter.	1 = 1
54.27	*FBA B par refresh*	Validates any changed fieldbus adapter module configuration settings. After refreshing, the value reverts automatically to *Done*. **Note:** This parameter cannot be changed while the drive is running.	*Done*
	Done	Refreshing done.	0

No.	Name/Value	Description	Def/FbEq16
	Refresh	Refreshing.	1
54.28	FBA B par table ver	Displays the parameter table revision of the fieldbus adapter module mapping file (stored in the memory of the drive). In format axyz, where ax = major table revision number; yz = minor table revision number. This parameter is read-only.	-
		Parameter table revision of adapter module.	-
54.29	FBA B drive type code	Displays the drive type code in the fieldbus adapter module mapping file (stored in the memory of the drive). This parameter is read-only.	-
	0…65535	Drive type code stored in the mapping file.	1 = 1
54.30	FBA B mapping file ver	Displays the fieldbus adapter module mapping file revision stored in the memory of the drive in decimal format. This parameter is read-only.	-
	0…65535	Mapping file revision.	1 = 1
54.31	D2FBA B comm status	Displays the status of the fieldbus adapter module communication.	-
	Not configured	Adapter is not configured.	0
	Initializing	Adapter is initializing.	1
	Time out	A timeout has occurred in the communication between the adapter and the drive.	2
	Configuration error	Adapter configuration error: mapping file not found in the file system of the drive, or mapping file upload has failed more than three times.	3
	Off-line	Fieldbus communication is off-line.	4
	On-line	Fieldbus communication is on-line, or fieldbus adapter has been configured not to detect a communication break. For more information, see the documentation of the fieldbus adapter.	5
	Reset	Adapter is performing a hardware reset.	6
54.32	FBA B comm SW ver	Displays the patch and build versions of the adapter module firmware in format xxyy, where xx = patch version number, yy = build version number. Example: C802 = 200.02 (patch version 200, build version 2).	
		Patch and build versions of adapter module firmware.	-
54.33	FBA B appl SW ver	Displays the major and minor versions of the adapter module firmware in format xyy, where x = major revision number, yy = minor revision number. Example: 300 = 3.00 (major version 3, minor version 00).	
		Major and minor versions of adapter module firmware.	-

55 FBA B data in		Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter B.	
55.01	FBA B data in1	Parameters 55.01…55.12 select data to be transferred from the drive to the fieldbus controller through fieldbus adapter B.	None
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3

No.	Name/Value	Description	*Def/FbEq16*
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits)	5
	Act2 16bit	Actual value ACT2 (16 bits)	6
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	SW 32bit	Status Word (32 bits)	14
	Act1 32bit	Actual value ACT1 (32 bits)	15
	Act2 32bit	Actual value ACT2 (32 bits)	16
	SW2 16bit	Status Word 2 (16 bits)	24
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
…	…	…	…
55.12	*FBA B data in12*	See parameter *55.01 FBA B data in1*.	*None*
56 FBA B data out		Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter B.	
56.01	*FBA B data out1*	Parameters *56.01*…*56.12* select data to be transferred from the fieldbus controller to the drive through fieldbus adapter B.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	CW2 16bit	Control Word 2 (16 bits)	21
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
…	…	…	…
56.12	*FBA B data out12*	See parameter *56.01 FBA B data out1*.	*None*
58 Embedded fieldbus		Configuration of the embedded fieldbus (EFB) interface. See also chapter *Fieldbus control through the embedded fieldbus interface (EFB)* (page *513*).	
58.01	*Protocol enable*	Enables/disables the embedded fieldbus interface and selects the protocol to use. **Note:** When the embedded fieldbus interface is enabled, the drive-to-drive link functionality is automatically disabled.	*None*
	None	None (communication disabled).	0
	Modbus RTU	Embedded fieldbus interface is enabled and uses the Modbus RTU protocol.	1
58.02	*Protocol ID*	Displays the protocol ID and revision. This parameter is read-only.	-
		Protocol ID and revision.	1 = 1

No.	Name/Value	Description	Def/FbEq16
58.03	*Node address*	Defines the node address of the drive on the fieldbus link. Values 1…247 are allowable. Two devices with the same address are not allowed on-line. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	1
	0…255	Node address (values 1…247 are allowable).	1 = 1
58.04	*Baud rate*	Selects the transfer rate of the fieldbus link. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	*19.2 kbps*
	9.6 kbps	9.6 kbit/s.	2
	19.2 kbps	19.2 kbit/s.	3
	38.4 kbps	38.4 kbit/s.	4
	57.6 kbps	57.6 kbit/s.	5
	76.8 kbps	76.8 kbit/s.	6
	115.2 kbps	115.2 kbit/s.	7
58.05	*Parity*	Selects the type of parity bit and the number of stop bits. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	*8 EVEN 1*
	8 NONE 1	Eight data bits, no parity bit, one stop bit.	0
	8 NONE 2	Eight data bits, no parity bit, two stop bits.	1
	8 EVEN 1	Eight data bits, even parity bit, one stop bit.	2
	8 ODD 1	Eight data bits, odd parity bit, one stop bit.	3
58.06	*Communication control*	Validates any changes in the EFB settings, or activates silent mode.	*Enabled*
	Enabled	Normal operation.	0
	Refresh settings	Validates any changed EFB configuration settings. Reverts automatically to *Enabled*.	1
	Silent mode	Activates silent mode (no messages are transmitted). Silent mode can be terminated by activating the *Refresh settings* selection of this parameter.	2

No.	Name/Value	Description	*DefFbEq16*
58.07	*Communication diagnostics*	Displays the status of the EFB communication. This parameter is read-only.	-

Bit	Name	Description
0	Init failed	1 = EFB initialization failed
1	Addr config err	1 = Node address not allowed by protocol
2	Silent mode	1 = Drive not allowed to transmit
		0 = Drive allowed to transmit
3	Autobauding	Reserved
4	Wiring error	1 = Errors detected (A/B wires possibly swapped)
5	Parity error	1 = Error detected: check parameters *58.04* and *58.05*
6	Baud rate error	1 = Error detected: check parameters *58.05* and *58.04*
7	No bus activity	1 = 0 bytes received during last 5 seconds
8	No packets	1 = 0 packets (addressed to any device) detected during last 5 seconds
9	Noise or addressing error	1 = Errors detected (interference, or another device with the same address on line)
10	Comm loss	1 = 0 packets addressed to the drive received within timeout (*58.16*)
11	CW/Ref loss	1 = No control word or references received within timeout (*58.16*)
12	Not active	Reserved
13	Protocol 1	Reserved
14	Protocol 2	Reserved
15	Internal error	Reserved

No.	Name/Value	Description	*DefFbEq16*
	0000h…FFFFh	EFB communication status.	1 = 1
58.08	*Received packets*	Displays a count of valid packets addressed to the drive. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Number of received packets addressed to the drive.	1 = 1
58.09	*Transmitted packets*	Displays a count of valid packets transmitted by the drive. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Number of transmitted packets.	1 = 1
58.10	*All packets*	Displays a count of valid packets addressed to any device on the bus. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Number of all received packets.	1 = 1
58.11	*UART errors*	Displays a count of character errors received by the drive. An increasing count indicates a configuration problem on the bus. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Number of UART errors.	1 = 1

No.	Name/Value	Description	*Def/FbEq16*
58.12	*CRC errors*	Displays a count of packets with a CRC error received by the drive. An increasing count indicates interference on the bus. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Number of CRC errors.	1 = 1
58.14	*Communication loss action*	Selects how the drive reacts to an EFB communication break. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*. See also parameters *58.15 Communication loss mode* and *58.16 Communication loss time*.	*Fault*
	No	No action taken (monitoring disabled).	0
	Fault	Drive trips on *6681 EFB comm loss*. This only occurs if control is expected from the EFB (EFB selected as source of start/stop/reference in the currently active control location), or if supervision is forced using parameter *58.36 EFB comm supervision force*.	1
	Last speed	Drive generates an *A7CE EFB comm loss* warning and freezes the speed to the level the drive was operating at. This only occurs if control is expected from the EFB, or if supervision is forced using parameter *58.36 EFB comm supervision force*. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Drive generates an *A7CE EFB comm loss* warning and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). This only occurs if control is expected from the EFB, or if supervision is forced using parameter *58.36 EFB comm supervision force*. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Fault always	Drive trips on *6681 EFB comm loss*. This occurs even though no control is expected from the EFB.	4
	Warning	Drive generates an *A7CE EFB comm loss* warning. This only occurs if control is expected from the EFB, or if supervision is forced using parameter *58.36 EFB comm supervision force*. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
58.15	*Communication loss mode*	Defines which message types reset the timeout counter for detecting an EFB communication loss. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*. See also parameters *58.14 Communication loss action* and *58.16 Communication loss time*.	*Cw / Ref1 / Ref2*
	Any message	Any message addressed to the drive resets the timeout.	1
	Cw / Ref1 / Ref2	A write of the control word or a reference from the fieldbus resets the timeout.	2

No.	Name/Value	Description	Def/FbEq16
58.16	*Communication loss time*	Sets a timeout for EFB communication. If a communication break lasts longer than the timeout, the action specified by parameter *58.14 Communication loss action* is taken. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*. See also parameter *58.15 Communication loss mode*.	3.0 s
	0.0 … 6000.0 s	EFB communication timeout.	1 = 1
58.17	*Transmit delay*	Defines a minimum response delay in addition to any fixed delay imposed by the protocol. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	0 ms
	0…65535 ms	Minimum response delay.	1 = 1
58.18	*EFB control word*	Displays the raw (unmodified) control word sent by the Modbus controller to the drive. For debugging purposes. This parameter is read-only.	-
	0000h…FFFFh	Control word sent by Modbus controller to the drive.	1 = 1
58.19	*EFB status word*	Displays the raw (unmodified) status word sent by the drive to the Modbus controller. For debugging purposes. This parameter is read-only.	-
	0000h…FFFFh	Status word sent by the drive to the Modbus controller.	1 = 1
58.25	*Control profile*	Defines the control profile used by the protocol.	*ABB Drives*
	ABB Drives	ABB Drives profile (with a 16-bit control word) with registers in the classic format for backward compatibility.	0
	Transparent	Transparent profile (16-bit or 32-bit control word) with registers in the classic format.	2
58.26	*EFB ref1 type*	Selects the type and scaling of reference 1 received through the embedded fieldbus interface. The scaled reference is displayed by *03.09 EFB reference 1*.	*Auto*
	Auto	Type and scaling are chosen automatically according to which reference chain (see settings *Torque*, *Speed*, *Frequency*) the incoming reference is connected to. If the reference is not connected to any chain, no scaling is applied (as with setting *Transparent*).	0
	Transparent	No scaling is applied.	1
	General	Generic reference with a scaling of 100 = 1 (ie. integer and two decimals).	2
	Torque	The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	The scaling is defined by parameter *46.02 Frequency scaling*.	5
58.27	*EFB ref2 type*	Selects the type and scaling of reference 2 received through the embedded fieldbus interface. The scaled reference is displayed by *03.10 EFB reference 2*. For the selections, see parameter *58.26 EFB ref1 type*.	*Torque*

No.	Name/Value	Description	Def/FbEq16
58.28	EFB act1 type	Selects the type/source and scaling of actual value 1 transmitted to the fieldbus network through the embedded fieldbus interface.	Auto
	Auto	Type/source and scaling follow the type of reference 1 selected by parameter 58.26 EFB ref1 type. See the individual settings below for the sources and scalings.	0
	Transparent	The value selected by parameter 58.31 EFB act1 transparent source is sent as actual value 1. No scaling is applied (the 16-bit scaling is 1 = 1 unit).	1
	General	The value selected by parameter 58.31 EFB act1 transparent source is sent as actual value 1 with a 16-bit scaling of 100 = 1 unit (ie. integer and two decimals).	2
	Torque	01.10 Motor torque is sent as actual value 1. The scaling is defined by parameter 46.03 Torque scaling.	3
	Speed	01.01 Motor speed used is sent as actual value 1. The scaling is defined by parameter 46.01 Speed scaling.	4
	Frequency	01.06 Output frequency is sent as actual value 1. The scaling is defined by parameter 46.02 Frequency scaling.	5
	Position	Motor position is sent as actual value 1. See parameter 90.06 Motor position scaled.	6
58.29	EFB act2 type	Selects the type/source and scaling of actual value 2 transmitted to the fieldbus network through the embedded fieldbus interface.	Torque
	Auto	Type/source and scaling follow the type of reference 2 selected by parameter 58.27 EFB ref2 type. See the individual settings below for the sources and scalings.	0
	Transparent	The value selected by parameter 58.32 EFB act2 transparent source is sent as actual value 2. No scaling is applied (the 16-bit scaling is 1 = 1 unit).	1
	General	The value selected by parameter 58.32 EFB act2 transparent source is sent as actual value 2 with a 16-bit scaling of 100 = 1 unit (ie. integer and two decimals).	2
	Torque	01.10 Motor torque is sent as actual value 2. The scaling is defined by parameter 46.03 Torque scaling.	3
	Speed	01.01 Motor speed used is sent as actual value 2. The scaling is defined by parameter 46.01 Speed scaling.	4
	Frequency	01.06 Output frequency is sent as actual value 2. The scaling is defined by parameter 46.02 Frequency scaling.	5
	Position	Motor position is sent as actual value 2. See parameter 90.06 Motor position scaled.	6
58.30	EFB status word transparent source	Selects the source of the status word when 58.25 Control profile is set to Transparent.	Not selected
	Not selected	None.	0
	Other	Source selection (see Terms and abbreviations on page 110).	-
58.31	EFB act1 transparent source	Selects the source of actual value 1 when 58.28 EFB act1 type is set to Transparent or General.	Not selected
	Not selected	None.	0
	Other	Source selection (see Terms and abbreviations on page 110).	-

No.	Name/Value	Description	Def/FbEq16
58.32	EFB act2 transparent source	Selects the source of actual value 1 when 58.29 EFB act2 type is set to Transparent or General.	Not selected
	Not selected	None.	0
	Other	Source selection (see Terms and abbreviations on page 110).	-
58.33	Addressing mode	Defines the mapping between parameters and holding registers in the 400101…465535 Modbus register range. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control.	Mode 0
	Mode 0	16-bit values (groups 1…99, indexes 1…99): Register address = 400000 + 100 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 2200 + 80 = 402280. 32-bit values (groups 1…99, indexes 1…99): Register address = 420000 + 200 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 420000 + 4400 + 160 = 424560.	0
	Mode 1	16-bit values (groups 1…255, indexes 1…255): Register address = 400000 + 256 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 5632 + 80 = 405712.	1
	Mode 2	32-bit values (groups 1…127, indexes 1…255): Register address = 400000 + 512 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 400000 + 11264 + 160 = 411424.	2
58.34	Word order	Selects in which order 16-bit registers of 32-bit parameters are transferred. For each register, the first byte contains the high order byte and the second byte contains the low order byte. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control.	LO-HI
	HI-LO	The first register contains the high order word, the second contains the low order word.	0
	LO-HI	The first register contains the low order word, the second contains the high order word.	1
58.36	EFB comm supervision force	Activates fieldbus communication monitoring separately for each control location (see section Local control vs. external control on page 20). The parameter is primarily intended for monitoring the communication with EFB when it is connected to the application program and not selected as a control source by drive parameters.	0000b

Bit	Name	Value
0	Ext 1	1 = Communication monitoring active when Ext 1 is being used.
1	Ext 2	1 = Communication monitoring active when Ext 2 is being used.
2	Local	1 = Communication monitoring active when local control is being used.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0111b	EFB communication monitoring selection.	1 = 1

No.	Name/Value	Description	Def/FbEq16
58.101	Data I/O 1	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400001. The master defines the type of the data (input or output). The value is transmitted in a Modbus frame consisting of two 16-bit words. If the value is 16-bit, it is transmitted in the LSW (least significant word). If the value is 32-bit, the subsequent parameter is also reserved for it and must be set to *None*.	CW 16bit
	None	None.	0
	CW 16bit	Control Word (16 bits).	1
	Ref1 16bit	Reference REF1 (16 bits).	2
	Ref2 16bit	Reference REF2 (16 bits).	3
	SW 16bit	Status Word (16 bits).	4
	Act1 16bit	Actual value ACT1 (16 bits).	5
	Act2 16bit	Actual value ACT2 (16 bits).	6
	CW 32bit	Control Word (32 bits).	11
	Ref1 32bit	Reference REF1 (32 bits).	12
	Ref2 32bit	Reference REF2 (32 bits).	13
	SW 32bit	Status Word (32 bits).	14
	Act1 32bit	Actual value ACT1 (32 bits).	15
	Act2 32bit	Actual value ACT2 (32 bits).	16
	CW2 16bit	Control Word 2 (16 bits). When a 32-bit control word is used, this setting means the most-significant 16 bits.	21
	SW2 16bit	Status Word 2 (16 bits). When a 32-bit control word is used, this setting means the most-significant 16 bits.	24
	RO/DIO control word	Parameter *10.99 RO/DIO control word*.	31
	AO1 data storage	Parameter *13.91 AO1 data storage*.	32
	AO2 data storage	Parameter *13.92 AO2 data storage*.	33
	Feedback data storage	Parameter *40.91 Feedback data storage*.	40
	Setpoint data storage	Parameter *40.92 Setpoint data storage*.	41
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
58.102	Data I/O 2	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400002. For the selections, see parameter *58.101 Data I/O 1*.	Ref1 16bit
58.103	Data I/O 3	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400003. For the selections, see parameter *58.101 Data I/O 1*.	Ref2 16bit
58.104	Data I/O 4	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400004. For the selections, see parameter *58.101 Data I/O 1*.	SW 16bit

No.	Name/Value	Description	*Def/FbEq16*
58.105	*Data I/O 5*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400005. For the selections, see parameter *58.101 Data I/O 1*.	*Act1 16bit*
58.106	*Data I/O 6*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400006. For the selections, see parameter *58.101 Data I/O 1*.	*Act2 16bit*
58.107	*Data I/O 7*	Parameter selector for Modbus register address 400007. For the selections, see parameter *58.101 Data I/O 1*.	*None*
…	…	…	…
58.124	*Data I/O 24*	Parameter selector for Modbus register address 400024. For the selections, see parameter *58.101 Data I/O 1*.	*None*

60 DDCS communication		DDCS communication configuration. The DDCS protocol is used in the communication between • drives in a master/follower configuration (see page *31*), • the drive and an external controller such as the AC 800M (see page *38*), or • the drive (or more precisely, an inverter unit) and the supply unit of the drive system (see page *40*). All of the above utilize a fiber optic link which also requires an FDCO module (typically with ZCU control units) or an RDCO module (with BCU control units). Master/follower and external controller communication can also be implemented through shielded twisted-pair cable connected to the XD2D connector of the drive. This group also contains parameters for drive-to-drive (D2D) communication supervision.	
60.01	*M/F communication port*	Selects the connection used by the master/follower functionality.	*Not in use*
	Not in use	None (communication disabled).	0
	Slot 1A	Channel A on FDCO module in slot 1 (with ZCU control unit only).	1
	Slot 2A	Channel A on FDCO module in slot 2 (with ZCU control unit only).	2
	Slot 3A	Channel A on FDCO module in slot 3 (with ZCU control unit only).	3
	Slot 1B	Channel B on FDCO module in slot 1 (with ZCU control unit only).	4
	Slot 2B	Channel B on FDCO module in slot 2 (with ZCU control unit only).	5
	Slot 3B	Channel B on FDCO module in slot 3 (with ZCU control unit only).	6
	RDCO CH 2	Channel 2 on RDCO module (with BCU control unit only).	12
	XD2D	Connector XD2D. **Note:** This connection cannot co-exist, and is not to be confused with, drive-to-drive (D2D) communication implemented by application programming (detailed in *Drive application programming manual (IEC 61131-3)*, 3AUA0000127808 [English]).	7

No.	Name/Value	Description	Def/FbEq16
60.02	M/F node address	Selects the node address of the drive for master/follower communication. No two nodes on-line may have the same address. **Note:** The allowable addresses for the master are 0 and 1. The allowable addresses for followers are 2…60.	1
	1…254	Node address.	
60.03	M/F mode	Defines the role of the drive on the master/follower or drive-to-drive link.	Not in use
	Not in use	Master/follower functionality not active.	0
	DDCS master	The drive is the master on the master/follower (DDCS) link.	1
	DDCS follower	The drive is a follower on the master/follower (DDCS) link.	2
	D2D master	The drive is the master on the drive-to-drive (D2D) link. **Note:** This setting is only to be used with D2D communication implemented by application programming. If you are using the master/follower functionality (see page 31) through the XD2D connector, select *DDCS master* instead.	3
	D2D follower	The drive is a follower on the drive-to-drive (D2D) link. **Note:** This setting is only to be used with D2D communication implemented by application programming. If you are using the master/follower functionality (see page 31) through the XD2D connector, select *DDCS follower* instead.	4
	DDCS forcing	The role of the drive on the master/follower (DDCS) link is defined by parameters *60.15 Force master* and *60.16 Force follower*.	5
	D2D forcing	The role of the drive on the drive-to-drive (D2D) link is defined by parameters *60.15 Force master* and *60.16 Force follower*. **Note:** This setting is only to be used with D2D communication implemented by application programming. If you are using the master/follower functionality (see page 31) through the XD2D connector, select *DDCS forcing* instead.	6
60.05	M/F HW connection	Selects the topology of the master/follower link. **Note:** Use the setting *Star* if using the master/follower functionality (see page 31) through the XD2D connector (as opposed to a fiber optic link).	Ring
	Ring	The devices are connected in a ring topology. Forwarding of messages is enabled.	0
	Star	The devices are connected in a star topology (for example, through a branching unit). Forwarding of messages is disabled.	1
60.07	M/F link control	Defines the light intensity of the transmission LED of RDCO module channel CH2. (This parameter is effective only when parameter *60.01 M/F communication port* is set to *RDCO CH 2*. FDCO modules have a hardware transmitter current selector.) In general, use higher values with longer fiber optic cables. The maximum setting is applicable to the maximum length of the fiber optic link. See *Specifications of the fiber optic master/follower link* (page 37).	10
	1…15	Light intensity.	

No.	Name/Value	Description	*Def/FbEq16*
60.08	*M/F comm loss timeout*	Sets a timeout for master/follower (DDCS) communication. If a communication break lasts longer than the timeout, the action specified by parameter *60.09 M/F comm loss function* is taken. As a rule of thumb, this parameter should be set to at least 3 times the transmit interval of the master.	100 ms
	0…65535 ms	Master/follower communication timeout.	
60.09	*M/F comm loss function*	Selects how the drive reacts to a master/follower communication break.	*Fault*
	No action	No action taken.	0
	Warning	The drive generates an *A7CB MF comm loss* warning. This only occurs if control is expected from the master/follower link, or if supervision is forced using parameter *60.32 M/F comm supervision force*. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	1
	Fault	Drive trips on *7582 MF comm loss*. This only occurs if control is expected from the master/follower link, or if supervision is forced using parameter *60.32 M/F comm supervision force*.	2
	Fault always	Drive trips on *7582 MF comm loss*. This occurs even though no control is expected from the master/follower link.	3
60.10	*M/F ref1 type*	Selects the type and scaling of reference 1 received from the master/follower link. The resulting value is shown by *03.13 M/F or D2D ref1*.	*Auto*
	Auto	Type and scaling are chosen automatically according to which reference chain (see settings *Torque*, *Speed*, *Frequency*) the incoming reference is connected to. If the reference is not connected to any chain, no scaling is applied (as with setting *Transparent*).	0
	Transparent	No scaling is applied.	1
	General	Generic reference with a scaling of 100 = 1 (ie. integer and two decimals).	2
	Torque	The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	The scaling is defined by parameter *46.02 Frequency scaling*.	5
60.11	*M/F ref2 type*	Selects the type and scaling of reference 2 received from the master/follower link. The resulting value is shown by *03.14 M/F or D2D ref2*. For the selections, see parameter *60.10 M/F ref1 type*.	*Torque*
60.12	*M/F act1 type*	Selects the type/source and scaling of actual value ACT1 transmitted to the master/follower link.	*Auto*
	Auto	Type/source and scaling follow the type of reference 1 selected by parameter *60.10 M/F ref1 type*. See the individual settings below for the sources and scalings.	0
	Transparent	Reserved.	1
	General	Reserved.	2
	Torque	*01.10 Motor torque* is sent as actual value 1. The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	*01.01 Motor speed used* is sent as actual value 1. The scaling is defined by parameter *46.01 Speed scaling*.	4

No.	Name/Value	Description	Def/FbEq16
	Frequency	*01.06 Output frequency* is sent as actual value 1. The scaling is defined by parameter *46.02 Frequency scaling*.	5
60.13	*M/F act2 type*	Selects the type/source and scaling of actual value ACT2 transmitted to the master/follower link.	*Auto*
	Auto	Type/source and scaling follow the type of reference 2 selected by parameter *60.11 M/F ref2 type*. See the individual settings below for the sources and scalings.	0
	Transparent	Reserved.	1
	General	Reserved.	2
	Torque	*01.10 Motor torque* is sent as actual value 2. The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	*01.01 Motor speed used* is sent as actual value 2. The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	*01.06 Output frequency* is sent as actual value 2. The scaling is defined by parameter *46.02 Frequency scaling*.	5
60.14	*M/F follower selection*	(Effective in the master only.) Defines the followers from which data is read. See also parameters *62.28*…*62.33*.	*None*
	Follower node 2	Data is read from the follower with node address 2.	2
	Follower node 3	Data is read from the follower with node address 3.	4
	Follower node 4	Data is read from the follower with node address 4.	8
	Follower nodes 2+3	Data is read from the followers with node addresses 2 and 3.	6
	Follower nodes 2+4	Data is read from the followers with node addresses 2 and 4.	10
	Follower nodes 3+4	Data is read from the followers with node addresses 3 and 4.	12
	Follower nodes 2+3+4	Data is read from the followers with node addresses 2, 3 and 4.	14
	None	None.	0
60.15	*Force master*	When parameter *60.03 M/F mode* is set to *DDCS forcing* or *D2D forcing*, this parameter selects a source that forces the drive to be the master on the master/follower link. 1 = Drive is master on the master/follower link	*FALSE*
	FALSE	0.	0
	TRUE	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
60.16	*Force follower*	When parameter *60.03 M/F mode* is set to *DDCS forcing* or *D2D forcing*, this parameter selects a source that forces the drive to be a follower on the master/follower link. 1 = Drive is follower on the master/follower link	*FALSE*
	FALSE	0.	0
	TRUE	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-

No.	Name/Value	Description	Def/FbEq16
60.17	*Follower fault action*	(Effective in the master only.) Selects how the drive reacts to a fault in a follower. See also parameter *60.23 M/F status supervision sel 1*. **Note:** Each follower must be configured to transmit its status word as one of the three data words in parameters *61.01*…*61.03*. In the master, the corresponding target parameter (*62.04*…*62.12*) must be set to *Follower SW*.	*Fault*
	No action	No action taken. Unaffected drives on the master/follower link will continue running.	0
	Warning	The drive generates a warning (*AFE7 Follower*).	1
	Fault	Drive trips on *FF7E Follower*. All followers will be stopped.	2
60.18	*Follower enable*	Interlocks the starting of the master to the status of the followers. See also parameter *60.23 M/F status supervision sel 1*. **Note:** Each follower must be configured to transmit its status word as one of the three data words in parameters *61.01*…*61.03*. In the master, the corresponding target parameter (*62.04*…*62.12*) must be set to *Follower SW*.	*Always*
	MSW bit 0	The master can only be started if all followers are ready to switch on (bit 0 of *06.11 Main status word* in each follower is on).	0
	MSW bit 1	The master can only be started if all followers are ready to operate (bit 1 of *06.11 Main status word* in each follower is on).	1
	MSW bits 0 + 1	The master can only be started if all followers are ready to switch on and ready to operate (bits 0 and 1 of *06.11 Main status word* in each follower are on).	2
	Always	The starting of the master is not interlocked to the status of the followers.	3
	MSW bit 12	The master can only be started if user-definable bit 12 of *06.11 Main status word* in each follower is on. See parameter *06.31 MSW bit 12 sel*.	4
	MSW bits 0 + 12	The master can only be started if both bit 0 and bit 12 of *06.11 Main status word* in each follower are on.	5
	MSW bits 1 + 12	The master can only be started if both bit 1 and bit 12 of *06.11 Main status word* in each follower are on.	6

No.	Name/Value	Description	*Def/FbEq16*
60.19	*M/F comm supervision sel 1*	Parameters *60.19…60.28* are only effective when the drive is the master on a D2D (drive-to-drive) link, implemented by application programming. See parameters *60.01 M/F communication port* and *60.03 M/F mode*, and *Drive (IEC 61131-3) application programming manual* (3AUA0000127808 [English]). In the master, parameters *60.19 M/F comm supervision sel 1* and *60.20 M/F comm supervision sel 2* specify the followers that are monitored for loss of communication. This parameter selects which followers (out of followers 1…16) are monitored. Each of the selected followers is polled by the master. If no reply is received, the action specified in *60.09 M/F comm loss function* is taken. The status of communication is shown by *62.37 M/F communication status 1* and *62.38 M/F communication status 2*.	-

Bit	Name	Description
0	Follower 1	1 = Follower 1 is polled by the master.
1	Follower 2	1 = Follower 2 is polled by the master.
…	…	…
15	Follower 16	1 = Follower 16 is polled by the master.

No.	Name/Value	Description	*Def/FbEq16*
	0000h…FFFFh	Selection of followers for D2D communication supervision (1).	1 = 1
60.20	*M/F comm supervision sel 2*	Selects which followers (out of followers 17…32) are monitored for loss of communication. See parameter *60.19 M/F comm supervision sel 1*.	-

Bit	Name	Description
0	Follower 17	1 = Follower 17 is polled by the master.
1	Follower 18	1 = Follower 18 is polled by the master.
…	…	…
15	Follower 32	1 = Follower 32 is polled by the master.

No.	Name/Value	Description	*Def/FbEq16*
	0000h…FFFFh	Selection of followers for D2D communication supervision (2).	1 = 1

No.	Name/Value	Description	*Def/FbEq16*
60.23	*M/F status supervision sel 1*	(This parameter is only effective when the drive is the master on a D2D link. See parameters *60.01 M/F communication port* and *60.03 M/F mode*.) In the master, parameters *60.23 M/F status supervision sel 1* and *60.24 M/F status supervision sel 2* specify the followers whose status word is monitored by the master. This parameter selects the followers (out of followers 1…16) whose status words are monitored by the master. If a follower reports a fault (bit 3 of the status word is on), the action specified in *60.17 Follower fault action* is taken. Bits 0 and 1 of the status word (ready states) are handled as defined by *60.18 Follower enable*. Using *60.27 M/F status supv mode sel 1* and *60.28 M/F status supv mode sel 2*, it is possible to define whether any given follower is only monitored when it is stopped. **Note:** Also activate communication supervision for the same followers in parameter *60.19 M/F comm supervision sel 1*. The status of communication is shown by *62.37 M/F communication status 1* and *62.38 M/F communication status 2*.	-

Bit	Name	Description
0	Follower 1	1 = Status of follower 1 is monitored.
1	Follower 2	1 = Status of follower 2 is monitored.
…	…	…
15	Follower 16	1 = Status of follower 16 is monitored.

	0000h…FFFFh	D2D follower status supervision selection (followers 1…16).	1 = 1
60.24	*M/F status supervision sel 2*	Selects the followers (out of followers 17…32) whose status words are monitored by the D2D master. **Note:** Also activate communication supervision for the same followers in parameter *60.20 M/F comm supervision sel 2*. See parameter *60.23 M/F status supervision sel 1*.	-

Bit	Name	Description
0	Follower 17	1 = Status of follower 17 is monitored.
1	Follower 18	1 = Status of follower 18 is monitored.
…	…	…
15	Follower 32	1 = Status of follower 32 is monitored.

	0000h…FFFFh	D2D follower status supervision selection (followers 17…32).	1 = 1

No.	Name/Value	Description	Def/FbEq16
60.27	*M/F status supv mode sel 1*	In the D2D master, parameters *60.27 M/F status supv mode sel 1* and *60.28 M/F status supv mode sel 2* specify the mode of follower status word monitoring. Each follower can individually be set to be monitored continuously, or only when it is in stopped state. This parameter selects the mode of status word monitoring of followers 1…16.	-

Bit	Name	Description
0	Follower 1	0 = Status of follower 1 is monitored continuously. 1 = Status of follower 1 is monitored only when it is in stopped state.
1	Follower 2	0 = Status of follower 2 is monitored continuously. 1 = Status of follower 2 is monitored only when it is in stopped state.
…	…	…
15	Follower 16	0 = Status of follower 16 is monitored continuously. 1 = Status of follower 16 is monitored only when it is in stopped state.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	D2D status supervision mode selection 1.	1 = 1
60.28	*M/F status supv mode sel 2*	Selects the mode of status word monitoring of followers 17…32.	-

Bit	Name	Description
0	Follower 17	0 = Status of follower 17 is monitored continuously. 1 = Status of follower 17 is monitored only when it is in stopped state.
1	Follower 18	0 = Status of follower 18 is monitored continuously. 1 = Status of follower 18 is monitored only when it is in stopped state.
…	…	…
15	Follower 32	0 = Status of follower 32 is monitored continuously. 1 = Status of follower 32 is monitored only when it is in stopped state.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	D2D status supervision mode selection 2.	1 = 1
60.31	*M/F wake up delay*	Defines a wake-up delay during which no master/follower communication faults or warnings are generated. This is to allow all drives on the master/follower link to power up. The master cannot be started until the delay elapses or all monitored followers are found to be ready.	60.0 s
	0.0 … 180.0 s	Master/follower wake-up delay.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
60.32	M/F comm supervision force	Activates master/follower communication monitoring separately for each control location (see section *Local control vs. external control* on page 20). The parameter is primarily intended for monitoring the communication with master or follower when it is connected to the application program and not selected as a control source by drive parameters.	0000b

Bit	Name	Value
0	Ext 1	1 = Communication monitoring active when Ext 1 is being used.
1	Ext 2	1 = Communication monitoring active when Ext 2 is being used.
2	Local	1 = Communication monitoring active when local control is being used.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0111b	Master/follower communication monitoring selection.	1 = 1
60.41	Extension adapter com port	Selects the channel used for connecting an optional FEA-xx extension adapter.	No connect
	No connect	None (communication disabled).	0
	Slot 1A	Channel A on FDCO module in slot 1.	1
	Slot 2A	Channel A on FDCO module in slot 2.	2
	Slot 3A	Channel A on FDCO module in slot 3.	3
	Slot 1B	Channel B on FDCO module in slot 1.	4
	Slot 2B	Channel B on FDCO module in slot 2.	5
	Slot 3B	Channel B on FDCO module in slot 3.	6
	RDCO CH 3	Channel CH 3 on RDCO module (with BCU control unit only).	13
60.50	DDCS controller drive type	In ModuleBus communication, defines whether the drive is of the “engineered” or “standard” type.	ABB engineered drive
	ABB engineered drive	The drive is an “engineered drive” (data sets 10…25 are used).	0
	ABB standard drive	The drive is a “standard drive” (data sets 1…4 are used).	1
60.51	DDCS controller comm port	Selects the DDCS channel used for connecting an external controller (such as an AC 800M).	Not in use
	Not in use	None (communication disabled).	0
	Slot 1A	Channel A on FDCO module in slot 1.	1
	Slot 2A	Channel A on FDCO module in slot 2.	2
	Slot 3A	Channel A on FDCO module in slot 3.	3
	Slot 1B	Channel B on FDCO module in slot 1.	4
	Slot 2B	Channel B on FDCO module in slot 2.	5
	Slot 3B	Channel B on FDCO module in slot 3.	6
	RDCO CH 0	Channel 0 on RDCO module (with BCU control unit only).	10
	XD2D	Connector XD2D.	7

No.	Name/Value	Description	Def/FbEq16
60.52	*DDCS controller node address*	Selects the node address of the drive for communication with the external controller. No two nodes on-line may have the same address. With an AC 800M (CI858) DriveBus connection, drives must be addressed 1…24. With an AC 80 DriveBus connection, drives must be addressed 1…12. With optical ModuleBus, the drive address is set according to the position value as follows: 1. Multiply the hundreds of the position value by 16. 2. Add the tens and ones of the position value to the result. For example, if the position value is 101, this parameter must be set to 1×16 + 1 = 17.	1
	1…254	Node address.	
60.55	*DDCS controller HW connection*	Selects the topology of the fiber optic link with an external controller.	*Star*
	Ring	The devices are connected in a ring topology. Forwarding of messages is enabled.	0
	Star	The devices are connected in a star topology (for example, through a branching unit). Forwarding of messages is disabled.	1
60.57	*DDCS controller link control*	Defines the light intensity of the transmission LED of RDCO module channel CH0. (This parameter is effective only when parameter *60.51 DDCS controller comm port* is set to *RDCO CH 0*. FDCO modules have a hardware transmitter current selector.) In general, use higher values with longer fiber optic cables. The maximum setting is applicable to the maximum length of the fiber optic link. See *Specifications of the fiber optic master/follower link* (page *37*).	10
	1…15	Light intensity.	
60.58	*DDCS controller comm loss time*	Sets a timeout for communication with the external controller. If a communication break lasts longer than the timeout, the action specified by parameter *60.59 DDCS controller comm loss function* is taken. As a rule of thumb, this parameter should be set to at least 3 times the transmit interval of the controller. **Notes:** • There is a 60-second boot-up delay immediately after power-up. During the delay, the communication break monitoring is disabled (but communication itself can be active). • With an AC 800M controller, the controller detects a communication break immediately but re-establishing the communication is done at 9-second idle intervals. Also note that the sending interval of a data set is not the same as the execution interval of the application task. On ModuleBus, the sending interval is defined by controller parameter *Scan Cycle Time* (by default, 100 ms).	100 ms
	0…60000 ms	Timeout for communication with external controller.	
60.59	*DDCS controller comm loss function*	Selects how the drive reacts to a communication break between the drive and the external controller.	*Fault*
	No action	No action taken (monitoring disabled).	0

No.	Name/Value	Description	*DefFbEq16*
	Fault	Drive trips on *7581 DDCS controller comm loss*. This only occurs if control is expected from the external controller, or if supervision is forced using parameter *60.65 DDCS controller comm supervision force*.	1
	Last speed	Drive generates an *A7CA DDCS controller comm loss* warning and freezes the speed to the level the drive was operating at. This only occurs if control is expected from the external controller, or if supervision is forced using parameter *60.65 DDCS controller comm supervision force*. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Drive generates an *A7CA DDCS controller comm loss* warning and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). This only occurs if control is expected from the external controller, or if supervision is forced using parameter *60.65 DDCS controller comm supervision force*. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Fault always	Drive trips on *7581 DDCS controller comm loss*. This occurs even though no control is expected from the external controller.	4
	Warning	Drive generates an *A7CA DDCS controller comm loss* warning. This only occurs if control is expected from the external controller, or if supervision is forced using parameter *60.65 DDCS controller comm supervision force*. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
60.60	*DDCS controller ref1 type*	Selects the type and scaling of reference 1 received from the external controller. The resulting value is shown by *03.11 DDCS controller ref 1*.	*Auto*
	Auto	Type and scaling are chosen automatically according to which reference chain (see settings *Torque*, *Speed*, *Frequency*) the incoming reference is connected to. If the reference is not connected to any chain, no scaling is applied (as with setting *Transparent*).	0
	Transparent	No scaling is applied.	1
	General	Generic reference with a scaling of 100 = 1 (ie. integer and two decimals).	2
	Torque	The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	The scaling is defined by parameter *46.02 Frequency scaling*.	5
60.61	*DDCS controller ref2 type*	Selects the type and scaling of reference 2 received from the external controller. The resulting value is shown by *03.12 DDCS controller ref 2*. For the selections, see parameter *60.60 DDCS controller ref1 type*.	*Auto*

No.	Name/Value	Description	*Def/FbEq16*
60.62	*DDCS controller act1 type*	Selects the type/source and scaling of actual value ACT1 transmitted to the external controller.	*Auto*
	Auto	Type/source and scaling follow the type of reference 1 selected by parameter *60.60 DDCS controller ref1 type*. See the individual settings below for the sources and scalings.	0
	Transparent	Reserved.	1
	General	Reserved.	2
	Torque	*01.10 Motor torque* is sent as actual value 1. The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	*01.01 Motor speed used* is sent as actual value 1. The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	*01.06 Output frequency* is sent as actual value 1. The scaling is defined by parameter *46.02 Frequency scaling*.	5
60.63	*DDCS controller act2 type*	Selects the type/source and scaling of actual value ACT2 transmitted to the external controller.	*Auto*
	Auto	Type/source and scaling follow the type of reference 2 selected by parameter *60.61 DDCS controller ref2 type*. See the individual settings below for the sources and scalings.	0
	Transparent	Reserved.	1
	General	Reserved.	2
	Torque	*01.10 Motor torque* is sent as actual value 2. The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	*01.01 Motor speed used* is sent as actual value 2. The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	*01.06 Output frequency* is sent as actual value 2. The scaling is defined by parameter *46.02 Frequency scaling*.	5
60.64	*Mailbox dataset selection*	Selects the pair of data sets used by the mailbox service in the drive/controller communication. See section *External controller interface* (page *38*).	*Dataset 32/33*
	Dataset 32/33	Data sets 32 and 33.	0
	Dataset 24/25	Data sets 24 and 25.	1
60.65	*DDCS controller comm supervision force*	Activates DDCS controller communication monitoring separately for each control location (see section *Local control vs. external control* on page *20*). The parameter is primarily intended for monitoring the communication with the controller when it is connected to the application program and not selected as a control source by drive parameters.	0000b

Bit	Name	Value
0	Ext 1	1 = Communication monitoring active when Ext 1 is being used.
1	Ext 2	1 = Communication monitoring active when Ext 2 is being used.
2	Local	1 = Communication monitoring active when local control is being used.
3…15	Reserved	

	0000b…0111b	DDCS controller communication monitoring selection.	1 = 1

No.	Name/Value	Description	*Def/FbEq16*
60.71	*INU-LSU communication port*	*(Only visible with a BCU control unit)* Selects the DDCS channel used for connecting to another converter (such as a supply unit). See also section *Control of a supply unit (LSU)* (page *40*).	*Not in use*; *RDCO CH 1* (*95.20* b11, *95.20* b15)
	Not in use	None (communication disabled).	0
	RDCO CH 1	Channel 1 on RDCO module (with BCU control unit only).	11
60.77	*INU-LSU link control*	*(Only visible with a BCU control unit)* Defines the light intensity of the transmission LED of RDCO module channel CH1. (This parameter is effective only when parameter *60.71 INU-LSU communication port* is set to *RDCO CH 1*. FDCO modules have a hardware transmitter current selector.) In general, use higher values with longer fiber optic cables. The maximum setting is applicable to the maximum length of the fiber optic link. See *Specifications of the fiber optic master/follower link* (page *37*).	10
	1…15	Light intensity.	
60.78	*INU-LSU comm loss timeout*	*(Only visible with a BCU control unit)* Sets a timeout for communication with another converter (such as the supply unit). If a communication break lasts longer than the timeout, the action specified by parameter *60.79 INU-LSU comm loss function* is taken.	100 ms
	0…65535 ms	Timeout for communication between converters.	
60.79	*INU-LSU comm loss function*	*(Only visible with a BCU control unit)* Selects how the inverter unit reacts to a communication break between the inverter unit and the other converter.	*Fault*
	No action	No action taken.	0
	Warning	The drive generates a warning (*AF80 INU-LSU comm loss*).	1
	Fault	Drive trips on *7580 INU-LSU comm loss*.	2

61 D2D and DDCS transmit data		Defines the data sent to the DDCS link. See also parameter group *60 DDCS communication*.	
61.01	*M/F data 1 selection*	Preselects the data to be sent as word 1 onto the master/follower link. See also parameter *61.25 M/F data 1 value*, and section *Master/follower functionality* (page *31*).	*Follower CW*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits) **Note:** Using this setting to send a reference to the follower is not recommended as the source signal is filtered. Use the “reference” selections instead.	5
	Act2 16bit	Actual value ACT2 (16 bits) **Note:** Using this setting to send a reference to the follower is not recommended as the source signal is filtered. Use the “reference” selections instead.	6

No.	Name/Value	Description	Def/FbEq16
	Follower CW	A word consisting of bits 0…11 of *06.01 Main control word* and the bits selected by parameters *06.45*…*06.48*. **Note:** Bit 3 of the follower control word is kept on as long as the master is modulating, and when it switches to 0, the follower coasts to a stop.	27
	Used speed reference	*24.01 Used speed reference* (page *218*).	6145
	Torque reference act 5	*26.75 Torque reference act 5* (page *240*).	6731
	Torque reference used	*26.02 Torque reference used* (page *234*).	6658
	ACS800 System ctrl SW	A follower status word compatible with an ACS800 (System Control Program) master. With this setting, status word bit 0 is cleared whenever the run enable signal is missing.	28
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
61.02	*M/F data 2 selection*	Preselects the data to be sent as word 2 onto the master/follower link. See also parameter *61.26 M/F data 2 value*. For the selections, see parameter *61.01 M/F data 1 selection*.	*Used speed reference*
61.03	*M/F data 3 selection*	Preselects the data to be sent as word 3 onto the master/follower link. See also parameter *61.27 M/F data 3 value*. For the selections, see parameter *61.01 M/F data 1 selection*.	*Torque reference act 5*
61.25	*M/F data 1 value*	Displays the data to be sent onto the master/follower link as word 1 as an integer. If no data has been preselected by *61.01 M/F data 1 selection*, the value to be sent can be written directly into this parameter.	0
	0…65535	Data to be sent as word 1 in master/follower communication.	
61.26	*M/F data 2 value*	Displays the data to be sent onto the master/follower link as word 2 as an integer. If no data has been preselected by *61.02 M/F data 2 selection*, the value to be sent can be written directly into this parameter.	0
	0…65535	Data to be sent as word 2 in master/follower communication.	
61.27	*M/F data 3 value*	Displays the data to be sent onto the master/follower link as word 3 as an integer. If no data has been preselected by *61.03 M/F data 3 selection*, the value to be sent can be written directly into this parameter.	0
	0…65535	Data to be sent as word 3 in master/follower communication.	

No.	Name/Value	Description	Def/FbEq16
61.45	*Data set 2 data 1 selection*	Parameters *61.45*…*61.50* preselect data to be sent in data sets 2 and 4 to the external controller. These data sets are used in ModuleBus communication with a “standard drive” (*60.50 DDCS controller drive type* = *ABB standard drive*). Parameters *61.95*…*61.100* display the data to be sent to the external controller. If no data has been preselected, the value to be sent can be written directly into these parameters. For example, this parameter preselects the data for word 1 of data set 2. Parameter *61.95 Data set 2 data 1 value* displays the selected data in integer format. If no data is preselected, the value to be sent can be written directly into parameter *61.95*.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits)	5
	Act2 16bit	Actual value ACT2 (16 bits)	6
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
61.46	*Data set 2 data 2 selection*	Preselects the data to be sent as word 2 of data set 2 to the external controller. See also parameter *61.96 Data set 2 data 2 value*. For the selections, see parameter *61.45 Data set 2 data 1 selection*.	*None*
61.47	*Data set 2 data 3 selection*	See parameter *61.45 Data set 2 data 1 selection*.	*None*
…	…	…	…
61.50	*Data set 4 data 3 selection*	See parameter *61.45 Data set 2 data 1 selection*.	*None*
61.51	*Data set 11 data 1 selection*	Parameters *61.51*…*61.74* preselect data to be sent in data sets 11, 13, 15, 17, 19, 21, 23 and 25 to the external controller. Parameters *61.101*…*61.124* display the data to be sent to the external controller. If no data has been preselected, the value to be sent can be written directly into these parameters. For example, this parameter preselects the data for word 1 of data set 11. Parameter *61.101 Data set 11 data 1 value* displays the selected data in integer format. If no data is preselected, the value to be sent can be written directly into parameter *61.101*.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits)	5
	Act2 16bit	Actual value ACT2 (16 bits)	6
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
61.52	*Data set 11 data 2 selection*	Preselects the data to be sent as word 2 of data set 11 to the external controller. See also parameter *61.102 Data set 11 data 2 value*. For the selections, see parameter *61.51 Data set 11 data 1 selection*.	*None*

No.	Name/Value	Description	*Def/FbEq16*
61.53	*Data set 11 data 3 selection*	Preselects the data to be sent as word 3 of data set 11 to the external controller. See also parameter *61.103 Data set 11 data 3 value*. For the selections, see parameter *61.51 Data set 11 data 1 selection*.	*None*
61.54	*Data set 13 data 1 selection*	See parameter *61.51 Data set 11 data 1 selection*.	*None*
…	…	…	…
61.74	*Data set 25 data 3 selection*	See parameter *61.51 Data set 11 data 1 selection*.	*None*
61.95	*Data set 2 data 1 value*	Displays (in integer format) the data to be sent to the external controller as word 1 of data set 2. If no data has been preselected by *61.45 Data set 2 data 1 selection*, the value to be sent can be written directly into this parameter.	0
	0…65535	Data to be sent as word 1 of data set 2.	
61.96	*Data set 2 data 2 value*	Displays (in integer format) the data to be sent to the external controller as word 2 of data set 2. If no data has been preselected by *61.46 Data set 2 data 2 selection*, the value to be sent can be written directly into this parameter.	0
	0…65535	Data to be sent as word 2 of data set 2.	
61.97	*Data set 2 data 3 value*	Displays (in integer format) the data to be sent to the external controller as word 3 of data set 2. If no data has been preselected by *61.47 Data set 2 data 3 selection*, the value to be sent can be written directly into this parameter.	0
	0…65535	Data to be sent as word 3 of data set 2.	
…	…	…	…
61.100	*Data set 4 data 3 value*	Displays (in integer format) the data to be sent to the external controller as word 3 of data set 4. If no data has been selected by *61.50 Data set 4 data 3 selection*, the value to be sent can be written directly into this parameter.	0
	0…65535	Data to be sent as word 3 of data set 4.	
61.101	*Data set 11 data 1 value*	Displays (in integer format) the data to be sent to the external controller as word 1 of data set 11. If no data has been preselected by *61.51 Data set 11 data 1 selection*, the value to be sent can be written directly into this parameter.	0
	0…65535	Data to be sent as word 1 of data set 11.	
61.102	*Data set 11 data 2 value*	Displays (in integer format) the data to be sent to the external controller as word 2 of data set 11. If no data has been preselected by *61.52 Data set 11 data 2 selection*, the value to be sent can be written directly into this parameter.	0
	0…65535	Data to be sent as word 2 of data set 11.	

No.	Name/Value	Description	Def/FbEq16
61.103	Data set 11 data 3 value	Displays (in integer format) the data to be sent to the external controller as word 3 of data set 11. If no data has been selected by 61.53 Data set 11 data 3 selection, the value to be sent can be written directly into this parameter.	0
	0…65535	Data to be sent as word 3 of data set 11.	
61.104	Data set 13 data 1 value	Displays (in integer format) the data to be sent to the external controller as word 1 of data set 13. If no data has been selected by 61.54 Data set 13 data 1 selection, the value to be sent can be written directly into this parameter.	0
	0…65535	Data to be sent as word 1 of data set 13.	
…	…	…	…
61.124	Data set 25 data 3 value	Displays (in integer format) the data to be sent to the external controller as word 3 of data set 25. If no data has been selected by 61.74 Data set 25 data 3 selection, the value to be sent can be written directly into this parameter.	0
	0…65535	Data to be sent as word 3 of data set 25.	
61.151	INU-LSU data set 10 data 1 sel	*(Parameters 61.151…61.203 only visible with a BCU control unit)* Parameters 61.151…61.153 preselect data to be sent in data set 10 to another converter (typically the supply unit of the drive). Parameters 61.201…61.203 display the data to be sent to the other converter. If no data has been preselected, the value to be sent can be written directly into these parameters. For example, this parameter preselects the data for word 1 of data set 10. Parameter 61.201 INU-LSU data set 10 data 1 value displays the selected data in integer format. If no data is preselected, the value to be sent can be written directly into parameter 61.201.	None; LSU CW (95.20 b11, 95.20 b15)
	None	None.	0
	LSU CW	Control word for the supply unit.	22
	DC voltage reference	94.20 DC voltage reference (page 391).	24084
	Reactive power reference	94.30 Reactive power reference (page 391).	24094
	Other	Source selection (see Terms and abbreviations on page 110).	-
61.152	INU-LSU data set 10 data 2 sel	Preselects the data to be sent as word 2 of data set 10 to the other converter. See also parameter 61.202 INU-LSU data set 10 data 2 value. For the selections, see parameter 61.151 INU-LSU data set 10 data 1 sel.	None; DC voltage reference (95.20 b15)
61.153	INU-LSU data set 10 data 3 sel	Preselects the data to be sent as word 3 of data set 10 to the other converter. See also parameter 61.203 INU-LSU data set 10 data 3 value. For the selections, see parameter 61.151 INU-LSU data set 10 data 1 sel.	None; Reactive power reference (95.20 b15)

No.	Name/Value	Description	Def/FbEq16
61.201	INU-LSU data set 10 data 1 value	Displays (in integer format) the data to be sent to the other converter as word 1 of data set 10. If no data has been preselected by 61.151 INU-LSU data set 10 data 1 sel, the value to be sent can be written directly into this parameter.	0
	0…65535	Data to be sent as word 1 of data set 10.	
61.202	INU-LSU data set 10 data 2 value	Displays (in integer format) the data to be sent to the other converter as word 2 of data set 10. If no data has been preselected by 61.152 INU-LSU data set 10 data 2 sel, the value to be sent can be written directly into this parameter.	0
	0…65535	Data to be sent as word 2 of data set 10.	
61.203	INU-LSU data set 10 data 3 value	Displays (in integer format) the data to be sent to the other converter as word 3 of data set 10. If no data has been selected by 61.153 INU-LSU data set 10 data 3 sel, the value to be sent can be written directly into this parameter.	0
	0…65535	Data to be sent as word 3 of data set 10.	

62 D2D and DDCS receive data		Mapping of data received through the DDCS link. See also parameter group 60 DDCS communication.	
62.01	M/F data 1 selection	(Follower only) Defines a target for the data received as word 1 from the master through the master/follower link. See also parameter 62.25 MF data 1 value.	None
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	Other	Source selection (see Terms and abbreviations on page 110).	-
62.02	M/F data 2 selection	(Follower only) Defines a target for the data received as word 2 from the master through the master/follower link. See also parameter 62.26 MF data 2 value. For the selections, see parameter 62.01 M/F data 1 selection.	None
62.03	M/F data 3 selection	(Follower only) Defines a target for the data received as word 3 from the master through the master/follower link. See also parameter 62.27 MF data 3 value. For the selections, see parameter 62.01 M/F data 1 selection.	None
62.04	Follower node 2 data 1 sel	Defines a target for the data received as word 1 from the first follower (ie. the follower with node address 2) through the master/follower link. See also parameter 62.28 Follower node 2 data 1 value.	Follower SW
	None	None.	0
	Follower SW	Status word of the follower. See also parameter 60.18 Follower enable.	26
	Other	Source selection (see Terms and abbreviations on page 110).	-

No.	Name/Value	Description	*Def/FbEq16*
62.05	*Follower node 2 data 2 sel*	Defines a target for the data received as word 2 from the first follower (ie. the follower with node address 2) through the master/follower link. See also parameter *62.29 Follower node 2 data 2 value*. For the selections, see parameter *62.04 Follower node 2 data 1 sel*.	*None*
62.06	*Follower node 2 data 3 sel*	Defines a target for the data received as word 3 from the first follower (ie. the follower with node address 2) through the master/follower link. See also parameter *62.30 Follower node 2 data 3 value*. For the selections, see parameter *62.04 Follower node 2 data 1 sel*.	*None*
62.07	*Follower node 3 data 1 sel*	Defines a target for the data received as word 1 from the second follower (ie. the follower with node address 3) through the master/follower link. See also parameter *62.31 Follower node 3 data 1 value*. For the selections, see parameter *62.04 Follower node 2 data 1 sel*.	*Follower SW*
62.08	*Follower node 3 data 2 sel*	Defines a target for the data received as word 2 from the second follower (ie. the follower with node address 3) through the master/follower link. See also parameter *62.32 Follower node 3 data 2 value*. For the selections, see parameter *62.04 Follower node 2 data 1 sel*.	*None*
62.09	*Follower node 3 data 3 sel*	Defines a target for the data received as word 3 from the second follower (ie. the follower with node address 3) through the master/follower link. See also parameter *62.33 Follower node 3 data 3 value*. For the selections, see parameter *62.04 Follower node 2 data 1 sel*.	*None*
62.10	*Follower node 4 data 1 sel*	Defines a target for the data received as word 1 from the third follower (ie. the follower with node address 4) through the master/follower link. See also parameter *62.34 Follower node 4 data 1 value*. For the selections, see parameter *62.04 Follower node 2 data 1 sel*.	*Follower SW*
62.11	*Follower node 4 data 2 sel*	Defines a target for the data received as word 2 from the third follower (ie. the follower with node address 4) through the master/follower link. See also parameter *62.35 Follower node 4 data 2 value*. For the selections, see parameter *62.04 Follower node 2 data 1 sel*.	*None*
62.12	*Follower node 4 data 3 sel*	Defines a target for the data received as word 3 from the third follower (ie. the follower with node address 4) through the master/follower link. See also parameter *62.36 Follower node 4 data 3 value*. For the selections, see parameter *62.04 Follower node 2 data 1 sel*.	*None*
62.25	*MF data 1 value*	(Follower only) Displays, in integer format, the data received from the master as word 1. Parameter *62.01 M/F data 1 selection* can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	0
	0…65535	Data received as word 1 in master/follower communication.	

No.	Name/Value	Description	*Def*/*FbEq16*
62.26	*MF data 2 value*	(Follower only) Displays, in integer format, the data received from the master as word 2. Parameter *62.02 M/F data 2 selection* can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	0
	0…65535	Data received as word 2 in master/follower communication.	
62.27	*MF data 3 value*	(Follower only) Displays, in integer format, the data received from the master as word 3. Parameter *62.03 M/F data 3 selection* can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	0
	0…65535	Data received as word 3 in master/follower communication.	
62.28	*Follower node 2 data 1 value*	Displays, in integer format, the data received from the first follower (ie. follower with node address 2) as word 1. Parameter *62.04 Follower node 2 data 1 sel* can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	0
	0…65535	Data received as word 1 from follower with node address 2.	
62.29	*Follower node 2 data 2 value*	Displays, in integer format, the data received from the first follower (ie. follower with node address 2) as word 2. Parameter *62.05 Follower node 2 data 2 sel* can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	0
	0…65535	Data received as word 2 from follower with node address 2.	
62.30	*Follower node 2 data 3 value*	Displays, in integer format, the data received from the first follower (ie. follower with node address 2) as word 3. Parameter *62.06 Follower node 2 data 3 sel* can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	0
	0…65535	Data received as word 3 from follower with node address 2.	
62.31	*Follower node 3 data 1 value*	Displays, in integer format, the data received from the second follower (ie. follower with node address 3) as word 1. Parameter *62.07 Follower node 3 data 1 sel* can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	0
	0…65535	Data received as word 1 from follower with node address 3.	
62.32	*Follower node 3 data 2 value*	Displays, in integer format, the data received from the second follower (ie. follower with node address 3) as word 2. Parameter *62.08 Follower node 3 data 2 sel* can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	0
	0…65535	Data received as word 2 from follower with node address 3.	
62.33	*Follower node 3 data 3 value*	Displays, in integer format, the data received from the second follower (ie. follower with node address 3) as word 3. Parameter *62.09 Follower node 3 data 3 sel* can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	0
	0…65535	Data received as word 3 from follower with node address 3.	

No.	Name/Value	Description	**DeflFbEq16**
62.34	*Follower node 4 data 1 value*	Displays, in integer format, the data received from the third follower (ie. follower with node address 4) as word 1. Parameter *62.10 Follower node 4 data 1 sel* can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	0
	0…65535	Data received as word 1 from follower with node address 4.	
62.35	*Follower node 4 data 2 value*	Displays, in integer format, the data received from the third follower (ie. follower with node address 4) as word 2. Parameter *62.11 Follower node 4 data 2 sel* can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	0
	0…65535	Data received as word 2 from follower with node address 4.	
62.36	*Follower node 4 data 3 value*	Displays, in integer format, the data received from the third follower (ie. follower with node address 4) as word 3. Parameter *62.12 Follower node 4 data 3 sel* can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	0
	0…65535	Data received as word 3 from follower with node address 4.	
62.37	*M/F communication status 1*	In the master, displays the status of the communication with followers specified by parameter *60.19 M/F comm supervision sel 1*. In a follower, bit 0 indicates the status of the communication with the master.	-

Bit	Name	Description
0	Follower 1	1 (in the master) = Communication with follower 1 OK. 1 (in a follower) = Communication with master OK.
1	Follower 2	1 = Communication with follower 2 OK.
…	…	…
15	Follower 16	1 = Communication with follower 16 OK.

No.	Name/Value	Description	**DeflFbEq16**
	0000h…FFFFh	M/F communication status (followers 1…16).	1 = 1
62.38	*M/F communication status 2*	In the master, displays the status of the communication with followers specified by parameter *60.20 M/F comm supervision sel 2*.	-

Bit	Name	Description
0	Follower 17	1 = Communication with follower 17 OK.
1	Follower 18	1 = Communication with follower 18 OK.
…	…	…
15	Follower 32	1 = Communication with follower 32 OK.

No.	Name/Value	Description	**DeflFbEq16**
	0000h…FFFFh	M/F communication status (followers 17…32).	1 = 1

No.	Name/Value	Description	Def/FbEq16
62.41	*M/F follower ready status 1*	In the master, displays the ready status of the communication with followers specified by parameter *60.23 M/F status supervision sel 1*.	-

Bit	Name	Description
0	Follower 1	1 = Follower 1 ready.
1	Follower 2	1 = Follower 2 ready.
…	…	…
15	Follower 16	1 = Follower 16 ready.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Follower 1…16 ready status.	1 = 1
62.42	*M/F follower ready status 2*	In the master, displays the ready status of the communication with followers specified by parameter *60.24 M/F status supervision sel 2*.	-

Bit	Name	Description
0	Follower 17	1 = Follower 17 ready.
1	Follower 18	1 = Follower 18 ready.
…	…	…
15	Follower 32	1 = Follower 32 ready.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Follower 17…32 ready status.	1 = 1
62.45	*Data set 1 data 1 selection*	Parameters *62.45*…*62.50* define a target for the data received in data sets 1 and 3 from the external controller. These data sets are used in ModuleBus communication with a “standard drive” (*60.50 DDCS controller drive type* = *ABB standard drive*). Parameters *62.95*…*62.100* display the data received from the external controller in integer format, and can be used as sources by other parameters. For example, this parameter selects a target for word 1 of data set 1. Parameter *62.95 Data set 1 data 1 value* displays the received data in integer format, and can also be used as a source by other parameters.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
62.46	*Data set 1 data 2 selection*	Defines a target for the data received as word 2 of data set 1. See also parameter *62.96 Data set 1 data 2 value*. For the selections, see parameter *62.45 Data set 1 data 1 selection*.	*None*
62.47	*Data set 1 data 3 selection*	See parameter *62.45 Data set 1 data 1 selection*.	*None*
…	…	…	…
62.50	*Data set 3 data 3 selection*	See parameter *62.45 Data set 1 data 1 selection*.	*None*

No.	Name/Value	Description	Def/FbEq16
62.51	Data set 10 data 1 selection	Parameters 62.51…62.74 define a target for the data received in data sets 10, 12, 14, 16, 18, 20, 22 and 24 from the external controller. Parameters 62.101…62.124 display the data received from the external controller in integer format, and can be used as sources by other parameters. For example, this parameter selects a target for word 1 of data set 10. Parameter 62.101 Data set 10 data 1 value displays the received data in integer format, and can also be used as a source by other parameters.	None
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	Other	Source selection (see Terms and abbreviations on page 110).	-
62.52	Data set 10 data 2 selection	Defines a target for the data received as word 2 of data set 10. See also parameter 62.102 Data set 10 data 2 value. For the selections, see parameter 62.51 Data set 10 data 1 selection.	None
62.53	Data set 10 data 3 selection	Defines a target for the data received as word 3 of data set 10. See also parameter 62.103 Data set 10 data 3 value. For the selections, see parameter 62.51 Data set 10 data 1 selection.	None
62.54	Data set 12 data 1 selection	See parameter 62.51 Data set 10 data 1 selection.	None
…	…	…	…
62.74	Data set 24 data 3 selection	See parameter 62.51 Data set 10 data 1 selection.	None
62.95	Data set 1 data 1 value	Displays (in integer format) the data received from the external controller as word 1 of data set 1. A target for this data can be selected by parameter 62.45 Data set 1 data 1 selection. The value can also be used as a source by another parameter.	0
	0…65535	Data received as word 1 of data set 1.	
62.96	Data set 1 data 2 value	Displays (in integer format) the data received from the external controller as word 2 of data set 1. A target for this data can be selected by parameter 62.46 Data set 1 data 2 selection. The value can also be used as a source by another parameter.	0
	0…65535	Data received as word 2 of data set 1.	

No.	Name/Value	Description	*Def/FbEq16*
62.97	*Data set 1 data 3 value*	Displays (in integer format) the data received from the external controller as word 3 of data set 1. A target for this data can be selected by parameter *62.47 Data set 1 data 3 selection*. The value can also be used as a source by another parameter.	0
	0…65535	Data received as word 3 of data set 1.	
…	…	…	…
62.100	*Data set 3 data 3 value*	Displays (in integer format) the data received from the external controller as word 3 of data set 3. A target for this data can be selected by parameter *62.50 Data set 3 data 3 selection*. The value can also be used as a source by another parameter.	0
	0…65535	Data received as word 3 of data set 3.	
62.101	*Data set 10 data 1 value*	Displays (in integer format) the data received from the external controller as word 1 of data set 10. A target for this data can be selected by parameter *62.51 Data set 10 data 1 selection*. The value can also be used as a source by another parameter.	0
	0…65535	Data received as word 1 of data set 10.	
62.102	*Data set 10 data 2 value*	Displays (in integer format) the data received from the external controller as word 2 of data set 10. A target for this data can be selected by parameter *62.52 Data set 10 data 2 selection*. The value can also be used as a source by another parameter.	0
	0…65535	Data received as word 2 of data set 10.	
62.103	*Data set 10 data 3 value*	Displays (in integer format) the data received from the external controller as word 3 of data set 10. A target for this data can be selected by parameter *62.53 Data set 10 data 3 selection*. The value can also be used as a source by another parameter.	0
	0…65535	Data received as word 3 of data set 10.	
62.104	*Data set 12 data 1 value*	Displays (in integer format) the data received from the external controller as word 1 of data set 12. A target for this data can be selected by parameter *62.54 Data set 12 data 1 selection*. The value can also be used as a source by another parameter.	0
	0…65535	Data received as word 1 of data set 12.	
…	…	…	…
62.124	*Data set 24 data 3 value*	Displays (in integer format) the data received from the external controller as word 3 of data set 24. A target for this data can be selected by parameter *62.74 Data set 24 data 3 selection*. The value can also be used as a source by another parameter.	0
	0…65535	Data received as word 3 of data set 24.	

No.	Name/Value	Description	*DefFbEq16*
62.151	*INU-LSU data set 11 data 1 sel*	*(Parameters 62.151…62.203 only visible with a BCU control unit)* Parameters *62.151*…*62.153* define a target for the data received in data set 11 from another converter (typically the supply unit of the drive). Parameters *62.201*…*62.203* display the data received from the other converter in integer format, and can be used as sources by other parameters. For example, this parameter selects a target for word 1 of data set 11. Parameter *62.201 INU-LSU data set 11 data 1 value* displays the received data in integer format, and can also be used as a source by other parameters.	*None*; *LSU SW* (*95.20* b11, *95.20* b15)
	None	None.	0
	LSU SW	Status word of the supply unit.	4
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
62.152	*INU-LSU data set 11 data 2 sel*	Defines a target for the data received as word 2 of data set 11. See also parameter *62.202 INU-LSU data set 11 data 2 value*. For the selections, see parameter *62.151 INU-LSU data set 11 data 1 sel*.	*None*
62.153	*INU-LSU data set 11 data 3 sel*	Defines a target for the data received as word 3 of data set 11. See also parameter *62.203 INU-LSU data set 11 data 3 value*. For the selections, see parameter *62.151 INU-LSU data set 11 data 1 sel*.	*None*
62.201	*INU-LSU data set 11 data 1 value*	Displays (in integer format) the data received from the other converter as word 1 of data set 11. A target for this data can be selected by parameter *62.151 INU-LSU data set 11 data 1 sel*. The value can also be used as a source by another parameter.	0
	0…65535	Data received as word 1 of data set 11.	
62.202	*INU-LSU data set 11 data 2 value*	Displays (in integer format) the data received from the other converter as word 2 of data set 11. A target for this data can be selected by parameter *62.152 INU-LSU data set 11 data 2 sel*. The value can also be used as a source by another parameter.	0
	0…65535	Data received as word 2 of data set 11.	
62.203	*INU-LSU data set 11 data 3 value*	Displays (in integer format) the data received from the other converter as word 3 of data set 11. A target for this data can be selected by parameter *62.153 INU-LSU data set 11 data 3 sel*. The value can also be used as a source by another parameter.	0
	0…65535	Data received as word 3 of data set 11.	

No.	Name/Value	Description	Def/FbEq16
90 Feedback selection		Motor and load feedback configuration. See also sections *Encoder support* (page 49) and *Position counter* (page 51), and the diagram on page 553.	
90.01	*Motor speed for control*	Displays the estimated or measured motor speed that is used for motor control, ie. final motor speed feedback selected by parameter *90.41 Motor feedback selection* and filtered by *90.42 Motor speed filter time*. In case measured feedback is selected, it is also scaled by the motor gear function (*90.43 Motor gear numerator* and *90.44 Motor gear denominator*). This parameter is read-only.	-
	-32768.00 … 32767.00 rpm	Motor speed used for control.	See par. 46.01
90.02	*Motor position*	Displays the motor position (within one revolution) received from the source selected by parameter *90.41 Motor feedback selection*. In case measured feedback is selected, it is also scaled by the motor gear function (*90.43 Motor gear numerator* and *90.44 Motor gear denominator*). This parameter is read-only.	-
	0.00000000 … 1.00000000 rev	Motor position.	32767 = 1 rev
90.03	*Load speed*	Displays the estimated or measured load speed that is used for motor control, ie. final load speed feedback selected by parameter *90.51 Load feedback selection* and filtered by parameter *90.52 Load speed filter time*. In case measured feedback is selected, it is also scaled by the load gear function (*90.53 Load gear numerator* and *90.54 Load gear denominator*). In case motor feedback or estimated feedback is used, it is inversely scaled by *90.61 Gear numerator* and *90.62 Gear denominator* (ie. *90.62* divided by *90.61*). This parameter is read-only.	-
	-32768.00 … 32767.00 rpm	Load speed.	See par. 46.01
90.04	*Load position*	Displays the load position received from the source selected by parameter *90.51 Load feedback selection*. The value is multiplied as specified by parameter *90.57 Load position resolution*. In case measured feedback is selected, it is also scaled by the load gear function (*90.53 Load gear numerator* and *90.54 Load gear denominator*). In case motor feedback or estimated feedback is used, it is inversely scaled by *90.61 Gear numerator* and *90.62 Gear denominator* (ie. *90.62* divided by *90.61*). An offset can be defined by *90.56 Load position offset*. This parameter is read-only.	-
	-2147483648 … 2147483647	Load position.	-

No.	Name/Value	Description	DefFbEq16
90.05	*Load position scaled*	Displays the scaled load position in decimal format. The position is relative to the initial position set by parameters *90.65* and *90.66*. The number of decimal places is defined by parameter *90.38 Pos counter decimals*. **Note:** This is a floating point parameter, and the accuracy is compromised near the ends of the range. Consider using parameter *90.07 Load position scaled int* instead of this parameter. This parameter is read-only.	-
	-2147483.648 … 2147483.647	Scaled load position in decimal format.	-
90.06	*Motor position scaled*	Displays the calculated motor position. The axis mode (linear or rollover) and resolution are defined by parameters *90.48 Motor position axis mode* and *90.49 Motor position resolution* respectively. **Note:** The position value can be sent on a fast time level to the fieldbus controller by selecting *Position* in either *50.07 FBA A actual 1 type*, *50.08 FBA A actual 2 type*, *50.37 FBA B actual 1 type* or *50.38 FBA B actual 2 type*. This parameter is read-only.	-
	-2147483.648 … 2147483.647	Motor position.	-
90.07	*Load position scaled int*	Displays the output of the position counter function as an integer, enabling backwards compatibility with ACS 600 and ACS800 drives. The position is relative to the initial position set by parameters *90.58* and *90.59*. See section *Position counter* (page *51*), and the block diagram on page *554*. This parameter is read-only.	-
	-2147483648 … 2147483647	Scaled load position in integer format.	-
90.10	*Encoder 1 speed*	Displays encoder 1 speed in rpm. This parameter is read-only.	-
	-32768.00 … 32767.00 rpm	Encoder 1 speed.	See par. *46.01*
90.11	*Encoder 1 position*	Displays the actual position of encoder 1 within one revolution. This parameter is read-only.	-
	0.00000000 … 1.00000000 rev	Encoder 1 position within one revolution.	32767 = 1 rev
90.12	*Encoder 1 multiturn revolutions*	Displays the revolutions of (multiturn) encoder 1 within its value range (see parameter *92.14 Revolution data width*). This parameter is read-only.	-
	0…16777215	Encoder 1 revolutions.	-

No.	Name/Value	Description	Def/FbEq16
90.13	*Encoder 1 revolution extension*	Displays the revolution count extension for encoder 1. With a single-turn encoder, the counter is incremented when encoder position (parameter *90.11*) wraps around in the positive direction, and decremented in the negative direction. With a multiturn encoder, the counter is incremented when the revolutions count (parameter *90.12*) exceeds the value range in the positive direction, and decremented in the negative direction. This parameter is read-only.	-
	-2147483648 … 2147483647	Encoder 1 revolution count extension.	-
90.14	*Encoder 1 position raw*	Displays the raw measurement data of encoder 1 position (within one revolution) as a 24-bit unsigned integer received from the encoder interface. This parameter is read-only.	-
	0…16777215	Raw encoder 1 position within one revolution.	-
90.15	*Encoder 1 revolutions raw*	Displays the revolutions of (multiturn) encoder 1 within its value range (see parameter *92.14 Revolution data width*) as a raw measurement. This parameter is read-only.	-
	0…16777215	Raw encoder 1 revolution count.	-
90.20	*Encoder 2 speed*	Displays encoder 2 speed in rpm. This parameter is read-only.	-
	-32768.00 … 32767.00 rpm	Encoder 2 speed.	See par. *46.01*
90.21	*Encoder 2 position*	Displays the actual position of encoder 2 within one revolution. This parameter is read-only.	-
	0.00000000 … 1.00000000 rev	Encoder 2 position within one revolution.	-
90.22	*Encoder 2 multiturn revolutions*	Displays the revolutions of (multiturn) encoder 2 within its value range (see parameter *93.14 Revolution data width*). This parameter is read-only.	-
	0…16777215	Encoder 2 revolutions.	-
90.23	*Encoder 2 revolution extension*	Displays the revolution count extension for encoder 2. With a single-turn encoder, the counter is incremented when encoder position (parameter *90.21*) wraps around in the positive direction, and decremented in the negative direction. With a multiturn encoder, the counter is incremented when the revolutions count (parameter *90.22*) exceeds the value range in the positive direction, and decremented in the negative direction. This parameter is read-only.	-
	-2147483648 … 2147483647	Encoder 2 revolution count extension.	-
90.24	*Encoder 2 position raw*	Displays the raw measurement data of of encoder 2 position (within one revolution) as a 24-bit unsigned integer received from the encoder interface. This parameter is read-only.	-
	0…16777215	Raw encoder 2 position within one revolution.	-

No.	Name/Value	Description	*Def/FbEq16*
90.25	*Encoder 2 revolutions raw*	Displays the revolutions of (multiturn) encoder 2 within its value range (see parameter *93.14 Revolution data width*) as a raw measurement. This parameter is read-only.	-
	0…16777215	Raw encoder 2 revolution count.	-
90.26	*Motor revolution extension*	Displays the motor revolution count extension. The counter is incremented when the position selected by *90.41 Motor feedback selection* wraps around in the positive direction, and decremented in the negative direction. This parameter is read-only.	-
	-2147483648 … 2147483647	Motor revolution count extension.	-
90.27	*Load revolution extension*	Displays the load revolution count extension. The counter is incremented when the position selected by *90.51 Load feedback selection* wraps around in the positive direction, and decremented in the negative direction. This parameter is read-only.	-
	-2147483648 … 2147483647	Load revolution count extension.	-
90.35	*Pos counter status*	Status information related to the position counter function. See section *Position counter* (page *51*). This parameter is read-only.	-
	0000 0000b … 0111 1111b	Position counter status word.	1 = 1

Bit	Name	Value
0	Encoder 1 feedback	1 = Encoder 1 selected as load feedback source
1	Encoder 2 feedback	1 = Encoder 2 selected as load feedback source
2	Internal position feedback	1 = Internal load position estimate selected as load feedback source
3	Motor feedback	1 = Motor feedback selected as load feedback source
4	Pos counter init ready	0 = Position counter not initialized, or encoder feedback was lost. Fresh counter initialization recommended. 1 = Position counter successfully initialized
5	Position counter re-init disabled	1 = Position counter initialization is being prevented by par. *90.68*
6	Position data inaccurate	1 = Encoder feedback intermittent or lost. (If the drive is running, estimated position is used whenever encoder feedback is unavailable. If the drive is in stopped state, position counting will continue based on encoder data after the connection is restored.)
7…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
90.38	Pos counter decimals	Scales the values of parameters 90.05 Load position scaled and 90.65 Pos counter init value when written from or read to from an external source (eg. fieldbus). The setting corresponds to the number of decimal places. For example, with the setting of 3, an integer value of 66770 written into 90.65 Pos counter init value is divided by 1000, so the final value applied will be 66.770. Likewise, the value of 90.05 Load position scaled is multiplied by 1000 when read.	3
	0…9	Number of position counter decimal places.	1 = 1
90.41	Motor feedback selection	Selects the motor speed feedback value used during motor control. **Note:** With a permanent magnet motor, make sure an autophasing routine (see page 59) is performed using the selected encoder. If necessary, set parameter 99.13 ID run requested to Autophasing to request a fresh autophasing routine.	Estimate
	Estimate	A calculated speed estimate generated from the DTC core is used.	0
	Encoder 1	Actual speed measured by encoder 1. The encoder is set up by the parameters in group 92 Encoder 1 configuration.	1
	Encoder 2	Actual speed measured by encoder 2. The encoder is set up by the parameters in group 93 Encoder 2 configuration.	2
90.42	Motor speed filter time	Defines a filter time for motor speed feedback used for control (90.01 Motor speed for control).	3 ms
	0 … 10000 ms	Motor speed filter time.	1 = 1 ms
90.43	Motor gear numerator	Parameters 90.43 and 90.44 define a gear function between the motor speed feedback and motor control. The gear is used to correct a difference between the motor and encoder speeds for example if the encoder is not mounted directly on the motor shaft. $\frac{\text{90.43 Motor gear numerator}}{\text{90.44 Motor gear denominator}} = \frac{\text{Motor speed}}{\text{Encoder speed}}$	1
	-2147483648 … 2147483647	Motor gear numerator.	-
90.44	Motor gear denominator	See parameter 90.43 Motor gear numerator.	1
	-2147483648 … 2147483647	Motor gear denominator.	-
90.45	Motor feedback fault	Selects how the drive reacts to loss of measured motor feedback.	Fault
	Fault	Drive trips on a 7301 Motor speed feedback or 7381 Encoder fault.	0
	Warning	Drive generates an A798 Encoder option comm loss, A7B0 Motor speed feedback or A7E1 Encoder warning and continues operation using estimated feedbacks. **Note:** Before using this setting, test the stability of the speed control loop with estimated feedback by running the drive on estimated feedback (see 90.41 Motor feedback selection).	1

No.	Name/Value	Description	*Def/FbEq16*
90.46	*Force open loop*	Forces the DTC motor model to use estimated motor speed as feedback. This parameter can be activated when the encoder data is obviously unreliable because of slippage, for example. **Note:** This parameter only affects the selection of feedback for the motor model, not for the speed controller.	*No*
	No	The motor model uses the feedback selected by *90.41 Motor feedback selection*.	0
	Yes	The motor model uses the calculated speed estimate (regardless of the setting of *90.41 Motor feedback selection*, which in this case only selects the source of feedback for the speed controller).	1
90.48	*Motor position axis mode*	Selects the axis type for motor position measurement.	*Rollover*
	Linear	Linear.	0
	Rollover	The value is between 0 and 1 revolutions, and rolls over at 360 degrees.	1
90.49	*Motor position resolution*	Defines how many bits are used for motor position count within one revolution. For example, with the setting of 24, the position value is multiplied by 16777216 for display in parameter *90.06 Motor position scaled* (or for fieldbus).	24
	0…31	Motor position resolution.	-
90.51	*Load feedback selection*	Selects the source of load speed and position feedbacks used in control.	*None*
	None	No load feedback selected.	0
	Encoder 1	Load feedbacks are updated based on the speed and position values read from encoder 1. The values are scaled by the load gear function (*90.53 Load gear numerator* and *90.54 Load gear denominator*). The encoder is set up by the parameters in group *92 Encoder 1 configuration*.	1
	Encoder 2	Load feedbacks are updated based on the speed and position values read from encoder 2. The values are scaled by the load gear function (*90.53 Load gear numerator* and *90.54 Load gear denominator*). The encoder is set up by the parameters in group *93 Encoder 2 configuration*.	2
	Estimate	Calculated speed and position estimates are used. The values are scaled from the motor side to the load side using the inverted ratio between *90.61 Gear numerator* and *90.62 Gear denominator* (ie. *90.62* divided by *90.61*).	3
	Motor feedback	The source selected by parameter *90.41 Motor feedback selection* for motor feedback is also used for load feedback. Any difference between the motor and load speeds (and positions) can be compensated by using the inverted ratio between *90.61 Gear numerator* and *90.62 Gear denominator* (ie. *90.62* divided by *90.61*).	4
90.52	*Load speed filter time*	Defines a filter time for load speed feedback (*90.03 Load speed*).	4 ms
	0 … 10000 ms	Load speed filter time.	-

No.	Name/Value	Description	Def/FbEq16
90.53	Load gear numerator	Parameters 90.53 and 90.54 define a gear function between the load (ie. driven equipment) speed and the encoder feedback selected by parameter 90.51 Load feedback selection. The gear can be used to correct a difference between the load and encoder speeds for example if the encoder is not mounted directly on the rotated machinery. $\frac{\text{90.53 Load gear numerator}}{\text{90.54 Load gear denominator}} = \frac{\text{Load speed}}{\text{Encoder speed}}$	1
	-2147483648 … 2147483647	Load gear numerator.	-
90.54	Load gear denominator	See parameter 90.53 Load gear numerator.	1
	-2147483648 … 2147483647	Load gear denominator.	-
90.55	Load feedback fault	Selects how the drive reacts to loss of load feedback.	Fault
	Fault	Drive trips on a 73A1 Load feedback fault.	0
	Warning	Drive generates an A798 Encoder option comm loss or A7B1 Load speed feedback warning and continues operation using estimated feedbacks.	1
90.56	Load position offset	Defines a load-side position offset. The resolution is determined by parameter 90.57 Load position resolution.	0 rev
	-2147483648 … 2147483647 rev	Load-side position offset.	-
90.57	Load position resolution	Defines how many bits are used for load position count within one revolution. For example, with the setting of 16, the position value is multiplied by 65536 for display in parameter 90.04 Load position.	16
	0…31	Load position resolution.	-
90.58	Pos counter init value int	Defines an initial position (or distance) for the position counter (as an integer value) when parameter 90.59 Pos counter init value int source is set to Pos counter init value int. See also section Position counter (page 51).	0
	-2147483648 … 2147483647	Initial integer value for position counter.	-
90.59	Pos counter init value int source	Selects the source of the initial position integer value. When the source selected by 90.67 Pos counter init cmd source activates, the value selected in this parameter is assumed to be the position of the load.	Pos counter init value int
	Zero	0.	0
	Pos counter init value int	Parameter 90.58 Pos counter init value int.	1
	Other	Source selection (see Terms and abbreviations on page 110).	-
90.60	Pos counter error and boot action	Selects how the position counter reacts to loss of load feedback.	Request re-initialization
	Request re-initialization	Bit 4 of 90.35 Pos counter status is cleared. Reinitialization of position counter is recommended.	0

No.	Name/Value	Description	Def/FbEq16
	Continue from previous value	Position counting resumes from the previous value over a loss of load feedback or control unit reboot. Bit 4 of *90.35 Pos counter status* is not cleared, but bit 6 is set to indicate that an error has occurred. **WARNING!** If load feedback is lost when the drive is in stopped state or not powered, the counter is not updated even if the load moves.	1
90.61	*Gear numerator*	Parameters *90.61* and *90.62* define a gear function between the motor and load speeds. $\frac{\text{90.61 Gear numerator}}{\text{90.62 Gear denominator}} = \frac{\text{Motor speed}}{\text{Load speed}}$	1
	-2147483648 … 2147483647	Gear numerator (motor-side).	-
90.62	*Gear denominator*	See parameter *90.61 Gear numerator*.	1
	-2147483648 … 2147483647	Gear denominator (load-side).	-
90.63	*Feed constant numerator*	Parameters *90.63* and *90.64* define the feed constant for the position calculation: $\frac{\text{90.63 Feed constant numerator}}{\text{90.64 Feed constant denominator}}$ The feed constant converts rotational motion into translatory motion. The feed constant is the distance the load moves during one turn of the motor shaft. The translatory load position is shown by parameter *90.05 Load position scaled*.	1
	-2147483648 … 2147483647	Feed constant numerator.	-
90.64	*Feed constant denominator*	See parameter *90.63 Feed constant numerator*.	1
	-2147483648 … 2147483647	Feed constant denominator.	-
90.65	*Pos counter init value*	Defines an initial position (or distance) for the position counter (as a decimal number) when parameter *90.66 Pos counter init value source* is set to *Pos counter init value*. The number of decimal places is defined by parameter *90.38 Pos counter decimals*.	0.000
	-2147483.648 … 2147483.647	Initial value for position counter.	-
90.66	*Pos counter init value source*	Selects the source of the initial position value. When the source selected by *90.67 Pos counter init cmd source* activates, the value selected in this parameter is assumed to be the position of the load (in decimal format).	*Pos counter init value*
	Zero	0.	0
	Pos counter init value	Parameter *90.65 Pos counter init value*.	1
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-

No.	Name/Value	Description	Def/FbEq16
90.67	Pos counter init cmd source	Selects a digital source (for example, a limit switch connected to a digital input) that initializes the position counter. When the digital source activates, the value selected by 90.66 Pos counter init value source is assumed to be the position of the load. **Note:** Position counter initialization can be prevented by parameter 90.68 Disable pos counter initialization.	Not selected
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
90.68	Disable pos counter initialization	Selects a source that prevents the initialization of the position counter.	Not selected
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-
90.69	Reset pos counter init ready	Selects a source that enables a new initialization of the position counter, ie. resets bit 4 of 90.35 Pos counter status.	Not selected
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 110).	-

No.	Name/Value	Description	*DeflFbEq16*
91 Encoder module settings		Configuration of encoder interface modules.	
91.01	*FEN DI status*	Displays the status of the digital inputs of FEN-xx encoder interface modules. This parameter is read-only.	-

Bit	Name	Information
0	DI1 /module 1	DI1 of interface module 1 (see parameters *91.11* and *91.12*)
1	DI2 /module 1	DI2 of interface module 1 (see parameters *91.11* and *91.12*)
2…3	Reserved	
4	DI1 /module 2	DI1 of interface module 2 (see parameters *91.13* and *91.14*)
5	DI2 /module 2	DI2 of interface module 2 (see parameters *91.13* and *91.14*)
6…15	Reserved	

No.	Name/Value	Description	*DeflFbEq16*
	0000 0000b … 0011 0011b	Status word of digital inputs on FEN-xx modules.	1 = 1
91.02	*Module 1 status*	Displays the type of the interface module found in the location specified by parameter *91.12 Module 1 location*. This parameter is read-only.	-
	No option	No module detected in the specified slot.	0
	No communication	A module has been detected but cannot be communicated with.	1
	Unknown	The module type is unknown.	2
	FEN-01	An FEN-01 module has been detected and is active.	16
	FEN-11	An FEN-11 module has been detected and is active.	17
	FEN-21	An FEN-21 module has been detected and is active.	18
	FEN-31	An FEN-31 module has been detected and is active.	21
	FSE-31	An FSE-31 module has been detected and is active.	25
91.03	*Module 2 status*	Displays the type of the interface module found in the location specified by parameter *91.14 Module 2 location*. For the indications, see parameter *91.02 Module 1 status*. This parameter is read-only.	-
91.04	*Module 1 temperature*	Displays the temperature measured through the sensor input of interface module 1. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms. This parameter is read-only.	-
	0…1000 °C, °F or ohm	Temperature measured through interface module 1.	-
91.06	*Module 2 temperature*	Displays the temperature measured through the sensor input of interface module 2. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms. This parameter is read-only.	-
	0…1000 °C, °F or ohm	Temperature measured through interface module 2.	-

No.	Name/Value	Description	*Def/FbEq16*
91.10	*Encoder parameter refresh*	Validates any changed encoder interface module parameters. This is needed for any parameter changes in groups 90…93 to take effect. After refreshing, the value reverts automatically to *Done*. **Notes:** • Permanent magnet motors only: The drive will perform a fresh autophasing routine (see page *59*) at next start if the motor feedback encoder settings have been changed. • The parameter cannot be changed while the drive is running.	*Done*
	Done	Refreshing done.	0
	Refresh	Refreshing.	1
91.11	*Module 1 type*	Defines the type of the module used as interface module 1.	*None*
	None	None (communication disabled).	0
	FEN-01	FEN-01.	1
	FEN-11	FEN-11.	2
	FEN-21	FEN-21.	3
	FEN-31	FEN-31.	4
	FSE-31	FSE-31.	5
91.12	*Module 1 location*	Specifies the slot (1…3) on the control unit of the drive into which the interface module is installed. Alternatively, specifies the node ID of the slot on an FEA-03 extension adapter.	*Slot 2*
	Slot 1	Slot 1.	1
	Slot 2	Slot 2.	2
	Slot 3	Slot 3.	3
	4…254	Node ID of the slot on the FEA-03 extension adapter.	1 = 1
91.13	*Module 2 type*	Defines the type of the module used as interface module 2.	*None*
	None	None (communication disabled).	0
	FEN-01	FEN-01.	1
	FEN-11	FEN-11.	2
	FEN-21	FEN-21.	3
	FEN-31	FEN-31.	4
	FSE-31	FSE-31.	5
91.14	*Module 2 location*	Specifies the slot (1…3) on the control unit of the drive into which the interface module is installed. Alternatively, specifies the node ID of the slot on an FEA-03 extension adapter.	*Slot 3*
	Slot 1	Slot 1.	1
	Slot 2	Slot 2.	2
	Slot 3	Slot 3.	3
	4…254	Node ID of the slot on the FEA-03 extension adapter.	1 = 1
91.21	*Module 1 temp sensor type*	Specifies the type of temperature sensor connected to interface module 1. Note that the module must also be activated by parameters *91.11*…*91.12*.	*None*
	None	None.	0
	PTC	PTC. (The unit is ohms.)	1

No.	Name/Value	Description	*DeflFbEq16*
	KTY-84	KTY84. (The unit is selected by parameter *96.16 Unit selection*.)	2
91.22	*Module 1 temp filter time*	Defines a filtering time for the temperature measurement through interface module 1.	1500 ms
	0…10000 ms	Filtering time for temperature measurement.	-
91.24	*Module 2 temp sensor type*	Specifies the type of temperature sensor connected to interface module 2. Note that the module must also be activated by parameters *91.13*…*91.14*.	*None*
	None	None.	0
	PTC	PTC. (The unit is ohms.)	1
	KTY-84	KTY84. (The unit is selected by parameter *96.16 Unit selection*.)	2
91.25	*Module 2 temp filter time*	Defines a filtering time for the temperature measurement through interface 2.	1500 ms
	0…10000 ms	Filtering time for temperature measurement.	-
91.31	*Module 1 TTL output source*	Selects the encoder input on interface module 1 whose signal is echoed by or emulated to the TTL output. See also section *Encoder support* (page *49*).	*Not selected*
	Not selected	TTL output not in use.	0
	Module input 1	Input 1 is echoed by or emulated to the TTL output.	1
	Module input 2	Input 2 is echoed by or emulated to the TTL output.	2
91.32	*Module 1 emulation pulses/rev*	Defines the number of TTL pulses per revolution for encoder emulation output of interface module 1.	0
	0…65535	Number of TTL pulses for emulation.	1 = 1
91.33	*Module 1 emulated Z-pulse offset*	With interface module 1, defines when zero pulses are emulated in relation to zero position received from the encoder. For example, with a value of 0.50000, a zero pulse is emulated whenever the encoder position passes 0.5 revolutions. With a value of 0.00000, a zero pulse is emulated whenever the encoder position passes zero position.	0.00000
	0.00000 … 1.00000 rev	Position of emulated zero pulses.	32767 = 1 rev
91.41	*Module 2 TTL output source*	Selects the encoder input on interface module 2 whose signal is echoed by or emulated to the TTL output. See also section *Encoder support* (page *49*).	*Not selected*
	Not selected	TTL output not in use.	0
	Module input 1	Input 1 is echoed by or emulated to the TTL output.	1
	Module input 2	Input 2 is echoed by or emulated to the TTL output.	2
91.42	*Module 2 emulation pulses/rev*	Defines the number of TTL pulses per revolution for encoder emulation output of interface module 2.	0
	0…65535	Number of TTL pulses for emulation.	1 = 1

No.	Name/Value	Description	Def/FbEq16
91.43	*Module 2 emulated Z-pulse offset*	With interface module 2, defines when zero pulses are emulated in relation to zero position received from the encoder. For example, with a value of 0.50000, a zero pulse is emulated whenever the encoder position passes 0.5 revolutions. With a value of 0.00000, a zero pulse is emulated whenever the encoder position passes zero position.	0
	0.00000 … 1.00000 rev	Position of emulated zero pulses.	32767 = 1 rev
92 Encoder 1 configuration		Settings for encoder 1. **Notes:** • The contents of the parameter group vary according to the selected encoder type. • It is recommended that encoder connection 1 (this group) is used whenever possible since the data received through that interface is fresher than the data received through connection 2 (group *93 Encoder 2 configuration*).	
92.01	*Encoder 1 type*	Selects the type of encoder/resolver 1.	*None configured*
	None configured	None.	0
	TTL	TTL. Module type (input): FEN-01 (X31), FEN-11 (X41) or FEN-21 (X51).	1
	TTL+	TTL+. Module type (input): FEN-01 (X32).	2
	Absolute encoder	Absolute encoder. Module type (input): FEN-11 (X42).	3
	Resolver	Resolver. Module type (input): FEN-21 (X52).	4
	HTL	HTL. Module type (input): FEN-31 (X82).	5
	HTL 1	HTL. Module type (input): FSE-31 (X31).	6
	HTL 2	HTL. Module type (input): FSE-31 (X32). Not supported at the time of publication.	7
92.02	*Encoder 1 source*	Selects the interface module that the encoder is connected to. (The physical locations and types of encoder interface modules are defined in parameter group *91 Encoder module settings*.)	*Module 1*
	Module 1	Interface module 1.	0
	Module 2	Interface module 2.	1
92.10	*Pulses/revolution*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* Defines the pulse number per revolution.	2048
	0…65535	Number of pulses.	-
92.10	*Sine/cosine number*	*(Visible when an absolute encoder is selected)* Defines the number of sine/cosine wave cycles within one revolution. **Note:** This parameter need not be set when an EnDat or SSI encoder is used in continuous mode. See parameter *92.30 Serial link mode*.	0
	0…65535	Number of sine/cosine wave cycles within one revolution.	-
92.10	*Excitation signal frequency*	*(Visible when a resolver is selected)* Defines the frequency of the excitation signal.	1 kHz
	1…20 kHz	Excitation signal frequency.	1 = 1 kHz

No.	Name/Value	Description	*Def/FbEq16*
92.11	*Pulse encoder type*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* Selects the type of encoder.	*Quadrature*
	Quadrature	Quadrature encoder (with two channels, A and B)	0
	Single track	Single-track encoder (with one channel, A). **Note:** With this setting, the measured speed value is always positive regardless of direction of rotation.	1
92.11	*Absolute position source*	*(Visible when an absolute encoder is selected)* Selects the source of the absolute position information.	*None*
	None	Not selected.	0
	Commut signals	Commutation signals.	1
	EnDat	Serial interface: EnDat encoder.	2
	Hiperface	Serial interface: HIPERFACE encoder.	3
	SSI	Serial interface: SSI encoder.	4
	Tamagawa	Serial interface: Tamagawa 17/33-bit encoder.	5
92.11	*Excitation signal amplitude*	*(Visible when a resolver is selected)* Defines the rms amplitude of the excitation signal.	4.0 V
	4.0 … 12.0 V	Excitation signal amplitude.	10 = 1 V
92.12	*Speed calculation mode*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* Selects the speed calculation mode. *With a single-track encoder (parameter *92.11 Pulse encoder type* is set to *Single track*), the speed is always positive.	*Auto rising*
	A&B all	Channels A and B: Rising and falling edges are used for speed calculation. *Channel B: Defines the direction of rotation. **Note:** With a single-track encoder (parameter *92.11 Pulse encoder type*), this setting acts like setting *A all*.	0
	A all	Channel A: Rising and falling edges are used for speed calculation. *Channel B: Defines the direction of rotation.	1
	A rising	Channel A: Rising edges are used for speed calculation. *Channel B: Defines the direction of rotation.	2
	A falling	Channel A: Falling edges are used for speed calculation. *Channel B: Defines the direction of rotation.	3
	Auto rising	One of the above modes is selected automatically depending on the pulse frequency as follows: **Pulse frequency of the channel(s)** → **Used mode** < 2442 Hz → *A&B all* 2442…4884 Hz → *A all* > 4884 Hz → *A rising*	4

No.	Name/Value	Description	Def/FbEq16
	Auto falling	One of the above modes is selected automatically depending on the pulse frequency as follows: <table><tr><th>Pulse frequency of the channel(s)</th><th>Used mode</th></tr><tr><td>< 2442 Hz</td><td>*A&B all*</td></tr><tr><td>2442…4884 Hz</td><td>*A all*</td></tr><tr><td>> 4884 Hz</td><td>*A falling*</td></tr></table>	5
92.12	*Zero pulse enable*	*(Visible when an absolute encoder is selected)* Enables the encoder zero pulse for the absolute encoder input (X42) of the FEN-11 interface module. **Note:** No zero pulse exists with serial interfaces, ie. when parameter *92.11 Absolute position source* is set to *EnDat*, *Hiperface*, *SSI* or *Tamagawa*.	*Disable*
	Disable	Zero pulse disabled.	0
	Enable	Zero pulse enabled.	1
92.12	*Resolver polepairs*	*(Visible when a resolver is selected)* Defines the number of pole pairs of the resolver.	1
	1…32	Number of resolver pole pairs.	1 = 1
92.13	*Position estimation enable*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* Selects whether position estimation is used with encoder 1 to increase position data resolution or not.	*Enable*
	Disable	Measured position used. (The resolution is 4 × pulses per revolution for quadrature encoders, 2 × pulses per revolution for single-track encoders.)	0
	Enable	Estimated position used. (Uses position interpolation; extrapolated at the time of data request.)	1
92.13	*Position data width*	*(Visible when an absolute encoder is selected)* Defines the number of bits used to indicate position within one revolution. For example, a setting of 15 bits corresponds to 32768 positions per revolution. The value is used when parameter *92.11 Absolute position source* is set to *EnDat*, *Hiperface* or *SSI*. When parameter *92.11 Absolute position source* is set to *Tamagawa*, this parameter is internally set to 17.	0
	0…32	Number of bits used in position indication within one revolution.	1 = 1
92.14	*Speed estimation enable*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* Selects whether calculated or estimated speed is used. Estimation increases the speed ripple in steady state operation, but improves the dynamics. **Note:** This parameter is not effective with FEN-xx modules with FPGA version VIEx 2000 or later.	*Disable*
	Disable	Last calculated speed used. (The calculation interval is 62.5 microseconds to 4 milliseconds.)	0
	Enable	Estimated speed (estimated at the time of data request) is used.	1

No.	Name/Value	Description	Def/FbEq16
92.14	*Revolution data width*	*(Visible when an absolute encoder is selected)* Defines the number of bits used in revolution counting with a multiturn encoder. For example, a setting of 12 bits would support counting up to 4096 revolutions. The value is used when parameter *92.11 Absolute position source* is set to *EnDat*, *Hiperface* or *SSI*. When parameter *92.11 Absolute position source* is set to *Tamagawa*, setting this parameter to a non-zero value activates multiturn data requesting.	0
	0…32	Number of bits used in revolution count.	1 = 1
92.15	*Transient filter*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* Activates transient filtering for the encoder (changes in direction of rotation are ignored above the selected pulse frequency).	*4880 Hz*
	4880 Hz	Change in direction of rotation allowed below 4880 Hz.	0
	2440 Hz	Change in direction of rotation allowed below 2440 Hz.	1
	1220 Hz	Change in direction of rotation allowed below 1220 Hz.	2
	Disabled	Change in direction of rotation allowed at any pulse frequency.	3
92.16	*Encoder 1 supply voltage*	*(Visible when parameter 92.01 Encoder 1 type = HTL 1 or HTL 2)* Selects the power supply voltage for encoder 1.	*0V*
	0V	Disabled.	0
	5V	5 V.	1
	24V	24 V.	2
92.17	*Accepted pulse freq of encoder 1*	*(Visible when parameter 92.01 Encoder 1 type = HTL 1 or HTL 2)* Defines the maximum pulse frequency of encoder 1.	0 kHz
	0…300 kHz	Pulse frequency.	1 = 1 kHz
92.21	*Encoder cable fault mode*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* Selects which encoder cable channels and wires are monitored for wiring faults.	*A, B*
	A, B	A and B.	0
	A, B, Z	A, B and Z.	1
	A+, A-, B+, B-	A+, A-, B+ and B-.	2
	A+, A-, B+, B-, Z+, Z-	A+, A-, B+, B-, Z+ and Z-.	3

No.	Name/Value	Description	Def/FbEq16
92.23	*Maximum pulse waiting time*	*(Visible when parameter 92.01 Encoder 1 type = TTL or HTL)* Determines a pulse waiting time used in speed calculation for the encoder interface. If no pulse edges are detected within this time, the measured speed is zeroed by the interface. Increasing the setting can improve measuring performance especially at low, near zero speeds. **Notes:** • The parameter is only supported by FEN-xx modules with FPGA version VIEx 2000 or later. On older modules, the pulse waiting time is fixed to 4 ms. • The parameter only affects speed measurement. Position is updated whenever a new pulse edge is detected. When the measured speed from the interface is zero, the drive updates its speed data based on position changes.	4 ms
	1…200 ms	Maximum pulse waiting time.	1 = 1 ms
92.24	*Pulse edge filtering*	*(Visible when parameter 92.01 Encoder 1 type = HTL)* Enables pulse edge filtering. Pulse edge filtering can improve the reliability of measurements especially from encoders with a single-ended connection. **Notes:** • Pulse edge filtering is only supported by FEN-31 modules with FPGA version VIE3 2200 or later. • Pulse edge filtering decreases the maximum pulse frequency. With 2 µs filtering time, the maximum pulse frequency is 200 kHz.	*No filtering*
	No filtering	Filtering disabled.	0
	1 µs	Filtering time: 1 microsecond.	1
	2 µs	Filtering time: 2 microseconds.	2
92.25	*Pulse overfrequency function*	*(Visible when parameter 92.01 Encoder 1 type = HTL)* Selects how the drive reacts when the encoder interface detects a pulse overfrequency condition. **Note:** This parameter is effective only with FEN-xx module FPGA version VIEx 2200 or later.	*Fault*
	Warning	The drive generates a warning, *7381 Encoder*. The FEN-xx module will continue to update speed and position data.	0
	Fault	The drive trips on fault *A7E1 Encoder*.	1
92.30	*Serial link mode*	*(Visible when an absolute encoder is selected)* Selects the serial link mode with an EnDat or SSI encoder.	*Initial position*
	Initial position	Single position transfer mode (initial position).	0
	Continuous	Continuous position data transfer mode.	1
	Continuous speed and position	Continuous speed and position data transfer mode. This setting is intended for EnDat 2.2 encoders without sin/cos signals. **Note:** This setting requires an FEN-11 interface revision H or later.	2

No.	Name/Value	Description	***DefIFbEq16***
92.31	*EnDat max calculation time*	*(Visible when an absolute encoder is selected)* Selects the maximum encoder calculation time for an EnDat encoder. **Note:** This parameter needs to be set only when an EnDat encoder is used in continuous mode, ie. without incremental sin/cos signals (supported only as encoder 1). See also parameter *92.30 Serial link mode*.	*50 ms*
	10 us	10 microseconds.	0
	100 us	100 microseconds.	1
	1 ms	1 millisecond.	2
	50 ms	50 milliseconds.	3
92.32	*SSI cycle time*	*(Visible when an absolute encoder is selected)* Selects the transmission cycle for an SSI encoder. **Note:** This parameter needs to be set only when an SSI encoder is used in continuous mode, ie. without incremental sin/cos signals (supported only as encoder 1). See also parameter *92.30 Serial link mode*.	*100 us*
	50 us	50 microseconds.	0
	100 us	100 microseconds.	1
	200 us	200 microseconds.	2
	500 us	500 microseconds.	3
	1 ms	1 millisecond.	4
	2 ms	2 milliseconds.	5
92.33	*SSI clock cycles*	*(Visible when an absolute encoder is selected)* Defines the length of an SSI message. The length is defined as the number of clock cycles. The number of cycles can be calculated by adding 1 to the number of bits in an SSI message frame.	2
	2…127	SSI message length.	-
92.34	*SSI position msb*	*(Visible when an absolute encoder is selected)* With an SSI encoder, defines the location of the MSB (most significant bit) of the position data within an SSI message.	1
	1…126	Position data MSB location (bit number).	-
92.35	*SSI revolution msb*	*(Visible when an absolute encoder is selected)* With an SSI encoder, defines the location of the MSB (most significant bit) of the revolution count within an SSI message.	1
	1…126	Revolution count MSB location (bit number).	-
92.36	*SSI data format*	*(Visible when an absolute encoder is selected)* Selects the data format for an SSI encoder.	*Binary*
	Binary	Binary code.	0
	Gray	Gray code.	1
92.37	*SSI baud rate*	*(Visible when an absolute encoder is selected)* Selects the baud rate for an SSI encoder.	*100 kBit/s*
	10 kBit/s	10 kbit/s.	0
	50 kBit/s	50 kbit/s.	1
	100 kBit/s	100 kbit/s.	2
	200 kBit/s	200 kbit/s.	3

No.	Name/Value	Description	Def/FbEq16
	500 kBit/s	500 kbit/s.	4
	1000 kBit/s	1000 kbit/s.	5
92.40	*SSI zero phase*	*(Visible when an absolute encoder is selected)* Defines the phase angle within one sine/cosine signal period that corresponds to the value of zero on the SSI serial link data. The parameter is used to adjust the synchronization of the SSI position data and the position based on sine/cosine incremental signals. Incorrect synchronization may cause an error of ±1 incremental period. **Note:** This parameter needs to be set only when an SSI encoder is used in initial position mode (see parameter *92.30 Serial link mode*).	*315-45 deg*
	315-45 deg	315-45 degrees.	0
	45-135 deg	45-135 degrees.	1
	135-225 deg	135-225 degrees.	2
	225-315 deg	225-315 degrees.	3
92.45	*Hiperface parity*	*(Visible when an absolute encoder is selected)* Defines the use of parity and stop bits with a HIPERFACE encoder. Typically this parameter need not be set.	*Odd*
	Odd	Odd parity indication bit, one stop bit.	0
	Even	Even parity indication bit, one stop bit.	1
92.46	*Hiperface baud rate*	*(Visible when an absolute encoder is selected)* Defines the transfer rate of the link with a HIPERFACE encoder. Typically this parameter need not be set.	*4800 bits/s*
	4800 bits/s	4800 bit/s.	0
	9600 bits/s	9600 bit/s.	1
	19200 bits/s	19200 bit/s.	2
	38400 bits/s	38400 bit/s.	3
92.47	*Hiperface node address*	*(Visible when an absolute encoder is selected)* Defines the node address for a HIPERFACE encoder. Typically this parameter need not be set.	64
	0…255	HIPERFACE encoder node address.	-

93 Encoder 2 configuration		Settings for encoder 2. **Notes:** • The contents of the parameter group vary according to the selected encoder type. • It is recommended that encoder connection 1 (group *92 Encoder 1 configuration*) is used whenever possible since the data received through that interface is fresher than the data received through connection 2 (this group).	
93.01	*Encoder 2 type*	Selects the type of encoder/resolver 2.	*None configured*
	None configured	None.	0
	TTL	TTL. Module type (input): FEN-01 (X31), FEN-11 (X41) or FEN-21 (X51).	1
	TTL+	TTL+. Module type (input): FEN-01 (X32).	2

No.	Name/Value	Description	Def/FbEq16
	Absolute encoder	Absolute encoder. Module type (input): FEN-11 (X42).	3
	Resolver	Resolver. Module type (input): FEN-21 (X52).	4
	HTL	HTL. Module type (input): FEN-31 (X82).	5
	HTL 1	HTL. Module type (input): FSE-31 (X31).	6
	HTL 2	HTL. Module type (input): FSE-31 (X32). Not supported at the time of publication.	7
93.02	*Encoder 2 source*	Selects the interface module that the encoder is connected to. (The physical locations and types of encoder interface modules are defined in parameter group *91 Encoder module settings*.)	*Module 1*
	Module 1	Interface module 1.	1
	Module 2	Interface module 2.	2
93.10	*Pulses/rev*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* See parameter *92.10 Pulses/revolution*.	2048
93.10	*Sine/cosine number*	*(Visible when an absolute encoder is selected)* See parameter *92.10 Sine/cosine number*.	0
93.10	*Excitation signal frequency*	*(Visible when a resolver is selected)* See parameter *92.10 Excitation signal frequency*.	1 kHz
93.11	*Pulse encoder type*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* See parameter *92.11 Pulse encoder type*.	*Quadrature*
93.11	*Absolute position source*	*(Visible when an absolute encoder is selected)* See parameter *92.11 Absolute position source*.	*None*
93.11	*Excitation signal amplitude*	*(Visible when a resolver is selected)* See parameter *92.11 Excitation signal amplitude*.	4.0 V
93.12	*Speed calculation mode*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* See parameter *92.12 Speed calculation mode*.	*Auto rising*
93.12	*Zero pulse enable*	*(Visible when an absolute encoder is selected)* See parameter *92.12 Zero pulse enable*.	*Disable*
93.12	*Resolver polepairs*	*(Visible when a resolver is selected)* See parameter *92.12 Resolver polepairs*.	1
93.13	*Position estimation enable*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* See parameter *92.13 Position estimation enable*.	*Enable*
93.13	*Position data width*	*(Visible when an absolute encoder is selected)* See parameter *92.13 Position data width*.	0
93.14	*Speed estimation enable*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* See parameter *92.14 Speed estimation enable*.	*Disable*
93.14	*Revolution data width*	*(Visible when an absolute encoder is selected)* See parameter *92.14 Revolution data width*.	0
93.15	*Transient filter*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* See parameter *92.15 Transient filter*.	*4880 Hz*
93.16	*Encoder 2 supply voltage*	*(Visible when parameter 93.01 Encoder 2 type = HTL 1* or *HTL 2)* See parameter *92.16 Encoder 1 supply voltage*.	*0V*
93.17	*Accepted pulse freq of encoder 2*	*(Visible when parameter 93.01 Encoder 2 type = HTL 1* or *HTL 2)* See parameter *92.17 Accepted pulse freq of encoder 1*.	0 kHz

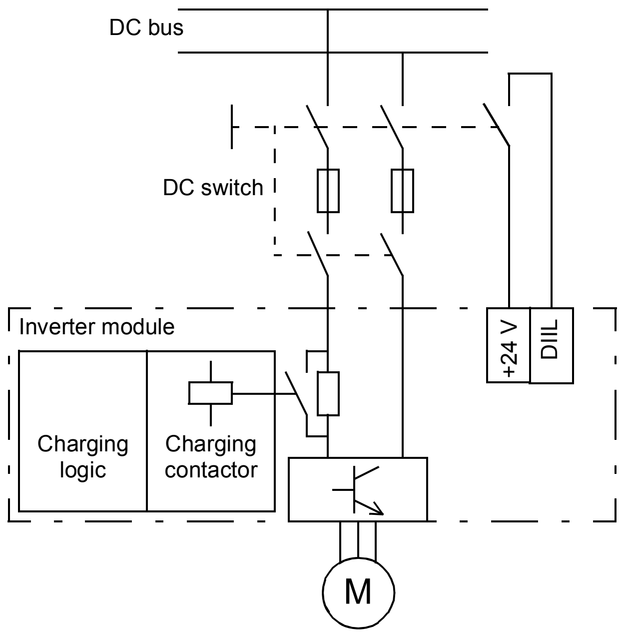
No.	Name/Value	Description	Def/FbEq16
93.21	*Encoder cable fault mode*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* See parameter *92.21 Encoder cable fault mode*.	*A, B*
93.23	*Maximum pulse waiting time*	*(Visible when parameter 93.01 Encoder 2 type = TTL or HTL)* See parameter *92.23 Maximum pulse waiting time*.	4 ms
93.24	*Pulse edge filtering*	*(Visible when parameter 93.01 Encoder 2 type = HTL)* See parameter *92.24 Pulse edge filtering*.	*No filtering*
93.25	*Pulse overfrequency function*	*(Visible when parameter 93.01 Encoder 2 type = HTL)* See parameter *92.25 Pulse overfrequency function*.	*Fault*
93.30	*Serial link mode*	*(Visible when an absolute encoder is selected)* See parameter *92.30 Serial link mode*.	*Initial position*
93.31	*EnDat calc time*	*(Visible when an absolute encoder is selected)* See parameter *92.31 EnDat max calculation time*.	*50 ms*
93.32	*SSI cycle time*	*(Visible when an absolute encoder is selected)* See parameter *92.32 SSI cycle time*.	*100 us*
93.33	*SSI clock cycles*	*(Visible when an absolute encoder is selected)* See parameter *92.33 SSI clock cycles*.	2
93.34	*SSI position msb*	*(Visible when an absolute encoder is selected)* See parameter *92.34 SSI position msb*.	1
93.35	*SSI revolution msb*	*(Visible when an absolute encoder is selected)* See parameter *92.35 SSI revolution msb*.	1
93.36	*SSI data format*	*(Visible when an absolute encoder is selected)* See parameter *92.36 SSI data format*.	*Binary*
93.37	*SSI baud rate*	*(Visible when an absolute encoder is selected)* See parameter *92.37 SSI baud rate*.	*100 kBit/s*
93.40	*SSI zero phase*	*(Visible when an absolute encoder is selected)* See parameter *92.40 SSI zero phase*.	*315-45 deg*
93.45	*Hiperface parity*	*(Visible when an absolute encoder is selected)* See parameter *92.45 Hiperface parity*.	*Odd*
93.46	*Hiperface baud rate*	*(Visible when an absolute encoder is selected)* See parameter *92.46 Hiperface baud rate*.	*4800 bits/s*
93.47	*Hiperface node address*	*(Visible when an absolute encoder is selected)* See parameter *92.47 Hiperface node address*.	64

94 LSU control		Control of the supply unit of the drive, such as DC voltage and reactive power reference. Note that the references defined here must also be selected as the reference source in the supply control program to be effective. This group is only visible with a BCU control unit.	
94.01	*LSU control*	Enables/disables the internal INU-LSU state machine. When the state machine is enabled, the inverter unit (INU) controls the supply unit (LSU) and prevents the inverter unit from starting until the supply unit is ready. When the state machine is disabled, the status of the supply unit (LSU) is ignored by the inverter unit.	*Off*; *On* (*95.20* b11, *95.20* b15)
	Off	INU-LSU state machine disabled.	0
	On	INU-LSU state machine enabled.	1

No.	Name/Value	Description	*Def/FbEq16*
94.10	*LSU max charging time*	Defines the maximum time the supply unit (LSU) is allowed for charging before a fault (*7584 LSU charge failed*) is generated.	15 s
	0…65535 s	Maximum charging time.	1 = 1 s
94.11	*LSU stop delay*	Defines a stop delay for the supply unit. This parameter can be used to delay the opening of the main breaker/contactor when a restart is expected.	600.0 s
	0.0 … 3600.0 s	Supply unit stop delay.	10 = 1 s
94.20	*DC voltage reference*	Displays the DC voltage reference sent to the supply unit. This parameter is read-only.	-
	0.0 … 2000.0 V	DC voltage reference sent to supply unit.	10 = 1 V
94.21	*DC voltage ref source*	Selects the source of the DC voltage reference to be sent to the supply unit.	*User ref*
	Zero	None.	0
	User ref	*94.22 User DC voltage reference*.	1
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
94.22	*User DC voltage reference*	Defines the DC voltage reference for the supply unit when *94.21 DC voltage ref source* is set to *User ref*.	0.0 V
	0.0 … 2000.0 V	User DC reference.	10 = 1 V
94.30	*Reactive power reference*	Displays the reactive power reference sent to the supply unit. This parameter is read-only.	-
	-3276.8 … 3276.7 kvar	Reactive power reference sent to the supply unit.	10 = 1 kvar
94.31	*Reactive power ref source*	Selects the source of the reactive power reference to be sent to the supply unit.	*User ref*
	Zero	None.	0
	User ref	*94.32 User reactive power reference*.	1
	Other	Source selection (see *Terms and abbreviations* on page *110*).	-
94.32	*User reactive power reference*	Defines the reactive power reference for the supply unit when *94.31 Reactive power ref source* is set to *User ref*.	0.0 kvar
	-3276.8 … 3276.7 kvar	User reactive power reference.	10 = 1 kvar

95 HW configuration		Various hardware-related settings.	
95.01	*Supply voltage*	Selects the supply voltage range. This parameter is used by the drive to determine the nominal voltage of the supply network. The parameter also affects the current ratings and the DC voltage control functions (trip and brake chopper activation limits) of the drive. ⚠ **WARNING!** An incorrect setting may cause the motor to rush uncontrollably, or the brake chopper or resistor to overload. **Note:** The selections shown depend on the hardware of the drive. If only one voltage range is valid for the drive in question, it is selected by default.	-
	Not given	No voltage range selected. The drive will not start modulating before a range is selected.	0
	208…240 V	208…240 V	1
	380…415 V	380…415 V	2

No.	Name/Value	Description	*Def*/*FbEq16*
	440…480 V	440…480 V	3
	500 V	500 V	4
	525…600 V	525…600 V	5
	660…690 V	660…690 V	6
95.02	*Adaptive voltage limits*	Enables adaptive voltage limits. Adaptive voltage limits can be used if, for example, an IGBT supply unit is used to raise the DC voltage level. The limits are calculated based on the measured DC voltage at the end of the pre-charging sequence. This function is also useful if the AC supply voltage to the drive is high, as the warning levels are raised accordingly.	*Disable*
	Disable	Adaptive voltage limits disabled.	0
	Enable	Adaptive voltage limits enabled.	1
95.04	*Control board supply*	Specifies how the control unit of the drive is powered. The default value depends on the type of the control unit and the setting of parameter *95.20*.	*Internal 24V* (ZCU); *External 24V* (BCU; *95.20* b4)
	Internal 24V	The drive control unit is powered from the drive power unit it is connected to. **Note:** If reduced run (see page *90*) is required, select *External 24V* or *Redundant external 24V* instead.	0
	External 24V	The drive control unit is powered from an external power supply. The drive power unit and power unit link faults are masked when the drive is in stopped state, so the main circuit can be powered down without faults while the control unit is powered.	1
	Redundant external 24V	(Type BCU control units only) The drive control unit is powered from two redundant external power supplies. The loss of one of the supplies generates a warning (*AFEC External power signal missing*). The drive power unit and power unit link faults are masked when the drive is in stopped state, so the main circuit can be powered down without faults while the control unit is powered.	2

No.	Name/Value	Description	Def/FbEq16
95.08	*DC switch monitoring*	*(Only visible with a ZCU control unit)* Enables/disables DC switch monitoring via the DIIL input. This setting is intended for use with inverter modules with an internal charging circuit that are connected to the DC bus through a DC switch. An auxiliary contact of the DC switch must be wired to the DIIL input so that the input switches off when the DC switch is opened.  If the DC switch is opened with the inverter running, the inverter is given a coast-to-stop command, and its charging circuit activated. Starting the inverter is prevented until the DC switch is closed and the DC circuit in the inverter unit recharged. **Notes:** • By default, DIIL is the input for the Run enable signal. Adjust *20.12 Run enable 1 source* if necessary. • An internal charging circuit is standard on some inverter module types but optional on others; check with your local ABB representative.	*Disable*; *Enable* (*95.20* b5)
	Disable	DC switch monitoring through the DIIL input disabled.	0
	Enable	DC switch monitoring through the DIIL input enabled.	1
95.09	*Fuse switch control*	*(Only visible with a BCU control unit)* Activates communication to a xSFC charging controller. This setting is intended for use with inverter modules that are connected to a DC bus through a DC switch/charging circuit controlled by a charging controller. On units without a DC switch, this parameter should be set to *Disable*. The charging controller monitors the charging of the inverter unit, and sends an enable command when the charging has finished (ie. DC switch is closed after the ‘charging OK’ lamp lights, and charging switch opened). For more information, see xSFC documentation.	*Enable*
	Disable	Communication with xSFC disabled.	0
	Enable	Communication with xSFC enabled.	1

No.	Name/Value	Description	Def/FbEq16
95.13	Reduced run mode	*(Only visible with a BCU control unit)* Specifies the number of inverter modules available. This parameter must be set if reduced run is required. A value other than 0 activates the reduced run function. If the control program cannot detect the number of modules specified by this parameter, a fault (*5695 Reduced run*) is generated. See section *Reduced run function* (page *90*). 0 = Reduced run disabled 1…12 = Number of modules available	0
	0…65535	Number of inverter modules available	-
95.14	Connected modules	*(Only visible with a BCU control unit)* Shows which of the parallel-connected inverter modules have been detected by the control program.	-

Bit	Name	Description
0	Module 1	1 = Module 1 has been detected.
1	Module 2	1 = Module 2 has been detected.
…	…	…
11	Module 12	1 = Module 12 has been detected.
12…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Inverter modules connected.	1 = 1
95.15	Special HW settings	Contains hardware-related settings that can be enabled and disabled by toggling the specific bits. **Note:** The installation of the hardware specified by this parameter may require derating of drive output, or impose other limitations. Refer to the hardware manual of the drive.	-

Bit	Name	Information
0	EX motor	1 = The driven motor is an Ex motor provided by ABB for potentially explosive atmospheres. This sets the required minimum switching frequency for ABB Ex motors. **Note:** For non-ABB Ex motors, contact your local ABB representative.
1	ABB Sine filter	1 = An ABB sine filter is connected to the output of the drive/inverter.
2	High speed mode	1 = Minimum switching frequency limit adaptation to output frequency active. This setting improves control performance at high output frequencies (typically above 120 Hz).
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0111b	Hardware options configuration word.	1 = 1

No.	Name/Value	Description	*Def/FbEq16*
95.20	*HW options word 1*	Specifies hardware-related options that require differentiated parameter defaults. Activating a bit in this parameter makes the necessary changes in other parameters – for example, activating an emergency stop option reserves a digital input. In many cases, the differentiated parameters will also be write-protected. This parameter, as well as the changes in other parameters implemented by it, are not affected by a parameter restore. **WARNING!** After switching any bits in this word, recheck the values of the affected parameters.	-

Bit	Name	Information
0	Supply frequency 60 Hz	0 = 50 Hz; 1 = 60 Hz. Affects parameters *11.45*, *11.59*, *12.20*, *13.18*, *30.11*, *30.12*, *30.13*, *30.14*, *31.26*, *31.27*, *40.15*, *40.37*, *41.15*, *41.37*, *46.01*, *46.02*.
1	Emergency stop Cat 0	1 = Emergency stop, Category 0, without FSO module. Affects *21.04*, *21.05*, *23.11*.
2	Emergency stop Cat 1	1 = Emergency stop, Category 1, without FSO module. Affects *10.24*, *21.04*, *21.05*, *23.11*.
3	RO2 for -07 cabinet cooling fan	1 = Control of cabinet cooling fan (used only with specific ACS880-07 hardware). Affects *10.27*, *10.28*, *10.29*.
4	Externally powered control unit	1 = Control unit powered externally. Affects *95.04*.
5	DC supply switch	1 = DC switch monitoring active. Affects *20.12*, *31.03*, *95.08*.
6	DOL motor switch	1 = Motor fan control active. Affects *10.24*, *35.100*, *35.103*, *35.104*.
7	xSFC-01 fuse switch controller	1 = xSFC charging controller used. Affects *95.09*.
8	Service switch	1 = Service switch connected. Affects *31.01*, *31.02*.
9	Output contactor	1 = Output contactor present. Affects *10.24*, *20.12*.
10	Brake resistor, sine filter, IP54 fan	1 = Status (eg. thermal) switches connected to DIIL input. Affects *20.11*, *20.12*.
11	INU-DSU communication	1 = Diode supply unit control by inverter unit active. Affects *60.71*, *61.151*, *62.151*, *94.01*.
12	Reserved	
13	du/dt filter activation	1 = Active: An external du/dt filter is connected to the drive/inverter output. The setting will limit the output switching frequency, and force the fan of the drive/inverter module to full speed. **Note:** This bit is to be left at 0 if the drive/inverter module is equipped with internal du/dt filtering (for example, frame R8i inverter modules with option +E205).
14	DOL fan activation	1 = The inverter unit consists of frame R8i modules with direct-on-line cooling fans (option +C188). Disables fan feedback monitoring and changes fan control to ON/OFF type.
15	INU-ISU communication	1 = IGBT supply unit control by inverter unit active. Affects *60.71*, *61.151*, *61.152*, *61.153*, *62.151*, *94.01*.

	0000h…FFFFh	Hardware options configuration word 1.	1 = 1

No.	Name/Value	Description	Def/FbEq16
95.21	HW options word 2	Specifies more hardware-related options that require differentiated parameter defaults. See parameter 95.20 HW options word 1. **WARNING!** After switching any bits in this word, recheck the values of the affected parameters.	-

Bit	Name	Information
0	Dual use	1 = Dual use active. For drives with option +N8200. (Allows higher output frequencies and frequency reference limits.)
1	SynRM	1 = Synchronous reluctance motor used. Affects parameters 25.02, 25.03, 25.15, 99.03, 99.13.
2	Salient PM	1 = Salient-pole permanent magnet motor used. Affects parameters 25.02, 25.03, 25.15, 99.03, 99.13.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0011b	Hardware options configuration word 2.	1 = 1
95.30	Parallel type filter	*(Only visible with a BCU control unit)* Filters the list of drive/inverter types listed by parameter 95.31 Parallel connection rating id.	All types
	All types	All types listed.	0
	-3 (380-415V)	-3 (380…415 V) types listed.	1
	-5 (380-500V)	-5 (380…500 V) types listed.	2
	-7 (525-690V)	-7 (525…690 V) types listed.	3
95.31	Parallel connection rating id	*(Only visible with a BCU control unit)* Defines the drive/inverter type if it consists of parallel-connected modules. If the drive/inverter consists of a single module, leave the value at Not selected.	Not selected
	Not selected	The drive/inverter does not consist of parallel-connected modules, or type not selected.	0
	[Drive/inverter type]	Drive/inverter type consisting of parallel-connected modules.	-

96 System		Language selection; access levels; macro selection; parameter save and restore; control unit reboot; user parameter sets; unit selection; data logger triggering; parameter checksum calculation; user lock.	
96.01	Language	Selects the language of the parameter interface and other displayed information when viewed on the control panel. **Notes:** • Not all languages listed below are necessarily supported. • This parameter does not affect the languages visible in the Drive composer PC tool. (Those are specified under View – Settings.)	-
	Not selected	None.	0
	English	English.	1033
	Deutsch	German.	1031
	Italiano	Italian.	1040
	Español	Spanish.	3082
	Portugues	Portuguese.	2070

No.	Name/Value	Description	*Def/FbEq16*
	Nederlands	Dutch.	1043
	Français	French.	1036
	Dansk	Danish.	1030
	Suomi	Finnish.	1035
	Svenska	Swedish.	1053
	Russki	Russian.	1049
	Polski	Polish.	1045
	Czech	Czech.	1029
	Chinese (Simplified, PRC)	Simplified Chinese.	2052
	Türkçe	Turkish.	1055
96.02	*Pass code*	Pass codes can be entered into this parameter to activate further access levels (see parameter *96.03 Access levels active*) or to configure the user lock. Entering "358" toggles the parameter lock, which prevents the changing of all other parameters through the control panel or the Drive composer PC tool. Entering the user pass code (by default, "10000000") enables parameters *96.100…96.102*, which can be used to define a new user pass code and to select the actions that are to be prevented. Entering an invalid pass code will close the user lock if open, ie. hide parameters *96.100…96.102*. After entering the code, check that the parameters are in fact hidden. **Note:** You must change the default user pass code to maintain a high level of cybersecurity. Store the code in a safe place – the protection cannot be disabled even by ABB if the code is lost. See also section *User lock* (page *89*).	0
	0…99999999	Pass code.	-
96.03	*Access levels active*	Shows which access levels have been activated by pass codes entered into parameter *96.02 Pass code*. This parameter is read-only.	0001h

Bit	Name
0	End user
1	Service
2	Advanced programmer
3…10	Reserved
11	OEM access level 1
12	OEM access level 2
13	OEM access level 3
14	Parameter lock
15	Reserved

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Active access levels.	-

No.	Name/Value	Description	Def/FbEq16
96.04	Macro select	Selects the application macro. See chapter Application macros (page 93) for more information. After a selection is made, the parameter reverts automatically to Done.	Done
	Done	Macro selection complete; normal operation.	0
	Factory	Factory macro (see page 94).	1
	Hand/Auto	Hand/Auto macro (see page 96).	2
	PID-CTRL	PID control macro (see page 98).	3
	T-CTRL	Torque control macro (see page 102).	4
	Sequence control	Sequential control macro (see page 104).	5
	FIELDBUS	Reserved.	6
96.05	Macro active	Shows which application macro is currently selected. See chapter Application macros (page 93) for more information. To change the macro, use parameter 96.04 Macro select.	Factory
	Factory	Factory macro (see page 94).	1
	Hand/Auto	Hand/Auto macro (see page 96).	2
	PID-CTRL	PID control macro (see page 98).	3
	T-CTRL	Torque control macro (see page 102).	4
	Sequence control	Sequential control macro (see page 104).	5
	FIELDBUS	Fieldbus control macro (see page 107).	6
96.06	Parameter restore	Restores the original settings of the control program, ie. parameter default values. **Note:** This parameter cannot be changed while the drive is running.	Done
	Done	Restoring is completed.	0
	Restore defaults	All editable parameter values are restored to default values, except • motor data and ID run results • parameter 31.42 Overcurrent fault limit • control panel/PC communication settings • I/O extension module settings • fieldbus adapter settings • encoder configuration data • application macro selection and the parameter defaults implemented by it • parameter 95.01 Supply voltage • parameter 95.09 Fuse switch control • differentiated defaults implemented by parameters 95.20 HW options word 1 and 95.21 HW options word 2 • user lock configuration parameters 96.100…96.102.	8
	Clear all	All editable parameter values are restored to default values, except • control panel/PC communication settings • fieldbus adapter settings • application macro selection and the parameter defaults implemented by it • parameter 95.01 Supply voltage • parameter 95.09 Fuse switch control • differentiated defaults implemented by parameters 95.20 HW options word 1 and 95.21 HW options word 2 • user lock configuration parameters 96.100…96.102. PC tool communication is interrupted during the restoring.	62

No.	Name/Value	Description	*Def/FbEq16*
96.07	*Parameter save manually*	Saves the valid parameter values to permanent memory. This parameter should be used to store values sent from a fieldbus, or when using an external power supply to the control board as the supply might have a very short hold-up time when powered off. **Note:** A new parameter value is saved automatically when changed from the PC tool or control panel but not when altered through a fieldbus adapter connection.	*Done*
	Done	Save completed.	0
	Save	Save in progress.	1
96.08	*Control board boot*	Changing the value of this parameter to 1 reboots the control unit (without requiring a power off/on cycle of the complete drive module). The value reverts to 0 automatically.	0
	0…1	1 = Reboot the control unit.	1 = 1
96.09	*FSO reboot*	Changing the value of (or the source selected by) this parameter from 0 to 1 reboots the optional FSO-xx safety functions module. **Note:** The value does not revert to 0 automatically.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
96.10	*User set status*	Shows the status of the user parameter sets. This parameter is read-only. See also section *User parameter sets* (page *88*).	-
	n/a	No user parameter sets have been saved.	0
	Loading	A user set is being loaded.	1
	Saving	A user set is being saved.	2
	Faulted	Invalid or empty parameter set.	3
	User set 1	User set 1 has been loaded.	4
	User set 2	User set 2 has been loaded.	5
	User set 3	User set 3 has been loaded.	6
	User set 4	User set 4 has been loaded.	7
96.11	*User set save/load*	Enables the saving and restoring of up to four custom sets of parameter settings. See section *User parameter sets* (page *88*). The set that was in use before powering down the drive is in use after the next power-up. **Notes:** • Hardware configuration settings such as I/O extension module, fieldbus and encoder configuration parameters (groups 14…16, 51…56, 58 and 92…93), and forced input/output values (such as *10.03 and 10.04*) are not included in user parameter sets. • Parameter changes made after loading a set are not automatically stored – they must be saved using this parameter.	*No action*
	No action	Load or save operation complete; normal operation.	0
	User set I/O mode	Load user parameter set using parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*.	1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Load set 1</td><td>Load user parameter set 1.</td><td>2</td></tr>
<tr><td></td><td>Load set 2</td><td>Load user parameter set 2.</td><td>3</td></tr>
<tr><td></td><td>Load set 3</td><td>Load user parameter set 3.</td><td>4</td></tr>
<tr><td></td><td>Load set 4</td><td>Load user parameter set 4.</td><td>5</td></tr>
<tr><td></td><td>Save to set 1</td><td>Save user parameter set 1.</td><td>18</td></tr>
<tr><td></td><td>Save to set 2</td><td>Save user parameter set 2.</td><td>19</td></tr>
<tr><td></td><td>Save to set 3</td><td>Save user parameter set 3.</td><td>20</td></tr>
<tr><td></td><td>Save to set 4</td><td>Save user parameter set 4.</td><td>21</td></tr>
<tr><td>96.12</td><td>User set I/O mode in1</td><td>When parameter 96.11 User set save/load is set to User set I/O mode, selects the user parameter set together with parameter 96.13 User set I/O mode in2 as follows:
<table>
<tr><th>Status of source defined by par. 96.12</th><th>Status of source defined by par. 96.13</th><th>User parameter set selected</th></tr>
<tr><td>0</td><td>0</td><td>Set 1</td></tr>
<tr><td>1</td><td>0</td><td>Set 2</td></tr>
<tr><td>0</td><td>1</td><td>Set 3</td></tr>
<tr><td>1</td><td>1</td><td>Set 4</td></tr>
</table></td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>0.</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1.</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (10.02 DI delayed status, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (10.02 DI delayed status, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (10.02 DI delayed status, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (10.02 DI delayed status, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (10.02 DI delayed status, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (10.02 DI delayed status, bit 5).</td><td>7</td></tr>
<tr><td></td><td>DIO1</td><td>Digital input/output DIO1 (11.02 DIO delayed status, bit 0).</td><td>10</td></tr>
<tr><td></td><td>DIO2</td><td>Digital input/output DIO2 (11.02 DIO delayed status, bit 1).</td><td>11</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations on page 110).</td><td>-</td></tr>
<tr><td>96.13</td><td>User set I/O mode in2</td><td>See parameter 96.12 User set I/O mode in1.</td><td>Not selected</td></tr>
</table>

No.	Name/Value	Description	*Def/FbEq16*
96.16	*Unit selection*	Selects the unit of parameters indicating power, temperature and torque.	0000 0000b

Bit	Name	Information
0	Power unit	0 = kW
		1 = hp
1	Reserved	
2	Temperature unit	0 = C (°C)
		1 = F (°F)
3	Reserved	
4	Torque unit	0 = Nm (N·m)
		1 = lbft (lb·ft)
5…15	Reserved	

No.	Name/Value	Description	*Def/FbEq16*
	0000 0000b … 0001 0101b	Unit selection word.	1 = 1
96.20	*Time sync primary source*	Defines the 1st priority external source for synchronization of the drive's time and date.	*DDCS Controller*
	Internal	No external source selected.	0
	DDCS Controller	External controller.	1
	Fieldbus A or B	Fieldbus interface A or B.	2
	Fieldbus A	Fieldbus interface A.	3
	Fieldbus B	Fieldbus interface B.	4
	D2D or M/F	The master station on a master/follower or drive-to-drive link.	5
	Embedded FB	Embedded fieldbus interface.	6
	Embedded Ethernet	Ethernet port on type BCU control unit.	7
	Panel link	Control panel, or Drive composer PC tool connected to the control panel.	8
	Ethernet tool link	Drive composer PC tool through an FENA module.	9
96.23	*M/F and D2D clock synchronization*	In the master drive, activates clock synchronization for master/follower and drive-to-drive communication.	*Inactive*
	Inactive	Clock synchronization not active.	0
	Active	Clock synchronization active.	1
96.24	*Full days since 1st Jan 1980*	Number of full days passed since beginning of the year 1980. This parameter, together with *96.25 Time in minutes within 24 h* and *96.26 Time in ms within one minute* makes it possible to set the date and time in the drive via the parameter interface from a fieldbus or application program. This may be necessary if the fieldbus protocol does not support time synchronization.	-
	1…59999	Days since beginning of 1980.	1 = 1
96.25	*Time in minutes within 24 h*	Number of full minutes passed since midnight. For example, the value 860 corresponds to 2:20 pm. See parameter *96.24 Full days since 1st Jan 1980*.	0 min
	1…1439	Minutes since midnight.	1 = 1
96.26	*Time in ms within one minute*	Number of milliseconds passed since last minute. See parameter *96.24 Full days since 1st Jan 1980*.	0 ms
	0…59999	Number of milliseconds since last minute.	1 = 1

No.	Name/Value	Description	Def/FbEq16
96.29	Time sync source status	Time source status word. This parameter is read-only.	-

Bit	Name	Description
0	Time tick received	1 = 1st priority tick received: Tick has been received from 1st priority source.
1	Aux Time tick received	1 = 2nd priority tick received: Tick has been received from 2nd priority source.
2	Tick interval is too long	1 = Yes: Tick interval too long (accuracy compromised).
3	DDCS controller	1 = Tick received: Tick has been received from an external controller.
4	Master/ Follower	1 = Tick received: Tick has been received through the master/follower link.
5	Reserved	
6	D2D	1 = Tick received: Tick has been received through the drive-to-drive link.
7	FbusA	1 = Tick received: Tick has been received through fieldbus interface A.
8	FbusB	1 = Tick received: Tick has been received through fieldbus interface B.
9	EFB	1 = Tick received: Tick has been received through the embedded fieldbus interface.
10	Ethernet	1 = Tick received: Tick has been received through the Ethernet port on type BCU control unit.
11	Panel link	1 = Tick received: Tick has been received from the control panel, or Drive composer PC tool connected to the control panel.
12	Ethernet tool link	1 = Tick received: Tick has been received from Drive composer PC tool through an FENA module.
13	Parameter setting	1 = Tick received: Tick has been set by parameters 96.24…96.26.
14	RTC	1 = RTC time in use: Time and date have been read from the real-time clock.
15	Drive On-Time	1 = Drive on-time in use: Time and date are displaying drive on-time.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Time source status word 1.	1 = 1
96.31	Drive ID number	Specifies an ID number for the drive. The ID can be read by an external controller through DDCS, for example, for comparison with an ID contained by the controller's application.	0
	0…32767	ID number.	1 = 1
96.53	Actual checksum	Displays the actual parameter configuration checksum. The checksum is generated and updated whenever an action is selected in 96.54 Checksum action. The parameters included in the calculation have been pre-selected, but the selection can be edited using the Drive customizer PC tool. See also section Parameter checksum calculation (page 88).	0h
	00000000h… FFFFFFFFh	Actual checksum.	-

No.	Name/Value	Description	Def/FbEq16
96.54	*Checksum action*	Selects how the drive reacts if the parameter checksum (*96.53 Actual checksum*) does not match any of the active approved checksums (*96.56*…*96.59*). The active checksums are selected by *96.55 Checksum control word*.	*No action*
	No action	No action taken. (The checksum feature is not in use.)	0
	Pure event	The drive generates an event log entry (*B686 Checksum mismatch*).	1
	Warning	The drive generates a warning (*A686 Checksum mismatch*).	2
	Warning and prevent start	The drive generates a warning (*A686 Checksum mismatch*). Starting the drive is prevented.	3
	Fault	The drive trips on *6200 Checksum mismatch*.	4
96.55	*Checksum control word*	Bits 0…3 select to which approved checksums (out of *96.56*…*96.59*) the actual checksum (*96.53*) is compared. Bits 4…7 select an approved (reference) checksum parameter (*96.56*…*96.59*) into which the actual checksum from parameter *96.53* is copied.	00000000b

Bit	Name	Description
0	Approved checksum 1	1 = Enabled: Checksum 1 (*96.56*) is observed.
1	Approved checksum 1	1 = Enabled: Checksum 2 (*96.57*) is observed.
2	Approved checksum 1	1 = Enabled: Checksum 3 (*96.58*) is observed.
3	Approved checksum 1	1 = Enabled: Checksum 4 (*96.59*) is observed.
4	Set approved checksum 1	1 = Set: Copy value of *96.53* into *96.56*.
5	Set approved checksum 1	1 = Set: Copy value of *96.53* into *96.57*.
6	Set approved checksum 1	1 = Set: Copy value of *96.53* into *96.58*.
7	Set approved checksum 1	1 = Set: Copy value of *96.53* into *96.59*.
8…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	00000000b… 11111111b	Checksum control word.	1 = 1
96.56	*Approved checksum 1*	Approved (reference) checksum 1.	0h
	00000000h… FFFFFFFFh	Approved checksum 1.	-
96.57	*Approved checksum 2*	Approved (reference) checksum 2.	0h
	00000000h… FFFFFFFFh	Approved checksum 2.	-
96.58	*Approved checksum 3*	Approved (reference) checksum 3.	0h
	00000000h… FFFFFFFFh	Approved checksum 3.	-
96.59	*Approved checksum 4*	Approved (reference) checksum 4.	0h
	00000000h… FFFFFFFFh	Approved checksum 4.	-

No.	Name/Value	Description	Def/FbEq16
96.61	*User data logger status word*	Provides status information on the user data logger (see page *475*).	0000b

Bit	Name	Description
0	Running	1 = The user data logger is running. The bit is cleared after the post-trigger time has passed.
1	Triggered	1 = The user data logger has been triggered. The bit is cleared when the logger is restarted.
2	Data available	1 = The user data logger contains data that can be read. Note that the bit is not cleared because the data is saved to the memory unit.
3	Configured	1 = The user data logger has been configured. Note that the bit is not cleared because the configuration data is saved to the memory unit.
4…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…1111b	User data logger status word.	1 = 1
96.63	*User data logger trigger*	Triggers, or selects a source that triggers, the user data logger.	*Off*
	Off	0.	0
	On	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
96.64	*User data logger start*	Starts, or selects a source that starts, the user data logger.	*Off*
	Off	0.	0
	On	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *110*).	-
96.65	*Factory data logger time level*	Selects the sampling interval for the factory data logger (see page *474*).	*500us*
	500us	500 microseconds.	500
	2ms	2 milliseconds.	2000
	10ms	10 milliseconds.	10000
96.70	*Disable adaptive program*	Enables/disables the adaptive program (if present). See also section *Adaptive programming* (page *27*).	*No*
	No	Adaptive program enabled.	0
	Yes	Adaptive program disabled.	1

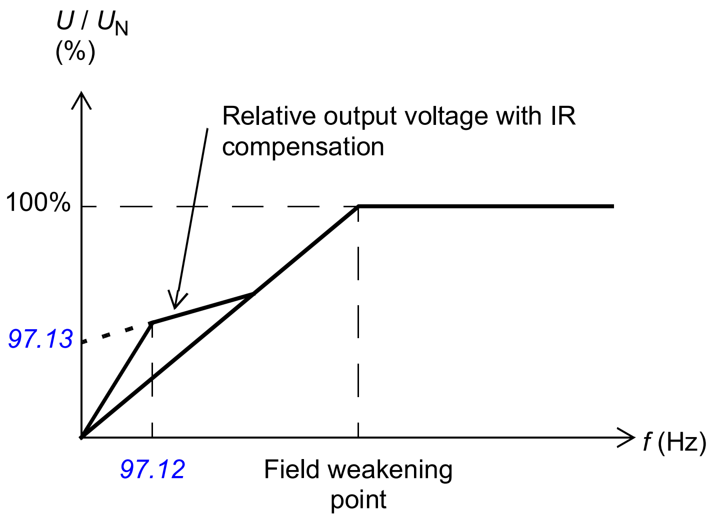
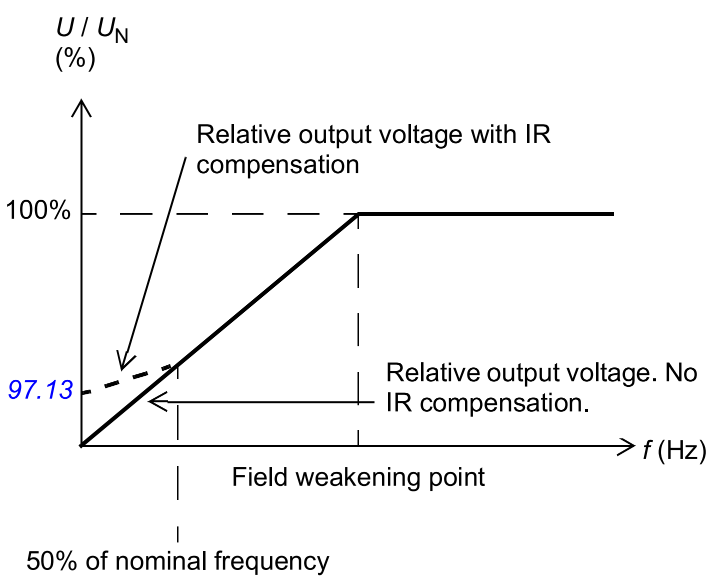
No.	Name/Value	Description	*Def/FbEq16*
96.100	*Change user pass code*	*(Visible when user lock is open)* To change the current user pass code, enter a new code into this parameter as well as *96.101 Confirm user pass code*. A warning will be active until the new pass code is confirmed. To cancel changing the pass code, close the user lock without confirming. To close the lock, enter an invalid pass code in parameter *96.02 Pass code*, activate parameter *96.08 Control board boot*, or cycle the power. See also section *User lock* (page *89*).	10000000
	10000000… 99999999	New user pass code.	-
96.101	*Confirm user pass code*	*(Visible when user lock is open)* Confirms the new user pass code entered in *96.100 Change user pass code*.	
	10000000… 99999999	Confirmation of new user pass code.	-
96.102	*User lock functionality*	*(Visible when user lock is open)* Selects the actions or functionalities to be prevented by the user lock. Note that the changes made take effect only when the user lock is closed. See parameter *96.02 Pass code*. **Note:** We recommend you select all the actions and functionalities unless otherwise required by the application.	0000h

Bit	Name	Information
0	Disable ABB access levels	1 = ABB access levels (service, advanced programmer, etc.; see *96.03*) disabled
1	Freeze parameter lock state	1 = Changing the parameter lock state prevented, ie. pass code 358 has no effect
2	Disable file download	1 = Loading of files to drive prevented. This applies to • firmware upgrades • safety functions module (*FSO-xx*) configuration • parameter restore • loading an adaptive program • loading and debugging an application program • changing home view of control panel • editing drive texts • editing the favorite parameters list on control panel • configuration settings made through control panel such as time/date formats and enabling/disabling clock display.
3…10	Reserved	
11	Disable OEM access level 1	1 = OEM access level 1 disabled
12	Disable OEM access level 2	1 = OEM access level 2 disabled
13	Disable OEM access level 3	1 = OEM access level 3 disabled
14…15	Reserved	

No.	Name/Value	Description	*Def/FbEq16*
	0000h…FFFFh	Selection of actions to be prevented by user lock.	-

No.	Name/Value	Description	Def/FbEq16
97 Motor control		Motor model settings.	
97.03	Slip gain	Defines the slip gain which is used to improve the estimated motor slip. 100% means full slip gain; 0% means no slip gain. The default value is 100%. Other values can be used if a static speed error is detected despite having the setting at full slip gain. **Example** (with nominal load and nominal slip of 40 rpm): A 1000 rpm constant speed reference is given to the drive. Despite having full slip gain (= 100%), a manual tachometer measurement from the motor axis gives a speed value of 998 rpm. The static speed error is 1000 rpm - 998 rpm = 2 rpm. To compensate the error, the slip gain should be increased to 105% (2 rpm / 40 rpm = 5%).	100%
	0 … 200%	Slip gain.	1 = 1%
97.04	Voltage reserve	Defines the minimum allowed voltage reserve. When the voltage reserve has decreased to the set value, the drive enters the field weakening area. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill. If the intermediate circuit DC voltage U_{dc} = 550 V and the voltage reserve is 5%, the RMS value of the maximum output voltage in steady-state operation is 0.95 × 550 V / sqrt(2) = 369 V The dynamic performance of the motor control in the field weakening area can be improved by increasing the voltage reserve value, but the drive enters the field weakening area earlier.	-2%
	-4 … 50%	Voltage reserve.	1 = 1%
97.05	Flux braking	Defines the level of flux braking power. (Other stopping and braking modes can be configured in parameter group 21 Start/stop mode). See section Flux braking (page 61). **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	Disabled
	Disabled	Flux braking is disabled.	0
	Moderate	Flux level is limited during the braking. Deceleration time is longer compared to full braking.	1
	Full	Maximum braking power. Almost all available current is used to convert the mechanical braking energy to thermal energy in the motor.	2
97.06	Flux reference select	Defines the source of flux reference. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	User flux reference
	Zero	None.	0
	User flux reference	Parameter 97.07 User flux reference.	1
	Other	Source selection (see Terms and abbreviations on page 110).	-
97.07	User flux reference	Defines the flux reference when parameter 97.06 Flux reference select is set to User flux reference.	100.00%
	0.00 … 200.00%	User-defined flux reference.	100 = 1%

No.	Name/Value	Description	*DefFbEq16*
97.09	*Switching freq mode*	An optimization setting for balancing between control performance and motor noise level. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	*Normal*
	Normal	Control performance optimized for long motor cables.	0
	Low noise	Minimizes motor noise. **Note:** This setting requires derating. Refer to the rating data in the *Hardware manual*.	1
	Cyclic	Control performance optimized for cyclic load applications. **Note:** This setting is not suitable for long motor cables.	2
	Custom	This setting is to be used by ABB-authorized service personnel only. **Note:** This setting may require derating. Refer to the rating data in the *Hardware manual*.	3
97.10	*Signal injection*	Enables the anti-cogging function: a high-frequency alternating signal is injected to the motor in the low speed region to improve the stability of torque control. This removes the “cogging” that can sometimes be seen as the rotor passes the motor magnetic poles. Anti-cogging can be enabled with different amplitude levels. **Notes:** • This is an expert level parameter and should not be adjusted without appropriate skill. • Use as low a level as possible that gives satisfactory performance. • Signal injection cannot be applied to asynchronous motors.	*Disabled*
	Disabled	Anti-cogging disabled.	0
	Enabled (5 %)	Anti-cogging enabled with amplitude level of 5%.	1
	Enabled (10 %)	Anti-cogging enabled with amplitude level of 10%.	2
	Enabled (15 %)	Anti-cogging enabled with amplitude level of 15%.	3
	Enabled (20 %)	Anti-cogging enabled with amplitude level of 20%.	4
97.11	*TR tuning*	Rotor time constant tuning. This parameter can be used to improve torque accuracy in closed-loop control of an induction motor. Normally, the motor identification run provides sufficient torque accuracy, but manual fine-tuning can be applied in exceptionally demanding applications to achieve optimal performance. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	100%
	25…400%	Rotor time constant tuning.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
97.12	*IR comp step-up frequency*	IR compensation (ie. output voltage boost) can be used in step-up applications to compensate for resistive losses in the step-up transformer, cabling and motor. As voltage cannot be fed through a step-up transformer at 0 Hz, a specific type of IR compensation should be used. This parameter adds a frequency breakpoint for parameter *97.13 IR compensation* as shown below.  0.0 Hz = Breakpoint disabled.	0.0 Hz
	0.0 … 50.0 Hz	IR compensation breakpoint for step-up applications.	1 = 1 Hz
97.13	*IR compensation*	Defines the relative output voltage boost at zero speed (IR compensation). The function is useful in applications with a high break-away torque where direct torque control (DTC mode) cannot be applied.  See also section *IR compensation for scalar motor control* on page *58*.	0.00%
	0.00 … 50.00%	Voltage boost at zero speed in percent of nominal motor voltage.	1 = 1%

No.	Name/Value	Description	*DeflFbEq16*
97.15	*Motor model temperature adaptation*	Selects whether the temperature-dependent parameters (such as stator or rotor resistance) of the motor model adapt to actual (measured or estimated) temperature or not. See parameter group *35 Motor thermal protection* for selection of temperature measurement sources.	*Disabled*
	Disabled	Temperature adaptation of motor model disabled.	0
	Estimated temperature	Estimated temperature (*35.01 Motor estimated temperature*) used for adaptation of motor model.	1
	Measured temperature 1	Measured temperature 1 (*35.02 Measured temperature 1*) used for adaptation of motor model.	2
	Measured temperature 2	Measured temperature 2 (*35.03 Measured temperature 2*) used for adaptation of motor model.	3
97.32	*Motor torque unfiltered*	Unfiltered motor torque in percent of the nominal motor torque.	-
	-1600.0 … 1600.0%	Unfiltered motor torque.	See par. *46.03*
97.33	*Speed estimate filter time*	Defines a filtering time for estimated speed. See the diagram on page *553*.	5.00 ms
	0.00 … 100.00 ms	Filtering time for estimated speed.	1 = 1 ms

98 User motor parameters		Motor values supplied by the user that are used in the motor model. These parameters are useful for non-standard motors, or to just get more accurate motor control of the motor on site. A better motor model always improves the shaft performance.	
98.01	*User motor model mode*	Activates the motor model parameters *98.02*…*98.14* and the rotor angle offset parameter *98.15*. **Notes**: • Parameter value is automatically set to zero when ID run is selected by parameter *99.13 ID run requested*. The values of parameters *98.02*…*98.15* are then updated according to the motor characteristics identified during the ID run. • Measurements made directly from the motor terminals during the ID run are likely to produce slightly different values than those on a datasheet from a motor manufacturer. • This parameter cannot be changed while the drive is running.	*Not selected*
	Not selected	Parameters *98.02*…*98.15* inactive.	0
	Motor parameters	The values of parameters *98.02*…*98.14* are used as the motor model.	1
	Position offset	The value of parameter *98.15* is used as the rotor angle offset. Parameters *98.02*…*98.14* are inactive.	2
	Motor parameters & position offset	The values of parameters *98.02*…*98.14* are used as the motor model, and the value of parameter *98.15* is used as the rotor angle offset.	3
98.02	*Rs user*	Defines the stator resistance R_S of the motor model. With a star-connected motor, R_S is the resistance of one winding. With a delta-connected motor, R_S is one-third of the resistance of one winding.	0.00000 p.u.
	0.00000 … 0.50000 p.u.	Stator resistance in per unit.	-

No.	Name/Value	Description	Def/FbEq16
98.03	*Rr user*	Defines the rotor resistance R_R of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000 … 0.50000 p.u.	Rotor resistance in per unit.	-
98.04	*Lm user*	Defines the main inductance L_M of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000 … 10.00000 p.u.	Main inductance in per unit.	-
98.05	*SigmaL user*	Defines the leakage inductance σL_S. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000 … 1.00000 p.u.	Leakage inductance in per unit.	-
98.06	*Ld user*	Defines the direct axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 p.u.
	0.00000 … 10.00000 p.u	Direct axis inductance in per unit.	-
98.07	*Lq user*	Defines the quadrature axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 p.u.
	0.00000 … 10.00000 p.u	Quadrature axis inductance in per unit.	-
98.08	*PM flux user*	Defines the permanent magnet flux. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 p.u.
	0.00000 … 2.00000 p.u	Permanent magnet flux in per unit.	-
98.09	*Rs user SI*	Defines the stator resistance R_S of the motor model.	0.00000 ohm
	0.00000 … 100.00000 ohm	Stator resistance.	-
98.10	*Rr user SI*	Defines the rotor resistance R_R of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 ohm
	0.00000 … 100.00000 ohm	Rotor resistance.	-
98.11	*Lm user SI*	Defines the main inductance L_M of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00 mH
	0.00 …100000.00 mH	Main inductance.	1 = 10000 mH
98.12	*SigmaL user SI*	Defines the leakage inductance σL_S. **Note:** This parameter is valid only for asynchronous motors.	0.00 mH
	0.00 …100000.00 mH	Leakage inductance.	1 = 10000 mH
98.13	*Ld user SI*	Defines the direct axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00 mH
	0.00 …100000.00 mH	Direct axis inductance.	1 = 10000 mH

No.	Name/Value	Description	Def/FbEq16
98.14	Lq user SI	Defines the quadrature axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00 mH
	0.00 …100000.00 mH	Quadrature axis inductance.	1 = 10000 mH
98.15	Position offset user	Defines an angle offset between the zero position of the synchronous motor and the zero position of the position sensor. This value is initially set by the autophasing routine when parameter 21.13 Autophasing mode is set to Turning with Z-pulse, and can be fine-tuned later on. **Notes:** • The value is in electrical degrees. The electrical angle equals the mechanical angle multiplied by the number of motor pole pairs. • This parameter is valid only for permanent magnet motors.	0 deg
	0…360 deg	Angle offset.	1 = 1 deg
99 Motor data		Motor configuration settings.	
99.03	Motor type	Selects the motor type. **Note:** This parameter cannot be changed while the drive is running.	Asynchronous motor; SynRM (95.21 b1); Permanent magnet motor (95.21 b2)
	Asynchronous motor	Standard squirrel cage AC induction motor (asynchronous induction motor).	0
	Permanent magnet motor	Permanent magnet motor. Three-phase AC synchronous motor with permanent magnet rotor and sinusoidal BackEMF voltage.	1
	SynRM	Synchronous reluctance motor. Three-phase AC synchronous motor with salient pole rotor without permanent magnets.	2
99.04	Motor control mode	Selects the motor control mode.	DTC
	DTC	Direct torque control. This mode is suitable for most applications. **Note:** Instead of direct torque control, scalar control is also available, and should be used in the following situations: • with multimotor applications 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after the motor identification (ID run) • if the nominal current of the motor is less than 1/6 of the nominal output current of the drive • if the drive is used with no motor connected (for example, for test purposes). See also section Operating modes of the drive (page 22).	0

No.	Name/Value	Description	Def/FbEq16
	Scalar	Scalar control. The outstanding motor control accuracy of DTC cannot be achieved in scalar control. Refer to the *DTC* selection above for a list of applications where scalar control should definitely be used. **Notes:** • Correct motor operation requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the inverter. • Some standard features are disabled in scalar control mode. See also section *Scalar motor control* (page *58*), and section *Operating modes of the drive* (page *22*).	1
99.06	*Motor nominal current*	Defines the nominal motor current. Must be equal to the value on the motor rating plate. If multiple motors are connected to the drive, enter the total current of the motors. **Notes:** • Correct motor operation requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the drive. • This parameter cannot be changed while the drive is running.	0.0 A
	0.0 … 32767.0 A	Nominal current of the motor. The allowable range is 1/6…2 × I_N (nominal current) of the drive (0…2 × I_N with scalar control mode).	1 = 1 A
99.07	*Motor nominal voltage*	Defines the nominal motor voltage supplied to the motor. This setting must match the value on the rating plate of the motor. **Notes:** • With permanent magnet motors, the nominal voltage is the BackEMF voltage at nominal speed of the motor. If the voltage is given as voltage per rpm, e.g. 60 V per 1000 rpm, the voltage for a nominal speed of 3000 rpm is 3 × 60 V = 180 V. • The stress on the motor insulation is always dependent on the drive supply voltage. This also applies to the case where the motor voltage rating is lower than that of the drive and the supply. • This parameter cannot be changed while the drive is running.	0.0 V
	0.0 … 32767.0 V	Nominal voltage of the motor. The allowable range is 1/6…2 × U_N (nominal voltage) of the drive. U_N equals the upper bound of the supply voltage range selected by parameter *95.01 Supply voltage*.	10 = 1 V
99.08	*Motor nominal frequency*	Defines the nominal motor frequency. This setting must match the value on the rating plate of the motor. **Note:** This parameter cannot be changed while the drive is running.	50.00 Hz
	0.00 … 500.00 Hz	Nominal frequency of the motor.	10 = 1 Hz
99.09	*Motor nominal speed*	Defines the nominal motor speed. The setting must match the value on the rating plate of the motor. **Note:** This parameter cannot be changed while the drive is running.	0 rpm
	0 … 30000 rpm	Nominal speed of the motor.	1 = 1 rpm

No.	Name/Value	Description	DeflFbEq16
99.10	Motor nominal power	Defines the nominal motor power. The setting must match the value on the rating plate of the motor. If nominal power is not shown on the rating plate, nominal torque can be entered instead in parameter 99.12. If multiple motors are connected to the drive, enter the total power of the motors. The unit is selected by parameter 96.16 Unit selection. **Note:** This parameter cannot be changed while the drive is running.	0.00 kW or hp
	0.00 … 10000.00 kW or 0.00 … 13404.83 hp	Nominal power of the motor.	1 = 1 unit
99.11	Motor nominal cos Φ	Defines the cosphi of the motor for a more accurate motor model. The value is not obligatory, but is useful with an asynchronous motor, especially when performing a standstill identification run. With a permanent magnet or synchronous reluctance motor, this value is not needed. **Notes:** • Do not enter an estimated value. If you do not know the exact value, leave the parameter at zero. • This parameter cannot be changed while the drive is running.	0.00
	0.00 … 1.00	Cosphi of the motor.	100 = 1
99.12	Motor nominal torque	Defines the nominal motor shaft torque. This value can be given instead of nominal power (99.10) if shown on the rating plate of the motor. The unit is selected by parameter 96.16 Unit selection. **Notes:** • This setting is an alternative to the nominal power value (99.10). If both are entered, 99.12 takes priority. • This parameter cannot be changed while the drive is running.	0.000 N·m or lb·ft
	0.000… N·m or lb·ft	Nominal motor torque.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
99.13	*ID run requested*	Selects the type of the motor identification routine (ID run) performed at the next start of the drive. During the ID run, the drive will identify the characteristics of the motor for optimum motor control. If no ID run has been performed yet (or if default parameter values have been restored using parameter *96.06 Parameter restore*), this parameter is automatically set to *Standstill*, signifying that an ID run must be performed. After the ID run, the drive stops and this parameter is automatically set to *None*. **Notes:** • For the *Advanced* ID run, the machinery must always be de-coupled from the motor. • With a permanent magnet or synchronous reluctance motor, a *Normal*, *Reduced* or *Standstill* ID run requires that the motor shaft is NOT locked and the load torque is less than 10%. • With scalar control mode (*99.04 Motor control mode* = *Scalar*), only the *Current measurement calibration* ID run mode is possible. • Configure motor temperature measurement (if used) in parameter group *35 Motor thermal protection* before activating the ID run. • Once the ID run is activated, it can be canceled by stopping the drive. • The ID run must be performed every time any of the motor parameters (*99.04*, *99.06*…*99.12*) have been changed. • Ensure that the Safe torque off and emergency stop circuits (if any) are closed during the ID run. • Mechanical brake (if present) is not opened by the logic for the ID run. • This parameter cannot be changed while the drive is running.	*None*; *Standstill* (*95.21* b1/b2)
	None	No motor ID run is requested. This mode can be selected only if the ID run (*Normal*, *Reduced*, *Standstill*, *Advanced*, *Advanced Standstill*) has already been performed once.	0
	Normal	Normal ID run. Guarantees good control accuracy for all cases. The ID run takes about 90 seconds. This mode should be selected whenever it is possible. **Notes:** • If the load torque will be higher than 20% of motor nominal torque, or if the machinery is not able to withstand the nominal torque transient during the ID run, then the driven machinery must be de-coupled from the motor during a Normal ID run. • Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction. **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	1

No.	Name/Value	Description	*DeflFbEq16*
	Reduced	Reduced ID run. This mode should be selected instead of the *Normal* or *Advanced* ID Run if • mechanical losses are higher than 20% (i.e. the motor cannot be de-coupled from the driven equipment), or if • flux reduction is not allowed while the motor is running (i.e. in case of a motor with an integrated brake supplied from the motor terminals). With this ID run mode, the resultant motor control in the field weakening area or at high torques is not necessarily as accurate as motor control following a Normal ID run. Reduced ID run is completed faster than the Normal ID Run (< 90 seconds). **Note:** Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction. **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	2
	Standstill	Standstill ID run. The motor is injected with DC current. With an AC induction (asynchronous) motor, the motor shaft is not rotated. With a permanent magnet motor or synchronous reluctance motor, the shaft can rotate up to half a revolution. **Note:** A standstill ID run should be selected only if the *Normal*, *Reduced* or *Advanced* ID run is not possible due to the restrictions caused by the connected mechanics (eg. with lift or crane applications). See also selection *Advanced Standstill*.	3
	Autophasing	The autophasing routine determines the start angle of a permanent magnet or synchronous reluctance motor (see page *59*). Autophasing does not update the other motor model values. Autophasing is automatically performed as part of the *Normal*, *Reduced*, *Standstill*, *Advanced* or *Advanced Standstill* ID runs. Using this setting, it is possible to perform autophasing alone. This is useful after changes in the feedback configuration, such as the replacement or addition of an absolute encoder, resolver, or pulse encoder with commutation signals. **Notes:** • This setting can only be used after a *Normal*, *Reduced*, *Standstill*, *Advanced* or *Advanced Standstill* ID run has already been performed. • Depending on the selected autophasing mode, the shaft can rotate during autophasing. See parameter *21.13 Autophasing mode*.	4
	Current measurement calibration	Requests current measurement calibration, ie. identification of current measurement offset and gain errors. The calibration will be performed at next start.	5

No.	Name/Value	Description	Def/FbEq16
	Advanced	Advanced ID run. Guarantees the best possible control accuracy. The ID run can take a couple of minutes. This mode should be selected when top performance is needed across the whole operating area. **Note:** The driven machinery must be de-coupled from the motor because of high torque and speed transients that are applied. **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. Several accelerations and decelerations are done. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	6
	Advanced Standstill	Advanced Standstill ID run. This selection is recommended with AC induction motors up to 75 kW instead of the *Standstill* ID run if • the exact nominal ratings of the motor are not known, or • the control performance of the motor is not satisfactory after a *Standstill* ID run. **Note:** The time it takes for the *Advanced Standstill* ID run to complete varies according to motor size. With a small motor, the ID run typically completes within 5 minutes; with a large motor, the ID run may take up to an hour.	7
99.14	*Last ID run performed*	Shows the type of ID run that was performed last. For more information about the different modes, see the selections of parameter *99.13 ID run requested*.	*None*
	None	No ID run has been performed.	0
	Normal	*Normal* ID run.	1
	Reduced	*Reduced* ID run.	2
	Standstill	*Standstill* ID run.	3
	Advanced	*Advanced* ID run.	6
	Advanced Standstill	*Advanced Standstill* ID run.	7
99.15	*Motor polepairs calculated*	Calculated number of pole pairs in the motor.	0
	0…1000	Number of pole pairs.	1 = 1
99.16	*Motor phase order*	Switches the rotation direction of motor. This parameter can be used if the motor turns in the wrong direction (for example, because of the wrong phase order in the motor cable), and correcting the cabling is considered impractical. **Notes:** • Changing this parameter does not affect speed reference polarities, so positive speed reference will rotate the motor forward. The phase order selection just ensures that “forward” is in fact the correct direction. • After changing this parameter, the sign of encoder feedback (if any) must be checked. This can be done by setting parameter *90.41 Motor feedback selection* to *Estimate*, and comparing the sign of *90.01 Motor speed for control* to *90.10 Encoder 1 speed* (or *90.20 Encoder 2 speed*). If the sign of the measurement is incorrect, the encoder wiring must be corrected or the sign of *90.43 Motor gear numerator* reversed.	*U V W*
	U V W	Normal.	0
	U W V	Reversed rotation direction.	1

No.	Name/Value	Description	Def/FbEq16
200 Safety		FSO-xx settings.	
This group contains parameters related to the optional FSO-xx safety functions module. For details on the parameters in this group, refer to the documentation of the FSO-xx module.			

7

Additional parameter data

What this chapter contains

This chapter lists the parameters with some additional data such as their ranges and 32-bit fieldbus scaling. For parameter descriptions, see chapter *Parameters* (page *109*).

Terms and abbreviations

Term	Definition
Actual signal	Signal measured or calculated by the drive. Usually can only be monitored but not adjusted; some counter-type signals can however be reset.
Analog src	Analog source: the parameter can be set to the value of another parameter by choosing “Other”, and selecting the source parameter from a list. **Note:** The source parameter must be a 32-bit real (floating point) number. To use a 16-bit integer (for example, received in DDCS data sets) as the source, data storage parameters *47.01*…*47.08* (see page *320*) can be used. In addition to the “Other” selection, the parameter may offer other pre-selected settings.
Binary src	Binary source: the value of the parameter can be taken from a specific bit in another parameter value (“Other”). Sometimes the value can be fixed to 0 (false) or 1 (true). In addition, the parameter may offer other pre-selected settings.
Data	Data parameter.

Term	Definition
FbEq32	32-bit fieldbus equivalent: The scaling between the value shown on the panel and the integer used in communication when a 32-bit value is selected for transmission to an external system. The corresponding 16-bit scalings are listed in chapter *Parameters* (page *109*).
List	Selection list.
No.	Parameter number.
PB	Packed Boolean (bit list).
Real	Real number.
Type	Parameter type. See *Analog src*, *Binary src*, *List*, *PB*, *Real*.

Fieldbus addresses

Refer to the *User's manual* of the fieldbus adapter.

Parameter groups 1…9

No.	Name	Type	Range	Unit	FbEq32
01 Actual values					
01.01	Motor speed used	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
01.02	Motor speed estimated	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
01.03	Motor speed %	*Real*	-1000.00 … 1000.00	%	100 = 1%
01.04	Encoder 1 speed filtered	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
01.05	Encoder 2 speed filtered	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
01.06	Output frequency	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
01.07	Motor current	*Real*	0.00 … 30000.00	A	100 = 1 A
01.08	Motor current % of motor nom	*Real*	0.0 … 1000.0	%	10 = 1%
01.10	Motor torque	*Real*	-1600.0 … 1600.0	%	10 = 1%
01.11	DC voltage	*Real*	0.00 … 2000.00	V	100 = 1 V
01.13	Output voltage	*Real*	0…2000	V	1 = 1 V
01.14	Output power	*Real*	-32768.00 … 32767.00	kW or hp	100 = 1 unit
01.15	Output power % of motor nom	*Real*	-300.00 … 300.00	%	10 = 1%
01.17	Motor shaft power	*Real*	-32768.00 … 32767.00	kW or hp	100 = 1 unit
01.18	Inverter GWh motoring	*Real*	0…32767	GWh	1 = 1 GWh
01.19	Inverter MWh motoring	*Real*	0…999	MWh	1 = 1 MWh
01.20	Inverter kWh motoring	*Real*	0…999	kWh	1 = 1 kWh
01.21	U-phase current	*Real*	-30000.00 … 30000.00	A	100 = 1 A
01.22	V-phase current	*Real*	-30000.00 … 30000.00	A	100 = 1 A
01.23	W-phase current	*Real*	-30000.00 … 30000.00	A	100 = 1 A
01.24	Flux actual %	*Real*	0…200	%	1 = 1%
01.29	Speed change rate	*Real*	-15000 … 15000	rpm/s	1 = 1 rpm/s
01.30	Nominal torque scale	*Real*	0.000…	N·m or lb·ft	1000 = 1 unit
01.31	Ambient temperature	*Real*	-40 … 120	°C or °F	10 = 1°
01.32	Inverter GWh regenerating	*Real*	0…32767	GWh	1 = 1 GWh
01.33	Inverter MWh regenerating	*Real*	0…999	MWh	1 = 1 MWh
01.34	Inverter kWh regenerating	*Real*	0…999	kWh	1 = 1 kWh
01.35	Mot - regen energy GWh	*Real*	-32768 … 32767	GWh	1 = 1 GWh
01.36	Mot - regen energy MWh	*Real*	-999…999	MWh	1 = 1 MWh
01.37	Mot - regen energy kWh	*Real*	-999…999	kWh	1 = 1 kWh
01.61	Abs motor speed used	*Real*	0.00 … 30000.00	rpm	100 = 1 rpm
01.62	Abs motor speed %	*Real*	0.00 … 1000.00	%	100 = 1 rpm
01.63	Abs output frequency	*Real*	0.00 … 500.00	Hz	100 = 1 Hz
01.64	Abs motor torque	*Real*	0.0 … 1600.0	%	10 = 1%
01.65	Abs output power	*Real*	0.00 … 32767.00	kW or hp	100 = 1 unit
01.66	Abs output power % motor nom	*Real*	0.00 … 300.00	%	10 = 1%
01.68	Abs motor shaft power	*Real*	0.00 … 32767.00	kW or hp	100 = 1 unit

No.	Name	Type	Range	Unit	FbEq32
03 Input references					
03.01	Panel reference	*Real*	-100000.00 … 100000.00	-	100 = 1
03.02	Panel reference 2	*Real*	-30000.00 … 30000.00	-	100 = 1
03.05	FB A reference 1	*Real*	-100000.00 … 100000.00	-	100 = 1
03.06	FB A reference 2	*Real*	-100000.00 … 100000.00	-	100 = 1
03.07	FB B reference 1	*Real*	-100000.00 … 100000.00	-	100 = 1
03.08	FB B reference 2	*Real*	-100000.00 … 100000.00	-	100 = 1
03.09	EFB reference 1	*Real*	-30000.00 … 30000.00	-	100 = 1
03.10	EFB reference 2	*Real*	-30000.00 … 30000.00	-	100 = 1
03.11	DDCS controller ref 1	*Real*	-30000.00 … 30000.00	-	100 = 1
03.12	DDCS controller ref 2	*Real*	-30000.00 … 30000.00	-	100 = 1
03.13	M/F or D2D ref1	*Real*	-30000.00 … 30000.00	-	100 = 1
03.14	M/F or D2D ref2	*Real*	-30000.00 … 30000.00	-	100 = 1
04 Warnings and faults					
04.01	Tripping fault	*Data*	0000h…FFFFh	-	1 = 1
04.02	Active fault 2	*Data*	0000h…FFFFh	-	1 = 1
04.03	Active fault 3	*Data*	0000h…FFFFh	-	1 = 1
04.04	Active fault 4	*Data*	0000h…FFFFh	-	1 = 1
04.05	Active fault 5	*Data*	0000h…FFFFh	-	1 = 1
04.06	Active warning 1	*Data*	0000h…FFFFh	-	1 = 1
04.07	Active warning 2	*Data*	0000h…FFFFh	-	1 = 1
04.08	Active warning 3	*Data*	0000h…FFFFh	-	1 = 1
04.09	Active warning 4	*Data*	0000h…FFFFh	-	1 = 1
04.10	Active warning 5	*Data*	0000h…FFFFh	-	1 = 1
04.11	Latest fault	*Data*	0000h…FFFFh	-	1 = 1
04.12	2nd latest fault	*Data*	0000h…FFFFh	-	1 = 1
04.13	3rd latest fault	*Data*	0000h…FFFFh	-	1 = 1
04.14	4th latest fault	*Data*	0000h…FFFFh	-	1 = 1
04.15	5th latest fault	*Data*	0000h…FFFFh	-	1 = 1
04.16	Latest warning	*Data*	0000h…FFFFh	-	1 = 1
04.17	2nd latest warning	*Data*	0000h…FFFFh	-	1 = 1
04.18	3rd latest warning	*Data*	0000h…FFFFh	-	1 = 1
04.19	4th latest warning	*Data*	0000h…FFFFh	-	1 = 1
04.20	5th latest warning	*Data*	0000h…FFFFh	-	1 = 1
04.21	Fault word 1	*PB*	0000h…FFFFh	-	1 = 1
04.22	Fault word 2	*PB*	0000h…FFFFh	-	1 = 1
04.31	Warning word 1	*PB*	0000h…FFFFh	-	1 = 1
04.32	Warning word 2	*PB*	0000h…FFFFh	-	1 = 1
04.40	Event word 1	*PB*	0000h…FFFFh	-	1 = 1
04.41	Event word 1 bit 0 code	*Data*	0000h…FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
04.42	Event word 1 bit 0 aux code	*Data*	0000 0000h … FFFF FFFFh	-	1 = 1
04.43	Event word 1 bit 1 code	*Data*	0000h…FFFFh	-	1 = 1
04.44	Event word 1 bit 1 aux code	*Data*	0000 0000h … FFFF FFFFh	-	1 = 1
…	…	…	…	…	
04.71	Event word 1 bit 15 code	*Data*	0000h…FFFFh	-	1 = 1
04.72	Event word 1 bit 15 aux code	*Data*	0000 0000h … FFFF FFFFh	-	1 = 1
04.120	Fault/Warning word compatibility	*List*	0…1	-	1 = 1
05 Diagnostics					
05.01	On-time counter	*Real*	0…65535	d	1 = 1 d
05.02	Run-time counter	*Real*	0…65535	d	1 = 1 d
05.04	Fan on-time counter	*Real*	0…65535	d	1 = 1 d
05.11	Inverter temperature	*Real*	-40.0 … 160.0	%	10 = 1%
05.22	Diagnostic word 3	*PB*	0000h…FFFFh	-	
05.41	Main fan service counter	*Real*	0…150	%	1 = 1%
05.42	Aux. fan service counter	*Real*	0…150	%	1 = 1%
06 Control and status words					
06.01	Main control word	*PB*	0000h…FFFFh	-	1 = 1
06.02	Application control word	*PB*	0000h…FFFFh	-	1 = 1
06.03	FBA A transparent control word	*PB*	00000000h…FFFFFFFFh	-	1 = 1
06.04	FBA B transparent control word	*PB*	00000000h…FFFFFFFFh	-	
06.05	EFB transparent control word	*PB*	00000000h…FFFFFFFFh	-	
06.11	Main status word	*PB*	0000h…FFFFh	-	1 = 1
06.16	Drive status word 1	*PB*	0000h…FFFFh	-	1 = 1
06.17	Drive status word 2	*PB*	0000h…FFFFh	-	1 = 1
06.18	Start inhibit status word	*PB*	0000h…FFFFh	-	1 = 1
06.19	Speed control status word	*PB*	0000h…FFFFh	-	1 = 1
06.20	Constant speed status word	*PB*	0000h…FFFFh	-	1 = 1
06.21	Drive status word 3	*PB*	0000h…FFFFh	-	1 = 1
06.25	Drive inhibit status word 2	*PB*	0000h…FFFFh	-	1 = 1
06.29	MSW bit 10 sel	*Binary src*	-	-	1 = 1
06.30	MSW bit 11 sel	*Binary src*	-	-	1 = 1
06.31	MSW bit 12 sel	*Binary src*	-	-	1 = 1
06.32	MSW bit 13 sel	*Binary src*	-	-	1 = 1
06.33	MSW bit 14 sel	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
(Parameters 06.36…06.43 only visible with a BCU control unit)					
06.36	LSU Status Word	*PB*	0000h…FFFFh	-	1 = 1
06.39	Internal state machine LSU CW	*PB*	0000h…FFFFh	-	1 = 1
06.40	LSU CW user bit 0 selection	*Binary src*	-	-	1 = 1
06.41	LSU CW user bit 1 selection	*Binary src*	-	-	1 = 1
06.42	LSU CW user bit 2 selection	*Binary src*	-	-	1 = 1
06.43	LSU CW user bit 3 selection	*Binary src*	-	-	1 = 1
06.45	Follower CW user bit 0 selection	*Binary src*	-	-	1 = 1
06.46	Follower CW user bit 1 selection	*Binary src*	-	-	1 = 1
06.47	Follower CW user bit 2 selection	*Binary src*	-	-	1 = 1
06.48	Follower CW user bit 3 selection	*Binary src*	-	-	1 = 1
06.50	User status word 1	*PB*	0000h…FFFFh	-	1 = 1
06.60	User status word 1 bit 0 sel	*Binary src*	-	-	1 = 1
06.61	User status word 1 bit 1 sel	*Binary src*	-	-	1 = 1
06.62	User status word 1 bit 2 sel	*Binary src*	-	-	1 = 1
06.63	User status word 1 bit 3 sel	*Binary src*	-	-	1 = 1
06.64	User status word 1 bit 4 sel	*Binary src*	-	-	1 = 1
06.65	User status word 1 bit 5 sel	*Binary src*	-	-	1 = 1
06.66	User status word 1 bit 6 sel	*Binary src*	-	-	1 = 1
06.67	User status word 1 bit 7 sel	*Binary src*	-	-	1 = 1
06.68	User status word 1 bit 8 sel	*Binary src*	-	-	1 = 1
06.69	User status word 1 bit 9 sel	*Binary src*	-	-	1 = 1
06.70	User status word 1 bit 10 sel	*Binary src*	-	-	1 = 1
06.71	User status word 1 bit 11 sel	*Binary src*	-	-	1 = 1
06.72	User status word 1 bit 12 sel	*Binary src*	-	-	1 = 1
06.73	User status word 1 bit 13 sel	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
06.74	User status word 1 bit 14 sel	*Binary src*	-	-	1 = 1
06.75	User status word 1 bit 15 sel	*Binary src*	-	-	1 = 1
06.100	User control word 1	*PB*	0000h…FFFFh	-	1 = 1
06.101	User control word 2	*PB*	0000h…FFFFh	-	1 = 1
07 System info					
07.03	Drive rating id	*List*	-	-	1 = 1
07.04	Firmware name	*List*	-	-	1 = 1
07.05	Firmware version	*Data*	-	-	1 = 1
07.06	Loading package name	*List*	-	-	1 = 1
07.07	Loading package version	*Data*	-	-	1 = 1
07.08	Bootloader version	*Data*	-	-	1 = 1
07.11	Cpu usage	*Real*	0…100	%	1 = 1%
07.13	PU logic version number	*Data*	-	-	1 = 1
07.21	Application environment status 1	*PB*	0000h…FFFFh	-	1 = 1
07.22	Application environment status 2	*PB*	0000h…FFFFh	-	1 = 1
07.23	Application name	*Data*	-	-	1 = 1
07.24	Application version	*Data*	-	-	1 = 1
07.25	Customization package name	*Data*	-	-	1 = 1
07.26	Customization package version	*Data*	-	-	1 = 1
07.30	Adaptive program status	*PB*	0000h…FFFFh	-	1 = 1
07.40	IEC application Cpu usage peak	*Real*	0.0 … 100.0	%	10 = 1%
07.41	IEC application Cpu load average	*Real*	0.0 … 100.0	%	10 = 1%

Parameter groups 10…99

No.	Name	Type	Range	Unit	FbEq32
10 Standard DI, RO					
10.01	DI status	*PB*	0000h…FFFFh	-	1 = 1
10.02	DI delayed status	*PB*	0000h…FFFFh	-	1 = 1
10.03	DI force selection	*PB*	0000h…FFFFh	-	1 = 1
10.04	DI force data	*PB*	0000h…FFFFh	-	1 = 1
10.05	DI1 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.06	DI1 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.07	DI2 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.08	DI2 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.09	DI3 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.10	DI3 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.11	DI4 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.12	DI4 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.13	DI5 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.14	DI5 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.15	DI6 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.16	DI6 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.21	RO status	*PB*	0000h…FFFFh	-	1 = 1
10.24	RO1 source	*Binary src*	-	-	1 = 1
10.25	RO1 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.26	RO1 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.27	RO2 source	*Binary src*	-	-	1 = 1
10.28	RO2 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.29	RO2 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.30	RO3 source	*Binary src*	-	-	1 = 1
10.31	RO3 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.32	RO3 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.51	DI filter time	*Real*	0.3 … 100.0	ms	10 = 1 ms
10.99	RO/DIO control word	*PB*	0000h…FFFFh	-	1 = 1
11 Standard DIO, FI, FO					
11.01	DIO status	*PB*	0000h…FFFFh	-	1 = 1
11.02	DIO delayed status	*PB*	0000h…FFFFh	-	1 = 1
11.05	DIO1 function	*List*	0…2	-	1 = 1
11.06	DIO1 output source	*Binary src*	-		1 = 1
11.07	DIO1 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
11.08	DIO1 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
11.09	DIO2 function	*List*	0…2	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
11.10	DIO2 output source	*Binary src*	-		1 = 1
11.11	DIO2 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
11.12	DIO2 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
11.38	Freq in 1 actual value	*Real*	0…16000	Hz	1 = 1 Hz
11.39	Freq in 1 scaled	*Real*	-32768.000 … 32767.000	-	1000 = 1
11.42	Freq in 1 min	*Real*	0…16000	Hz	1 = 1 Hz
11.43	Freq in 1 max	*Real*	0…16000	Hz	1 = 1 Hz
11.44	Freq in 1 at scaled min	*Real*	-32768.000 … 32767.000	-	1000 = 1
11.45	Freq in 1 at scaled max	*Real*	-32768.000 … 32767.000	-	1000 = 1
11.54	Freq out 1 actual value	*Real*	0…16000	Hz	1 = 1 Hz
11.55	Freq out 1 source	*Analog src*	-	-	1 = 1
11.58	Freq out 1 src min	*Real*	-32768.000 … 32767.000	-	1000 = 1
11.59	Freq out 1 src max	*Real*	-32768.000 … 32767.000	-	1000 = 1
11.60	Freq out 1 at src min	*Real*	0…16000	Hz	1 = 1 Hz
11.61	Freq out 1 at src max	*Real*	0…16000	Hz	1 = 1 Hz
11.81	DIO filter time	*Real*	0.3 … 100.0	ms	10 = 1 ms
12 Standard AI					
12.01	AI tune	enum	0…4	-	
12.03	AI supervision function	*List*	0…4	-	1 = 1
12.04	AI supervision selection	*PB*	0000h…FFFFh	-	1 = 1
12.05	AI supervision force	*PB*	0000h…FFFFh	-	1 = 1
12.11	AI1 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
12.12	AI1 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
12.15	AI1 unit selection	*List*	-	-	1 = 1
12.16	AI1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
12.17	AI1 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
12.18	AI1 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
12.19	AI1 scaled at AI1 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
12.20	AI1 scaled at AI1 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
12.21	AI2 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
12.22	AI2 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
12.25	AI2 unit selection	*List*	-	-	1 = 1
12.26	AI2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
12.27	AI2 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
12.28	AI2 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
12.29	AI2 scaled at AI2 min	*Real*	-32768.000 … 32767.000	-	1000 = 1

No.	Name	Type	Range	Unit	FbEq32
12.30	AI2 scaled at AI2 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
13 Standard AO					
13.11	AO1 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
13.12	AO1 source	*Analog src*	-	-	1 = 1
13.16	AO1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
13.17	AO1 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
13.18	AO1 source max	*Real*	-32768.0 … 32767.0	-	10 = 1
13.19	AO1 out at AO1 src min	*Real*	0.000 … 22.000	mA	1000 = 1 mA
13.20	AO1 out at AO1 src max	*Real*	0.000 … 22.000	mA	1000 = 1 mA
13.21	AO2 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
13.22	AO2 source	*Analog src*	-	-	1 = 1
13.26	AO2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
13.27	AO2 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
13.28	AO2 source max	*Real*	-32768.0 … 32767.0	-	10 = 1
13.29	AO2 out at AO2 src min	*Real*	0.000 … 22.000	mA	1000 = 1 mA
13.30	AO2 out at AO2 src max	*Real*	0.000 … 22.000	mA	1000 = 1 mA
13.91	AO1 data storage	*Real*	-327.68 … 327.67	-	100 = 1
13.92	AO2 data storage	*Real*	-327.68 … 327.67	-	100 = 1
14 I/O extension module 1					
14.01	Module 1 type	*List*	0…4	-	1 = 1
14.02	Module 1 location	*Real*	1…254	-	1 = 1
14.03	Module 1 status	*List*	0…4	-	1 = 1
DIx (14.01 Module 1 type = FDIO-01)					
14.05	DI status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
14.06	DI delayed status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
14.08	DI filter time	*Real*	0.8 … 100.0	ms	10 = 1 ms
14.12	DI1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.13	DI1 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.17	DI2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.18	DI2 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.22	DI3 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.23	DI3 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
Common parameters for DIOx (14.01 Module 1 type = FIO-01 or *FIO-11)*					
14.05	DIO status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
14.06	DIO delayed status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
DIO1/DIO2 (14.01 Module 1 type = FIO-01 or *FIO-11)*					
14.08	DIO filter time	*Real*	0.8 … 100.0	ms	10 = 1 ms
14.09	DIO1 function	*List*	0…1	-	1 = 1
14.11	DIO1 output source	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
14.12	DIO1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.13	DIO1 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.14	DIO2 function	*List*	0…1	-	1 = 1
14.16	DIO2 output source	*Binary src*	-	-	1 = 1
14.17	DIO2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.18	DIO2 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
DIO3/DIO4 (14.01 Module 1 type = FIO-01)					
14.19	DIO3 function	*List*	0…1	-	1 = 1
14.21	DIO3 output source	*Binary src*	-	-	1 = 1
14.22	DIO3 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.23	DIO3 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.24	DIO4 function	*List*	0…1	-	1 = 1
14.26	DIO4 output source	*Binary src*	-	-	1 = 1
14.27	DIO4 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.28	DIO4 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
RO1/RO2 (14.01 Module 1 type = FIO-01 or *FDIO-01)*					
14.31	RO status	*PB*	0000h…FFFFh	-	1 = 1
14.34	RO1 source	*Binary src*	-	-	1 = 1
14.35	RO1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.36	RO1 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.37	RO2 source	*Binary src*	-	-	1 = 1
14.38	RO2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.39	RO2 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
Common parameters for AIx (14.01 Module 1 type = FIO-11 or *FAIO-01)*					
14.19	AI supervision function	*List*	0…4	-	1 = 1
14.20	AI supervision selection	*PB*	0000h…FFFFh	-	1 = 1
14.21	AI tune	*List*	0…6 (*FIO-11*) 0…4 (*FAIO-01*)	-	1 = 1
14.22	AI force selection	*PB*	0000h…FFFFh	-	1 = 1
AI1/AI2 (14.01 Module 1 type = FIO-11 or *FAIO-01)*					
14.26	AI1 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.27	AI1 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
14.28	AI1 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.29	AI1 HW switch position	*List*	-	-	1 = 1
14.30	AI1 unit selection	*List*	-	-	1 = 1
14.31	AI1 filter gain	*List*	0…7	-	1 = 1
14.32	AI1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s

No.	Name	Type	Range	Unit	FbEq32
14.33	AI1 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.34	AI1 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.35	AI1 scaled at AI1 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
14.36	AI1 scaled at AI1 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
14.41	AI2 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.42	AI2 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
14.43	AI2 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.44	AI2 HW switch position	*List*	-	-	1 = 1
14.45	AI2 unit selection	*List*	-	-	1 = 1
14.46	AI2 filter gain	*List*	0…7	-	1 = 1
14.47	AI2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
14.48	AI2 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.49	AI2 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.50	AI2 scaled at AI2 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
14.51	AI2 scaled at AI2 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
AI3 (14.01 Module 1 type = FIO-11)					
14.56	AI3 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.57	AI3 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
14.58	AI3 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.59	AI3 HW switch position	*List*	-	-	1 = 1
14.60	AI3 unit selection	*List*	-	-	1 = 1
14.61	AI3 filter gain	*List*	0…7	-	1 = 1
14.62	AI3 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
14.63	AI3 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.64	AI3 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.65	AI3 scaled at AI3 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
14.66	AI3 scaled at AI3 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
Common parameters for AOx (14.01 Module 1 type = FIO-11 or FAIO-01)					
14.71	AO force selection	*PB*	00000000h…FFFFFFFFh	-	1 = 1
AO1 (14.01 Module 1 type = FIO-11 or FAIO-01)					
14.76	AO1 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
14.77	AO1 source	*Analog src*	-	-	1 = 1
14.78	AO1 force data	*Real*	0.000 … 22.000	mA	1000 = 1 mA
14.79	AO1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
14.80	AO1 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
14.81	AO1 source max	*Real*	-32768.0 … 32767.0	-	10 = 1

No.	Name	Type	Range	Unit	FbEq32
14.82	AO1 out at AO1 src min	Real	0.000 … 22.000	mA	1000 = 1 mA
14.83	AO1 out at AO1 src max	Real	0.000 … 22.000	mA	1000 = 1 mA
AO2 (14.01 Module 1 type = FAIO-01)					
14.86	AO2 actual value	Real	0.000 … 22.000	mA	1000 = 1 mA
14.87	AO2 source	Analog src	-	-	1 = 1
14.88	AO2 force data	Real	0.000 … 22.000	mA	1000 = 1 mA
14.89	AO2 filter time	Real	0.000 … 30.000	s	1000 = 1 s
14.90	AO2 source min	Real	-32768.0 … 32767.0	-	10 = 1
14.91	AO2 source max	Real	-32768.0 … 32767.0	-	10 = 1
14.92	AO2 out at AO2 src min	Real	0.000 … 22.000	mA	1000 = 1 mA
14.93	AO2 out at AO2 src max	Real	0.000 … 22.000	mA	1000 = 1 mA
15 I/O extension module 2					
15.01	Module 2 type	List	0…4	-	1 = 1
15.02	Module 2 location	Real	1…254	-	1 = 1
15.03	Module 2 status	List	0…2	-	1 = 1
DIx (15.01 Module 2 type = FDIO-01)					
15.05	DI status	PB	00000000h…FFFFFFFFh	-	1 = 1
15.06	DI delayed status	PB	00000000h…FFFFFFFFh	-	1 = 1
15.08	DI filter time	Real	0.8 … 100.0	ms	10 = 1 ms
15.12	DI1 ON delay	Real	0.00 … 3000.00	s	100 = 1 s
15.13	DI1 OFF delay	Real	0.00 … 3000.00	s	100 = 1 s
15.17	DI2 ON delay	Real	0.00 … 3000.00	s	100 = 1 s
15.18	DI2 OFF delay	Real	0.00 … 3000.00	s	100 = 1 s
15.22	DI3 ON delay	Real	0.00 … 3000.00	s	100 = 1 s
15.23	DI3 OFF delay	Real	0.00 … 3000.00	s	100 = 1 s
Common parameters for DIOx (15.01 Module 2 type = FIO-01 or *FIO-11)*					
15.05	DIO status	PB	00000000h…FFFFFFFFh	-	1 = 1
15.06	DIO delayed status	PB	00000000h…FFFFFFFFh	-	1 = 1
DIO1/DIO2 (15.01 Module 2 type = FIO-01 or *FIO-11)*					
15.08	DIO filter time	Real	0.8 … 100.0	ms	10 = 1 ms
15.09	DIO1 function	List	0…1	-	1 = 1
15.11	DIO1 output source	Binary src	-	-	1 = 1
15.12	DIO1 ON delay	Real	0.00 … 3000.00	s	100 = 1 s
15.13	DIO1 OFF delay	Real	0.00 … 3000.00	s	100 = 1 s
15.14	DIO2 function	List	0…1	-	1 = 1
15.16	DIO2 output source	Binary src	-	-	1 = 1
15.17	DIO2 ON delay	Real	0.00 … 3000.00	s	100 = 1 s
15.18	DIO2 OFF delay	Real	0.00 … 3000.00	s	100 = 1 s

No.	Name	Type	Range	Unit	FbEq32
DIO3/DIO4 (15.01 Module 2 type = FIO-01)					
15.19	DIO3 function	*List*	0…1	-	1 = 1
15.21	DIO3 output source	*Binary src*	-	-	1 = 1
15.22	DIO3 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.23	DIO3 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.24	DIO4 function	*List*	0…1	-	1 = 1
15.26	DIO4 output source	*Binary src*	-	-	1 = 1
15.27	DIO4 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.28	DIO4 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
RO1/RO2 (15.01 Module 2 type = FIO-01 or *FDIO-01)*					
15.31	RO status	*PB*	0000h…FFFFh	-	1 = 1
15.34	RO1 source	*Binary src*	-	-	1 = 1
15.35	RO1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.36	RO1 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.37	RO2 source	*Binary src*	-	-	1 = 1
15.38	RO2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.39	RO2 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
Common parameters for AIx (15.01 Module 2 type = FIO-11 or *FAIO-01)*					
15.19	AI supervision function	*List*	0…4	-	1 = 1
15.20	AI supervision selection	*PB*	0000h…FFFFh	-	1 = 1
15.21	AI tune	*List*	0…6 (*FIO-11*) 0…4 (*FAIO-01*)	-	1 = 1
15.22	AI force selection	*PB*	00000000h…FFFFFFFFh	-	1 = 1
AI1/AI2 (15.01 Module 2 type = FIO-11 or *FAIO-01)*					
15.26	AI1 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.27	AI1 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
15.28	AI1 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.29	AI1 HW switch position	*List*	-	-	1 = 1
15.30	AI1 unit selection	*List*	-	-	1 = 1
15.31	AI1 filter gain	*List*	0…7	-	1 = 1
15.32	AI1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
15.33	AI1 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.34	AI1 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.35	AI1 scaled at AI1 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
15.36	AI1 scaled at AI1 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
15.41	AI2 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.42	AI2 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1

No.	Name	Type	Range	Unit	FbEq32
15.43	AI2 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.44	AI2 HW switch position	*List*	-	-	1 = 1
15.45	AI2 unit selection	*List*	-	-	1 = 1
15.46	AI2 filter gain	*List*	0…7	-	1 = 1
15.47	AI2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
15.48	AI2 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.49	AI2 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.50	AI2 scaled at AI2 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
15.51	AI2 scaled at AI2 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
AI3 (15.01 Module 2 type = FIO-11)					
15.56	AI3 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.57	AI3 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
15.58	AI3 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.59	AI3 HW switch position	*List*	-	-	1 = 1
15.60	AI3 unit selection	*List*	-	-	1 = 1
15.61	AI3 filter gain	*List*	0…7	-	1 = 1
15.62	AI3 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
15.63	AI3 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.64	AI3 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.65	AI3 scaled at AI3 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
15.66	AI3 scaled at AI3 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
Common parameters for AOx (15.01 Module 2 type = FIO-11 or *FAIO-01)*					
15.71	AO force selection	*PB*	00000000h…FFFFFFFFh	-	1 = 1
AO1 (15.01 Module 2 type = FIO-11 or *FAIO-01)*					
15.76	AO1 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
15.77	AO1 source	*Analog src*	-	-	1 = 1
15.78	AO1 force data	*Real*	0.000 … 22.000	mA	1000 = 1 mA
15.79	AO1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
15.80	AO1 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
15.81	AO1 source max	*Real*	-32768.0 … 32767.0	-	10 = 1
15.82	AO1 out at AO1 src min	*Real*	0.000 … 22.000	mA	1000 = 1 mA
15.83	AO1 out at AO1 src max	*Real*	0.000 … 22.000	mA	1000 = 1 mA
AO2 (15.01 Module 2 type = FAIO-01)					
15.86	AO2 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
15.87	AO2 source	*Analog src*	-	-	1 = 1
15.88	AO2 force data	*Real*	0.000 … 22.000	mA	1000 = 1 mA
15.89	AO2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s

No.	Name	Type	Range	Unit	FbEq32
15.90	AO2 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
15.91	AO2 source max	*Real*	-32768.0 … 32767.0	-	10 = 1
15.92	AO2 out at AO2 src min	*Real*	0.000 … 22.000	mA	1000 = 1 mA
15.93	AO2 out at AO2 src max	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16 I/O extension module 3					
16.01	Module 3 type	*List*	0…4	-	1 = 1
16.02	Module 3 location	*Real*	1…254	-	1 = 1
16.03	Module 3 status	*List*	0…2	-	1 = 1
DIx (16.01 Module 3 type = FDIO-01)					
16.05	DI status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
16.06	DI delayed status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
16.08	DI filter time	*Real*	0.8 … 100.0	ms	10 = 1 ms
16.12	DI1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.13	DI1 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.17	DI2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.18	DI2 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.22	DI3 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.23	DI3 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
Common parameters for DIOx (16.01 Module 3 type = FIO-01 or *FIO-11)*					
16.05	DIO status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
16.06	DIO delayed status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
DIO1/DIO2 (16.01 Module 3 type = FIO-01 or *FIO-11)*					
16.08	DIO filter time	*Real*	0.8 … 100.0	ms	10 = 1 ms
16.09	DIO1 function	*List*	0…1	-	1 = 1
16.11	DIO1 output source	*Binary src*	-	-	1 = 1
16.12	DIO1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.13	DIO1 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.14	DIO2 function	*List*	0…1	-	1 = 1
16.16	DIO2 output source	*Binary src*	-	-	1 = 1
16.17	DIO2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.18	DIO2 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
DIO3/DIO4 (16.01 Module 3 type = FIO-01)					
16.19	DIO3 function	*List*	0…1	-	1 = 1
16.21	DIO3 output source	*Binary src*	-	-	1 = 1
16.22	DIO3 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.23	DIO3 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.24	DIO4 function	*List*	0…1	-	1 = 1
16.26	DIO4 output source	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
16.27	DIO4 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.28	DIO4 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
RO1/RO2 (16.01 Module 3 type = FIO-01 or FDIO-01)					
16.31	RO status	*PB*	0000h…FFFFh	-	1 = 1
16.34	RO1 source	*Binary src*	-	-	1 = 1
16.35	RO1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.36	RO1 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.37	RO2 source	*Binary src*	-	-	1 = 1
16.38	RO2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.39	RO2 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
Common parameters for AIx (16.01 Module 3 type = FIO-11 or FAIO-01)					
16.19	AI supervision function	*List*	0…4	-	1 = 1
16.20	AI supervision selection	*PB*	0000h…FFFFh	-	1 = 1
16.21	AI tune	*List*	0…6 (*FIO-11*) 0…4 (*FAIO-01*)	-	1 = 1
16.22	AI force selection	*PB*	00000000h…FFFFFFFFh	-	1 = 1
AI1/AI2 (16.01 Module 3 type = FIO-11 or FAIO-01)					
16.26	AI1 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.27	AI1 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
16.28	AI1 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.29	AI1 HW switch position	*List*	-	-	1 = 1
16.30	AI1 unit selection	*List*	-	-	1 = 1
16.31	AI1 filter gain	*List*	0…7	-	1 = 1
16.32	AI1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
16.33	AI1 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.34	AI1 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.35	AI1 scaled at AI1 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
16.36	AI1 scaled at AI1 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
16.41	AI2 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.42	AI2 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
16.43	AI2 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.44	AI2 HW switch position	*List*	-	-	1 = 1
16.45	AI2 unit selection	*List*	-	-	1 = 1
16.46	AI2 filter gain	*List*	0…7	-	1 = 1
16.47	AI2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
16.48	AI2 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.49	AI2 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V

No.	Name	Type	Range	Unit	FbEq32
16.50	AI2 scaled at AI2 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
16.51	AI2 scaled at AI2 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
AI3 (16.01 Module 3 type = FIO-11)					
16.56	AI3 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.57	AI3 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
16.58	AI3 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.59	AI3 HW switch position	*List*	-	-	1 = 1
16.60	AI3 unit selection	*List*	-	-	1 = 1
16.61	AI3 filter gain	*List*	0…7	-	1 = 1
16.62	AI3 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
16.63	AI3 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.64	AI3 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.65	AI3 scaled at AI3 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
16.66	AI3 scaled at AI3 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
Common parameters for AOx (16.01 Module 3 type = FIO-11 or FAIO-01)					
16.71	AO force selection	*PB*	00000000h…FFFFFFFFh	-	1 = 1
AO1 (16.01 Module 3 type = FIO-11 or FAIO-01)					
16.76	AO1 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16.77	AO1 source	*Analog src*	-	-	1 = 1
16.78	AO1 force data	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16.79	AO1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
16.80	AO1 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
16.81	AO1 source max	*Real*	-32768.0 … 32767.0	-	10 = 1
16.82	AO1 out at AO1 src min	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16.83	AO1 out at AO1 src max	*Real*	0.000 … 22.000	mA	1000 = 1 mA
AO2 (16.01 Module 3 type = FAIO-01)					
16.86	AO2 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16.87	AO2 source	*Analog src*	-	-	1 = 1
16.88	AO2 force data	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16.89	AO2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
16.90	AO2 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
16.91	AO2 source max	*Real*	-32768.0 … 32767.0	-	10 = 1
16.92	AO2 out at AO2 src min	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16.93	AO2 out at AO2 src max	*Real*	0.000 … 22.000	mA	1000 = 1 mA
19 Operation mode					
19.01	Actual operation mode	*List*	-	-	1 = 1
19.11	Ext1/Ext2 selection	*Binary src*	-	-	1 = 1
19.12	Ext1 control mode	*List*	1…6	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
19.14	Ext2 control mode	*List*	1…6	-	1 = 1
19.16	Local control mode	*List*	0…1	-	1 = 1
19.17	Local control disable	*List*	0…1	-	1 = 1
19.20	Scalar control reference unit	*List*	0…1	-	1 = 1
20 Start/stop/direction					
20.01	Ext1 commands	*List*	-	-	1 = 1
20.02	Ext1 start trigger type	*List*	0…1	-	1 = 1
20.03	Ext1 in1 source	*Binary src*	-	-	1 = 1
20.04	Ext1 in2 source	*Binary src*	-	-	1 = 1
20.05	Ext1 in3 source	*Binary src*	-	-	1 = 1
20.06	Ext2 commands	*List*	-	-	1 = 1
20.07	Ext2 start trigger type	*List*	0…1	-	1 = 1
20.08	Ext2 in1 source	*Binary src*	-	-	1 = 1
20.09	Ext2 in2 source	*Binary src*	-	-	1 = 1
20.10	Ext2 in3 source	*Binary src*	-	-	1 = 1
20.11	Run enable stop mode	*List*	0…2	-	1 = 1
20.12	Run enable 1 source	*Binary src*	-	-	1 = 1
20.19	Enable start command	*Binary src*	-	-	1 = 1
20.23	Positive speed enable	*Binary src*	-	-	1 = 1
20.24	Negative speed enable	*Binary src*	-	-	1 = 1
20.25	Jogging enable	*Binary src*	-	-	1 = 1
20.26	Jogging 1 start source	*Binary src*	-	-	1 = 1
20.27	Jogging 2 start source	*Binary src*	-	-	1 = 1
20.30	Enable signals warning function	*PB*	00b…11b	-	1 = 1
21 Start/stop mode					
21.01	Start mode	*List*	0…3	-	1 = 1
21.02	Magnetization time	*Real*	0…10000	ms	1 = 1 ms
21.03	Stop mode	*List*	0…2	-	1 = 1
21.04	Emergency stop mode	*List*	0…2	-	1 = 1
21.05	Emergency stop source	*Binary src*	-	-	1 = 1
21.06	Zero speed limit	*Real*	0.00 … 30000.00	rpm	100 = 1 rpm

No.	Name	Type	Range	Unit	FbEq32
21.07	Zero speed delay	*Real*	0…30000	ms	1 = 1 ms
21.08	DC current control	*PB*	00b…11b	-	1 = 1
21.09	DC hold speed	*Real*	0.00 … 1000.00	rpm	100 = 1 rpm
21.10	DC current reference	*Real*	0.0 … 100.0	%	10 = 1%
21.11	Post magnetization time	*Real*	0…3000	s	1 = 1 s
21.12	Continuous magnetization command	*Binary src*	-	-	1 = 1
21.13	Autophasing mode	*List*	0…3	-	1 = 1
21.14	Pre-heating input source	*Binary src*	-	-	1 = 1
21.16	Pre-heating current	*Real*	0.0 … 30.0	%	10 = 1%
21.18	Auto restart time	*Real*	0.0, 0.1 … 5.0	s	10 = 1 s
21.19	Scalar start mode	*List*	0…2	-	1 = 1
21.20	Follower force ramp stop	*Binary src*	-	-	1 = 1
22 Speed reference selection					
22.01	Speed ref unlimited	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.11	Speed ref1 source	*Analog src*	-	-	1 = 1
22.12	Speed ref2 source	*Analog src*	-	-	1 = 1
22.13	Speed ref1 function	*List*	0…5	-	1 = 1
22.14	Speed ref1/2 selection	*Binary src*	-	-	1 = 1
22.15	Speed additive 1 source	*Analog src*	-	-	1 = 1
22.16	Speed share	*Real*	-8.000 … 8.000	-	1000 = 1
22.17	Speed additive 2 source	*Analog src*	-	-	1 = 1
22.21	Constant speed function	*PB*	00b…11b	-	1 = 1
22.22	Constant speed sel1	*Binary src*	-	-	1 = 1
22.23	Constant speed sel2	*Binary src*	-	-	1 = 1
22.24	Constant speed sel3	*Binary src*	-	-	1 = 1
22.26	Constant speed 1	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.27	Constant speed 2	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.28	Constant speed 3	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.29	Constant speed 4	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.30	Constant speed 5	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.31	Constant speed 6	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.32	Constant speed 7	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.41	Speed ref safe	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.42	Jogging 1 ref	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm

No.	Name	Type	Range	Unit	FbEq32
22.43	Jogging 2 ref	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.51	Critical speed function	*PB*	00b…11b	-	1 = 1
22.52	Critical speed 1 low	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.53	Critical speed 1 high	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.54	Critical speed 2 low	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.55	Critical speed 2 high	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.56	Critical speed 3 low	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.57	Critical speed 3 high	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.71	Motor potentiometer function	*List*	0…2	-	1 = 1
22.72	Motor potentiometer initial value	*Real*	-32768.00 … 32767.00	-	100 = 1
22.73	Motor potentiometer up source	*Binary src*	-	-	1 = 1
22.74	Motor potentiometer down source	*Binary src*	-	-	1 = 1
22.75	Motor potentiometer ramp time	*Real*	0.0 … 3600.0	s	10 = 1 s
22.76	Motor potentiometer min value	*Real*	-32768.00 … 32767.00	-	100 = 1
22.77	Motor potentiometer max value	*Real*	-32768.00 … 32767.00	-	100 = 1
22.80	Motor potentiometer ref act	*Real*	-32768.00 … 32767.00	-	100 = 1
22.81	Speed reference act 1	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.82	Speed reference act 2	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.83	Speed reference act 3	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.84	Speed reference act 4	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.85	Speed reference act 5	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.86	Speed reference act 6	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.87	Speed reference act 7	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
23 Speed reference ramp					
23.01	Speed ref ramp input	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
23.02	Speed ref ramp output	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
23.11	Ramp set selection	*Binary src*	-	-	1 = 1
23.12	Acceleration time 1	*Real*	0.000 …1800.000	s	1000 = 1 s
23.13	Deceleration time 1	*Real*	0.000 …1800.000	s	1000 = 1 s
23.14	Acceleration time 2	*Real*	0.000 …1800.000	s	1000 = 1 s
23.15	Deceleration time 2	*Real*	0.000 …1800.000	s	1000 = 1 s
23.16	Shape time acc 1	*Real*	0.000 …1800.000	s	1000 = 1 s
23.17	Shape time acc 2	*Real*	0.000 …1800.000	s	1000 = 1 s
23.18	Shape time dec 1	*Real*	0.000 …1800.000	s	1000 = 1 s
23.19	Shape time dec 2	*Real*	0.000 …1800.000	s	1000 = 1 s
23.20	Acc time jogging	*Real*	0.000 …1800.000	s	1000 = 1 s
23.21	Dec time jogging	*Real*	0.000 …1800.000	s	1000 = 1 s
23.23	Emergency stop time	*Real*	0.000 …1800.000	s	1000 = 1 s

No.	Name	Type	Range	Unit	FbEq32
23.24	Speed ramp in zero source	*Binary src*	-	-	1 = 1
23.26	Ramp out balancing enable	*Binary src*	-	-	1 = 1
23.27	Ramp out balancing ref	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
23.28	Variable slope enable	*List*	0…1	-	1 = 1
23.29	Variable slope rate	*Real*	2…30000	ms	1 = 1 ms
23.39	Follower speed correction out	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
23.40	Follower speed correction enable	*Binary src*	-	-	1 = 1
23.41	Follower speed correction gain	*Real*	0.00 … 100.00	%	100 = 1%
23.42	Follower speed corr torq source	*Analog src*	-	-	1 = 1
24 Speed reference conditioning					
24.01	Used speed reference	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
24.02	Used speed feedback	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
24.03	Speed error filtered	*Real*	-30000.0 … 30000.0	rpm	100 = 1 rpm
24.04	Speed error inverted	*Real*	-30000.0 … 30000.0	rpm	100 = 1 rpm
24.11	Speed correction	*Real*	-10000.00 … 10000.00	rpm	100 = 1 rpm
24.12	Speed error filter time	*Real*	0…10000	ms	1 = 1 ms
24.13	RFE speed filter	*List*	0…1	-	1 = 1
24.14	Frequency of zero	*Real*	0.50 … 500.00	Hz	10 = 1 Hz
24.15	Damping of zero	*Real*	-1.000 … 1.000	-	100 = 1
24.16	Frequency of pole	*Real*	0.50 … 500.00	Hz	10 = 1 Hz
24.17	Damping of pole	*Real*	-1.000 … 1.000	-	100 = 1
24.41	Speed error window control enable	*Binary src*	-	-	1 = 1
24.42	Speed window control mode	*List*	0…1	-	1 = 1
24.43	Speed error window high	*Real*	0.00 … 3000.00	rpm	100 = 1 rpm
24.44	Speed error window low	*Real*	0.00 … 3000.00	rpm	100 = 1 rpm
24.46	Speed error step	*Real*	-3000.00 … 3000.00	rpm	100 = 1 rpm
25 Speed control					
25.01	Torque reference speed control	*Real*	-1600.0 … 1600.0	%	10 = 1%
25.02	Speed proportional gain	*Real*	0.00 … 250.00	-	100 = 1
25.03	Speed integration time	*Real*	0.00 … 1000.00	s	100 = 1 s
25.04	Speed derivation time	*Real*	0.000 … 10.000	s	1000 = 1 s
25.05	Derivation filter time	*Real*	0…10000	ms	1 = 1 ms
25.06	Acc comp derivation time	*Real*	0.00 … 1000.00	s	100 = 1 s
25.07	Acc comp filter time	*Real*	0.0 … 1000.0	ms	10 = 1 ms
25.08	Drooping rate	*Real*	0.00 … 100.00	%	100 = 1%
25.09	Speed ctrl balancing enable	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
25.10	Speed ctrl balancing ref	*Real*	-300.0 … 300.0	%	10 = 1%
25.11	Speed control min torque	*Real*	-1600.0 … 0.0	%	10 = 1%
25.12	Speed control max torque	*Real*	0.0 … 1600.0	%	10 = 1%
25.13	Min torq sp ctrl em stop	*Real*	-1600 … 0	%	10 = 1%
25.14	Max torq sp ctrl em stop	*Real*	0…1600	%	10 = 1%
25.15	Proportional gain em stop	*Real*	1.00 … 250.00	-	100 = 1
25.18	Speed adapt min limit	*Real*	0…30000	rpm	1 = 1 rpm
25.19	Speed adapt max limit	*Real*	0…30000	rpm	1 = 1 rpm
25.21	Kp adapt coef at min speed	*Real*	0.000 … 10.000	-	1000 = 1
25.22	Ti adapt coef at min speed	*Real*	0.000 … 10.000	-	1000 = 1
25.25	Torque adapt max limit	*Real*	0.0 … 1600.0	%	10 = 1%
25.26	Torque adapt filt time	*Real*	0.000 … 100.000	s	1000 = 1 s
25.27	Kp adapt coef at min torque	*Real*	0.000 … 10.000	-	1000 = 1
25.30	Flux adaption enable	*List*	0…1	-	1 = 1
25.33	Speed controller autotune	*Binary src*	-	-	1 = 1
25.34	Speed controller autotune mode	*List*	0…2	-	1 = 1
25.37	Mechanical time constant	*Real*	0.00 … 1000.00	s	100 = 1 s
25.38	Autotune torque step	*Real*	0.00 … 100.00	%	100 = 1%
25.39	Autotune speed step	*Real*	0.00 … 100.00	%	100 = 1%
25.40	Autotune repeat times	*Real*	1…10	-	1 = 1
25.53	Torque prop reference	*Real*	-30000.0 … 30000.0	%	10 = 1%
25.54	Torque integral reference	*Real*	-30000.0 … 30000.0	%	10 = 1%
25.55	Torque deriv reference	*Real*	-30000.0 … 30000.0	%	10 = 1%
25.56	Torque acc compensation	*Real*	-30000.0 … 30000.0	%	10 = 1%
25.57	Torque reference unbalanced	*Real*	-30000.0 … 30000.0	%	10 = 1%
26 Torque reference chain					
26.01	Torque reference to TC	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.02	Torque reference used	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.08	Minimum torque ref	*Real*	-1000.0 … 0.0	%	10 = 1%
26.09	Maximum torque ref	*Real*	0.0 … 1000.0	%	10 = 1%
26.11	Torque ref1 source	*Analog src*	-	-	1 = 1
26.12	Torque ref2 source	*Analog src*	-	-	1 = 1
26.13	Torque ref1 function	*List*	0…5	-	1 = 1
26.14	Torque ref1/2 selection	*Binary src*	-	-	1 = 1
26.15	Load share	*Real*	-8.000 … 8.000	-	1000 = 1
26.16	Torque additive 1 source	*Analog src*	-	-	1 = 1
26.17	Torque ref filter time	*Real*	0.000 … 30.000	s	1000 = 1 s

No.	Name	Type	Range	Unit	FbEq32
26.18	Torque ramp up time	*Real*	0.000 … 60.000	s	1000 = 1 s
26.19	Torque ramp down time	*Real*	0.000 … 60.000	s	1000 = 1 s
26.25	Torque additive 2 source	*Analog src*	-	-	1 = 1
26.26	Force torque ref add 2 zero	*Binary src*	-	-	1 = 1
26.41	Torque step	*Real*	-300.0 … 300.0	%	10 = 1%
26.42	Torque step enable	*List*	0…1	-	1 = 1
26.51	Oscillation damping	*Binary src*	-	-	1 = 1
26.52	Oscillation damping out enable	*Binary src*	-	-	1 = 1
26.53	Oscillation compensation input	*List*	0…1	-	1 = 1
26.55	Oscillation damping frequency	*Real*	0.1 … 60.0	Hz	10 = 1 Hz
26.56	Oscillation damping phase	*Real*	0…360	deg	1 = 1 deg
26.57	Oscillation damping gain	*Real*	0.0 … 100.0	%	10 = 1%
26.58	Oscillation damping output	*Real*	-1600.000 … 1600.000	%	1000 = 1%
26.70	Torque reference act 1	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.71	Torque reference act 2	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.72	Torque reference act 3	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.73	Torque reference act 4	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.74	Torque ref ramp out	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.75	Torque reference act 5	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.76	Torque reference act 6	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.77	Torque ref add A actual	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.78	Torque ref add B actual	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.81	Rush control gain	*Real*	0.0 … 10000.0	-	10 = 1
26.82	Rush control integration time	*Real*	0.0 … 10.0	s	10 = 1 s
28 Frequency reference chain					
28.01	Frequency ref ramp input	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.02	Frequency ref ramp output	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.11	Frequency ref1 source	*Analog src*	-	-	1 = 1
28.12	Frequency ref2 source	*Analog src*	-	-	1 = 1
28.13	Frequency ref1 function	*List*	0…5	-	1 = 1
28.14	Frequency ref1/2 selection	*Binary src*	-	-	1 = 1
28.21	Constant frequency function	*PB*	00b…11b	-	1 = 1
28.22	Constant frequency sel1	*Binary src*	-	-	1 = 1
28.23	Constant frequency sel2	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
28.24	Constant frequency sel3	*Binary src*	-	-	1 = 1
28.26	Constant frequency 1	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.27	Constant frequency 2	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.28	Constant frequency 3	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.29	Constant frequency 4	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.30	Constant frequency 5	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.31	Constant frequency 6	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.32	Constant frequency 7	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.41	Frequency ref safe	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.51	Critical frequency function	*PB*	00b…11b	-	1 = 1
28.52	Critical frequency 1 low	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.53	Critical frequency 1 high	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.54	Critical frequency 2 low	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.55	Critical frequency 2 high	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.56	Critical frequency 3 low	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.57	Critical frequency 3 high	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.71	Freq ramp set selection	*Binary src*	-	-	1 = 1
28.72	Freq acceleration time 1	*Real*	0.000 …1800.000	s	1000 = 1 s
28.73	Freq deceleration time 1	*Real*	0.000 …1800.000	s	1000 = 1 s
28.74	Freq acceleration time 2	*Real*	0.000 …1800.000	s	1000 = 1 s
28.75	Freq deceleration time 2	*Real*	0.000 …1800.000	s	1000 = 1 s
28.76	Freq ramp in zero source	*Binary src*	-	-	1 = 1
28.77	Freq ramp hold	*Binary src*	-	-	1 = 1
28.78	Freq ramp output balancing	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.79	Freq ramp out balancing enable	*Binary src*	-	-	1 = 1
28.90	Frequency ref act 1	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.91	Frequency ref act 2	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.92	Frequency ref act 3	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.96	Frequency ref act 7	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.97	Frequency ref unlimited	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
30 Limits					
30.01	Limit word 1	*PB*	0000h…FFFFh	-	1 = 1
30.02	Torque limit status	*PB*	0000h…FFFFh	-	1 = 1
30.11	Minimum speed	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
30.12	Maximum speed	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
30.13	Minimum frequency	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
30.14	Maximum frequency	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
30.15	Maximum start current enable	*List*	0…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
30.16	Maximum start current	*Real*	0.00 … 30000.00	A	100 = 1 A
30.17	Maximum current	*Real*	0.00 … 30000.00	A	100 = 1 A
30.18	Minimum torque sel	*Binary src*	-	-	1 = 1
30.19	Minimum torque 1	*Real*	-1600.0 … 0.0	%	10 = 1%
30.20	Maximum torque 1	*Real*	0.0 … 1600.0	%	10 = 1%
30.21	Minimum torque 2 source	*Analog src*	-	-	1 = 1
30.22	Maximum torque 2 source	*Analog src*	-	-	1 = 1
30.23	Minimum torque 2	*Real*	-1600.0 … 0.0	%	10 = 1%
30.24	Maximum torque 2	*Real*	0.0 … 1600.0	%	10 = 1%
30.25	Maximum torque sel	*Binary src*	-	-	1 = 1
30.26	Power motoring limit	*Real*	0.00 … 600.00	%	100 = 1%
30.27	Power generating limit	*Real*	-600.00 … 0.00	%	100 = 1%
30.30	Overvoltage control	*List*	0…1	-	1 = 1
30.31	Undervoltage control	*List*	0…1	-	1 = 1
31 Fault functions					
31.01	External event 1 source	*Binary src*	-	-	1 = 1
31.02	External event 1 type	*List*	0…3	-	1 = 1
31.03	External event 2 source	*Binary src*	-	-	1 = 1
31.04	External event 2 type	*List*	0…3	-	1 = 1
31.05	External event 3 source	*Binary src*	-	-	1 = 1
31.06	External event 3 type	*List*	0…3	-	1 = 1
31.07	External event 4 source	*Binary src*	-	-	1 = 1
31.08	External event 4 type	*List*	0…3	-	1 = 1
31.09	External event 5 source	*Binary src*	-	-	1 = 1
31.10	External event 5 type	*List*	0…3	-	1 = 1
31.11	Fault reset selection	*Binary src*	-	-	1 = 1
31.12	Autoreset selection	*PB*	0000h…FFFFh	-	1 = 1
31.13	User selectable fault	*Real*	0000h…FFFFh	-	1 = 1
31.14	Number of trials	*Real*	0…5	-	1 = 1
31.15	Total trials time	*Real*	1.0 … 600.0	s	10 = 1 s
31.16	Delay time	*Real*	0.0 … 120.0	s	10 = 1 s
31.19	Motor phase loss	*List*	0…1	-	1 = 1
31.20	Earth fault	*List*	0…2	-	1 = 1
31.21	Supply phase loss	*List*	0…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
31.22	STO indication run/stop	*List*	0…5	-	1 = 1
31.23	Wiring or earth fault	*List*	0…1	-	1 = 1
31.24	Stall function	*List*	0…2	-	1 = 1
31.25	Stall current limit	*Real*	0.0 … 1600.0	%	10 = 1%
31.26	Stall speed limit	*Real*	0.00 … 10000.00	rpm	100 = 1 rpm
31.27	Stall frequency limit	*Real*	0.00 … 500.00	Hz	100 = 1 Hz
31.28	Stall time	*Real*	0…3600	s	1 = 1 s
31.30	Overspeed trip margin	*Real*	0.00 … 10000.00	rpm	100 = 1 rpm
31.32	Emergency ramp supervision	*Real*	0…300	%	1 = 1%
31.33	Emergency ramp supervision delay	*Real*	0…32767	s	1 = 1 s
31.35	Main fan fault function	*List*	0…2	-	1 = 1
31.36	Aux fan fault bypass	*List*	0…1	-	1 = 1
31.37	Ramp stop supervision	*Real*	0…300	%	1 = 1%
31.38	Ramp stop supervision delay	*Real*	0…32767	s	1 = 1 s
31.40	Disable warning messages	*PB*	0000h…FFFFh	-	1 = 1
31.42	Overcurrent fault limit	*Real*	0.00 … 30000.00	A	100 = 1 A
32 Supervision					
32.01	Supervision status	*PB*	000b…111b	-	1 = 1
32.05	Supervision 1 function	*List*	0…6	-	1 = 1
32.06	Supervision 1 action	*List*	0…3	-	1 = 1
32.07	Supervision 1 signal	*Analog src*	-	-	1 = 1
32.08	Supervision 1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
32.09	Supervision 1 low	*Real*	-21474830.00 … 21474830.00	-	100 = 1
32.10	Supervision 1 high	*Real*	-21474830.00 … 21474830.00	-	100 = 1
32.15	Supervision 2 function	*List*	0…6	-	1 = 1
32.16	Supervision 2 action	*List*	0…3	-	1 = 1
32.17	Supervision 2 signal	*Analog src*	-	-	1 = 1
32.18	Supervision 2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
32.19	Supervision 2 low	*Real*	-21474830.00 … 21474830.00	-	100 = 1
32.20	Supervision 2 high	*Real*	-21474830.00 … 21474830.00	-	100 = 1
32.25	Supervision 3 function	*List*	0…6	-	1 = 1
32.26	Supervision 3 action	*List*	0…3	-	1 = 1
32.27	Supervision 3 signal	*Analog src*	-	-	1 = 1
32.28	Supervision 3 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
32.29	Supervision 3 low	*Real*	-21474830.00 … 21474830.00	-	100 = 1

No.	Name	Type	Range	Unit	FbEq32
32.30	Supervision 3 high	*Real*	-21474830.00 … 21474830.00	-	100 = 1
33 Generic timer & counter					
33.01	Counter status	*PB*	000000b…111111b	-	1 = 1
33.10	On-time 1 actual	*Real*	0…4294967295	s	1 = 1 s
33.11	On-time 1 warn limit	*Real*	0…4294967295	s	1 = 1 s
33.12	On-time 1 function	*PB*	00b…11b	-	1 = 1
33.13	On-time 1 source	*Binary src*	-	-	1 = 1
33.14	On-time 1 warn message	*List*	-	-	1 = 1
33.20	On-time 2 actual	*Real*	0…4294967295	s	1 = 1 s
33.21	On-time 2 warn limit	*Real*	0…4294967295	s	1 = 1 s
33.22	On-time 2 function	*PB*	00b…11b	-	1 = 1
33.23	On-time 2 source	*Binary src*	-	-	1 = 1
33.24	On-time 2 warn message	*List*	-	-	1 = 1
33.30	Edge counter 1 actual	*Real*	0…4294967295	-	1 = 1
33.31	Edge counter 1 warn limit	*Real*	0…4294967295	-	1 = 1
33.32	Edge counter 1 function	*PB*	0000b…1111b	-	1 = 1
33.33	Edge counter 1 source	*Binary src*	-	-	1 = 1
33.34	Edge counter 1 divider	*Real*	1…4294967295	-	1 = 1
33.35	Edge counter 1 warn message	*List*	-	-	1 = 1
33.40	Edge counter 2 actual	*Real*	0…4294967295	-	1 = 1
33.41	Edge counter 2 warn limit	*Real*	0…4294967295	-	1 = 1
33.42	Edge counter 2 function	*PB*	0000b…1111b	-	1 = 1
33.43	Edge counter 2 source	*Binary src*	-	-	1 = 1
33.44	Edge counter 2 divider	*Real*	1…4294967295	-	1 = 1
33.45	Edge counter 2 warn message	*List*	-	-	1 = 1
33.50	Value counter 1 actual	*Real*	-2147483008 … 2147483008	-	1 = 1
33.51	Value counter 1 warn limit	*Real*	-2147483008 … 2147483008	-	1 = 1
33.52	Value counter 1 function	*PB*	00b…11b	-	1 = 1
33.53	Value counter 1 source	*Analog src*	-	-	1 = 1
33.54	Value counter 1 divider	*Real*	0.001 … 2147483.000	-	1000 = 1
33.55	Value counter 1 warn message	*List*	-	-	1 = 1
33.60	Value counter 2 actual	*Real*	-2147483008 … 2147483008	-	1 = 1
33.61	Value counter 2 warn limit	*Real*	-2147483008 … 2147483008	-	1 = 1
33.62	Value counter 2 function	*PB*	00b…11b	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
33.63	Value counter 2 source	*Analog src*	-	-	1 = 1
33.64	Value counter 2 divider	*Real*	0.001 … 2147483.000	-	1000 = 1
33.65	Value counter 2 warn message	*List*	-	-	1 = 1
35 Motor thermal protection					
35.01	Motor estimated temperature	*Real*	-60 … 1000	°C or °F	1 = 1°
35.02	Measured temperature 1	*Real*	-60 … 1000 °C, -76 … 1832 °F, 0…5000 ohm	°C, °F or ohm	1 = 1 unit
35.03	Measured temperature 2	*Real*	-60 … 1000 °C, -76 … 1832 °F, 0…5000 ohm	°C, °F or ohm	1 = 1 unit
35.04	FPTC status word	*PB*	0000h…FFFFh	-	1 = 1
35.11	Temperature 1 source	*List*	0…11	-	1 = 1
35.12	Temperature 1 fault limit	*Real*	-60 … 1000 °C, -76 … 1832 °F or 0…5000 ohm	°C, °F or ohm	1 = 1 unit
35.13	Temperature 1 warning limit	*Real*	-60 … 1000 °C, -76 … 1832 °F or 0…5000 ohm	°C, °F or ohm	1 = 1 unit
35.14	Temperature 1 AI source	*Analog src*	-	-	1 = 1
35.21	Temperature 2 source	*List*	0…11	-	1 = 1
35.22	Temperature 2 fault limit	*Real*	-60 … 1000 °C, -76 … 1832 °F or 0…5000 ohm	°C, °F or ohm	1 = 1 unit
35.23	Temperature 2 warning limit	*Real*	-60 … 1000 °C, -76 … 1832 °F or 0…5000 ohm	°C, °F or ohm	1 = 1 unit
35.24	Temperature 2 AI source	*Analog src*	-	-	1 = 1
35.30	FPTC configuration word	*PB*	0000h…FFFFh	-	1 = 1
35.50	Motor ambient temperature	*Real*	-60 … 100 °C or -76 … 212 °F	°C or °F	1 = 1°
35.51	Motor load curve	*Real*	50…150	%	1 = 1%
35.52	Zero speed load	*Real*	50…150	%	1 = 1%
35.53	Break point	*Real*	1.00 … 500.00	Hz	100 = 1 Hz
35.54	Motor nominal temperature rise	*Real*	0…300 °C or 32…572 °F	°C or °F	1 = 1°
35.55	Motor thermal time constant	*Real*	100…10000	s	1 = 1 s
35.60	Cable temperature	*Real*	0.0 … 200.0	%	10 = 1%
35.61	Cable nominal current	*Real*	0.00 … 10000.0	A	100 = 1 A
35.62	Cable thermal rise time	*Real*	0…50000	s	1 = 1 s
35.100	DOL starter control source	*Binary src*	-	-	1 = 1
35.101	DOL starter on delay	*Real*	0…42949673	s	1 = 1 s
35.102	DOL starter off delay	*Real*	0…715828	min	1 = 1 min

No.	Name	Type	Range	Unit	FbEq32
35.103	DOL starter feedback source	*Binary src*	-	-	1 = 1
35.104	DOL starter feedback delay	*Real*	0…42949673	s	1 = 1 s
35.105	DOL starter status word	*PB*	0000b…1111b	-	1 = 1
35.106	DOL starter event type	*List*	0…2	-	1 = 1
36 Load analyzer					
36.01	PVL signal source	*Analog src*	-	-	1 = 1
36.02	PVL filter time	*Real*	0.00 … 120.00	s	100 = 1 s
36.06	AL2 signal source	*Analog src*	-	-	1 = 1
36.07	AL2 signal scaling	*Real*	0.00 … 32767.00	-	100 = 1
36.09	Reset loggers	*List*	0…3	-	1 = 1
36.10	PVL peak value	*Real*	-32768.00 … 32767.00	-	100 = 1
36.11	PVL peak date	*Data*	-	-	1 = 1
36.12	PVL peak time	*Data*	-	-	1 = 1
36.13	PVL current at peak	*Real*	-32768.00 … 32767.00	A	100 = 1 A
36.14	PVL DC voltage at peak	*Real*	0.00 … 2000.00	V	100 = 1 V
36.15	PVL speed at peak	*Real*	-32768.00 … 32767.00	rpm	100 = 1 rpm
36.16	PVL reset date	*Data*	-	-	1 = 1
36.17	PVL reset time	*Data*	-	-	1 = 1
36.20	AL1 0 to 10%	*Real*	0.00 … 100.00	%	100 = 1%
36.21	AL1 10 to 20%	*Real*	0.00 … 100.00	%	100 = 1%
36.22	AL1 20 to 30%	*Real*	0.00 … 100.00	%	100 = 1%
36.23	AL1 30 to 40%	*Real*	0.00 … 100.00	%	100 = 1%
36.24	AL1 40 to 50%	*Real*	0.00 … 100.00	%	100 = 1%
36.25	AL1 50 to 60%	*Real*	0.00 … 100.00	%	100 = 1%
36.26	AL1 60 to 70%	*Real*	0.00 … 100.00	%	100 = 1%
36.27	AL1 70 to 80%	*Real*	0.00 … 100.00	%	100 = 1%
36.28	AL1 80 to 90%	*Real*	0.00 … 100.00	%	100 = 1%
36.29	AL1 over 90%	*Real*	0.00 … 100.00	%	100 = 1%
36.40	AL2 0 to 10%	*Real*	0.00 … 100.00	%	100 = 1%
36.41	AL2 10 to 20%	*Real*	0.00 … 100.00	%	100 = 1%
36.42	AL2 20 to 30%	*Real*	0.00 … 100.00	%	100 = 1%
36.43	AL2 30 to 40%	*Real*	0.00 … 100.00	%	100 = 1%
36.44	AL2 40 to 50%	*Real*	0.00 … 100.00	%	100 = 1%
36.45	AL2 50 to 60%	*Real*	0.00 … 100.00	%	100 = 1%
36.46	AL2 60 to 70%	*Real*	0.00 … 100.00	%	100 = 1%
36.47	AL2 70 to 80%	*Real*	0.00 … 100.00	%	100 = 1%
36.48	AL2 80 to 90%	*Real*	0.00 … 100.00	%	100 = 1%
36.49	AL2 over 90%	*Real*	0.00 … 100.00	%	100 = 1%
36.50	AL2 reset date	*Data*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
36.51	AL2 reset time	*Data*	-	-	1 = 1
37 User load curve					
37.01	ULC output status word	*PB*	0000h…FFFFh	-	1 = 1
37.02	ULC supervision signal	*List*	-	-	1 = 1
37.03	ULC overload actions	*List*	0…3	-	1 = 1
37.04	ULC underload actions	*List*	0…3	-	1 = 1
37.11	ULC speed table point 1	*Real*	0.0 … 30000.0	rpm	10 = 1 rpm
37.12	ULC speed table point 2	*Real*	0.0 … 30000.0	rpm	10 = 1 rpm
37.13	ULC speed table point 3	*Real*	0.0 … 30000.0	rpm	10 = 1 rpm
37.14	ULC speed table point 4	*Real*	0.0 … 30000.0	rpm	10 = 1 rpm
37.15	ULC speed table point 5	*Real*	0.0 … 30000.0	rpm	10 = 1 rpm
37.16	ULC frequency table point 1	*Real*	0.0 … 500.0	Hz	10 = 1 Hz
37.17	ULC frequency table point 2	*Real*	0.0 … 500.0	Hz	10 = 1 Hz
37.18	ULC frequency table point 3	*Real*	0.0 … 500.0	Hz	10 = 1 Hz
37.19	ULC frequency table point 4	*Real*	0.0 … 500.0	Hz	10 = 1 Hz
37.20	ULC frequency table point 5	*Real*	0.0 … 500.0	Hz	10 = 1 Hz
37.21	ULC underload point 1	*Real*	0.0 … 1600.0	%	10 = 1%
37.22	ULC underload point 2	*Real*	0.0 … 1600.0	%	10 = 1%
37.23	ULC underload point 3	*Real*	0.0 … 1600.0	%	10 = 1%
37.24	ULC underload point 4	*Real*	0.0 … 1600.0	%	10 = 1%
37.25	ULC underload point 5	*Real*	0.0 … 1600.0	%	10 = 1%
37.31	ULC overload point 1	*Real*	0.0 … 1600.0	%	10 = 1%
37.32	ULC overload point 2	*Real*	0.0 … 1600.0	%	10 = 1%
37.33	ULC overload point 3	*Real*	0.0 … 1600.0	%	10 = 1%
37.34	ULC overload point 4	*Real*	0.0 … 1600.0	%	10 = 1%
37.35	ULC overload point 5	*Real*	0.0 … 1600.0	%	10 = 1%
37.41	ULC overload timer	*Real*	0.0 … 10000.0	s	10 = 1 s
37.42	ULC underload timer	*Real*	0.0 … 10000.0	s	10 = 1 s
40 Process PID set 1					
40.01	Process PID output actual	*Real*	-32768.00 … 32767.00	rpm, % or Hz	100 = 1 rpm, % or Hz
40.02	Process PID feedback actual	*Real*	-32768.00 … 32767.00	rpm, % or Hz	100 = 1 rpm, % or Hz
40.03	Process PID setpoint actual	*Real*	-32768.00 … 32767.00	rpm, % or Hz	100 = 1 rpm, % or Hz
40.04	Process PID deviation actual	*Real*	-32768.00 … 32767.00	rpm, % or Hz	100 = 1 rpm, % or Hz
40.05	Process PID trim output act	*Real*	-32768.00 … 32767.00	rpm, % or Hz	100 = 1 rpm, % or Hz
40.06	Process PID status word	*PB*	0000h…FFFFh	-	1 = 1
40.07	Set 1 PID operation mode	*List*	0…2	-	1 = 1
40.08	Set 1 feedback 1 source	*Analog src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
40.09	Set 1 feedback 2 source	*Analog src*	-	-	1 = 1
40.10	Set 1 feedback function	*List*	0…11	-	1 = 1
40.11	Set 1 feedback filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
40.12	Set 1 unit selection	*List*	0…2	-	1 = 1
40.14	Set 1 setpoint scaling	*Real*	-32768.00 … 32767.00	-	100 = 1
40.15	Set 1 output scaling	*Real*	-32768.00 … 32767.00	-	100 = 1
40.16	Set 1 setpoint 1 source	*Analog src*	-	-	1 = 1
40.17	Set 1 setpoint 2 source	*Analog src*	-	-	1 = 1
40.18	Set 1 setpoint function	*List*	0…11	-	1 = 1
40.19	Set 1 internal setpoint sel1	*Binary src*	-	-	1 = 1
40.20	Set 1 internal setpoint sel2	*Binary src*	-	-	1 = 1
40.21	Set 1 internal setpoint 1	*Real*	-32768.00 … 32767.00	rpm, % or Hz	100 = 1 rpm, % or Hz
40.22	Set 1 internal setpoint 2	*Real*	-32768.00 … 32767.00	rpm, % or Hz	100 = 1 rpm, % or Hz
40.23	Set 1 internal setpoint 3	*Real*	-32768.00 … 32767.00	rpm, % or Hz	100 = 1 rpm, % or Hz
40.24	Set 1 internal setpoint 4	*Real*	-32768.00 … 32767.00	rpm, % or Hz	100 = 1 rpm, % or Hz
40.25	Set 1 setpoint selection	*Binary src*	-	-	1 = 1
40.26	Set 1 setpoint min	*Real*	-32768.00 … 32767.00	-	100 = 1
40.27	Set 1 setpoint max	*Real*	-32768.00 … 32767.00	-	100 = 1
40.28	Set 1 setpoint increase time	*Real*	0.0 … 1800.0	s	10 = 1 s
40.29	Set 1 setpoint decrease time	*Real*	0.0 … 1800.0	s	10 = 1 s
40.30	Set 1 setpoint freeze enable	*Binary src*	-	-	1 = 1
40.31	Set 1 deviation inversion	*Binary src*	-	-	1 = 1
40.32	Set 1 gain	*Real*	0.10 … 100.00	-	100 = 1
40.33	Set 1 integration time	*Real*	0.0 … 32767.0	s	10 = 1 s
40.34	Set 1 derivation time	*Real*	0.000 … 10.000	s	1000 = 1 s
40.35	Set 1 derivation filter time	*Real*	0.0 … 10.0	s	10 = 1 s
40.36	Set 1 output min	*Real*	-32768.0 … 32767.0	-	10 = 1
40.37	Set 1 output max	*Real*	-32768.0 … 32767.0	-	10 = 1
40.38	Set 1 output freeze enable	*Binary src*	-	-	1 = 1
40.39	Set 1 deadband range	*Real*	0.0 … 32767.0	-	10 = 1
40.40	Set 1 deadband delay	*Real*	0.0 … 3600.0	s	10 = 1 s
40.41	Set 1 sleep mode	*List*	0…2	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
40.42	Set 1 sleep enable	*Binary src*	-	-	1 = 1
40.43	Set 1 sleep level	*Real*	0.0 … 32767.0	-	10 = 1
40.44	Set 1 sleep delay	*Real*	0.0 … 3600.0	s	10 = 1 s
40.45	Set 1 sleep boost time	*Real*	0.0 … 3600.0	s	10 = 1 s
40.46	Set 1 sleep boost step	*Real*	0.0 … 32767.0	-	10 = 1
40.47	Set 1 wake-up deviation	*Real*	-32768.00 … 32767.00	rpm, % or Hz	100 = 1 rpm, % or Hz
40.48	Set 1 wake-up delay	*Real*	0.00 … 60.00	s	100 = 1 s
40.49	Set 1 tracking mode	*Binary src*	-	-	1 = 1
40.50	Set 1 tracking ref selection	*Analog src*	-	-	1 = 1
40.51	Set 1 trim mode	*List*	0…3	-	1 = 1
40.52	Set 1 trim selection	*List*	1…3	-	1 = 1
40.53	Set 1 trimmed ref pointer	*Analog src*	-	-	1 = 1
40.54	Set 1 trim mix	*Real*	0.000 … 1.000	-	1000 = 1
40.55	Set 1 trim adjust	*Real*	-100.000 … 100.000	-	1000 = 1
40.56	Set 1 trim source	*List*	1…2	-	1 = 1
40.57	PID set1/set2 selection	*Binary src*	-	-	1 = 1
40.60	Set 1 PID activation source	*Binary src*	-	-	1 = 1
40.91	Feedback data storage	*Real*	-327.68 … 327.67	-	100 = 1
40.92	Setpoint data storage	*Real*	-327.68 … 327.67	-	100 = 1
41 Process PID set 2					
41.07	Set 2 PID operation mode	*List*	0…2	-	1 = 1
41.08	Set 2 feedback 1 source	*Analog src*	-	-	1 = 1
41.09	Set 2 feedback 2 source	*Analog src*	-	-	1 = 1
41.10	Set 2 feedback function	*List*	0…11	-	1 = 1
41.11	Set 2 feedback filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
41.12	Set 2 unit selection	*List*	0…2	-	1 = 1
41.14	Set 2 setpoint scaling	*Real*	-32768 … 32767	-	100 = 1
41.15	Set 2 output scaling	*Real*	-32768 … 32767	-	100 = 1
41.16	Set 2 setpoint 1 source	*Analog src*	-	-	1 = 1
41.17	Set 2 setpoint 2 source	*Analog src*	-	-	1 = 1
41.18	Set 2 setpoint function	*List*	0…11	-	1 = 1
41.19	Set 2 internal setpoint sel1	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
41.20	Set 2 internal setpoint sel2	*Binary src*	-	-	1 = 1
41.21	Set 2 internal setpoint 1	*Real*	-32768.0 … 32767.0	rpm, % or Hz	100 = 1 rpm, % or Hz
41.22	Set 2 internal setpoint 2	*Real*	-32768.0 … 32767.0	rpm, % or Hz	100 = 1 rpm, % or Hz
41.23	Set 2 internal setpoint 3	*Real*	-32768.0 … 32767.0	rpm, % or Hz	100 = 1 rpm, % or Hz
41.24	Set 2 internal setpoint 4	*Real*	-32768.0 … 32767.0	rpm, % or Hz	100 = 1 rpm, % or Hz
41.25	Set 2 setpoint selection	*Binary src*	-	-	1 = 1
41.26	Set 2 setpoint min	*Real*	-32768.0 … 32767.0	-	100 = 1
41.27	Set 2 setpoint max	*Real*	-32768.0 … 32767.0	-	100 = 1
41.28	Set 2 setpoint increase time	*Real*	0.0 … 1800.0	s	10 = 1 s
41.29	Set 2 setpoint decrease time	*Real*	0.0 … 1800.0	s	10 = 1 s
41.30	Set 2 setpoint freeze enable	*Binary src*	-	-	1 = 1
41.31	Set 2 deviation inversion	*Binary src*	-	-	1 = 1
41.32	Set 2 gain	*Real*	0.1 … 100.0	-	100 = 1
41.33	Set 2 integration time	*Real*	0.0 … 3600.0	s	10 = 1 s
41.34	Set 2 derivation time	*Real*	0.0 … 10.0	s	1000 = 1 s
41.35	Set 2 derivation filter time	*Real*	0.0 … 10.0	s	10 = 1 s
41.36	Set 2 output min	*Real*	-32768.0 … 32767.0	-	10 = 1
41.37	Set 2 output max	*Real*	-32768.0 … 32767.0	-	10 = 1
41.38	Set 2 output freeze enable	*Binary src*	-	-	1 = 1
41.39	Set 2 deadband range	*Real*	0.0 … 32767.0	-	10 = 1
41.40	Set 2 deadband delay	*Real*	0.0 … 3600.0	s	10 = 1 s
41.41	Set 2 sleep mode	*List*	0…2	-	1 = 1
41.42	Set 2 sleep enable	*Binary src*	-	-	1 = 1
41.43	Set 2 sleep level	*Real*	0.0 … 32767.0	-	10 = 1
41.44	Set 2 sleep delay	*Real*	0.0 … 3600.0	s	10 = 1 s
41.45	Set 2 sleep boost time	*Real*	0.0 … 3600.0	s	10 = 1 s
41.46	Set 2 sleep boost step	*Real*	0.0 … 32767.0	-	10 = 1
41.47	Set 2 wake-up deviation	*Real*	-32768.00 … 32767.00	rpm, % or Hz	100 = 1 rpm, % or Hz
41.48	Set 2 wake-up delay	*Real*	0.00 … 60.00	s	100 = 1 s
41.49	Set 2 tracking mode	*Binary src*	-	-	1 = 1
41.50	Set 2 tracking ref selection	*Analog src*	-	-	1 = 1
41.51	Set 2 trim mode	*List*	0…3	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
41.52	Set 2 trim selection	*List*	1…3	-	1 = 1
41.53	Set 2 trimmed ref pointer	*Analog src*	-	-	1 = 1
41.54	Set 2 trim mix	*Real*	0.000 … 1.000	-	1000 = 1
41.55	Set 2 trim adjust	*Real*	-100.000 … 100.000	-	1000 = 1
41.56	Set 2 trim source	*List*	1…2	-	1 = 1
41.60	Set 2 PID activation source	*Binary src*	-	-	1 = 1
43 Brake chopper					
43.01	Braking resistor temperature	*Real*	0.0 … 120.0	%	10 = 1%
43.06	Brake chopper function	*List*	0…3	-	1 = 1
43.07	Brake chopper run enable	*Binary src*	-	-	1 = 1
43.08	Brake resistor thermal tc	*Real*	0…10000	s	1 = 1 s
43.09	Brake resistor Pmax cont	*Real*	0.00 … 10000.00	kW	100 = 1 kW
43.10	Brake resistance	*Real*	0.0 … 1000.0	ohm	10 = 1 ohm
43.11	Brake resistor fault limit	*Real*	0…150	%	1 = 1%
43.12	Brake resistor warning limit	*Real*	0…150	%	1 = 1%
44 Mechanical brake control					
44.01	Brake control status	*PB*	00000000b…11111111b	-	1 = 1
44.02	Brake torque memory	*Real*	-1600.0 … 1600.0	%	10 = 1%
44.03	Brake open torque reference	*Real*	-1600.0 … 1600.0	%	10 = 1%
44.06	Brake control enable	*Binary src*	-	-	1 = 1
44.07	Brake acknowledge selection	*Binary src*	-	-	1 = 1
44.08	Brake open delay	*Real*	0.00 … 5.00	s	100 = 1 s
44.09	Brake open torque source	*Analog src*	-	-	1 = 1
44.10	Brake open torque	*Real*	-1000…1000	%	10 = 1%
44.11	Keep brake closed	*Binary src*	-	-	1 = 1
44.12	Brake close request	*Binary src*	-	-	1 = 1
44.13	Brake close delay	*Real*	0.00 … 60.00	s	100 = 1 s
44.14	Brake close level	*Real*	0.0 … 1000.0	rpm	100 = 1 rpm
44.15	Brake close level delay	*Real*	0.00 … 10.00	s	100 = 1 s
44.16	Brake reopen delay	*Real*	0.00 … 10.00	s	100 = 1 s
44.17	Brake fault function	*List*	0…2	-	1 = 1
44.18	Brake fault delay	*Real*	0.00 … 60.00	s	100 = 1 s
45 Energy efficiency					
45.01	Saved GW hours	*Real*	0…65535	GWh	1 = 1 GWh
45.02	Saved MW hours	*Real*	0…999	MWh	1 = 1 MWh

No.	Name	Type	Range	Unit	FbEq32
45.03	Saved kW hours	*Real*	0.0 … 999.0	kWh	10 = 1 kWh
45.05	Saved money x1000	*Real*	0…4294967295	thousand	1 = 1 thousand
45.06	Saved money	*Real*	0.00 … 999.99	(selecta-ble)	100 = 1 unit
45.08	CO2 reduction in kilotons	*Real*	0…65535	metric kiloton	1 = 1 metric kiloton
45.09	CO2 reduction in tons	*Real*	0.0 … 999.9	metric ton	10 = 1 metric ton
45.11	Energy optimizer	*List*	0…1	-	1 = 1
45.12	Energy tariff 1	*Real*	0.000 … 4294967.295	(selecta-ble)	1000 = 1 unit
45.13	Energy tariff 2	*Real*	0.000 … 4294967.295	(selecta-ble)	1000 = 1 unit
45.14	Tariff selection	*Binary src*	-	-	1 = 1
45.17	Tariff currency unit	*List*	100…102	-	1 = 1
45.18	CO2 conversion factor	*Real*	0.000 … 65.535	metric ton/ MWh	1000 = 1 metric ton/MWh
45.19	Comparison power	*Real*	0.0 … 100000.0	kW	10 = 1 kW
45.21	Energy calculations reset	*List*	0…1	-	1 = 1
46 Monitoring/scaling settings					
46.01	Speed scaling	*Real*	0.10 … 30000.00	rpm	100 = 1 rpm
46.02	Frequency scaling	*Real*	0.10 … 1000.00	Hz	100 = 1 Hz
46.03	Torque scaling	*Real*	0.1 … 1000.0	%	10 = 1%
46.04	Power scaling	*Real*	0.10 … 30000.00 kW or 0.10 … 40214.48 hp	kW or hp	100 = 1 unit
46.05	Current scaling	*Real*	0…30000	A	1 = 1 A
46.06	Speed ref zero scaling	*Real*	0.00 … 30000.00	rpm	100 = 1 rpm
46.07	Frequency ref zero scaling	*Real*	0.00 … 1000.00	Hz	100 = 1 Hz
46.11	Filter time motor speed	*Real*	0…20000	ms	1 = 1 ms
46.12	Filter time output frequency	*Real*	0…20000	ms	1 = 1 ms
46.13	Filter time motor torque	*Real*	0…20000	ms	1 = 1 ms
46.14	Filter time power out	*Real*	0…20000	ms	1 = 1 ms
46.21	At speed hysteresis	*Real*	0.00 … 30000.00	rpm	100 = 1 rpm
46.22	At frequency hysteresis	*Real*	0.00 … 1000.00	Hz	100 = 1 Hz
46.23	At torque hysteresis	*Real*	0.0 … 300.0	%	1 = 1%
46.31	Above speed limit	*Real*	0.00 … 30000.00	rpm	100 = 1 rpm
46.32	Above frequency limit	*Real*	0.00 … 1000.00	Hz	100 = 1 Hz
46.33	Above torque limit	*Real*	0.0 … 1600.0	%	10 = 1%
46.42	Torque decimals	*List*	0…2	-	1 = 1
47 Data storage					
47.01	Data storage 1 real32	*Real*	Defined by *47.31*	-	1000 = 1
47.02	Data storage 2 real32	*Real*	Defined by *47.32*	-	1000 = 1

No.	Name	Type	Range	Unit	FbEq32
47.03	Data storage 3 real32	*Real*	Defined by *47.33*	-	1000 = 1
47.04	Data storage 4 real32	*Real*	Defined by *47.34*	-	1000 = 1
47.05	Data storage 5 real32	*Real*	Defined by *47.35*	-	1000 = 1
47.06	Data storage 6 real32	*Real*	Defined by *47.36*	-	1000 = 1
47.07	Data storage 7 real32	*Real*	Defined by *47.37*	-	1000 = 1
47.08	Data storage 8 real32	*Real*	Defined by *47.38*	-	1000 = 1
47.11	Data storage 1 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.12	Data storage 2 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.13	Data storage 3 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.14	Data storage 4 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.15	Data storage 5 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.16	Data storage 6 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.17	Data storage 7 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.18	Data storage 8 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.21	Data storage 1 int16	*Real*	-32768 … 32767	-	1 = 1
47.22	Data storage 2 int16	*Real*	-32768 … 32767	-	1 = 1
47.23	Data storage 3 int16	*Real*	-32768 … 32767	-	1 = 1
47.24	Data storage 4 int16	*Real*	-32768 … 32767	-	1 = 1
47.25	Data storage 5 int16	*Real*	-32768 … 32767	-	1 = 1
47.26	Data storage 6 int16	*Real*	-32768 … 32767	-	1 = 1
47.27	Data storage 7 int16	*Real*	-32768 … 32767	-	1 = 1
47.28	Data storage 8 int16	*Real*	-32768 … 32767	-	1 = 1
47.31	Data storage 1 real32 type	*List*	0…5	-	1 = 1
47.32	Data storage 2 real32 type	*List*	0…5	-	1 = 1
47.33	Data storage 3 real32 type	*List*	0…5	-	1 = 1
47.34	Data storage 4 real32 type	*List*	0…5	-	1 = 1
47.35	Data storage 5 real32 type	*List*	0…5	-	1 = 1
47.36	Data storage 6 real32 type	*List*	0…5	-	1 = 1
47.37	Data storage 7 real32 type	*List*	0…5	-	1 = 1
47.38	Data storage 8 real32 type	*List*	0…5	-	1 = 1
49 Panel port communication					
49.01	Node ID number	*Real*	1…32	-	1 = 1
49.03	Baud rate	*List*	1…5	-	1 = 1
49.04	Communication loss time	*Real*	0.3 … 3000.0	s	10 = 1 s
49.05	Communication loss action	*List*	0…5	-	1 = 1
49.06	Refresh settings	*List*	0…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
49.07	Panel comm supervision force	*PB*	0000h…FFFFh	-	1 = 1
49.08	Secondary comm. loss action	*List*	0…5	-	1 = 1
49.14	Panel speed reference unit	*List*	0…1	-	1 = 1
49.15	Minimum ext speed ref panel	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
49.16	Maximum ext speed ref panel	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
49.17	Minimum ext frequency ref panel	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
49.18	Maximum ext frequency ref panel	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
50 Fieldbus adapter (FBA)					
50.01	FBA A enable	*List*	0…3	-	1 = 1
50.02	FBA A comm loss func	*List*	0…5	-	1 = 1
50.03	FBA A comm loss t out	*Real*	0.3 … 6553.5	s	10 = 1 s
50.04	FBA A ref1 type	*List*	0…5	-	1 = 1
50.05	FBA A ref2 type	*List*	0…5	-	1 = 1
50.07	FBA A actual 1 type	*List*	0…6	-	1 = 1
50.08	FBA A actual 2 type	*List*	0…6	-	1 = 1
50.09	FBA A SW transparent source	*Analog src*	-	-	1 = 1
50.10	FBA A act1 transparent source	*Analog src*	-	-	1 = 1
50.11	FBA A act2 transparent source	*Analog src*	-	-	1 = 1
50.12	FBA A debug mode	*List*	0…1	-	1 = 1
50.13	FBA A control word	*Data*	00000000h … FFFFFFFFh	-	1 = 1
50.14	FBA A reference 1	*Real*	-2147483648 … 2147483647	-	1 = 1
50.15	FBA A reference 2	*Real*	-2147483648 … 2147483647	-	1 = 1
50.16	FBA A status word	*Data*	00000000h … FFFFFFFFh	-	1 = 1
50.17	FBA A actual value 1	*Real*	-2147483648 … 2147483647	-	1 = 1
50.18	FBA A actual value 2	*Real*	-2147483648 … 2147483647	-	1 = 1
50.21	FBA A timelevel sel	*List*	0…3	-	1 = 1
50.26	FBA A comm supervision force	*PB*	0000h…FFFFh	-	1 = 1
50.31	FBA B enable	*List*	0…1	-	1 = 1
50.32	FBA B comm loss func	*Real*	0…5	-	1 = 1
50.33	FBA B comm loss timeout	*List*	0.3 … 6553.5	s	10 = 1 s
50.34	FBA B ref1 type	*List*	0…5	-	1 = 1
50.35	FBA B ref2 type	*List*	0…5	-	1 = 1
50.37	FBA B actual 1 type	*List*	0…6	-	1 = 1
50.38	FBA B actual 2 type	*List*	0…6	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
50.39	FBA B SW transparent source	*Analog src*	-	-	1 = 1
50.40	FBA B act1 transparent source	*Analog src*	-	-	1 = 1
50.41	FBA B act2 transparent source	*List*	-	-	1 = 1
50.42	FBA B debug mode	*Data*	0…1	-	1 = 1
50.43	FBA B control word	*Real*	00000000h … FFFFFFFFh	-	1 = 1
50.44	FBA B reference 1	*Real*	-2147483648 … 2147483647	-	1 = 1
50.45	FBA B reference 2	*Data*	-2147483648 … 2147483647	-	1 = 1
50.46	FBA B status word	*Real*	00000000h … FFFFFFFFh	-	1 = 1
50.47	FBA B actual value 1	*Real*	-2147483648 … 2147483647	-	1 = 1
50.48	FBA B actual value 2		-2147483648 … 2147483647	-	1 = 1
50.51	FBA B timelevel sel	*List*	0…3	-	1 = 1
50.56	FBA B comm supervision force	*PB*	0000h…FFFFh	-	1 = 1
51 FBA A settings					
51.01	FBA A type	*List*	-	-	1 = 1
51.02	FBA A Par2	*Real*	0…65535	-	1 = 1
…	…	…	…	…	
51.26	FBA A Par26	*Real*	0…65535	-	1 = 1
51.27	FBA A par refresh	*List*	0…1	-	1 = 1
51.28	FBA A par table ver	*Data*	-	-	1 = 1
51.29	FBA A drive type code	*Real*	0…65535	-	1 = 1
51.30	FBA A mapping file ver	*Real*	0…65535	-	1 = 1
51.31	D2FBA A comm status	*List*	0…6	-	1 = 1
51.32	FBA A comm SW ver	*Data*	-	-	1 = 1
51.33	FBA A appl SW ver	*Data*	-	-	1 = 1
52 FBA A data in					
52.01	FBA A data in1	*List*	-	-	1 = 1
…	…	…	…	…	
52.12	FBA A data in12	*List*	-	-	1 = 1
53 FBA A data out					
53.01	FBA A data out1	*List*	-	-	1 = 1
…	…	…	…	…	
53.12	FBA A data out12	*List*	-	-	1 = 1
54 FBA B settings					
54.01	FBA B type				
54.02	FBA B Par2	UINT16	0…65535	-	
…	…	…	…	…	
54.26	FBA B Par26	UINT16	0…65535	-	

No.	Name	Type	Range	Unit	FbEq32
54.27	FBA B par refresh	*List*	0…1	-	
54.28	FBA B par table ver	UINT16	0…65535	-	
54.29	FBA B drive type code	UINT16	0…65535	-	
54.30	FBA B mapping file ver	UINT16	0…65535	-	
54.31	D2FBA B comm status	*List*	0…6	-	
54.32	FBA B comm SW ver	UINT16	0…65535	-	
54.33	FBA B appl SW ver	UINT16	0…65535	-	
55 FBA B data in					
55.01	FBA B data in1	*List*	-	-	1 = 1
…	…	…	…	…	
55.12	FBA B data in12	*List*	-	-	1 = 1
56 FBA B data out					
56.01	FBA B data out1	*List*	-	-	1 = 1
…	…	…	…	…	
56.12	FBA B data out12	*List*	-	-	1 = 1
58 Embedded fieldbus					
58.01	Protocol enable	*List*	0…1	-	1 = 1
58.02	Protocol ID	*Real*	0000h…FFFFh	-	1 = 1
58.03	Node address	*Real*	0…255	-	1 = 1
58.04	Baud rate	*List*	2…7	-	1 = 1
58.05	Parity	*List*	0…3	-	1 = 1
58.06	Communication control	*List*	0…2	-	1 = 1
58.07	Communication diagnostics	*PB*	0000h…FFFFh	-	1 = 1
58.08	Received packets	*Real*	0…4294967295	-	1 = 1
58.09	Transmitted packets	*Real*	0…4294967295	-	1 = 1
58.10	All packets	*Real*	0…4294967295	-	1 = 1
58.11	UART errors	*Real*	0…4294967295	-	1 = 1
58.12	CRC errors	*Real*	0…4294967295	-	1 = 1
58.14	Communication loss action	*List*	0…5	-	1 = 1
58.15	Communication loss mode	*List*	1…2	-	1 = 1
58.16	Communication loss time	*Real*	0.0 … 6000.0	s	10 = 1 s
58.17	Transmit delay	*Real*	0…65535	ms	1 = 1 ms
58.18	EFB control word	*PB*	0000h…FFFFh	-	1 = 1
58.19	EFB status word	*PB*	0000h…FFFFh	-	1 = 1
58.25	Control profile	*List*	0, 2	-	1 = 1
58.26	EFB ref1 type	*List*	0…5	-	1 = 1
58.27	EFB ref2 type	*List*	0…5	-	1 = 1
58.28	EFB act1 type	*List*	0…6	-	1 = 1
58.29	EFB act2 type	*List*	0…6	-	1 = 1
58.30	EFB status word transparent source	*Analog src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
58.31	EFB act1 transparent source	*Analog src*	-	-	1 = 1
58.32	EFB act2 transparent source	*Analog src*	-	-	1 = 1
58.33	Addressing mode	*List*	0…2	-	1 = 1
58.34	Word order	*List*	0…1	-	1 = 1
58.36	EFB comm supervision force	*PB*	0000h…FFFFh	-	1 = 1
58.101	Data I/O 1	*Analog src*	-	-	1 = 1
58.102	Data I/O 2	*Analog src*	-	-	1 = 1
58.103	Data I/O 3	*Analog src*	-	-	1 = 1
58.104	Data I/O 4	*Analog src*	-	-	1 = 1
58.105	Data I/O 5	*Analog src*	-	-	1 = 1
58.106	Data I/O 6	*Analog src*	-	-	1 = 1
58.107	Data I/O 7	*Analog src*	-	-	1 = 1
…	…	…	…	…	
58.124	Data I/O 24	*Analog src*	-	-	1 = 1
60 DDCS communication					
60.01	M/F communication port	*List*	-	-	-
60.02	M/F node address	*Real*	1…254	-	-
60.03	M/F mode	*List*	0…6	-	-
60.05	M/F HW connection	*List*	0…1	-	-
60.07	M/F link control	*Real*	1…15	-	-
60.08	M/F comm loss timeout	*Real*	0…65535	ms	-
60.09	M/F comm loss function	*List*	0…3	-	-
60.10	M/F ref1 type	*List*	0…5	-	-
60.11	M/F ref2 type	*List*	0…5	-	-
60.12	M/F act1 type	*List*	0…5	-	-
60.13	M/F act2 type	*List*	0…5	-	-
60.14	M/F follower selection	*Real*	0…16	-	-
60.15	Force master	*Binary src*	-	-	1 = 1
60.16	Force follower	*Binary src*	-	-	1 = 1
60.17	Follower fault action	*List*	0…2	-	-
60.18	Follower enable	*List*	0…6	-	-
60.19	M/F comm supervision sel 1	*PB*	0000h…FFFFh	-	1 = 1
60.20	M/F comm supervision sel 2	*PB*	0000h…FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
60.23	M/F status supervision sel 1	*PB*	0000h…FFFFh	-	1 = 1
60.24	M/F status supervision sel 2	*PB*	0000h…FFFFh	-	1 = 1
60.27	M/F status supv mode sel 1	*PB*	0000h…FFFFh	-	1 = 1
60.28	M/F status supv mode sel 2	*PB*	0000h…FFFFh	-	1 = 1
60.31	M/F wake up delay	*Real*	0.0 … 180.0	s	10 = 1 s
60.32	M/F comm supervision force	*PB*	0000h…FFFFh	-	1 = 1
60.41	Extension adapter com port	*List*	-	-	-
60.50	DDCS controller drive type	*List*	0…1	-	-
60.51	DDCS controller comm port	*List*	-	-	-
60.52	DDCS controller node address	*Real*	1…254	-	-
60.55	DDCS controller HW connection	*List*	0…1	-	-
60.57	DDCS controller link control	*Real*	1…15	-	-
60.58	DDCS controller comm loss time	*Real*	0…60000	ms	-
60.59	DDCS controller comm loss function	*List*	0…5	-	-
60.60	DDCS controller ref1 type	*List*	0…5	-	-
60.61	DDCS controller ref2 type	*List*	0…5	-	-
60.62	DDCS controller act1 type	*List*	0…5	-	-
60.63	DDCS controller act2 type	*List*	0…5	-	-
60.64	Mailbox dataset selection	*List*	0…1	-	-
60.65	DDCS controller comm supervision force	*PB*	0000h…FFFFh	-	1 = 1
(Parameters 60.71…60.79 only visible with a BCU control unit)					
60.71	INU-LSU communication port	*List*	-	-	1 = 1
60.77	INU-LSU link control	*Real*	1…15	-	-
60.78	INU-LSU comm loss timeout	*Real*	0…65535	ms	-
60.79	INU-LSU comm loss function	*Binary src*	-	-	1 = 1
61 D2D and DDCS transmit data					
61.01	M/F data 1 selection	*List*	-	-	-
61.02	M/F data 2 selection	*List*	-	-	-
61.03	M/F data 3 selection	*List*	-	-	-
61.25	M/F data 1 value	*Real*	0…65535	-	-
61.26	M/F data 2 value	*Real*	0…65535	-	-
61.27	M/F data 3 value	*Real*	0…65535	-	-
61.45	Data set 2 data 1 selection	*List*	-	-	-
61.46	Data set 2 data 2 selection	*List*	-	-	-
61.47	Data set 2 data 3 selection	*List*	-	-	-
61.48	Data set 4 data 1 selection	*List*	-	-	-
61.49	Data set 4 data 2 selection	*List*	-	-	-
61.50	Data set 4 data 3 selection	*List*	-	-	-

No.	Name	Type	Range	Unit	FbEq32
61.51	Data set 11 data 1 selection	*List*	-	-	-
61.52	Data set 11 data 2 selection	*List*	-	-	-
61.53	Data set 11 data 3 selection	*List*	-	-	-
61.54	Data set 13 data 1 selection	*List*	-	-	-
61.55	Data set 13 data 2 selection	*List*	-	-	-
61.56	Data set 13 data 3 selection	*List*	-	-	-
61.57	Data set 15 data 1 selection	*List*	-	-	-
61.58	Data set 15 data 2 selection	*List*	-	-	-
61.59	Data set 15 data 3 selection	*List*	-	-	-
61.60	Data set 17 data 1 selection	*List*	-	-	-
61.61	Data set 17 data 2 selection	*List*	-	-	-
61.62	Data set 17 data 3 selection	*List*	-	-	-
61.63	Data set 19 data 1 selection	*List*	-	-	-
61.64	Data set 19 data 2 selection	*List*	-	-	-
61.65	Data set 19 data 3 selection	*List*	-	-	-
61.66	Data set 21 data 1 selection	*List*	-	-	-
61.67	Data set 21 data 2 selection	*List*	-	-	-
61.68	Data set 21 data 3 selection	*List*	-	-	-
61.69	Data set 23 data 1 selection	*List*	-	-	-
61.70	Data set 23 data 2 selection	*List*	-	-	-
61.71	Data set 23 data 3 selection	*List*	-	-	-
61.72	Data set 25 data 1 selection	*List*	-	-	-
61.73	Data set 25 data 2 selection	*List*	-	-	-
61.74	Data set 25 data 3 selection	*List*	-	-	-
61.95	Data set 2 data 1 value	*Real*	0…65535	-	-
61.96	Data set 2 data 2 value	*Real*	0…65535	-	-
61.97	Data set 2 data 3 value	*Real*	0…65535	-	-
61.98	Data set 4 data 1 value	*Real*	0…65535	-	-
61.99	Data set 4 data 2 value	*Real*	0…65535	-	-
61.100	Data set 4 data 3 value	*Real*	0…65535	-	-
61.101	Data set 11 data 1 value	*Real*	0…65535	-	-
61.102	Data set 11 data 2 value	*Real*	0…65535	-	-
61.103	Data set 11 data 3 value	*Real*	0…65535	-	-
61.104	Data set 13 data 1 value	*Real*	0…65535	-	-
61.105	Data set 13 data 2 value	*Real*	0…65535	-	-
61.106	Data set 13 data 3 value	*Real*	0…65535	-	-
61.107	Data set 15 data 1 value	*Real*	0…65535	-	-
61.108	Data set 15 data 2 value	*Real*	0…65535	-	-
61.109	Data set 15 data 3 value	*Real*	0…65535	-	-
61.110	Data set 17 data 1 value	*Real*	0…65535	-	-
61.111	Data set 17 data 2 value	*Real*	0…65535	-	-

No.	Name	Type	Range	Unit	FbEq32
61.112	Data set 17 data 3 value	*Real*	0…65535	-	-
61.113	Data set 19 data 1 value	*Real*	0…65535	-	-
61.114	Data set 19 data 2 value	*Real*	0…65535	-	-
61.115	Data set 19 data 3 value	*Real*	0…65535	-	-
61.116	Data set 21 data 1 value	*Real*	0…65535	-	-
61.117	Data set 21 data 2 value	*Real*	0…65535	-	-
61.118	Data set 21 data 3 value	*Real*	0…65535	-	-
61.119	Data set 23 data 1 value	*Real*	0…65535	-	-
61.120	Data set 23 data 2 value	*Real*	0…65535	-	-
61.121	Data set 23 data 3 value	*Real*	0…65535	-	-
61.122	Data set 25 data 1 value	*Real*	0…65535	-	-
61.123	Data set 25 data 2 value	*Real*	0…65535	-	-
61.124	Data set 25 data 3 value	*Real*	0…65535	-	-
(Parameters 61.151…61.203 only visible with a BCU control unit)					
61.151	INU-LSU data set 10 data 1 sel	*List*	-	-	-
61.152	INU-LSU data set 10 data 2 sel	*List*	-	-	-
61.153	INU-LSU data set 10 data 3 sel	*List*	-	-	-
61.201	INU-LSU data set 10 data 1 value	*Real*	0…65535	-	-
61.202	INU-LSU data set 10 data 2 value	*Real*	0…65535	-	-
61.203	INU-LSU data set 10 data 3 value	*Real*	0…65535	-	-
62 D2D and DDCS receive data					
62.01	M/F data 1 selection	*List*	-	-	-
62.02	M/F data 2 selection	*List*	-	-	-
62.03	M/F data 3 selection	*List*	-	-	-
62.04	Follower node 2 data 1 sel	*List*	-	-	-
62.05	Follower node 2 data 2 sel	*List*	-	-	-
62.06	Follower node 2 data 3 sel	*List*	-	-	-
62.07	Follower node 3 data 1 sel	*List*	-	-	-
62.08	Follower node 3 data 2 sel	*List*	-	-	-
62.09	Follower node 3 data 3 sel	*List*	-	-	-
62.10	Follower node 4 data 1 sel	*List*	-	-	-
62.11	Follower node 4 data 2 sel	*List*	-	-	-
62.12	Follower node 4 data 3 sel	*List*	-	-	-
62.25	MF data 1 value	*Real*	0…65535	-	-
62.26	MF data 2 value	*Real*	0…65535	-	-
62.27	MF data 3 value	*Real*	0…65535	-	-

No.	Name	Type	Range	Unit	FbEq32
62.28	Follower node 2 data 1 value	*Real*	0…65535	-	-
62.29	Follower node 2 data 2 value	*Real*	0…65535	-	-
62.30	Follower node 2 data 3 value	*Real*	0…65535	-	-
62.31	Follower node 3 data 1 value	*Real*	0…65535	-	-
62.32	Follower node 3 data 2 value	*Real*	0…65535	-	-
62.33	Follower node 3 data 3 value	*Real*	0…65535	-	-
62.34	Follower node 4 data 1 value	*Real*	0…65535	-	-
62.35	Follower node 4 data 2 value	*Real*	0…65535	-	-
62.36	Follower node 4 data 3 value	*Real*	0…65535	-	-
62.37	M/F communication status 1	*PB*	0000h…FFFFh	-	1 = 1
62.38	M/F communication status 2	*PB*	0000h…FFFFh	-	1 = 1
62.41	M/F follower ready status 1	*PB*	0000h…FFFFh	-	1 = 1
62.42	M/F follower ready status 2	*PB*	0000h…FFFFh	-	1 = 1
62.45	Data set 1 data 1 selection	*List*	-	-	-
62.46	Data set 1 data 2 selection	*List*	-	-	-
62.47	Data set 1 data 3 selection	*List*	-	-	-
62.48	Data set 3 data 1 selection	*List*	-	-	-
62.49	Data set 3 data 2 selection	*List*	-	-	-
62.50	Data set 3 data 3 selection	*List*	-	-	-
62.51	Data set 10 data 1 selection	*List*	-	-	-
62.52	Data set 10 data 2 selection	*List*	-	-	-
62.53	Data set 10 data 3 selection	*List*	-	-	-
62.54	Data set 12 data 1 selection	*List*	-	-	-
62.55	Data set 12 data 2 selection	*List*	-	-	-
62.56	Data set 12 data 3 selection	*List*	-	-	-
62.57	Data set 14 data 1 selection	*List*	-	-	-
62.58	Data set 14 data 2 selection	*List*	-	-	-
62.59	Data set 14 data 3 selection	*List*	-	-	-
62.60	Data set 16 data 1 selection	*List*	-	-	-
62.61	Data set 16 data 2 selection	*List*	-	-	-
62.62	Data set 16 data 3 selection	*List*	-	-	-
62.63	Data set 18 data 1 selection	*List*	-	-	-
62.64	Data set 18 data 2 selection	*List*	-	-	-
62.65	Data set 18 data 3 selection	*List*	-	-	-
62.66	Data set 20 data 1 selection	*List*	-	-	-
62.67	Data set 20 data 2 selection	*List*	-	-	-
62.68	Data set 20 data 3 selection	*List*	-	-	-
62.69	Data set 22 data 1 selection	*List*	-	-	-
62.70	Data set 22 data 2 selection	*List*	-	-	-
62.71	Data set 22 data 3 selection	*List*	-	-	-
62.72	Data set 24 data 1 selection	*List*	-	-	-

No.	Name	Type	Range	Unit	FbEq32
62.73	Data set 24 data 2 selection	List	-	-	-
62.74	Data set 24 data 3 selection	List	-	-	-
62.95	Data set 1 data 1 value	Real	0…65535	-	-
62.96	Data set 1 data 2 value	Real	0…65535	-	-
62.97	Data set 1 data 3 value	Real	0…65535	-	-
62.98	Data set 3 data 1 value	Real	0…65535	-	-
62.99	Data set 3 data 2 value	Real	0…65535	-	-
62.100	Data set 3 data 3 value	Real	0…65535	-	-
62.101	Data set 10 data 1 value	Real	0…65535	-	-
62.102	Data set 10 data 2 value	Real	0…65535	-	-
62.103	Data set 10 data 3 value	Real	0…65535	-	-
62.104	Data set 12 data 1 value	Real	0…65535	-	-
62.105	Data set 12 data 2 value	Real	0…65535	-	-
62.106	Data set 12 data 3 value	Real	0…65535	-	-
62.107	Data set 14 data 1 value	Real	0…65535	-	-
62.108	Data set 14 data 2 value	Real	0…65535	-	-
62.109	Data set 14 data 3 value	Real	0…65535	-	-
62.110	Data set 16 data 1 value	Real	0…65535	-	-
62.111	Data set 16 data 2 value	Real	0…65535	-	-
62.112	Data set 16 data 3 value	Real	0…65535	-	-
62.113	Data set 18 data 1 value	Real	0…65535	-	-
62.114	Data set 18 data 2 value	Real	0…65535	-	-
62.115	Data set 18 data 3 value	Real	0…65535	-	-
62.116	Data set 20 data 1 value	Real	0…65535	-	-
62.117	Data set 20 data 2 value	Real	0…65535	-	-
62.118	Data set 20 data 3 value	Real	0…65535	-	-
62.119	Data set 22 data 1 value	Real	0…65535	-	-
62.120	Data set 22 data 2 value	Real	0…65535	-	-
62.121	Data set 22 data 3 value	Real	0…65535	-	-
62.122	Data set 24 data 1 value	Real	0…65535	-	-
62.123	Data set 24 data 2 value	Real	0…65535	-	-
62.124	Data set 24 data 3 value	Real	0…65535	-	-
(Parameters 62.151…62.203 only visible with a BCU control unit)					
62.151	INU-LSU data set 11 data 1 sel	Real	List	-	-
62.152	INU-LSU data set 11 data 2 sel	Real	List	-	-
62.153	INU-LSU data set 11 data 3 sel	Real	List	-	-
62.201	INU-LSU data set 11 data 1 value	Real	0…65535	-	-
62.202	INU-LSU data set 11 data 2 value	Real	0…65535	-	-
62.203	INU-LSU data set 11 data 3 value	Real	0…65535	-	-

No.	Name	Type	Range	Unit	FbEq32
90 Feedback selection					
90.01	Motor speed for control	*Real*	-32768.00 … 32767.00	rpm	100 = 1 rpm
90.02	Motor position	*Real*	0.00000000 … 1.00000000	rev	100000000 = 1 rev
90.03	Load speed	*Real*	-32768.00 … 32767.00	rpm	100 = 1 rpm
90.04	Load position	*Real*	-2147483648 … 2147483647	-	1 = 1
90.05	Load position scaled	*Real*	-2147483.648 … 2147483.647	-	100000 = 1
90.06	Motor position scaled	*Real*	-2147483.648 … 2147483.647	-	1000 = 1
90.07	Load position scaled int	*Real*	-2147483648 … 2147483647	-	1 = 1
90.10	Encoder 1 speed	*Real*	-32768.00 … 32767.00	rpm	100 = 1 rpm
90.11	Encoder 1 position	*Real*	0.00000000 … 1.00000000	rev	100000000 = 1 rev
90.12	Encoder 1 multiturn revolutions	*Real*	0…16777215	-	1 = 1
90.13	Encoder 1 revolution extension	*Real*	-2147483648 … 2147483647	-	1 = 1
90.14	Encoder 1 position raw	*Real*	0…16777215	-	1 = 1
90.15	Encoder 1 revolutions raw	*Real*	0…16777215	-	1 = 1
90.20	Encoder 2 speed	*Real*	-32768.00 … 32767.00	rpm	100 = 1 rpm
90.21	Encoder 2 position	*Real*	0.00000000 … 1.00000000	rev	100000000 = 1 rev
90.22	Encoder 2 multiturn revolutions	*Real*	0…16777215	-	1 = 1
90.23	Encoder 2 revolution extension	*Real*	-2147483648 … 2147483647	-	1 = 1
90.24	Encoder 2 position raw	*Real*	0…16777215	-	1 = 1
90.25	Encoder 2 revolutions raw	*Real*	0…16777215	-	1 = 1
90.26	Motor revolution extension	*Real*	-2147483648 … 2147483647	-	1 = 1
90.27	Load revolution extension	*Real*	-2147483648 … 2147483647	-	1 = 1
90.35	Pos counter status	*PB*	000000b…111111b	-	1 = 1
90.38	Pos counter decimals	*List*	0…9	-	1 = 1
90.41	Motor feedback selection	*List*	0…2	-	1 = 1
90.42	Motor speed filter time	*Real*	0…10000	ms	1 = 1 ms
90.43	Motor gear numerator	*Real*	-32768…32767	-	1 = 1
90.44	Motor gear denominator	*Real*	-32768…32767	-	1 = 1
90.45	Motor feedback fault	*List*	0…1	-	1 = 1
90.46	Force open loop	*List*	0…1	-	1 = 1
90.48	Motor position axis mode	*List*	0…1	-	1 = 1
90.49	Motor position resolution	*Real*	0…31	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
90.51	Load feedback selection	*List*	0…4	-	1 = 1
90.52	Load speed filter time	*Real*	0…10000	ms	1 = 1 ms
90.53	Load gear numerator	*Real*	-2147483648 … 2147483647	-	1 = 1
90.54	Load gear denominator	*Real*	-2147483648 … 2147483647	-	1 = 1
90.55	Load feedback fault	*List*	0…1	-	1 = 1
90.56	Load position offset	*Real*	-2147483648 … 2147483647	rev	1 = 1 rev
90.57	Load position resolution	*Real*	0…31	-	1 = 1
90.58	Pos counter init value int	*Real*	-2147483648 … 2147483647	-	1 = 1
90.59	Pos counter init value int source	*Binary src*	-	-	1 = 1
90.60	Pos counter error and boot action	*List*	0…1	-	1 = 1
90.61	Gear numerator	*Real*	-2147483648 … 2147483647	-	1 = 1
90.62	Gear denominator	*Real*	-2147483648 … 2147483647	-	1 = 1
90.63	Feed constant numerator	*Real*	-2147483648 … 2147483647	-	1 = 1
90.64	Feed constant denominator	*Real*	-2147483648 … 2147483647	-	1 = 1
90.65	Pos counter init value	*Real*	-2147483.648 … 2147483.647	-	1 = 1
90.66	Pos counter init value source	*Binary src*	-	-	1 = 1
90.67	Pos counter init cmd source	*Binary src*	-	-	1 = 1
90.68	Disable pos counter initialization	*Binary src*	-	-	1 = 1
90.69	Reset pos counter init ready	*Binary src*	-	-	1 = 1
91 Encoder module settings					
91.01	FEN DI status	*PB*	000000b…111111b	-	1 = 1
91.02	Module 1 status	*List*	-	-	1 = 1
91.03	Module 2 status	*List*	-	-	1 = 1
91.04	Module 1 temperature	*Real*	0…1000	°C, °F or ohm	1 = 1 unit
91.06	Module 2 temperature	*Real*	0…1000	°C, °F or ohm	1 = 1 unit
91.10	Encoder parameter refresh	*List*	0…1	-	1 = 1
91.11	Module 1 type	*List*	0…4	-	1 = 1
91.12	Module 1 location	*Real*	1…254	-	1 = 1
91.13	Module 2 type	*List*	0…4	-	1 = 1
91.14	Module 2 location	*Real*	1…254	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
91.21	Module 1 temp sensor type	*List*	0…2	-	1 = 1
91.22	Module 1 temp filter time	*Real*	0…10000	ms	1 = 1 ms
91.24	Module 2 temp sensor type	*List*	0…2	-	1 = 1
91.25	Module 2 temp filter time	*Real*	0…10000	ms	1 = 1 ms
91.31	Module 1 TTL output source	*List*	0…2	-	1 = 1
91.32	Module 1 emulation pulses/rev	*Real*	0…65535	-	1 = 1
91.33	Module 1 emulated Z-pulse offset	*Real*	0.00000 … 1.00000	rev	100000 = 1 rev
91.41	Module 2 TTL output source	*List*	0…2	-	1 = 1
91.42	Module 2 emulation pulses/rev	*Real*	0…65535	-	1 = 1
91.43	Module 2 emulated Z-pulse offset	*Real*	0.00000 … 1.00000	rev	100000 = 1 rev
92 Encoder 1 configuration					
92.01	Encoder 1 type	*List*	0…7	-	1 = 1
92.02	Encoder 1 source	*List*	1…2	-	1 = 1
Other parameters in this group when a TTL, TTL+ and HTL encoder is selected (92.16, 92.17, 92.23…92.25 visible depending on encoder type selection)					
92.10	Pulses/revolution	*Real*	0…65535	-	1 = 1
92.11	Pulse encoder type	*List*	0…1	-	1 = 1
92.12	Speed calculation mode	*List*	0…5	-	1 = 1
92.13	Position estimation enable	*List*	0…1	-	1 = 1
92.14	Speed estimation enable	*List*	0…1	-	1 = 1
92.15	Transient filter	*List*	0…3	-	1 = 1
92.16	Encoder 1 supply voltage	*List*	0…2	-	1 = 1
92.17	Accepted pulse freq of encoder 1	*Real*	0…300	kHz	1 = 1 kHz
92.21	Encoder cable fault mode	*List*	0…3	-	1 = 1
92.23	Maximum pulse waiting time	*Real*	1…200	ms	1 = 1 ms
92.24	Pulse edge filtering	*List*	0…2	-	1 = 1
92.25	Pulse overfrequency function	*List*	0…1	-	1 = 1
Other parameters in this group when an absolute encoder is selected					
92.10	Sine/cosine number	*Real*	0…65535	-	1 = 1
92.11	Absolute position source	*List*	0…5	-	1 = 1
92.12	Zero pulse enable	*List*	0…1	-	1 = 1
92.13	Position data width	*Real*	0…32	-	1 = 1
92.14	Revolution data width	*Real*	0…32	-	1 = 1
92.30	Serial link mode	*List*	0…2	-	1 = 1
92.31	EnDat max calculation time	*List*	0…3	-	1 = 1
92.32	SSI cycle time	*List*	0…5	-	1 = 1
92.33	SSI clock cycles	*Real*	2…127	-	1 = 1
92.34	SSI position msb	*Real*	1…126	-	1 = 1
92.35	SSI revolution msb	*Real*	1…126	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
92.36	SSI data format	*List*	0…1	-	1 = 1
92.37	SSI baud rate	*List*	0…5	-	1 = 1
92.40	SSI zero phase	*List*	0…3	-	1 = 1
92.45	Hiperface parity	*List*	0…1	-	1 = 1
92.46	Hiperface baud rate	*List*	0…3	-	1 = 1
92.47	Hiperface node address	*Real*	0…255	-	1 = 1
Other parameters in this group when a resolver is selected					
92.10	Excitation signal frequency	*Real*	1…20	kHz	1 = 1 kHz
92.11	Excitation signal amplitude	*Real*	4.0 … 12.0	V	10 = 1 V
92.12	Resolver polepairs	*List*	1…32	-	1 = 1
93 Encoder 2 configuration					
93.01	Encoder 2 type	*List*	0…7	-	1 = 1
93.02	Encoder 2 source	*List*	1…2	-	1 = 1
Other parameters in this group when a TTL, TTL+ and HTL encoder is selected (93.16, 93.17, 93.23…93.25 visible depending on encoder type selection)					
93.10	Pulses/rev	*Real*	0…65535	-	1 = 1
93.11	Pulse encoder type	*List*	0…1	-	1 = 1
93.12	Speed calculation mode	*List*	0…5	-	1 = 1
93.13	Position estimation enable	*List*	0…1	-	1 = 1
93.14	Speed estimation enable	*List*	0…1	-	1 = 1
93.15	Transient filter	*List*	0…3	-	1 = 1
93.16	Encoder 2 supply voltage	*List*	0…2	-	1 = 1
93.17	Accepted pulse freq of encoder 2	*Real*	0…300	kHz	1 = 1 kHz
93.21	Encoder cable fault mode	*List*	0…3	-	1 = 1
93.23	Maximum pulse waiting time	*Real*	1…200	ms	1 = 1 ms
93.24	Pulse edge filtering	*List*	0…2	-	1 = 1
93.25	Pulse overfrequency function	*List*	0…1	-	1 = 1
Other parameters in this group when an absolute encoder is selected					
93.10	Sine/cosine number	*Real*	0…65535	-	1 = 1
93.11	Absolute position source	*List*	0…5	-	1 = 1
93.12	Zero pulse enable	*List*	0…1	-	1 = 1
93.13	Position data width	*Real*	0…32	-	1 = 1
93.14	Revolution data width	*Real*	0…32	-	1 = 1
93.30	Serial link mode	*List*	0…2	-	1 = 1
93.31	EnDat calc time	*List*	0…3	-	1 = 1
93.32	SSI cycle time	*List*	0…5	-	1 = 1
93.33	SSI clock cycles	*Real*	2…127	-	1 = 1
93.34	SSI position msb	*Real*	1…126	-	1 = 1
93.35	SSI revolution msb	*Real*	1…126	-	1 = 1
93.36	SSI data format	*List*	0…1	-	1 = 1
93.37	SSI baud rate	*List*	0…5	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
93.40	SSI zero phase	*List*	0…3	-	1 = 1
93.45	Hiperface parity	*List*	0…1	-	1 = 1
93.46	Hiperface baud rate	*List*	0…3	-	1 = 1
93.47	Hiperface node address	*Real*	0…255	-	1 = 1
Other parameters in this group when a resolver is selected					
93.10	Excitation signal frequency	*Real*	1…20	kHz	1 = 1 kHz
93.11	Excitation signal amplitude	*Real*	4.0 … 12.0	V	10 = 1 V
93.12	Resolver polepairs	*List*	1…32	-	1 = 1
94 LSU control					
(This group only visible with a BCU control unit)					
94.01	LSU control	*List*	0…1	-	1 = 1
94.10	LSU max charging time	*Real*	0…65535	s	1 = 1 s
94.11	LSU stop delay	*Real*	0.0 … 3600.0	s	10 = 1 s
94.20	DC voltage reference	*Real*	0.0 … 2000.0	V	10 = 1 V
94.21	DC voltage ref source	*List*	-	-	1 = 1
94.22	User DC voltage reference	*Real*	0.0 … 2000.0	V	10 = 1 V
94.30	Reactive power reference	*Real*	-3276.8 … 3276.7	kvar	10 = 1 kvar
94.31	Reactive power ref source	*List*	-	-	1 = 1
94.32	User reactive power reference	*Real*	-3276.8 … 3276.7	kvar	10 = 1 kvar
95 HW configuration					
95.01	Supply voltage	*List*	0…6	-	1 = 1
95.02	Adaptive voltage limits	*List*	0…1	-	1 = 1
95.04	Control board supply	*List*	0…2	-	1 = 1
(Parameter 95.08 only visible with a ZCU control unit)					
95.08	DC switch monitoring	*List*	0…1	-	1 = 1
(Parameters 95.09…95.14 only visible with a BCU control unit)					
95.09	Fuse switch control	*List*	0…1	-	1 = 1
95.13	Reduced run mode	*List*	0…65535	-	1 = 1
95.14	Connected modules	*PB*	0000h…FFFFh	-	1 = 1
95.15	Special HW settings	*PB*	0000h…FFFFh	-	1 = 1
95.20	HW options word 1	*PB*	0000h…FFFFh	-	1 = 1
95.21	HW options word 2	*PB*	0000h…FFFFh	-	1 = 1
95.30	Parallel type filter	*List*	0…4	-	1 = 1
95.31	Parallel connection rating id	*List*	-	-	1 = 1
96 System					
96.01	Language	*List*	-	-	1 = 1
96.02	Pass code	*Data*	0…99999999	-	1 = 1
96.03	Access levels active	*PB*	0000h…FFFFh	-	1 = 1
96.04	Macro select	*List*	0…6	-	1 = 1
96.05	Macro active	*List*	1…6	-	1 = 1
96.06	Parameter restore	*List*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
96.07	Parameter save manually	*List*	0…1	-	1 = 1
96.08	Control board boot	*Real*	0…1	-	1 = 1
96.09	FSO reboot	*Binary src*	-	-	-
96.10	User set status	*List*	-	-	-
96.11	User set save/load	*List*	-	-	-
96.12	User set I/O mode in1	*Binary src*	-	-	-
96.13	User set I/O mode in2	*Binary src*	-	-	-
96.16	Unit selection	*PB*	0000h…FFFFh	-	1 = 1
96.20	Time sync primary source	*List*	0…9	-	1 = 1
96.23	M/F and D2D clock synchronization	*List*	0…1	-	1 = 1
96.24	Full days since 1st Jan 1980	*Real*	1…59999	-	1 = 1
96.25	Time in minutes within 24 h	*Real*	0…1439	-	1 = 1
96.26	Time in ms within one minute	*Real*	0…59999	-	1 = 1
96.29	Time sync source status	*PB*	0000h…FFFFh	-	1 = 1
96.31	Drive ID number	*Real*	0…32767	-	1 = 1
96.53	Actual checksum	*Real*	00000000h…FFFFFFFFh	-	1 = 1
96.54	Checksum action	*List*	0…4	-	1 = 1
96.55	Checksum control word	*PB*	0000h…FFFFh	-	1 = 1
96.56	Approved checksum 1	*Real*	00000000h…FFFFFFFFh	-	1 = 1
96.57	Approved checksum 2	*Real*	00000000h…FFFFFFFFh	-	1 = 1
96.58	Approved checksum 3	*Real*	00000000h…FFFFFFFFh	-	1 = 1
96.59	Approved checksum 4	*Real*	00000000h…FFFFFFFFh	-	1 = 1
96.61	User data logger status word	*PB*	0000h…FFFFh	-	1 = 1
96.63	User data logger trigger	*Binary src*	-	-	-
96.64	User data logger start	*Binary src*	-	-	-
96.65	Factory data logger time level	*List*	-	-	1 = 1
96.70	Disable adaptive program	*List*	0…1	-	1 = 1
(Parameters 96.100…96.102 only visible when enabled by parameter 96.02)					
96.100	Change user pass code	*Data*	10000000…99999999	-	1 = 1
96.101	Confirm user pass code	*Data*	10000000…99999999	-	1 = 1
96.102	User lock functionality	*PB*	0000h…FFFFh	-	1 = 1
97 Motor control					
97.03	Slip gain	*Real*	0…200	%	1 = 1%
97.04	Voltage reserve	*Real*	-4…50	%	1 = 1%
97.05	Flux braking	*List*	0…2	-	1 = 1
97.06	Flux reference select	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
97.07	User flux reference	*Real*	0.00 … 200.00	%	100 = 1%
97.09	Switching freq mode	*List*	0…3	-	1 = 1
97.10	Signal injection	*List*	0…4	-	1 = 1
97.11	TR tuning	*Real*	25…400	%	1 = 1%
97.12	IR comp step-up frequency	*Real*	0.0 … 50.0	Hz	10 = 1 Hz
97.13	IR compensation	*Real*	0.00 … 50.00	%	100 = 1%
97.15	Motor model temperature adaptation	*List*	0…3	-	1 = 1
97.32	Motor torque unfiltered	*Real*	-1600.0 … 1600.0	%	10 = 1%
97.33	Speed estimate filter time	*Real*	0.00 … 100.00	ms	100 = 1 ms
98 User motor parameters					
98.01	User motor model mode	*List*	0…3	-	1 = 1
98.02	Rs user	*Real*	0.0000 … 0.50000	p.u.	100000 = 1 p.u.
98.03	Rr user	*Real*	0.0000 … 0.50000	p.u.	100000 = 1 p.u.
98.04	Lm user	*Real*	0.00000 … 10.00000	p.u.	100000 = 1 p.u.
98.05	SigmaL user	*Real*	0.00000 … 1.00000	p.u.	100000 = 1 p.u.
98.06	Ld user	*Real*	0.00000 … 10.00000	p.u.	100000 = 1 p.u.
98.07	Lq user	*Real*	0.00000 … 10.00000	p.u.	100000 = 1 p.u.
98.08	PM flux user	*Real*	0.00000 … 2.00000	p.u.	100000 = 1 p.u.
98.09	Rs user SI	*Real*	0.00000 … 100.00000	ohm	100000 = 1 p.u.
98.10	Rr user SI	*Real*	0.00000 … 100.00000	ohm	100000 = 1 p.u.
98.11	Lm user SI	*Real*	0.00 … 100000.00	mH	100 = 1 mH
98.12	SigmaL user SI	*Real*	0.00 … 100000.00	mH	100 = 1 mH
98.13	Ld user SI	*Real*	0.00 … 100000.00	mH	100 = 1 mH
98.14	Lq user SI	*Real*	0.00 … 100000.00	mH	100 = 1 mH
98.15	Position offset user	*Real*	0…360	degrees electrical	1 = 1 deg
99 Motor data					
99.03	Motor type	*List*	0…2	-	1 = 1
99.04	Motor control mode	*List*	0…1	-	1 = 1
99.06	Motor nominal current	*Real*	0.0 … 32767.0	A	10 = 1 A
99.07	Motor nominal voltage	*Real*	0.0 … 32767.0	V	10 = 1 V
99.08	Motor nominal frequency	*Real*	0.00 … 500.00	Hz	10 = 1 Hz
99.09	Motor nominal speed	*Real*	0 … 30000	rpm	1 = 1 rpm
99.10	Motor nominal power	*Real*	0.00 … 10000.00 kW or 0.00 … 13404.83 hp	kW or hp	100 = 1 unit

No.	Name	Type	Range	Unit	FbEq32
99.11	Motor nominal cos Φ	*Real*	0.00 … 1.00	-	100 = 1
99.12	Motor nominal torque	*Real*	0.000 …	N·m or lb·ft	1000 = 1 unit
99.13	ID run requested	*List*	0…7	-	1 = 1
99.14	Last ID run performed	*List*	0…7	-	1 = 1
99.15	Motor polepairs calculated	*Real*	0…1000	-	1 = 1
99.16	Motor phase order	*List*	0…1	-	1 = 1
200 Safety					
This group contains parameters related to the optional FSO-xx safety functions module. For details on the parameters in this group, refer to the documentation of the FSO-xx module.					

8

Fault tracing

What this chapter contains

The chapter lists the warning and fault messages including possible causes and corrective actions. The causes of most warnings and faults can be identified and corrected using the information in this chapter. If not, an ABB service representative should be contacted.

Warnings and faults are listed below in separate tables. Each table is sorted by warning/fault code.

Safety

WARNING! Only qualified electricians are allowed to service the drive. Read the *Safety instructions* on the first pages of the Hardware manual before working on the drive.

Indications

Warnings and faults

Warnings and faults indicate an abnormal drive status. The codes and names of active warnings/faults are displayed on the control panel of the drive as well as the Drive composer PC tool. Only the codes of warnings/faults are available over fieldbus.

Warnings do not need to be reset; they stop showing when the cause of the warning ceases. Warnings do not latch and the drive will continue to operate the motor.

Faults do latch inside the drive and cause the drive to trip, and the motor stops. After the cause of a fault has been removed, the fault can be reset from a selectable source (see parameter *31.11 Fault reset selection*) such as the control panel, Drive composer PC tool, the digital inputs of the drive, or fieldbus. After the fault is reset, the drive can be restarted. Note that some faults require a reboot of the control unit either by switching the power off and on, or using parameter *96.08 Control board boot* – this is mentioned in the fault listing wherever appropriate.

Warning and fault indications can be directed to a relay output or a digital input/output by selecting *Warning*, *Fault* or *Fault (-1)* in the source selection parameter. See sections

- *Programmable digital inputs and outputs* (page *28*)
- *Programmable relay outputs* (page *28*), and
- *Programmable I/O extensions* (page *29*).

Pure events

In addition to warnings and faults, there are pure events that are only recorded in the event logs of the drive. The codes of these events are included in the *Warning messages* table.

Editable messages

For some warnings and faults, the message text can be edited and instructions and contact information added. To edit these messages, choose **Menu** - **Settings** - **Edit texts** on the control panel.

Warning/fault history and analysis

Event logs

The drive has two event logs that can be accessed from the main Menu on the control panel. The logs can also be accessed (and reset) using the Drive composer PC tool.

One of the logs contains faults and fault resets. The other log lists warnings and pure events, as well as clearing entries. Both logs contain 32 most recent events. All indications are stored in the event logs with a time stamp and other information.

Auxiliary codes

Some events generate an auxiliary code that often helps in pinpointing the problem. The auxiliary code is displayed on the control panel together with the message. It is also stored in the event log details. In the Drive composer PC tool, the auxiliary code (if any) is shown in the event listing.

Factory data logger

The drive has a data logger that samples preselected drive values at 500-microsecond (default; see parameter *96.65 Factory data logger time level*) intervals. By default, approximately 700 samples recorded immediately before and after a fault are saved to the memory unit of the drive. The fault data of the last five faults is accessible in the event log when viewed in the Drive composer pro PC tool. (The fault data is not accessible through the control panel.)

The values that are recorded in the factory data log are *01.07 Motor current*, *01.10 Motor torque*, *01.11 DC voltage*, *01.24 Flux actual %*, *06.01 Main control word*, *06.11 Main status word*, *24.01 Used speed reference*, *30.01 Limit word 1*, *30.02 Torque limit status* and *90.01 Motor speed for control*. The selection of parameters cannot be changed by the user.

Other data loggers

User data logger

A custom data logger can be configured using the Drive composer pro PC tool. This functionality enables the free selection of up to eight drive parameters to be sampled at selectable intervals. The triggering conditions and the length of the monitoring period can also be defined by the user within the limit of approximately 8000 samples. In addition to the PC tool, the status of the logger is shown by drive parameter *96.61 User data logger status word*. The triggering sources can be selected by parameters *96.63 User data logger trigger* and *96.64 User data logger start*). The configuration, status and collected data is saved to the memory unit for later analysis.

PSL2 data logger

The BCU control unit used with certain drive types (especially those with parallel-connected inverter modules) contains a data logger that collects data from the inverter modules to help fault tracing and analysis. The data is saved onto the SD memory card attached to the BCU, and can be analyzed by ABB service personnel.

Parameters that contain warning/fault information

The drive is able to store a list of the active faults actually causing the drive to trip at the present time. The faults are displayed in parameter group *04 Warnings and faults* (page *117*). The parameter group also displays a list of faults and warnings that have previously occurred.

Event word (parameters *04.40*…*04.72*)

Parameter *04.40 Event word 1* can be configured by the user to indicate the status of 16 selectable events (ie. faults, warnings or pure events). It is possible to specify an auxiliary code for each event to filter out other auxiliary codes.

QR Code generation for mobile service application

A QR Code (or a series of QR Codes) can be generated by the drive for display on the control panel. The QR Code contains drive identification data, information on the latest events, and values of status and counter parameters. The code can be read with a mobile device containing the ABB service application, which then sends the data to ABB for analysis. For more information on the application, contact your local ABB service representative.

The QR Code can be generated by choosing **Menu** - **Assistants** - **QR code** on the control panel.

Warning messages

Note: The list also contains events that only appear in the Event log.

Code (hex)	Warning	Cause	What to do
A2A1	Current calibration	Current offset and gain measurement calibration will occur at next start.	Informative warning. (See parameter *99.13 ID run requested*.)
A2B1	Overcurrent	Output current has exceeded internal fault limit.	Check motor load. Check acceleration times in parameter group *23 Speed reference ramp* (speed control), *26 Torque reference chain* (torque control) or *28 Frequency reference chain* (frequency control). Also check parameters *46.01 Speed scaling*, *46.02 Frequency scaling* and *46.03 Torque scaling*. Check motor and motor cable (including phasing and delta/star connection). Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group 99 corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable. Check encoder cable (including phasing). Check the auxiliary code (format XXXY YYZZ). With parallel-connected inverter modules, "Y YY" specifies through which BCU control unit channel the fault was received. "ZZ" indicates the phase that triggered the fault (**0:** No detailed information available, **1:** U-phase, **2:** V-phase, **4:** W-phase, **3/5/6/7:** multiple phases).
A2B3	Earth leakage Programmable fault: *31.20 Earth fault*	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. Try running the motor in scalar control mode if allowed. (See parameter *99.04 Motor control mode*.) If no earth fault can be detected, contact your local ABB representative.
A2B4	Short circuit	Short-circuit in motor cable(s) or motor.	Check motor and motor cable for cabling errors. Check there are no power factor correction capacitors or surge absorbers in motor cable.

Code (hex)	Warning	Cause	What to do
A2BA	IGBT overload	Excessive IGBT junction to case temperature. This warning protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A3A1	DC link overvoltage	Intermediate circuit DC voltage too high (when the drive is stopped).	Check the supply voltage setting (parameter *95.01 Supply voltage*). Note that the wrong setting of the parameter may cause the motor to rush uncontrollably, or may overload the brake chopper or resistor. Check the supply voltage. With A3A1 or A3A2 on parallel-connected inverter modules, the auxiliary code indicates the affected module. The format of the code is 000X XX00, where “XXX” specifies the channel on the BCU control unit. If the problem persists, contact your local ABB representative.
A3A2	DC link undervoltage	Intermediate circuit DC voltage too low (when the drive is stopped).	
A3AA	DC not charged	The voltage of the intermediate DC circuit has not yet risen to operating level.	
A480	Motor cable overload	Calculated motor cable temperature has exceeded warning limit.	Check the settings of parameters *35.61* and *35.62*. Check the dimensioning of the motor cable in regard to required load.
A490	Incorrect temperature sensor setup	Problem with motor temperature measurement.	Check the auxiliary code (format 0XYY ZZZZ). “X” identifies the affected temperature monitoring function (0 = parameter *35.11*, 1 = parameter *35.21*). “YY” indicates the selected temperature source, ie. the setting of the selection parameter in hexadecimal. “ZZZZ” indicates the problem (see actions for each code below).
	0001	Sensor type mismatch	Check parameters *35.11*/*35.21* against *91.21*/*91.24*.
	0002	Temperature under limit	Check parameters *35.11*…*35.14*/*35.21*…*35.24* (and *91.21*/*91.24* if sensor is connected to an encoder interface). Check the sensor and its wiring.
	0003	Short circuit	
	0004	Open circuit	
A491	External temperature 1 (Editable message text)	Measured temperature 1 has exceeded warning limit.	Check the value of parameter *35.02 Measured temperature 1*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of *35.13 Temperature 1 warning limit*.
A492	External temperature 2 (Editable message text)	Measured temperature 2 has exceeded warning limit.	Check the value of parameter *35.03 Measured temperature 2*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of *35.23 Temperature 2 warning limit*.

Code (hex)	Warning	Cause	What to do
A497	Motor temperature 1 (Editable message text)	The thermistor protection module installed in slot 1 indicates overtemperature.	Check the cooling of the motor. Check the motor load and drive ratings. Check the wiring of the temperature sensor. Repair wiring if faulty. Measure the resistance of the sensor. Replace sensor if faulty.
A498	Motor temperature 2 (Editable message text)	The thermistor protection module installed in slot 2 indicates overtemperature.	
A499	Motor temperature 3 (Editable message text)	The thermistor protection module installed in slot 3 indicates overtemperature.	
A4A0	Control board temperature	Control unit temperature is excessive.	Check the auxiliary code. See actions for each code below.
	(none)	Temperature above warning limit	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up.
	1	Thermistor broken	Contact an ABB service representative for control unit replacement.
A4A1	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A4A9	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C (104 °F), ensure that load current does not exceed derated load capacity of drive. See appropriate *Hardware manual.* Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.
A4B0	Excess temperature	Power unit temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power. Check the auxiliary code (format XXXY YYZZ). “Y YY” specifies through which BCU control unit channel the fault was received. “ZZ” specifies the location (**1:** U-phase, **2:** V-phase, **3:** W-phase, **4:** INT board, **5:** Brake chopper, **6:** Air inlet (sensor connected to INT board X10), **7:** PCB compartment fan or power supply board, **8:** du/dt filter or temperature switch (XT) (sensor connected to INT board X7), **9:** Sensor connected to INT board X6, **0FA:** Ambient temperature).

Code (hex)	Warning	Cause	What to do
A4B1	Excess temperature difference	High temperature difference between the IGBTs of different phases.	Check the motor cabling. Check cooling of drive module(s). Check the auxiliary code (format XXXY YYZZ). “XXX” indicates the source of difference (**0:** Single module, difference between phase IGBTs, **1:** parallel-connected modules, minimum-maximum difference between all IGBTs of all modules). With parallel-connected modules, “Y YY” specifies through which BCU control unit channel the fault was received. “ZZ” specifies the phase (**0:** single module, **1:** U-phase [parallel connection], **2:** W-phase [parallel connection], **3:** W-phase [parallel connection]).
A4B2	PCB space cooling	Temperature difference between ambient and drive module PCB space is excessive.	Check the cooling fan inside the PCB space. With parallel-connected modules, check the auxiliary code (format XXXY YYZZ). “Y YY” specifies through which BCU control unit channel the fault was received.
A4F6	IGBT temperature	Drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A580	PU communication	Communication errors detected between the drive control unit and the power unit.	Check the connections between the drive control unit and the power unit. Check the auxiliary code (format XXXY YYZZ). With parallel-connected modules, “Y YY” specifies the affected BCU control unit channel (**0:** broadcast). “ZZ” specifies the error source (**8:** Transmission errors in PSL link [see “XXX”], **9:** Transmitter FIFO warning limit hit). “XXX” specifies the transmission error direction and detailed warning code (**0:** Rx/communication error, **1:** Tx/Reed-Solomon symbol error, **2:** Tx/no synchronization error, **3:** Tx/Reed-Solomon decoder failures, **4:** Tx/Manchester coding errors).
A581	Fan	Cooling fan feedback missing.	Check the setting of parameter *95.20 HW options word 1*, bit 14. Check the auxiliary code to identify the fan. Code **0** denotes main fan 1. Other codes (format XYZ): “X” specifies state code (**1:** ID run, **2:** normal). “Y” specifies the index of the inverter unit connected to BCU (**0…n**, always **0** for ZCU control units). “Z” specifies the index of the fan (**1:** Main fan 1, **2:** Main fan 2, **3:** Main fan 3). Check fan operation and connection. Replace fan if faulty.

Code (hex)	Warning	Cause	What to do
A582	Auxiliary fan missing	An auxiliary cooling fan (connected to the fan connectors on the control unit) is stuck or disconnected.	The auxiliary code identifies the fan (**1:** Auxiliary fan 1, **2:** Auxiliary fan 2). Check auxiliary fan(s) and connection(s). Replace faulty fan. Make sure the front cover of the drive module is in place and tightened. If the commissioning of the drive requires that the cover is off, this warning will be generated even if the corresponding fault is defeated. See fault *5081 Auxiliary fan broken* (page *499*).
A5A0	Safe torque off Programmable warning: *31.22 STO indication run/stop*	Safe torque off function is active, i.e. safety circuit signal(s) connected to connector XSTO is lost.	Check safety circuit connections. For more information, see appropriate drive hardware manual and description of parameter *31.22 STO indication run/stop* (page *259*).
A5EA	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	Check the auxiliary code (format XXXY YYZZ). "Y YY" specifies through which BCU control unit channel the fault was received ("0 00" with a ZCU control unit). "ZZ" specifies the location (**1:** U-phase IGBT, **2:** V-phase IGBT, **3:** W-phase IGBT, **4:** Power unit INT board, **5:** Brake chopper, **6:** Air inlet, **7:** Power supply board, **8:** du/dt filter, **FAh:** Air in temp).
A5EB	PU board powerfail	Power unit power supply failure.	Contact your local ABB representative.
A5EC	PU communication internal	Communication errors detected between the drive control unit and the power unit.	Check the connections between the drive control unit and the power unit.
A5ED	Measurement circuit ADC	Problem with measurement circuit of power unit (analog to digital converter)	Contact your local ABB representative.
A5EE	Measurement circuit DFF	Problem with current or voltage measurement of power unit	Contact your local ABB representative.
A5EF	PU state feedback	State feedback from output phases does not match control signals.	Contact your local ABB representative.
A5F0	Charging feedback	Charging in progress	Informative warning. Wait until charging finishes before starting the inverter unit.
A5F3	Switching frequency below requested	Adequate motor control at requested output frequency cannot be reached because of limited switching frequency (eg. by parameter *95.15*).	Informative warning.
A5F4	Control unit battery	The battery of the control unit is low.	Replace control unit battery. This warning can be suppressed using parameter *31.40*.

Code (hex)	Warning	Cause	What to do
A682	Flash erase speed exceeded	The flash memory (in the memory unit) has been erased too frequently, compromising the lifetime of the memory.	Avoid forcing unnecessary parameter saves by parameter *96.07* or cyclic parameter writes (such as user logger triggering through parameters). Check the auxiliary code (format XYYY YZZZ). “X” specifies the source of warning (**1:** generic flash erase supervision). “ZZZ” specifies the flash subsector number that generated the warning.
A683	Data saving to power unit	An error in saving data to the power unit.	Check the auxiliary code. See actions for each code below.
	0	An error is preventing saving from initializing.	Cycle the power to the drive. If the control unit is externally powered, also reboot the control unit (using parameter *96.08 Control board boot*) or by cycling its power. If the problem persists, contact your local ABB representative.
	1		
	2	Write error.	
A684	SD card	Error related to SD card used to store data (BCU control unit only).	Check the auxiliary code. See actions for each code below.
	1	No SD card	Insert a compatible, writable SD card into the SD CARD slot of the BCU control unit.
	2	SD card write-protected	
	3	SD card unreadable	
A686	Checksum mismatch Programmable warning: *96.54 Checksum action*	The calculated parameter checksum does not match any enabled reference checksum.	Check that all necessary approved (reference) checksums (*96.56*…*96.59*) are enabled in *96.55 Checksum control word*. Check the parameter configuration. Using *96.55 Checksum control word*, enable a checksum parameter and copy the actual checksum into that parameter.
A687	Checksum configuration	An action has been defined for a parameter checksum mismatch but the feature has not been configured.	Contact your local ABB representative for configuring the feature, or disable the feature in *96.54 Checksum action*.
A688	Parameter map configuration	Too much data in parameter mapping table created in Drive customizer.	See the *Drive customizer PC tool user’s manual* (3AUA0000104167 [English]).
A689	Mapped parameter value cut	Parameter value saturated eg. by the scaling specified in parameter mapping table (created in Drive customizer).	Check parameter scaling and format in parameter mapping table. See the *Drive customizer PC tool user’s manual* (3AUA0000104167 [English]).
A6A4	Motor nominal value	The motor parameters are set incorrectly. The drive is not dimensioned correctly.	Check the auxiliary code. See actions for each code below.

Code (hex)	Warning	Cause	What to do
	1	Slip frequency is too small	Check the settings of the motor configuration parameters in groups 98 and 99. Check that the drive is sized correctly for the motor.
	2	Synchronous and nominal speeds differ too much	
	3	Nominal speed is higher than synchronous speed with 1 pole pair	
	4	Nominal current is outside limits	
	5	Nominal voltage is outside limits	
	6	Nominal power is higher than apparent power	
	7	Nominal power not consistent with nominal speed and torque	
A6A5	No motor data	Parameters in group 99 have not been set.	Check that all the required parameters in group 99 have been set. **Note:** It is normal for this warning to appear during the start-up and continue until the motor data is entered.
A6A6	Supply voltage unselected	The supply voltage has not been defined.	Set supply voltage in parameter *95.01 Supply voltage*.
A6B0	User lock is open	The user lock is open, ie. user lock configuration parameters *96.100*…*96.102* are visible.	Close the user lock by entering an invalid pass code in parameter *96.02 Pass code*. See section *User lock* (page *89*).
A6B1	User pass code not confirmed	A new user pass code has been entered in parameter *96.100* but not confirmed in *96.101*.	Confirm the new pass code by entering the same code in *96.101*. To cancel, close the user lock without confirming the new code. See section *User lock* (page *89*).
A6D1	FBA A parameter conflict	The drive does not have a functionality requested by a PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups *50 Fieldbus adapter (FBA)* and *51 FBA A settings*.
A6D2	FBA B parameter conflict	The drive does not have a functionality requested by a PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups *50 Fieldbus adapter (FBA)* and *54 FBA B settings*.

Code (hex)	Warning	Cause	What to do
A6DA	Reference source parametrization	A reference source is simultaneously connected to multiple parameters with different units.	Check the reference source selection parameters. Check the auxiliary code (format XXYY 00ZZ). "XX" and "YY" specify the two sets of parameters where the source was connected to (**01** = speed reference chain [*22.11*, *22.12*, *22.15*, *22.17*], **02** = frequency reference chain [*28.11*, *28.12*], **03** = torque reference chain [*26.11*, *26.12*, *26.16*], **04** = other torque-related parameters [*26.25*, *30.21*, *30.22*, *44.09*], **05** = process PID control parameters [*40.16*, *40.17*, *40.50*, *41.16*, *41.17*, *41.50*]). "ZZ" indicates the conflicting reference source (**01…0E** = index in parameter group 3, **33** = process PID control, **3D** = motor potentiometer, **65** = AI1, **66** = AI2, **6F** = frequency input).
A6E5	AI parametrization	The current/voltage hardware setting of an analog input does not correspond to parameter settings.	Check the auxiliary code. The code identifies the analog input whose settings are in conflict. Adjust either the hardware setting (on the drive control unit) or parameter *12.15*/*12.25*. **Note:** Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.
A6E6	ULC configuration	User load curve configuration error.	Check the auxiliary code (format XXXX ZZZZ). "ZZZZ" indicates the problem (see actions for each code below).
	0000	Speed points inconsistent.	Check that each speed point (parameters *37.11*…*37.15*) has a higher value than the previous point.
	0001	Frequency points inconsistent.	Check that each frequency point (*37.16*…*37.20*) has a higher value than the previous point.
	0002	Underload point above overload point.	Check that each overload point (*37.31*…*37.35*) has a higher value than the corresponding underload point (*37.21*…*37.25*).
	0003	Overload point below underload point.	
A780	Motor stall Programmable warning: *31.24 Stall function*	Motor is operating in stall region because of e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.
A781	Motor fan Programmable warning: *35.106 DOL starter event type*	No feedback received from external fan.	Check external fan (or other equipment controlled) by the logic. Check settings of parameters *35.100*…*35.106*.

Code (hex)	Warning	Cause	What to do
A782	FEN temperature	Error in temperature measurement when temperature sensor (KTY or PTC) connected to encoder interface FEN-xx is used.	Check that parameter *35.11 Temperature 1 source* / *35.21 Temperature 2 source* setting corresponds to actual encoder interface installation. Check the settings of parameters *91.21* and *91.24*. Check that the corresponding module is activated in parameters *91.11*…*91.14*. Use parameter *91.10 Encoder parameter refresh* to validate any changes in the settings.
		Error in temperature measurement when KTY sensor connected to encoder interface FEN-01 is used.	FEN-01 does not support temperature measurement with KTY sensor. Use PTC sensor or other encoder interface module.
A791	Brake resistor	Brake resistor broken or not connected.	Check that a brake resistor has been connected. Check the condition of the brake resistor.
A793	BR excess temperature	Brake resistor temperature has exceeded warning limit defined by parameter *43.12 Brake resistor warning limit*.	Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check warning limit setting, parameter *43.12 Brake resistor warning limit*. Check that the resistor has been dimensioned correctly. Check that braking cycle meets allowed limits.
A794	BR data	Brake resistor data has not been given.	One or more of the resistor data settings (parameters *43.08*…*43.10*) is incorrect. The parameter is specified by the auxiliary code.
	0000 0001	Resistance value too low.	Check value of *43.10*.
	0000 0002	Thermal time constant not given.	Check value of *43.08*.
	0000 0003	Maximum continuous power not given.	Check value of *43.09*.
A797	Speed feedback configuration	Speed feedback configuration has changed.	Check the auxiliary code (format XXYY ZZZZ). “XX” specifies the number of the encoder interface module (**01**: *91.11*/*91.12*, **02**: *91.13*/*91.14*), “YY” specifies the encoder (**01:** *92 Encoder 1 configuration*, **02:** *93 Encoder 2 configuration*). “ZZZZ” indicates the problem (see actions for each code below).
	0001	Adapter not found in specified slot.	Check module location (*91.12* or *91.14*).
	0002	Detected type of interface module does not match parameter setting.	Check the module type (*91.11* or *91.13*) against status (*91.02* or *91.03*).
	0003	Logic version too old.	Contact your local ABB representative.
	0004	Software version too old.	Contact your local ABB representative.

Code (hex)	Warning	Cause	What to do
	0006	Encoder type incompatible with interface module type.	Check module type (*91.11* or *91.13*) against encoder type (*92.01* or *93.01*).
	0007	Adapter not configured.	Check module location (*91.12* or *91.14*).
	0008	Speed feedback configuration has changed.	Use parameter *91.10 Encoder parameter refresh* to validate any changes in the settings.
	0009	No encoders configured to encoder module	Configure the encoder in group *92 Encoder 1 configuration* or *93 Encoder 2 configuration*.
	000A	Non-existing emulation input.	Check input selection (*91.31* or *91.41*).
	000B	Echo not supported by selected input (for example, resolver or absolute encoder).	Check input selection (*91.31* or *91.41*), interface module type, and encoder type.
	000C	Emulation in continuous mode not supported.	Check input selection (*91.31* or *91.41*) and serial link mode (*92.30* or *93.30*) settings.
A798	Encoder option comm loss	Encoder feedback not used as actual feedback, or measured motor feedback lost (and parameter *90.45*/*90.55* is set to *Warning*).	Check that the encoder is selected as feedback source in parameter *90.41* or *90.51*. Check that the encoder interface module is properly seated in its slot. Check that the encoder interface module or slot connectors are not damaged. To pinpoint the problem, try installing the module into a different slot. Check the auxiliary code (format XXXX YYYY). "YYYY" indicates the problem (see actions for each code below).
	0001	Failed answer to encoder configuration message.	Contact your local ABB representative.
	0002	Failed answer to adapter watchdog disable message.	Contact your local ABB representative.
	0003	Failed answer to adapter watchdog enable message.	Contact your local ABB representative.
	0004	Failed answer to adapter configuration message.	Contact your local ABB representative.
	0005	Too many failed answers inline to speed and position messages.	Contact your local ABB representative.
	0006	DDCS driver failed.	Contact your local ABB representative.
A79B	BC short circuit	Short circuit in brake chopper IGBT	Replace brake chopper if external. Drives with internal choppers will need to be returned to ABB. Ensure brake resistor is connected and not damaged.

Code (hex)	Warning	Cause	What to do
A79C	BC IGBT excess temperature	Brake chopper IGBT temperature has exceeded internal warning limit.	Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check the dimensioning and cooling of the cabinet. Check resistor overload protection function settings (parameters *43.06…43.10*). Check minimum allowed resistor value for the chopper being used. Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
A7A1	Mechanical brake closing failed Programmable warning: *44.17 Brake fault function*	Status of mechanical brake acknowledgement is not as expected during brake close.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that acknowledgement signal matches actual status of brake.
A7A2	Mechanical brake opening failed Programmable warning: *44.17 Brake fault function*	Status of mechanical brake acknowledgement is not as expected during brake open.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that acknowledgement signal matches actual status of brake.
A7A5	Mechanical brake opening not allowed Programmable warning: *44.17 Brake fault function*	Open conditions of mechanical brake cannot be fulfilled (for example, brake has been prevented from opening by parameter *44.11 Keep brake closed*).	Check mechanical brake settings in parameter group *44 Mechanical brake control* (especially *44.11 Keep brake closed*). Check that acknowledgement signal (if used) matches actual status of brake.
A7AA	Extension AI parameterization	The hardware current/voltage setting of an analog input (on an I/O extension module) does not correspond to parameter settings.	Check the auxiliary code (format XX00 00YY). "XX" specifies the number of the I/O extension module (**01:** parameter group *14 I/O extension module 1*, **02:** *15 I/O extension module 2*, **03:** *16 I/O extension module 3*). "YY" specifies the analog input on the module. For example, in case of I/O extension module 1, analog input AI1 (auxiliary code 0000 0101), the hardware current/voltage setting on the module is shown by parameter *14.29*. The corresponding parameter setting is *14.30*. Adjust either the hardware setting on the module or the parameter to solve the mismatch. **Note:** Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.

Code (hex)	Warning	Cause	What to do
A7AB	Extension I/O configuration failure	The I/O extension module types and locations specified by parameters do not match the detected configuration.	Check the auxiliary code. The code indicates which I/O extension module is affected. Check the type and location settings of the modules (parameters *14.01*, *14.02*, *15.01*, *15.02*, *16.01* and *16.02*). Check that the modules are properly installed.
A7B0	Motor speed feedback Programmable warning: *90.45 Motor feedback fault*	No motor speed feedback is received.	Check the auxiliary code (format XXYY ZZZZ). "XX" specifies the number of the encoder interface module (**01**: *91.11*/*91.12*, **02**: *91.13*/*91.14*), "YY" specifies the encoder (**01:** *92 Encoder 1 configuration*, **02:** *93 Encoder 2 configuration*). "ZZZZ" indicates the problem (see actions for each code below).
	0001	Motor gear definition invalid or outside limits.	Check motor gear settings (*90.43* and *90.44*).
	0002	Encoder not configured.	Check encoder settings (*92 Encoder 1 configuration* or *93 Encoder 2 configuration*). Use parameter *91.10 Encoder parameter refresh*) to validate any changes in the settings.
	0003	Encoder stopped working.	Check encoder status.
	0004	Encoder drift detected.	Check for slippage between encoder and motor.
A7B1	Load speed feedback Programmable warning: *90.55 Load feedback fault*	No load speed feedback is received.	Check the auxiliary code (format XXYY ZZZZ). "XX" specifies the number of the encoder interface module (**01**: *91.11*/*91.12*, **02**: *91.13*/*91.14*), "YY" specifies the encoder (**01:** *92 Encoder 1 configuration*, **02:** *93 Encoder 2 configuration*). "ZZZZ" indicates the problem (see actions for each code below).
	0001	Load gear definition invalid or outside limits.	Check load gear settings (*90.53* and *90.54*).
	0002	Feed constant definition invalid or outside limits.	Check feed constant settings (*90.63* and *90.64*).
	0003	Encoder stopped working.	Check encoder status.
A7C1	FBA A communication Programmable warning: *50.02 FBA A comm loss func*	Cyclical communication between drive and fieldbus adapter module A or between PLC and fieldbus adapter module A is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter groups *50 Fieldbus adapter (FBA)*, *51 FBA A settings*, *52 FBA A data in* and *53 FBA A data out*. Check cable connections. Check if communication master is able to communicate.

Code (hex)	Warning	Cause	What to do
A7C2	FBA B communication Programmable warning: *50.32 FBA B comm loss func*	Cyclical communication between drive and fieldbus adapter module B or between PLC and fieldbus adapter module B is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter group *50 Fieldbus adapter (FBA)*. Check cable connections. Check if communication master is able to communicate.
A7CA	DDCS controller comm loss Programmable warning: *60.59 DDCS controller comm loss function*	DDCS (fiber optic) communication between drive and external controller is lost.	Check status of controller. See user documentation of controller. Check settings of parameter group *60 DDCS communication*. Check cable connections. If necessary, replace cables.
A7CB	MF comm loss Programmable warning: *60.09 M/F comm loss function*	Master/follower communication is lost.	Check the auxiliary code. The code indicates which node address (defined by parameter *60.02* in each drive) on the master/follower link is affected. Check settings of parameter group *60 DDCS communication*. On the FDCO module (if present), check that the DDCS link switch is not set to 0 (OFF). Check cable connections. If necessary, replace cables.
A7CE	EFB comm loss Programmable warning: *58.14 Communication loss action*	Communication break in embedded fieldbus (EFB) communication.	Check the status of the fieldbus master (online/offline/error etc.). Check cable connections to the XD2D connector on the control unit.
A7E1	Encoder Programmable warning: *90.45 Motor feedback fault*	Encoder error.	Check the auxiliary code (format XXYY ZZZZ). "XX" specifies the number of the encoder interface module (**01**: *91.11*/*91.12*, **02**: *91.13*/*91.14*), "YY" specifies the encoder (**01:** *92 Encoder 1 configuration*, **02:** *93 Encoder 2 configuration*). "ZZZZ" indicates the problem (see actions for each code below).
	0001	Cable fault	Check the conductor order at both ends of the encoder cable. Check the groundings of the encoder cable. If the encoder was working previously, check the encoder, encoder cable and encoder interface module for damage. See also parameter *92.21 Encoder cable fault mode*.
	0002	No encoder signal	Check the condition of the encoder.
	0003	Overspeed	Contact your local ABB representative.
	0004	Overfrequency	Contact your local ABB representative.
	0005	Resolver ID run failed	Contact your local ABB representative.
	0006	Resolver overcurrent fault	Contact your local ABB representative.
	0007	Speed scaling error	Contact your local ABB representative.

Code (hex)	Warning	Cause	What to do
	0008	Absolute encoder communication error	Contact your local ABB representative.
	0009	Absolute encoder initialization error	Contact your local ABB representative.
	000A	Absolute SSI encoder configuration error	Contact your local ABB representative.
	000B	Encoder reported an internal error	See the documentation of the encoder.
	000C	Encoder reported a battery error	See the documentation of the encoder.
	000D	Encoder reported overspeed or decreased resolution due to overspeed	See the documentation of the encoder.
	000E	Encoder reported a position counter error	See the documentation of the encoder.
	000F	Encoder reported an internal error	See the documentation of the encoder.
A7EE	Control panel loss Programmable warning: *49.05 Communication loss action*	Control panel (or PC tool) has stopped communicating.	Check PC tool or control panel connection. Check control panel connector. Check mounting platform if being used. Disconnect and reconnect the control panel.
A880	Motor bearing Programmable warnings: *33.14 On-time 1 warn message* *33.24 On-time 2 warn message* *33.55 Value counter 1 warn message* *33.65 Value counter 2 warn message*	Warning generated by an on-time timer or a value counter.	Check the auxiliary code. Check the source of the warning corresponding to the code: 0: *33.13 On-time 1 source* 1: *33.23 On-time 2 source* 4: *33.53 Value counter 1 source* 5: *33.63 Value counter 2 source*.
A881	Output relay	Warning generated by an edge counter. Programmable warnings: *33.35 Edge counter 1 warn message* *33.45 Edge counter 2 warn message*	Check the auxiliary code. Check the source of the warning corresponding to the code: 2: *33.33 Edge counter 1 source* 3: *33.43 Edge counter 2 source*.
A882	Motor starts		
A883	Power ups		
A884	Main contactor		
A885	DC charge		
A886	On-time 1 (Editable message text) Programmable warning: *33.14 On-time 1 warn message*	Warning generated by on-time timer 1.	Check the source of the warning (parameter *33.13 On-time 1 source*).
A887	On-time 2 (Editable message text) Programmable warning: *33.24 On-time 2 warn message*	Warning generated by on-time timer 2.	Check the source of the warning (parameter *33.23 On-time 2 source*).
A888	Edge counter 1 (Editable message text) Programmable warning: *33.35 Edge counter 1 warn message*	Warning generated by edge counter 1.	Check the source of the warning (parameter *33.33 Edge counter 1 source*).

Code (hex)	Warning	Cause	What to do
A889	Edge counter 2 (Editable message text) Programmable warning: *33.45 Edge counter 2 warn message*	Warning generated by edge counter 2.	Check the source of the warning (parameter *33.43 Edge counter 2 source*).
A88A	Value counter 1 (Editable message text) Programmable warning: *33.55 Value counter 1 warn message*	Warning generated by value counter 1.	Check the source of the warning (parameter *33.53 Value counter 1 source*).
A88B	Value counter 2 (Editable message text) Programmable warning: *33.65 Value counter 2 warn message*	Warning generated by value counter 2.	Check the source of the warning (parameter *33.63 Value counter 2 source*).
A88C	Device clean	Warning generated by an on-time timer. Programmable warnings: *33.14 On-time 1 warn message* *33.24 On-time 2 warn message*	Check the auxiliary code. Check the source of the warning corresponding to the code: 0: *33.13 On-time 1 source* 1: *33.23 On-time 2 source* 10: *05.04 Fan on-time counter*.
A88D	DC capacitor		
A88E	Cabinet fan		
A88F	Cooling fan		
A890	Additional cooling		
A8A0	AI supervision Programmable warning: *12.03 AI supervision function*	An analog signal is outside the limits specified for the analog input.	Check the auxiliary code (format XYY). "X" specifies the location of the input (**0**: AI on control unit; **1**: I/O extension module 1, etc.), "YY" specifies the input and limit (**01:** AI1 under minimum, **02:** AI1 over maximum, **03:** AI2 under minimum, **04:** AI2 over maximum). Check signal level at the analog input. Check the wiring connected to the input. Check the minimum and maximum limits of the input in parameter group *12 Standard AI*, *14 I/O extension module 1*, *15 I/O extension module 2* or *16 I/O extension module 3*.
A8B0	Signal supervision (Editable message text) Programmable warning: *32.06 Supervision 1 action*	Warning generated by the signal supervision 1 function.	Check the source of the warning (parameter *32.07 Supervision 1 signal*).
A8B1	Signal supervision 2 (Editable message text) Programmable warning: *32.16 Supervision 2 action*	Warning generated by the signal supervision 2 function.	Check the source of the warning (parameter *32.17 Supervision 2 signal*).
A8B2	Signal supervision 3 (Editable message text) Programmable warning: *32.26 Supervision 3 action*	Warning generated by the signal supervision 3 function.	Check the source of the warning (parameter *32.27 Supervision 3 signal*).
A8BE	ULC overload warning Programmable fault: *37.03 ULC overload actions*	Selected signal has exceeded the user overload curve.	Check for any operating conditions increasing the monitored signal (for example, the loading of the motor if the torque or current is being monitored). Check the definition of the load curve (parameter group *37 User load curve*).

Code (hex)	Warning	Cause	What to do
A8BF	ULC underload warning Programmable fault: *37.04 ULC underload actions*	Selected signal has fallen below the user underload curve.	Check for any operating conditions decreasing the monitored signal (for example, loss of load if the torque or current is being monitored). Check the definition of the load curve (parameter group *37 User load curve*).
A8C0	Fan service counter	A cooling fan has reached the end of its estimated lifetime. See parameters *05.41* and *05.42*.	Check the auxiliary code. The code indicates which fan is to be replaced. 0: Main cooling fan 1: Auxiliary cooling fan 2: Auxiliary cooling fan 2 3: Cabinet cooling fan 4: PCB compartment fan Refer to the hardware manual of the drive for fan replacement instructions.
A981	External warning 1 (Editable message text) Programmable warning: *31.01 External event 1 source* *31.02 External event 1 type*	Fault in external device 1.	Check the external device. Check setting of parameter *31.01 External event 1 source*.
A982	External warning 2 (Editable message text) Programmable warning: *31.03 External event 2 source* *31.04 External event 2 type*	Fault in external device 2.	Check the external device. Check setting of parameter *31.03 External event 2 source*.
A983	External warning 3 (Editable message text) Programmable warning: *31.05 External event 3 source* *31.06 External event 3 type*	Fault in external device 3.	Check the external device. Check setting of parameter *31.05 External event 3 source*.
A984	External warning 4 (Editable message text) Programmable warning: *31.07 External event 4 source* *31.08 External event 4 type*	Fault in external device 4.	Check the external device. Check setting of parameter *31.07 External event 4 source*.
A985	External warning 5 (Editable message text) Programmable warning: *31.09 External event 5 source* *31.10 External event 5 type*	Fault in external device 5.	Check the external device. Check setting of parameter *31.09 External event 5 source*.
AF80	INU-LSU comm loss Programmable warning: *60.79 INU-LSU comm loss function*	DDCS (fiber optic) communication between converters (for example, the inverter unit and the supply unit) is lost.	Check status of other converter (parameters *06.36* and *06.39*). Check settings of parameter group *60 DDCS communication*. Check the corresponding settings in the control program of the other converter. Check cable connections. If necessary, replace cables.

Code (hex)	**Warning**	**Cause**	**What to do**
AF85	Line side unit warning	The supply unit has generated a warning.	If using a control panel or the Drive composer tool, connect to the supply unit to read the warning code. Refer to the firmware manual of the supply unit for instructions related to the code.
AF8C	Process PID sleep mode	The drive is entering sleep mode.	Informative warning. See section *Sleep function for process PID control* (page *66*), and parameters *40.41*…*40.48*.
AF90	Speed controller autotuning	The speed controller autotune routine did not complete successfully.	Check the auxiliary code (format XXXX YYYY). "YYYY" indicates the problem (see actions for each code below).
	0000	The drive was stopped before the autotune routine finished.	Repeat autotune until successful.
	0001	The drive was started but was not ready to follow the autotune command.	Make sure the prerequisites of the autotune run are fulfilled. See section *Before activating the autotune routine* (page *44*).
	0002	Required torque reference could not be reached before the drive reached maximum speed.	Decrease torque step (parameter *25.38*) or increase speed step (*25.39*).
	0003	Motor could not accelerate/decelerate to maximum/minimum speed.	Increase torque step (parameter *25.38*) or decrease speed step (*25.39*).
	0005	Motor could not decelerate with full autotune torque.	Decrease torque step (parameter *25.38*) or speed step (*25.39*).
AFAA	Autoreset	A fault is about to be autoreset.	Informative warning. See the settings in parameter group *31 Fault functions*.
AFE1	Emergency stop (off2)	Drive has received an emergency stop (mode selection off2) command.	Check that it is safe to continue operation. Reset the source of the emergency stop signal (such as an emergency stop push button). Restart drive. If the emergency stop was unintentional, check the source of the stop signal (for example, *21.05 Emergency stop source*, or control word received from an external control system).
		(Follower drive in a master/follower configuration) Drive has received a stop command from the master.	Informative warning. After stopping on a ramp stop (Off1 or Off3) command, the master sends a short, 10-millisecond coast stop (Off2) command to the follower(s). The Off2 stop is stored in the event log of the follower.
AFE2	Emergency stop (off1 or off3)	Drive has received an emergency stop (mode selection Off1 or Off3) command.	Check that it is safe to continue operation. Reset the source of the emergency stop signal (such as an emergency stop push button). Restart drive. If the emergency stop was unintentional, check the source of the stop signal (for example, *21.05 Emergency stop source*, or control word received from an external control system).

Code (hex)	Warning	Cause	What to do
AFE7	Follower	A follower drive has tripped.	Check the auxiliary code. Add 2 to the code to find out the node address of the faulted drive. Correct the fault in the follower drive.
AFEA	Enable start signal missing (Editable message text)	No enable start signal received.	Check the setting of (and the source selected by) parameter *20.19 Enable start command*.
AFEB	Run enable missing (Editable message text)	No run enable signal is received.	Check setting of parameter *20.12 Run enable 1 source*. Switch signal on (e.g. in the fieldbus Control Word) or check wiring of selected source.
AFEC	External power signal missing	*95.04 Control board supply* is set to *External 24V* but no voltage is connected to the XPOW connector of the control unit.	Check the external 24 V DC power supply to the control unit, or change the setting of parameter *95.04*.
AFF6	Identification run	Motor ID run will occur at next start, or is in progress.	Informative warning.
AFF7	Autophasing	Autophasing will occur at next start.	Informative warning.
B5A0	STO event Programmable event: *31.22 STO indication run/stop*	Safe torque off function is active, i.e. safety circuit signal(s) connected to connector XSTO is lost.	Check safety circuit connections. For more information, see appropriate drive hardware manual and description of parameter *31.22 STO indication run/stop* (page *259*).
B5A4	SW internal diagnostics	Control unit rebooted unexpectedly.	Informative event.
B686	Checksum mismatch Programmable event: *96.54 Checksum action*	The calculated parameter checksum does not match any enabled reference checksum.	See *A686 Checksum mismatch* (page *482*).

Fault messages

Code (hex)	Fault	Cause	What to do
2281	Calibration	Measured offset of output phase current measurement or difference between output phase U2 and W2 current measurement is too great (the values are updated during current calibration).	Try performing the current calibration again (select *Current measurement calibration* at parameter *99.13*). If the fault persists, contact your local ABB representative.
2310	Overcurrent	Output current has exceeded internal fault limit.	See *A2B1 Overcurrent* (page *477*).
2330	Earth leakage Programmable fault: *31.20 Earth fault*	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. Try running the motor in scalar control mode if allowed. (See parameter *99.04 Motor control mode*.) With parallel-connected modules, check the auxiliary code (format XXXY YYZZ). “Y YY” specifies through which BCU control unit channel the fault was received. If no earth fault can be detected, contact your local ABB representative.
2340	Short circuit	Short-circuit in motor cable(s) or motor	Check motor and motor cable for cabling errors. Check there are no power factor correction capacitors or surge absorbers in motor cable. Check the auxiliary code (format XXXY YYZZ). With parallel-connected inverter modules, “Y YY” specifies through which BCU control unit channel the fault was received. “ZZ” indicates the location of the short circuit (**0:** No detailed information available, **1:** Upper branch of U-phase, **2:** Lower branch of U-phase, **4:** Upper branch of V-phase, **8:** Lower branch of V-phase, **10:** Upper branch of W-phase, **20:** Lower branch of W-phase, **other:** combinations of the above). After correcting the cause of the fault, reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power.
2381	IGBT overload	Excessive IGBT junction to case temperature. This fault protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.

Code (hex)	Fault	Cause	What to do
2391	BU current difference	AC phase current difference between parallel-connected inverter modules is excessive.	Check motor cabling. Check there are no power factor correction capacitors or surge absorbers in motor cable. Check the auxiliary code (format XXXY YYZZ). "XXX" specifies the source of the first error (see "YYY"). "YYY" specifies the module through which BCU control unit channel the fault was received (**1:** Channel 1, **2:** Channel 2, **4:** Channel 3, **8:** Channel 4, …, **800:** Channel 12, **other:** combinations of the above). "ZZ" indicates the phase (**1:** U, **2:** V, **3:** W).
2392	BU earth leakage	Total earth leakage of inverter modules is excessive.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Measure insulation resistances of motor cables and motor. Contact your local ABB representative.
3130	Input phase loss Programmable fault: *31.21 Supply phase loss*	Intermediate circuit DC voltage is oscillating due to missing input power line phase or blown fuse.	Check input power line fuses. Check for loose power cable connections. Check for input power supply imbalance.
3180	Charge relay lost	No acknowledgement received from charge relay.	Contact your local ABB representative.
3181	Wiring or earth fault Programmable fault: *31.23 Wiring or earth fault*	The drive hardware is supplied from a common DC bus.	Switch off the protection in parameter *31.23*.
		Incorrect input power and motor cable connection (i.e. input power cable is connected to the motor connection).	Check the power connections.
		Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. Try running the motor in scalar control mode if allowed. (See parameter *99.04 Motor control mode*.)

Code (hex)	Fault	Cause	What to do
3210	DC link overvoltage	Excessive intermediate circuit DC voltage.	Check that overvoltage control is on (parameter *30.30 Overvoltage control*). Check that the supply voltage matches the nominal input voltage of the drive. Check the supply line for static or transient overvoltage. Check brake chopper and resistor (if present). Check deceleration time. Use coast-to-stop function (if applicable). Retrofit drive with brake chopper and brake resistor. With parallel-connected modules, check the auxiliary code (format XXXY YYZZ). “Y YY” specifies through which BCU control unit channel the fault was received.
3220	DC link undervoltage	Intermediate circuit DC voltage is not sufficient because of a missing supply phase, blown fuse or fault in the rectifier bridge.	Check supply cabling, fuses and switchgear. With parallel-connected modules, check the auxiliary code (format XXXY YYZZ). “Y YY” specifies through which BCU control unit channel the fault was received.
3280	Standby timeout	Automatic restart failed (see section *Automatic restart* on page *75*).	Check the condition of the supply (voltage, cabling, fuses, switchgear).
3291	BU DC link difference	Difference in DC voltages between parallel-connected inverter modules.	Check the auxiliary code (format XXXY YYZZ). “XXX” specifies the source of the first error (see “YYY”). “YYY” specifies the module through which BCU control unit channel the fault was received (**1:** Channel 1, **2:** Channel 2, **4:** Channel 3, **8:** Channel 4, …, **800:** Channel 12).
3381	Output phase loss Programmable fault: *31.19 Motor phase loss*	Motor circuit fault due to missing motor connection (all three phases are not connected).	Connect motor cable.
3385	Autophasing	Autophasing routine (see section *Autophasing* on page *59*) has failed.	Try other autophasing modes (see parameter *21.13 Autophasing mode*) if possible. If the *Turning with Z-pulse* mode is selected, check the zero pulse given by the encoder. Check that the motor ID run has been successfully completed. Clear parameter *98.15 Position offset user*. Check that the encoder is not slipping on the motor shaft. Check that the motor is not already turning when the autophasing routine starts. Check the setting of parameter *99.03 Motor type*.

Code (hex)	Fault	Cause	What to do
4000	Motor cable overload	Calculated motor cable temperature has exceeded warning limit.	Check the settings of parameters *35.61* and *35.62*. Check the dimensioning of the motor cable in regard to required load.
4210	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4290	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C (104 °F), ensure that load current does not exceed derated load capacity of drive. See appropriate *Hardware manual*. Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.
42F1	IGBT temperature	Drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4310	Excess temperature	Power unit module temperature is excessive.	See *A4B0 Excess temperature* (page *479*).
4380	Excess temperature difference	High temperature difference between the IGBTs of different phases.	See *A4B1 Excess temperature difference* (page *480*).
4381	PCB space cooling	Temperature difference between ambient and drive module PCB space is excessive.	See *A4B2 PCB space cooling* (page *480*).
4981	External temperature 1 (Editable message text)	Measured temperature 1 has exceeded fault limit.	Check the value of parameter *35.02 Measured temperature 1*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of parameter *35.12 Temperature 1 fault limit*.
4982	External temperature 2 (Editable message text)	Measured temperature 2 has exceeded fault limit.	Check the value of parameter *35.03 Measured temperature 2*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of parameter *35.22 Temperature 2 fault limit*.
4990	FPTC not found	A thermistor protection module has been activated by parameter *35.30* but cannot be detected.	Power down the control unit and make sure that the module is properly inserted in the correct slot. The last digit of the auxiliary code identifies the slot.

Code (hex)	Fault	Cause	What to do
4991	Safe motor temperature 1 (Editable message text)	The thermistor protection module installed in slot 1 indicates overtemperature.	Check the cooling of the motor. Check the motor load and drive ratings. Check the wiring of the temperature sensor. Repair wiring if faulty. Measure the resistance of the sensor. Replace sensor if faulty.
4992	Safe motor temperature 2 (Editable message text)	The thermistor protection module installed in slot 2 indicates overtemperature.	
4993	Safe motor temperature 3 (Editable message text)	The thermistor protection module installed in slot 3 indicates overtemperature.	
5080	Fan	Cooling fan feedback missing.	See *A581 Fan* (page *480*).
5081	Auxiliary fan broken	An auxiliary cooling fan (connected to the fan connectors on the control unit) is stuck or disconnected.	Check the auxiliary code. The auxiliary code identifies the fan (**1:** Auxiliary fan 1, **2:** Auxiliary fan 2). Check auxiliary fan(s) and connection(s). Replace faulty fan. Make sure the front cover of the drive module is in place and tightened. If the commissioning of the drive requires that the cover is off, activate parameter *31.36 Aux fan fault bypass* within 2 minutes from control unit reboot to temporarily suppress the fault.
5090	STO hardware failure	Safe torque off hardware failure.	Contact your local ABB representative, quoting the auxiliary code. The code contains location information, especially with parallel-connected inverter modules. When converted into a 32-bit binary number, the bits of the code indicate the following: 31…28: Number of faulty inverter module (0…11 decimal). 1111: STO_ACT states of control unit and inverter modules in conflict 27: STO_ACT state of inverter modules 26: STO_ACT state of control unit 25: STO1 of control unit 24: STO2 of control unit 23…12: STO1 of inverter modules 12…1 (Bits of non-existing modules set to 1) 11…0: STO2 of inverter modules 12…1 (Bits of non-existing modules set to 1)
5091	Safe torque off Programmable fault: *31.22 STO indication run/stop*	Safe torque off function is active, i.e. safety circuit signal(s) connected to connector XSTO is broken during start or run.	Check safe torque off circuit connections. For more information, see appropriate drive hardware manual and description of parameter *31.22 STO indication run/stop* (page *259*).
5092	PU logic error	Power unit memory has cleared.	Cycle the power to the drive. If the control unit is externally powered, also reboot the control unit (using parameter *96.08 Control board boot*) or by cycling its power. If the problem persists, contact your local ABB representative.

Code (hex)	Fault	Cause	What to do
5093	Rating ID mismatch	The hardware of the drive does not match the information stored in the memory unit. This may occur eg. after a firmware update or memory unit replacement.	Cycle the power to the drive. Check the auxiliary code. The auxiliary code categories are as follows: 1 = PU and CU ratings not the same. Rating ID has changed. 2 = Parallel connection rating ID has changed. 3 = PU types not the same in all power units. 4 = Parallel connection rating ID is active in a single power unit setup. 5 = It is not possible to implement the selected rating with the current PUs. 6 = PU rating ID is 0. 7 = Reading PU rating ID or PU type failed on PU connection. 8 = PU not supported (illegal rating ID). With parallel connection faults (BCU control unit), the format of the auxiliary code is 0X0Y. “Y” indicates the auxiliary code category, “X” indicates the first faulty PU channel in hexadecimal (1…C). (With a ZCU control unit, “X” can be 1 or 2 but this is irrelevant to the fault.)
5094	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	See *A5EA Measurement circuit temperature* (page *481*).
5681	PU communication	The way the control unit is powered does not correspond to parameter setting.	Check setting of *95.04 Control board supply*.
		Communication errors detected between the drive control unit and the power unit.	Check the connection between the control unit and the power unit. Check the auxiliary code (format XXXY YYZZ). With parallel-connected modules, “Y YY” specifies the affected BCU control unit channel (**0:** broadcast). “ZZ” specifies the error source (**1:** Transmitter side [link error], **2:** Transmitter side [no communication], **3:** Receiver side [link error], **4:** Receiver side [no communication], **5:** Transmitter FIFO error [see “XXX”], **6:** Module [xINT board] not found, **7:** BAMU board not found). “XXX” specifies the transmitter FIFO error code (**1:** Internal error [invalid call parameter], **2:** Internal error [configuration not supported], **3:** Transmission buffer full).
5682	Power unit lost	Connection between the drive control unit and the power unit is lost.	Check the connection between the control unit and the power unit.
5690	PU communication internal	Internal communication error.	Contact your local ABB representative.
5691	Measurement circuit ADC	Measurement circuit fault.	Contact your local ABB representative, quoting the auxiliary code.

Code (hex)	Fault	Cause	What to do
5692	PU board powerfail	Power unit power supply failure.	Check the auxiliary code (format ZZZY YYXX). "YY Y" specifies the affected inverter module (**0…C**, always **0** for ZCU control units). "XX" specifies the affected power supply (**1:** Power supply 1, **2:** Power supply 2, **3:** both supplies).
5693	Measurement circuit DFF	Measurement circuit fault.	Contact your local ABB representative, quoting the auxiliary code.
5694	PU communication configuration	Version check cannot find a matching power unit FPGA logic.	Contact your local ABB representative.
5695	Reduced run	Number of inverter modules detected does not match the value of parameter *95.13 Reduced run mode*.	Check that the value of *95.13 Reduced run mode* corresponds to the number of inverter modules present. Check that the modules present are powered from the DC bus and connected by fiber optic cables to the BCU control unit. If all modules of the inverter unit are in fact available (eg. maintenance work has been completed), check that parameter *95.13* is set to 0 (reduced run function disabled).
5696	PU state feedback	State feedback from output phases does not match control signals.	Contact your local ABB representative, quoting the auxiliary code.
5697	Charging feedback	Incorrect parameter setting.	Check the setting of *95.09 Fuse switch control*. The parameter should be enabled only if an xSFC charging controller is installed.
		The charging switch and DC switch were operated out of sequence, or a start command was issued before the unit was ready.	The normal power-up sequence is: 1. Close charging switch. 2. After charging finishes (charging OK lamp lights), close DC switch. 3. Open charging switch.
		Charging circuit fault.	Check the charging circuit. With a frame R6i/R7i inverter module, the auxiliary code "FA" indicates that the charging contactor status feedback does not match the control signal. With parallel-connected frame R8i modules, the auxiliary code (format XX00), "XX" specifies the affected BCU control unit channel.
5698	Unknown power unit fault	Unidentified power unit logic fault.	Check power unit logic and firmware compatibility. Contact your local ABB representative.
6000	Internal SW error	Internal error.	Contact your local ABB representative, quoting the auxiliary code.
6181	FPGA version incompatible	Firmware and FPGA file version in the power unit are incompatible.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
		Update of power unit logic failed.	Retry.

Code (hex)	Fault	Cause	What to do
6200	Checksum mismatch Programmable fault: *96.54 Checksum action*	The calculated parameter checksum does not match any enabled reference checksum.	See *A686 Checksum mismatch* (page *482*).
6306	FBA A mapping file	Fieldbus adapter A mapping file read error.	Contact your local ABB representative.
6307	FBA B mapping file	Fieldbus adapter B mapping file read error.	Contact your local ABB representative.
6481	Task overload	Internal fault.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
6487	Stack overflow	Internal fault.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
64A1	Internal file load	File read error.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
64A2	Internal record load	Internal record load error.	Contact your local ABB representative.
64A3	Application loading	Application file incompatible or corrupted.	Check the auxiliary code. See actions for each code below.
	8006	Not enough memory for the application.	Reduce the size of the application. Reduce the number of parameter mappings. See the drive-specific log generated by Automation Builder.
	8007	The application contains the wrong system library version.	Update the system library or reinstall Automation Builder. See the drive-specific log generated by Automation Builder.
	8008	The application is empty.	In Automation Builder, give a “Clean” command and reload the application.
	8009	The application contains invalid tasks.	In Automation Builder, check application task configuration, give a “Clean all” command, and reload the application.
	800A	The application contains an unknown target (system) library function.	Update the system library or reinstall Automation Builder. See the drive-specific log generated by Automation Builder.
64A5	Licensing fault	Running the control program is prevented either because a restrictive license exists, or because a required license is missing.	Record the auxiliary codes of all active licensing faults and contact your product vendor for further instructions.
64A6	Adaptive program	Error running the adaptive program.	Check the auxiliary code (format XXXX YYYY). “XXXX” specifies the number of the function block (**0000** = generic error). “YYYY” indicates the problem (see actions for each code below).

Code (hex)	Fault	Cause	What to do
	000A	Program corrupted or block non-existent	Restore the template program or download the program to the drive.
	000C	Required block input missing	Check the inputs of the block.
	000E	Program corrupted or block non-existent	Restore the template program or download the program to the drive.
	0011	Program too large.	Remove blocks until the error stops.
	0012	Program is empty.	Correct the program and download it to the drive.
	001C	A nonexisting parameter or block is used in the program.	Edit the program to correct the parameter reference, or to use an existing block.
	001D	Parameter type invalid for selected pin.	Edit the program to correct the parameter reference.
	001E	Output to parameter failed because the parameter was write-protected.	Check the parameter reference in the program. Check for other sources affecting the target parameter.
	0023	Program file incompatible with current firmware version.	Adapt the program to current block library and firmware version.
	0024		
	002A	Too many blocks.	Edit the program to reduce the number of blocks.
	Other	–	Contact your local ABB representative, quoting the auxiliary code.
64B0	Memory unit detached	The memory unit was detached when the control unit was powered.	Switch off the power to the control unit and reinstall the memory unit. In case the memory unit was not actually removed when the fault occurred, check that the memory unit is properly inserted into its connector and its mounting screw is tight. Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
64B1	Internal SSW fault	Internal fault.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
64B2	User set fault	Loading of user parameter set failed because • requested set does not exist • set is not compatible with control program • drive was switched off during loading.	Ensure that a valid user parameter set exists. Reload if uncertain.
64E1	Kernel overload	Operating system error.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
6581	Parameter system	Parameter load or save failed.	Try forcing a save using parameter *96.07 Parameter save manually*. Retry.

Code (hex)	Fault	Cause	What to do
65A1	FBA A parameter conflict	The drive does not have a functionality requested by PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups *50 Fieldbus adapter (FBA)* and *51 FBA A settings*.
65A2	FBA B parameter conflict	The drive does not have a functionality requested by PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups *50 Fieldbus adapter (FBA)* and *54 FBA B settings*.
65B1	Reference source parametrization	A reference source is simultaneously connected to multiple parameters with different units.	See *A6DA Reference source parametrization* (page *484*).
6681	EFB comm loss Programmable fault: *58.14 Communication loss action*	Communication break in embedded fieldbus (EFB) communication.	Check the status of the fieldbus master (online/offline/error etc.). Check cable connections to the XD2D connector on the control unit.
6682	EFB config file	Embedded fieldbus (EFB) configuration file could not be read.	Contact your local ABB representative.
6683	EFB invalid parameterization	Embedded fieldbus (EFB) parameter settings inconsistent or not compatible with selected protocol.	Check the settings in parameter group *58 Embedded fieldbus*.
6684	EFB load fault	Embedded fieldbus (EFB) protocol firmware could not be loaded.	Contact your local ABB representative.
		Version mismatch between EFB protocol firmware and drive firmware.	
6881	Text data overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6882	Text 32-bit table overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6883	Text 64-bit table overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6885	Text file overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
7080	Option module comm loss	Communication between drive and an option module is lost.	See *A798 Encoder option comm loss* (page *486*).
7081	Control panel loss Programmable fault: *49.05 Communication loss action*	Control panel (or PC tool) has stopped communicating.	Check PC tool or control panel connection. Check control panel connector. Disconnect and reconnect the control panel. Check the auxiliary code. The code specifies the I/O port used as follows: **0:** Panel, **1:** Fieldbus interface A, **2:** Fieldbus interface B, **3:** Ethernet, **4:** D2D/EFB port).

Code (hex)	Fault	Cause	What to do
7082	Ext I/O comm loss	The I/O extension module types specified by parameters do not match the detected configuration.	Check the auxiliary code (format XXYY YYYY). "XX" specifies the number of the I/O extension module (**01:** parameter group *14 I/O extension module 1*, **02:** *15 I/O extension module 2*, **03:** *16 I/O extension module 3*). "YY YYYY" indicates the problem (see actions for each code below).
	00 0001	Communication with module failed.	Check that the module is properly seated in its slot. Check that the module and the slot connector is not damaged. Try installing the module into another slot.
	00 0002	Module not found.	Check the type and location settings of the modules (parameters *14.01*/*14.02*, *15.01*/*15.02* or *16.01*/*16.02*). Check that the module is properly seated in its slot. Check that the module and the slot connector is not damaged. Try installing the module into another slot.
	00 0003	Configuration of module failed.	
	00 0004	Configuration of module failed.	
7083	Panel reference conflict	Use of saved control panel reference in multiple control modes attempted.	The control panel reference can only be saved for one reference type at a time. Consider the possibility of using a copied reference instead of saved reference (see the reference selection parameter).
7084	Panel/PC tool version conflict	The current version of the control panel and/or PC tool does not support a function. (For example, older panel versions cannot be used as a source of external reference.)	Update control panel and/or PC tool. Contact your local ABB representative if necessary.
7085	Incompatible option module	Option module not supported. (For example, type Fxxx-xx-M fieldbus adapter modules are not supported.)	Check the auxiliary code. The code specifies the interface to which the unsupported module is connected: **1:** Fieldbus interface A, **2:** Fieldbus interface B. Replace the module with a supported type.
7121	Motor stall Programmable fault: *31.24 Stall function*	Motor is operating in stall region because of e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.
7181	Brake resistor	Brake resistor broken or not connected.	Check that a brake resistor has been connected. Check the condition of the brake resistor. Check the dimensioning of the brake resistor.

Code (hex)	Fault	Cause	What to do
7183	BR excess temperature	Brake resistor temperature has exceeded fault limit defined by parameter *43.11 Brake resistor fault limit*.	Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check fault limit setting, parameter *43.11 Brake resistor fault limit*. Check that braking cycle meets allowed limits.
7184	Brake resistor wiring	Brake resistor short circuit or brake chopper control fault.	Check brake chopper and brake resistor connection. Ensure brake resistor is not damaged. After correcting the cause of the fault, reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power.
7191	BC short circuit	Short circuit in brake chopper IGBT.	Ensure brake resistor is connected and not damaged. Check the electrical specifications of the brake resistor against the *Hardware manual*. Replace brake chopper (if replaceable). After correcting the cause of the fault, reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power.
7192	BC IGBT excess temperature	Brake chopper IGBT temperature has exceeded internal fault limit.	Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check the dimensioning and cooling of the cabinet. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
71A2	Mechanical brake closing failed Programmable fault: *44.17 Brake fault function*	Mechanical brake control fault. Activated eg. if brake acknowledgement is not as expected during brake closing.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that acknowledgement signal matches actual status of brake.
71A3	Mechanical brake opening failed Programmable fault: *44.17 Brake fault function*	Mechanical brake control fault. Activated eg. if brake acknowledgement is not as expected during brake opening.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that acknowledgement signal matches actual status of brake.

Code (hex)	Fault	Cause	What to do
71A5	Mechanical brake opening not allowed Programmable fault: *44.17 Brake fault function*	Open conditions of mechanical brake cannot be fulfilled (for example, brake has been prevented from opening by parameter *44.11 Keep brake closed*).	Check mechanical brake settings in parameter group *44 Mechanical brake control* (especially *44.11 Keep brake closed*). Check that acknowledgement signal (if used) matches actual status of brake.
		In an encoderless application, the brake is kept closed by a brake close request (either from parameter *44.12 Brake close request* or from an FSO-xx safety functions module) against a modulating drive for longer than 5 seconds.	Check the source signal selected by parameter *44.12 Brake close request*. Check the safety circuits connected to the FSO-xx safety functions module.
71B1	Motor fan Programmable fault: *35.106 DOL starter event type*	No feedback received from external fan.	Check external fan (or other equipment controlled) by the logic. Check settings of parameters *35.100*…*35.106*.
7301	Motor speed feedback Programmable fault: *90.45 Motor feedback fault*	No motor speed feedback received.	See *A7B0 Motor speed feedback* (page *488*).
7310	Overspeed	Motor is turning faster than highest allowed speed due to incorrectly set minimum/maximum speed, insufficient braking torque or changes in load when using torque reference.	Check minimum/maximum speed settings, parameters *30.11 Minimum speed* and *30.12 Maximum speed*. Check adequacy of motor braking torque. Check applicability of torque control. Check need for brake chopper and resistor(s).
		Incorrect estimated speed.	Check the status of motor current measurement. Perform a *Normal*, *Advanced* or *Advanced Standstill* ID run instead of, for example, a *Reduced* or *Standstill* ID run. See parameter *99.13 ID run requested* (page *414*).
7380	Encoder internal	Internal fault.	Contact your local ABB representative.
7381	Encoder Programmable fault: *90.45 Motor feedback fault*	Encoder feedback fault.	See *A7E1 Encoder* (page *489*).
73A0	Speed feedback configuration	Speed feedback configuration incorrect.	See *A797 Speed feedback configuration* (page *485*).
73A1	Load feedback Programmable fault: *90.55 Load feedback fault*	No load feedback received.	Check the auxiliary code (format XXYY ZZZZ). “XX” specifies the number of the encoder interface module (**01**: *91.11*/*91.12*, **02**: *91.13*/*91.14*), “YY” specifies the encoder (**01:** *92 Encoder 1 configuration*, **02:** *93 Encoder 2 configuration*). “ZZZZ” indicates the problem (see actions for each code below).
	0001	Load gear definition invalid or outside limits.	Check load gear settings (*90.53* and *90.54*).

Code (hex)	Fault	Cause	What to do
	0002	Feed constant definition invalid or outside limits.	Check feed constant settings (*90.63* and *90.64*).
	0003	Motor/load gear definition invalid or outside limits.	Check motor/load gear settings (*90.61* and *90.62*).
	0004	Encoder not configured.	Check encoder settings (*92 Encoder 1 configuration* or *93 Encoder 2 configuration*). Use parameter *91.10 Encoder parameter refresh*) to validate any changes in the settings.
	0005	Encoder stopped working.	Check encoder status.
73B0	Emergency ramp failed	Emergency stop did not finish within expected time.	Check the settings of parameters *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*. Check the predefined ramp times (*23.11*…*23.19* for mode Off1, *23.23* for mode Off3).
73B1	Stop failed	Ramp stop did not finish within expected time.	Check the settings of parameters *31.37 Ramp stop supervision* and *31.38 Ramp stop supervision delay*. Check the predefined ramp times in parameter group *23 Speed reference ramp*.
73F0	Overfrequency	Maximum allowed output frequency exceeded.	Without a dual-use license, the fault limit is 598 Hz. Contact your local ABB representative for dual-use licensing information.
7510	FBA A communication Programmable fault: *50.02 FBA A comm loss func*	Cyclical communication between drive and fieldbus adapter module A or between PLC and fieldbus adapter module A is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter groups *50 Fieldbus adapter (FBA)*, *51 FBA A settings*, *52 FBA A data in* and *53 FBA A data out*. Check cable connections. Check if communication master is able to communicate.
7520	FBA B communication Programmable fault: *50.32 FBA B comm loss func*	Cyclical communication between drive and fieldbus adapter module B or between PLC and fieldbus adapter module B is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter group *50 Fieldbus adapter (FBA)*. Check cable connections. Check if communication master is able to communicate.
7580	INU-LSU comm loss Programmable fault: *60.79 INU-LSU comm loss function*	DDCS (fiber optic) communication between converters (for example, the inverter unit and the supply unit) is lost.	Check status of other converter (parameters *06.36* and *06.39*). Check settings of parameter group *60 DDCS communication*. Check the corresponding settings in the control program of the other converter. Check cable connections. If necessary, replace cables.

Code (hex)	Fault	Cause	What to do
7581	DDCS controller comm loss Programmable fault: *60.59 DDCS controller comm loss function*	DDCS (fiber optic) communication between drive and external controller is lost.	Check status of controller. See user documentation of controller. Check settings of parameter group *60 DDCS communication*. Check cable connections. If necessary, replace cables.
7582	MF comm loss Programmable fault: *60.09 M/F comm loss function*	Master/follower communication is lost.	See *A7CB MF comm loss* (page *489*).
7583	Line side unit faulted	The supply unit (or other converter) connected to the inverter unit has generated a fault.	Check fault status of supply unit (or other converter). Refer to the firmware manual of the supply unit.
7584	LSU charge failed	The supply unit was not ready (ie. the main contactor/breaker could not be closed) within expected time.	Check setting of parameter *94.10 LSU max charging time*. Check that the supply unit is enabled, allowed to start, and can be controlled by the inverter unit (eg. not in local control mode).
8001	ULC underload fault Programmable fault: *37.04 ULC underload actions*	Selected signal has fallen below the user underload curve.	See *A8BF ULC underload warning* (page *492*).
8002	ULC overload fault Programmable fault: *37.03 ULC overload actions*	Selected signal has exceeded the user overload curve.	See *A8BE ULC overload warning* (page *491*).
80A0	AI supervision Programmable fault: *12.03 AI supervision function*	An analog signal is outside the limits specified for the analog input.	Check the auxiliary code (format XXXX XYZZ). "Y" specifies the location of the input (**0:** Control unit, **1:** I/O extension module 1, **2:** I/O extension module 2, **3:** I/O extension module 3). "ZZ" specifies the limit (**01:** AI1 under minimum, **02:** AI1 above maximum, **03:** AI2 under minimum, **04:** AI2 above maximum). Check signal level at the analog input. Check the wiring connected to the input. Check the minimum and maximum limits of the input in parameter group *12 Standard AI*.
80B0	Signal supervision (Editable message text) Programmable fault: *32.06 Supervision 1 action*	Fault generated by the signal supervision 1 function.	Check the source of the fault (parameter *32.07 Supervision 1 signal*).
80B1	Signal supervision 2 (Editable message text) Programmable fault: *32.16 Supervision 2 action*	Fault generated by the signal supervision 2 function.	Check the source of the fault (parameter *32.17 Supervision 2 signal*).
80B2	Signal supervision 3 (Editable message text) Programmable fault: *32.26 Supervision 3 action*	Fault generated by the signal supervision 3 function.	Check the source of the fault (parameter *32.27 Supervision 3 signal*).

Code (hex)	Fault	Cause	What to do
9081	External fault 1 (Editable message text) Programmable fault: *31.01 External event 1 source* *31.02 External event 1 type*	Fault in external device 1.	Check the external device. Check setting of parameter *31.01 External event 1 source*.
9082	External fault 2 (Editable message text) Programmable fault: *31.03 External event 2 source* *31.04 External event 2 type*	Fault in external device 2.	Check the external device. Check setting of parameter *31.03 External event 2 source*.
9083	External fault 3 (Editable message text) Programmable fault: *31.05 External event 3 source* *31.06 External event 3 type*	Fault in external device 3.	Check the external device. Check setting of parameter *31.05 External event 3 source*.
9084	External fault 4 (Editable message text) Programmable fault: *31.07 External event 4 source* *31.08 External event 4 type*	Fault in external device 4.	Check the external device. Check setting of parameter *31.07 External event 4 source*.
9085	External fault 5 (Editable message text) Programmable fault: *31.09 External event 5 source* *31.10 External event 5 type*	Fault in external device 5.	Check the external device. Check setting of parameter *31.09 External event 5 source*.
FA81	Safe torque off 1 loss	Safe torque off function is active, ie. STO circuit 1 is broken.	Check safety circuit connections. For more information, see appropriate drive hardware manual and description of parameter *31.22 STO indication run/stop* (page 259). Check the auxiliary code, The code contains location information, especially with parallel-connected inverter modules. When converted into a 32-bit binary number, the bits of the code indicate the following: 31…28: Number of faulty inverter module (0…11 decimal). 1111: STO_ACT states of control unit and inverter modules in conflict 27: STO_ACT state of inverter modules 26: STO_ACT state of control unit 25: STO1 of control unit 24: STO2 of control unit 23…12: STO1 of inverter modules 12…1 (Bits of non-existing modules set to 1) 11…0: STO2 of inverter modules 12…1 (Bits of non-existing modules set to 1)
FA82	Safe torque off 2 loss	Safe torque off function is active, ie. STO circuit 2 is broken.	

Code (hex)	Fault	Cause	What to do
FB11	Memory unit missing	No memory unit is attached to the control unit.	Power down the control unit. Check that the memory unit is properly inserted into the control unit.
		The memory unit attached to the control unit is empty.	Power down the control unit. Attach a memory unit (with the appropriate firmware) to the control unit.
FB12	Memory unit incompatible	The memory unit attached to the control unit is incompatible.	Power down the control unit. Attach a compatible memory unit.
FB13	Memory unit FW incompatible	The firmware on the attached memory unit is incompatible with the drive.	Power down the control unit. Attach a memory unit with compatible firmware.
FB14	Memory unit FW load failed	The firmware on the attached memory unit could not be loaded to the drive.	Power down the control unit. Check that the memory unit is properly inserted into the control unit. If the problem persists, replace the memory unit.
FF61	ID run	Motor ID run was not completed successfully.	Check the nominal motor values in parameter group *99 Motor data*. Check that no external control system is connected to the drive. Cycle the power to the drive (and its control unit, if powered separately). Check that the motor shaft is not locked. Check the auxiliary code. The second number of the code indicates the problem (see actions for each code below).
	0001	Maximum current limit too low.	Check settings of parameters *99.06 Motor nominal current* and *30.17 Maximum current*. Make sure that *30.17* > *99.06*. Check that the drive is dimensioned correctly according to the motor.
	0002	Maximum speed limit or calculated field weakening point too low.	Check settings of parameters • *30.11 Minimum speed* • *30.12 Maximum speed* • *99.07 Motor nominal voltage* • *99.08 Motor nominal frequency* • *99.09 Motor nominal speed*. Make sure that • *30.12* > (0.55 × *99.09*) > (0.50 × synchronous speed) • *30.11* ≤ 0, and • supply voltage ≥ (0.66 × *99.07*).
	0003	Maximum torque limit too low.	Check settings of parameter *99.12 Motor nominal torque*, and the torque limits in group *30 Limits*. Make sure that the maximum torque limit in force is greater than 100%.
	0004	Current measurement calibration did not finish within reasonable time.	Contact your local ABB representative.
	0005…0008	Internal error.	Contact your local ABB representative.

Code (hex)	Fault	Cause	What to do
	0009	(Asynchronous motors only) Acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000A	(Asynchronous motors only) Deceleration did not finish within reasonable time.	Contact your local ABB representative.
	000B	(Asynchronous motors only) Speed dropped to zero during ID run.	Contact your local ABB representative.
	000C	(Permanent magnet motors only) First acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000D	(Permanent magnet motors only) Second acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000E…0010	Internal error.	Contact your local ABB representative.
FF7E	Follower	A follower drive has tripped.	Check the auxiliary code. Add 2 to the code to find out the node address of the faulted drive. Correct the fault in the follower drive.
FF81	FB A force trip	A fault trip command has been received through fieldbus adapter A.	Check the fault information provided by the PLC.
FF82	FB B force trip	A fault trip command has been received through fieldbus adapter B.	Check the fault information provided by the PLC.
FF8E	EFB force trip	A fault trip command has been received through the embedded fieldbus interface.	Check the fault information provided by the Modbus controller.

9

Fieldbus control through the embedded fieldbus interface (EFB)

What this chapter contains

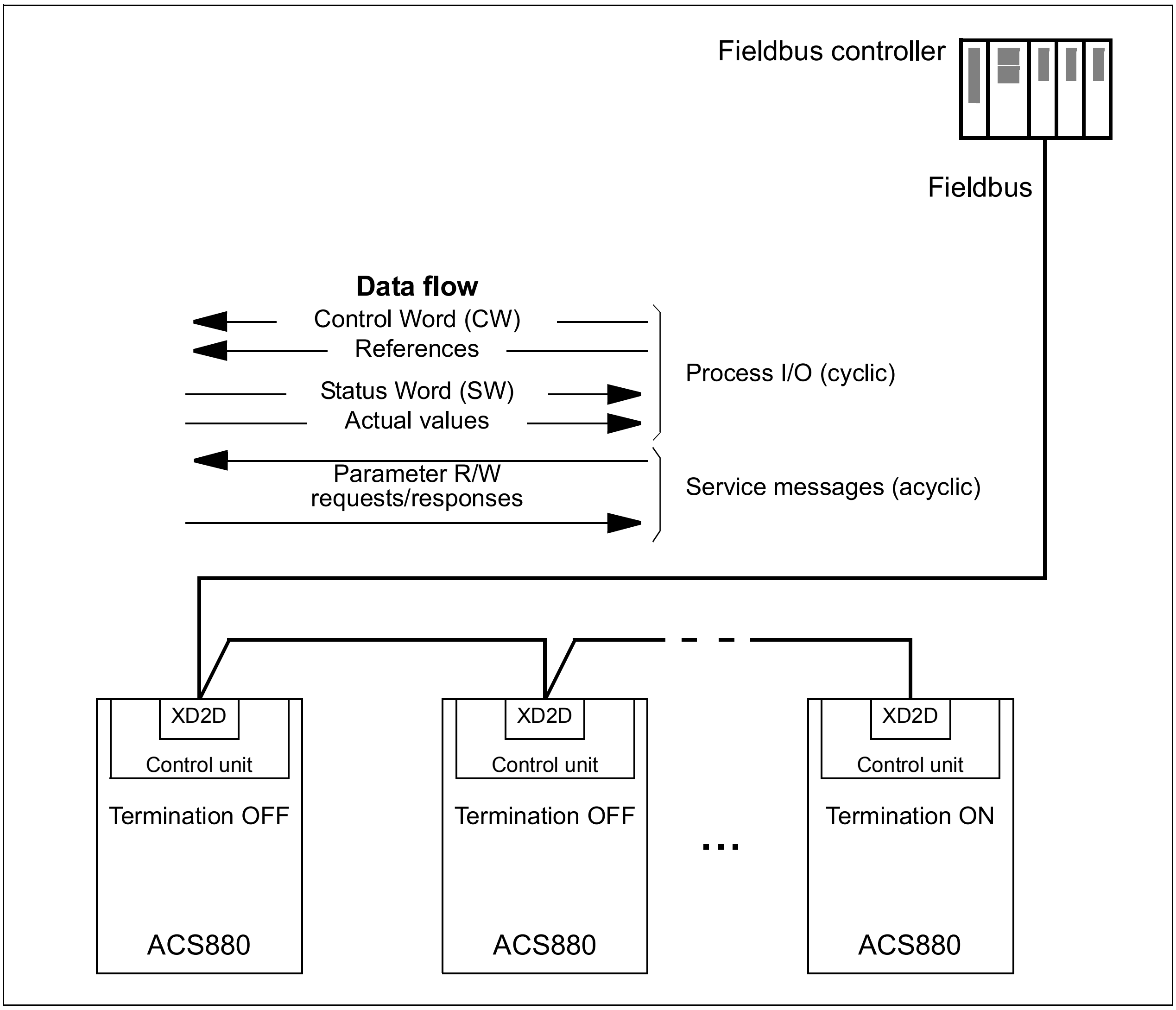
The chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) using the embedded fieldbus interface.

System overview

The drive can be connected to an external control system through a communication link using either a fieldbus adapter or the embedded fieldbus interface.

The embedded fieldbus interface supports the Modbus RTU protocol. The drive control program can handle 10 Modbus registers in a 10-millisecond time level. For example, if the drive receives a request to read 20 registers, it will start its response within 22 ms of receiving the request – 20 ms for processing the request and 2 ms overhead for handling the bus. The actual response time depends on other factors as well, such as the baud rate (a parameter setting in the drive).

The drive can be set to receive all of its control information through the fieldbus interface, or the control can be distributed between the embedded fieldbus interface and other available sources, for example, digital and analog inputs.



Connecting the fieldbus to the drive

Connect the fieldbus to terminal XD2D on the control unit of the drive. See the appropriate *Hardware Manual* for more information on the connection, chaining and termination of the link.

Note: If the XD2D connector is reserved by the embedded fieldbus interface (parameter *58.01 Protocol enable* is set to *Modbus RTU*), the drive-to-drive link functionality is automatically disabled.

Setting up the embedded fieldbus interface

Set the drive up for the embedded fieldbus communication with the parameters shown in the table below. The **Setting for fieldbus control** column gives either the value to use or the default value. The **Function/Information column** gives a description of the parameter.

Parameter	**Setting for fieldbus control**	**Function/Information**
COMMUNICATION INITIALIZATION		
58.01 Protocol enable	*Modbus RTU*	Initializes embedded fieldbus communication. Drive-to-drive link operation is automatically disabled.
EMBEDDED MODBUS CONFIGURATION		
58.03 Node address	1 (default)	Node address. There must be no two nodes with the same node address online.
58.04 Baud rate	*19.2 kbps* (default)	Defines the communication speed of the link. Use the same setting as in the master station.
58.05 Parity	*8 EVEN 1* (default)	Selects the parity and stop bit setting. Use the same setting as in the master station.
58.14 Communication loss action	*Fault* (default)	Defines the action taken when a communication loss is detected.
58.15 Communication loss mode	*Cw / Ref1 / Ref2* (default)	Enables/disables communication loss monitoring and defines the means for resetting the counter of the communication loss delay.
58.16 Communication loss time	3.0 s (default)	Defines the timeout limit for the communication monitoring.
58.17 Transmit delay	0 ms (default)	Defines a response delay for the drive.
58.25 Control profile	*ABB Drives* (default), *Transparent*	Selects the control profile used by the drive. See section *Basics of the embedded fieldbus interface* (page *519*).
58.26 EFB ref1 type … *58.29 EFB act2 type*	*Auto*, *Transparent*, *General*, *Torque*, *Speed*, *Frequency*	Selects the reference and actual value types. With the *Auto* setting, the type is selected automatically according to the currently active drive control mode.
58.30 EFB status word transparent source	*Other*	Defines the source of status word when *58.25 Control profile* = *Transparent*.
58.31 EFB act1 transparent source	*Other*	Defines the source of actual value 1 when *58.28 EFB act1 type* = *Transparent* or *General*.
58.32 EFB act2 transparent source	*Other*	Defines the source of actual value 2 when *58.29 EFB act2 type* = *Transparent* or *General*.

Parameter	Setting for fieldbus control	Function/Information
58.33 Addressing mode	eg. *Mode 0* (default)	Defines the mapping between parameters and holding registers in the 400001…465536 (100…65535) Modbus register range.
58.34 Word order	*LO-HI* (default)	Defines the order of the data words in the Modbus message frame.
58.101 Data I/O 1 … *58.124 Data I/O 24*	For example, the default settings (I/Os 1…6 contain the control word, the status word, two references and two actual values)	Define the address of the drive parameter which the Modbus master accesses when it reads from or writes to the register address corresponding to Modbus In/Out parameters. Select the parameters that you want to read or write through the Modbus I/O words.
	RO/DIO control word, *AO1 data storage*, *AO2 data storage*, *Feedback data storage*, *Setpoint data storage*	These settings write the incoming data into storage parameters *10.99 RO/DIO control word*, *13.91 AO1 data storage*, *13.92 AO2 data storage*, *40.91 Feedback data storage* or *40.92 Setpoint data storage*.
58.06 Communication control	*Refresh settings*	Validates the settings of the configuration parameters.

The new settings will take effect when the drive is powered up the next time, or when they are validated by parameter *58.06 Communication control*.

Setting the drive control parameters

After the embedded fieldbus interface has been set up, check and adjust the drive control parameters listed in the table below. The **Setting for fieldbus control** column gives the value or values to use when the embedded fieldbus signal is the desired source or destination for that particular drive control signal. The **Function/Information** column gives a description of the parameter.

Parameter	Setting for fieldbus control	Function/Information
CONTROL COMMAND SOURCE SELECTION		
20.01 Ext1 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.
20.02 Ext2 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT2 is selected as the active control location.
SPEED REFERENCE SELECTION		
22.11 Speed ref1 source	*EFB ref1* or *EFB ref2*	Selects a reference received through the embedded fieldbus interface as speed reference 1.

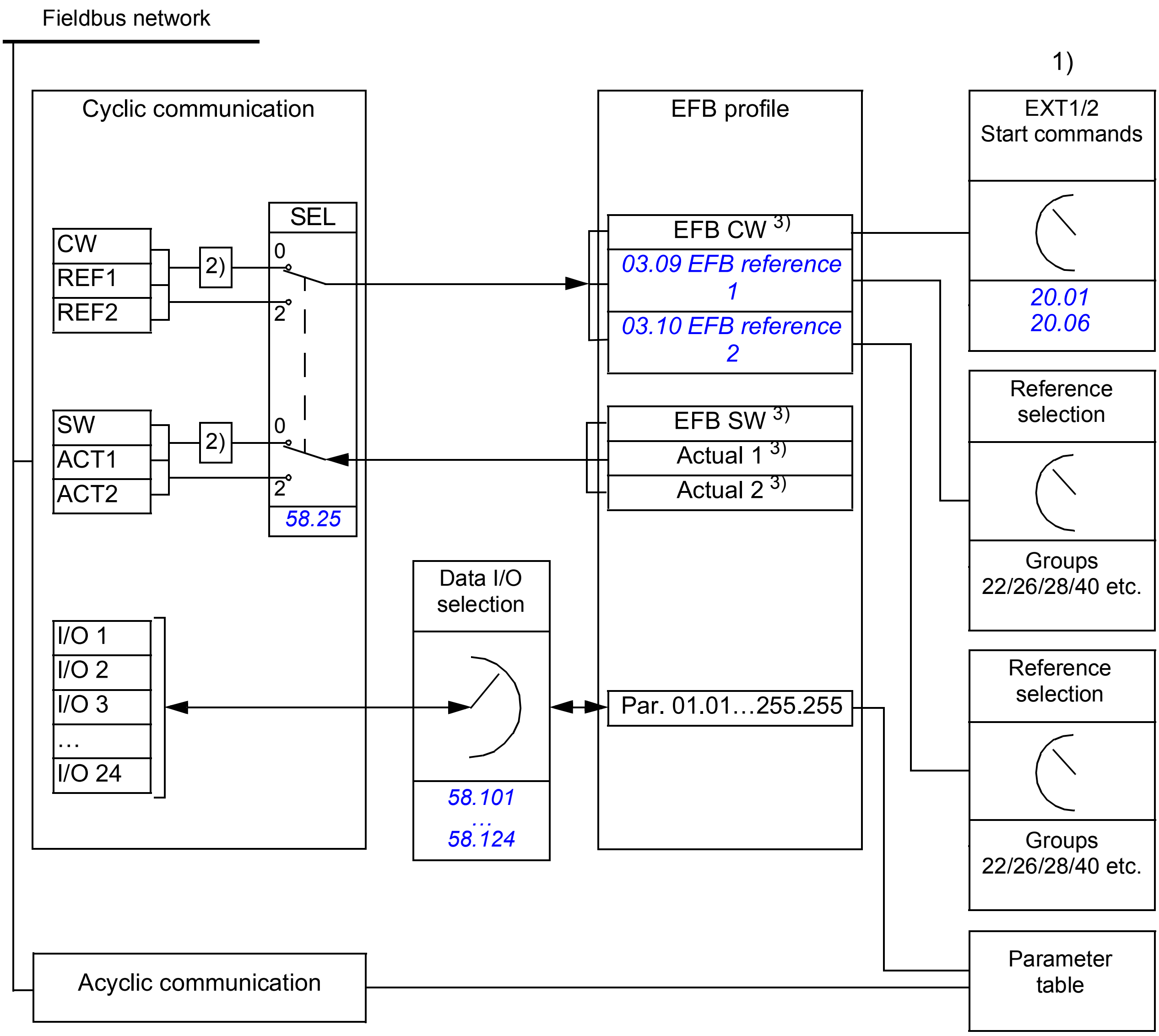
Parameter	Setting for fieldbus control	Function/Information
22.12 Speed ref2 source	*EFB ref1* or *EFB ref2*	Selects a reference received through the embedded fieldbus interface as speed reference 2.
TORQUE REFERENCE SELECTION		
26.11 Torque ref1 source	*EFB ref1* or *EFB ref2*	Selects a reference received through the embedded fieldbus interface as torque reference 1.
26.12 Torque ref2 source	*EFB ref1* or *EFB ref2*	Selects a reference received through the embedded fieldbus interface as torque reference 2.
FREQUENCY REFERENCE SELECTION		
28.11 Frequency ref1 source	*EFB ref1* or *EFB ref2*	Selects a reference received through the embedded fieldbus interface as frequency reference 1.
28.12 Frequency ref2 source	*EFB ref1* or *EFB ref2*	Selects a reference received through the embedded fieldbus interface as frequency reference 2.
OTHER SELECTIONS		
EFB references can be selected as the source at virtually any signal selector parameter by selecting *Other*, then either *03.09 EFB reference 1* or *03.10 EFB reference 2*.		
CONTROL OF RELAY OUTPUTS, ANALOG OUTPUTS AND DIGITAL INPUT/OUTPUTS		
10.24 RO1 source	*RO/DIO control word bit0*	Connects bit 0 of storage parameter *10.99 RO/DIO control word* to relay output RO1.
10.27 RO2 source	*RO/DIO control word bit1*	Connects bit 1 of storage parameter *10.99 RO/DIO control word* to relay output RO2.
10.30 RO3 source	*RO/DIO control word bit2*	Connects bit 2 of storage parameter *10.99 RO/DIO control word* to relay output RO3.
11.05 DIO1 function *11.09 DIO2 function*	*Output* (default)	Sets the digital input/output to output mode.
11.06 DIO1 output source	*RO/DIO control word bit8*	Connects bit 8 of storage parameter *10.99 RO/DIO control word* to digital input/output DIO1.
11.10 DIO2 output source	*RO/DIO control word bit9*	Connects bit 9 of storage parameter *10.99 RO/DIO control word* to digital input/output DIO2.
13.12 AO1 source	*AO1 data storage*	Connects storage parameter *13.91 AO1 data storage* to analog output AO1.
13.22 AO2 source	*AO2 data storage*	Connects storage parameter *13.92 AO2 data storage* to analog output AO2.

Parameter	Setting for fieldbus control	Function/Information
PROCESS PID FEEDBACK AND SETPOINT		
40.08 Set 1 feedback 1 source	*Feedback data storage*	Connect the bits of the storage parameter (*10.99 RO/DIO control word*) to the digital input/outputs of the drive.
40.16 Set 1 setpoint 1 source	*Setpoint data storage*	
SYSTEM CONTROL INPUTS		
96.07 Parameter save manually	*Save* (reverts to *Done*)	Saves parameter value changes (including those made through fieldbus control) to permanent memory.

Basics of the embedded fieldbus interface

The cyclic communication between a fieldbus system and the drive consists of 16-bit data words or 32-bit data words (with the transparent control profiles).

The diagram below illustrates the operation of the embedded fieldbus interface. The signals transferred in the cyclic communication are explained further below the diagram.



1. See also other parameters which can be controlled through fieldbus.
2. Data conversion if parameter *58.25 Control profile* is set to *ABB Drives*. See section *About the control profiles* (page *522*).
3. If parameter *58.25 Control profile* is set to *Transparent*,

- the sources of the status word and actual values are selected by parameters *58.30*…*58.32* (otherwise, actual values 1 and 2 are automatically selected according to reference type), and
- the control word is displayed by *06.05 EFB transparent control word*.

Control word and Status word

The Control Word (CW) is a 16-bit or 32-bit packed boolean word. It is the principal means of controlling the drive from a fieldbus system. The CW is sent by the fieldbus controller to the drive. By drive parameters, the user selects the EFB CW as the source of drive control commands (such as start/stop, emergency stop, selection between external control locations 1/2, or fault reset). The drive switches between its states according to the bit-coded instructions of the CW.

The fieldbus CW is either written to the drive as it is (see parameter *06.05 EFB transparent control word*), or the data is converted. See section *About the control profiles* (page *522*).

The fieldbus Status Word (SW) is a 16-bit or 32-bit packed boolean word. It contains status information from the drive to the fieldbus controller. The drive SW is either written to the fieldbus SW as it is or the data is converted. See section *About the control profiles* (page *522*).

References

EFB references 1 and 2 are 16-bit or 32-bit signed integers. The contents of each reference word can be used as the source of virtually any signal, such as the speed, frequency, torque or process reference. In embedded fieldbus communication, references 1 and 2 are displayed by *03.09 EFB reference 1* and *03.10 EFB reference 2* respectively. Whether the references are scaled or not depends on the settings of *58.26 EFB ref1 type* and *58.27 EFB ref2 type*. See section *About the control profiles* (page *522*).

Actual values

Fieldbus actual signals (ACT1 and ACT2) are 16-bit or 32-bit signed integers. They convey selected drive parameter values from the drive to the master. Whether the actual values are scaled or not depends on the settings of *58.28 EFB act1 type* and *58.29 EFB act2 type*. See section *About the control profiles* (page *522*).

Data input/outputs

Data input/outputs are 16-bit or 32-bit words containing selected drive parameter values. Parameters *58.101 Data I/O 1* … *58.124 Data I/O 24* define the addresses from which the master either reads data (input) or to which it writes data (output).

Control of drive outputs through EFB

The address selection parameters of the data input/outputs have a setting with which the data can be written into a storage parameter in the drive. These storage parameters are readily selectable as signal sources of the drive outputs.

The desired values of the relay outputs (RO) and digital input/outputs (DIO) can be written in a 16-bit word into *10.99 RO/DIO control word*, which is then selected as the source of those outputs. Each of the analog outputs (AO) of the drive have a dedicated storage parameter (*13.91 AO1 data storage* and *13.92 AO2 data storage*), which are available in the source selection parameters *13.12 AO1 source* and *13.22 AO2 source*.

Sending process PID feedback and setpoint values through EFB

The drive also has storage parameters for incoming process PID feedback (*40.91 Feedback data storage*) as well as a process PID setpoint (*40.92 Setpoint data storage*). The feedback storage parameter is selectable in the source selection parameters *40.08 Set 1 feedback 1 source* and *40.09 Set 1 feedback 2 source*.

The corresponding parameters in process PID control set 2 (group *41 Process PID set 2*) have the same selections.

Register addressing

The address field of Modbus requests for accessing holding registers is 16 bits. This allows the Modbus protocol to support addressing of 65536 holding registers.

Historically, Modbus master devices used 5-digit decimal addresses from 40001 to 49999 to represent holding register addresses. The 5-digit decimal addressing limited to 9999 the number of holding registers that could be addressed.

Modern Modbus master devices typically provide a means to access the full range of 65536 Modbus holding registers. One of these methods is to use 6-digit decimal addresses from 400001 to 465536. This manual uses 6-digit decimal addressing to represent Modbus holding register addresses.

Modbus master devices that are limited to the 5-digit decimal addressing may still access registers 400001 to 409999 by using 5-digit decimal addresses 40001 to 49999. Registers 410000 to 465536 are inaccessible to these masters.

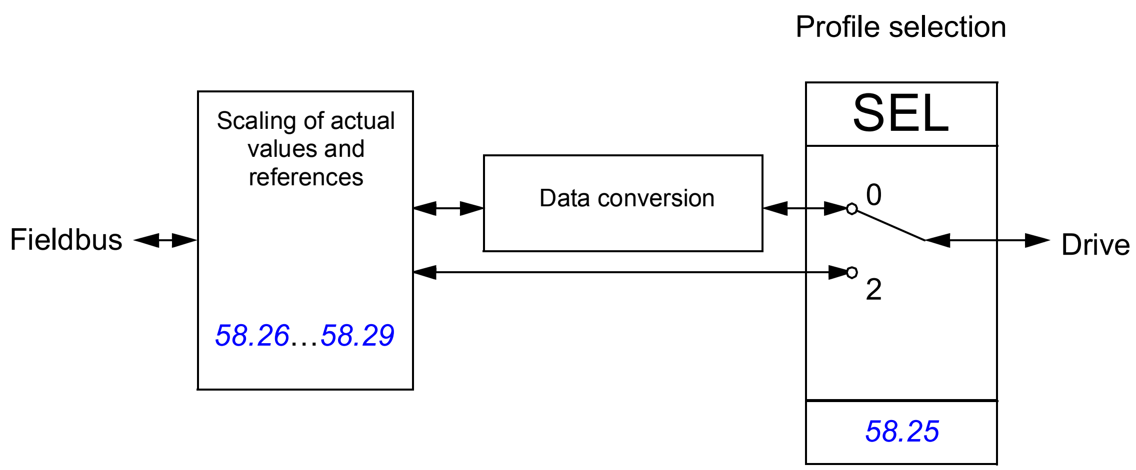
Note: Register addresses of 32-bit parameters cannot be accessed by using 5-digit register numbers.

About the control profiles

A control profile defines the rules for data transfer between the drive and the fieldbus master, for example:

- if packed boolean words are converted and how
- how drive register addresses are mapped for the fieldbus master.

You can configure the drive to receive and send messages according to the ABB Drives profile or the Transparent profile. With the ABB Drives profile, the embedded fieldbus interface of the drive converts the control word and status word to and from the native data used in the drive. The Transparent profile involves no data conversion. The figure below illustrates the effect of the profile selection.



Control profile selection with parameter *58.25 Control profile*:
- (0) *ABB Drives*
- (2) *Transparent*

Note that scaling of references and actual values can be selected independent of the profile selection by parameters *58.26…58.29*.

The ABB Drives profile

Control Word

The table below shows the contents of the fieldbus Control Word for the ABB Drives control profile. The embedded fieldbus interface converts this word to the form in which it is used in the drive. The upper case boldface text refers to the states shown in *State transition diagram* on page *526*.

Bit	Name	Value	STATE/Description
0	OFF1_ CONTROL	1	Proceed to READY TO OPERATE.
		0	Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	OFF2_ CONTROL	1	Continue operation (OFF2 inactive).
		0	Emergency OFF, coast to stop. Proceed to **OFF2 ACTIVE**, proceed to **SWITCH-ON INHIBITED**.
2	OFF3_ CONTROL	1	Continue operation (OFF3 inactive).
		0	Emergency stop, stop within time defined by drive parameter. Proceed to OFF3 ACTIVE; proceed to SWITCH-ON INHIBITED. Warning: Ensure that the motor and driven machine can be stopped using this stop mode.
3	INHIBIT_ OPERATION	1	Proceed to **OPERATION ENABLED**. **Note:** Run enable signal must be active; see the drive documentation. If the drive is set to receive the Run enable signal from the fieldbus, this bit activates the signal.
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	RAMP_OUT_ ZERO	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**.
		0	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	Enable ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**.
		0	Halt ramping (Ramp Function Generator output held).
6	RAMP_IN_ ZERO	1	Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp Function Generator input to zero.
7	RESET	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Continue normal operation.

Bit	Name	Value	STATE/Description
8	JOGGING_1	1	Accelerate to jogging 1 reference. **Notes:** • Bits 4…6 must be 0. • See also section *Jogging* (page *55*).
		0	Jogging 1 disabled.
9	JOGGING_2	1	Accelerate to jogging 2 reference. See notes at bit 8.
		0	Jogging 2 disabled.
10	REMOTE_CMD	1	Fieldbus control enabled.
		0	Control word and reference will not get through to the drive, except for CW bits OFF1, OFF2 and OFF3.
11	EXT_CTRL_LOC	1	Select External Control Location EXT2. Effective if the control location is parameterized to be selected from the fieldbus.
		0	Select External Control Location EXT1. Effective if the control location is parameterized to be selected from the fieldbus.
12…15	Reserved		

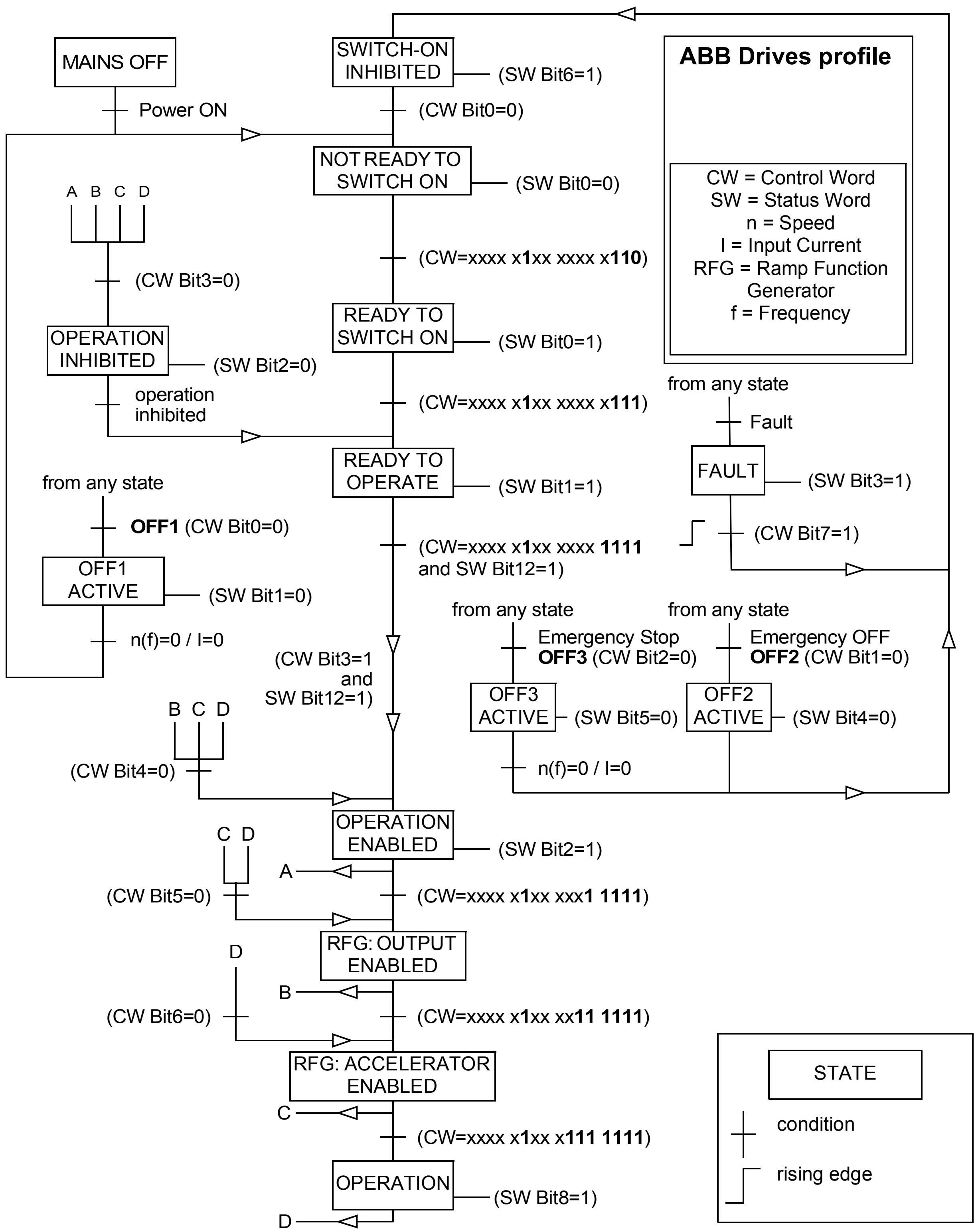
Status Word

The table below shows the fieldbus Status Word for the ABB Drives control profile. The embedded fieldbus interface converts the drive Status Word into this form for the fieldbus. The upper case boldface text refers to the states shown in *State transition diagram* on page *526*.

Bit	Name	Value	STATE/Description
0	RDY_ON	1	READY TO SWITCH ON.
		0	NOT READY TO SWITCH ON.
1	RDY_RUN	1	READY TO OPERATE.
		0	OFF1 ACTIVE.
2	RDY_REF	1	OPERATION ENABLED.
		0	OPERATION INHIBITED.
3	TRIPPED	1	FAULT.
		0	No fault.
4	OFF_2_STA	1	OFF2 inactive.
		0	OFF2 ACTIVE.
5	OFF_3_STA	1	OFF3 inactive.
		0	OFF3 ACTIVE.
6	SWC_ON_ INHIB	1	SWITCH-ON INHIBITED.
		0	–
7	ALARM	1	Warning/Alarm.
		0	No warning/alarm.
8	AT_ SETPOINT	1	OPERATING. Actual value equals Reference = is within tolerance limits, i.e. in speed control, speed error is 10% max. of nominal motor speed.
		0	Actual value differs from Reference = is outside tolerance limits.
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	ABOVE_ LIMIT	1	Actual frequency or speed equals or exceeds supervision limit (set by drive parameter). Valid in both directions of rotation.
		0	Actual frequency or speed within supervision limit.
11	USER_0		S
12	EXT_RUN_ ENABLE	1	External Run enable signal received.
		0	No external Run enable signal received.
13…15	Reserved		

State transition diagram

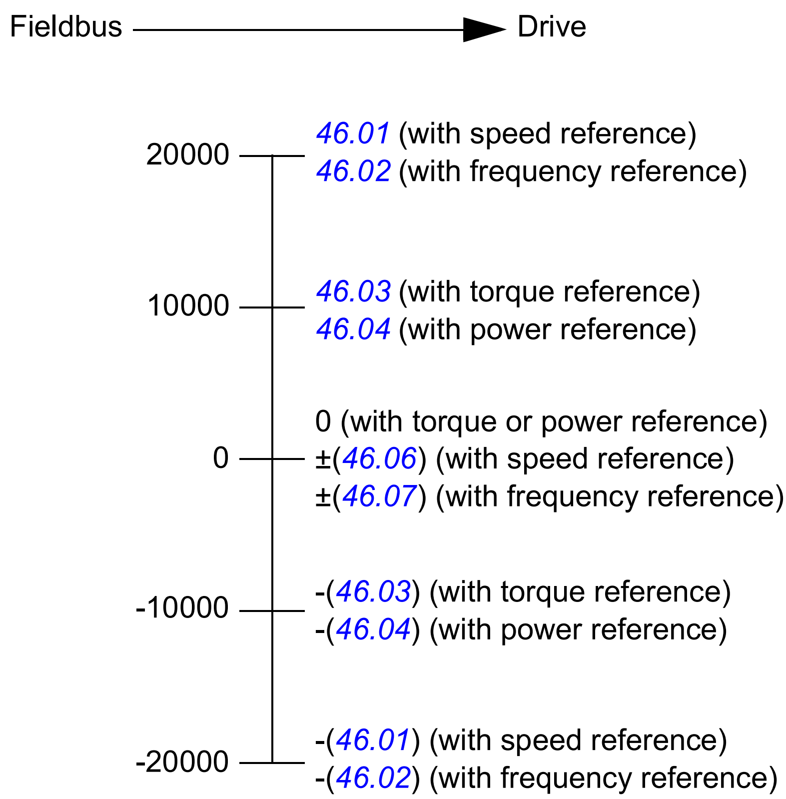
The diagram below shows the state transitions in the drive when the drive is using the ABB Drives profile, and configured to follow the commands of the control word from the embedded fieldbus interface. The upper case texts refer to the states which are used in the tables representing the fieldbus Control and Status words. See sections *Control Word* on page *523* and *Status Word* on page *525*.



References

The ABB drives profile supports the use of two references, EFB reference 1 and EFB reference 2. The references are 16-bit words each containing a sign bit and a 15-bit integer. A negative reference is formed by calculating the two’s complement from the corresponding positive reference.

The references are scaled as defined by parameters *46.01…46.07*; which scaling is in use depends on the setting of *58.26 EFB ref1 type* and *58.27 EFB ref2 type* (see page *341*).

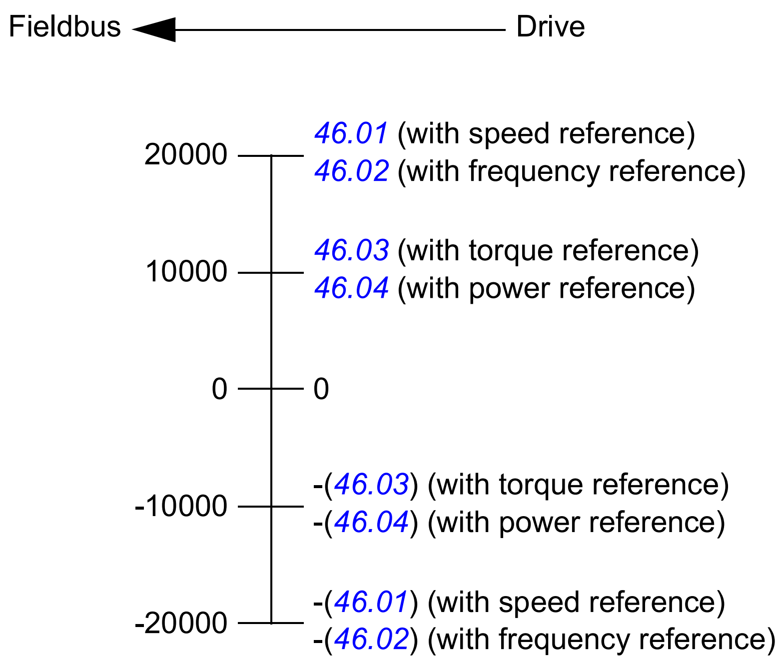


The scaled references are shown by parameters *03.09 EFB reference 1* and *03.10 EFB reference 2*.

Actual values

The ABB Drives profile supports the use of two fieldbus actual values, ACT1 and ACT2. The actual values are 16-bit words each containing a sign bit and a 15-bit integer. A negative value is formed by calculating the two's complement from the corresponding positive value.

The actual values are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of parameters *58.28 EFB act1 type* and *58.29 EFB act2 type* (see page *342*).



Modbus holding register addresses

The table below shows the default Modbus holding register addresses for drive data. This profile provides a converted 16-bit access to the data.

Register address	Register data (16-bit words)
400001	Control word. See section *Control Word* (page 523). The selection can be changed using parameter *58.101 Data I/O 1*.
400002	Reference 1 (REF1). The selection can be changed using parameter *58.102 Data I/O 2*.
400003	Reference 2 (REF2). The selection can be changed using parameter *58.103 Data I/O 3*.
400004	Status Word (SW). See section *Status Word* (page 525). The selection can be changed using parameter *58.104 Data I/O 4*.
400005	Actual value 1 (ACT1). The selection can be changed using parameter *58.105 Data I/O 5*.
400006	Actual value 2 (ACT2). The selection can be changed using parameter *58.106 Data I/O 6*.
400007…400024	Data in/out 7…24. Selected by parameters *58.107 Data I/O 7* … *58.124 Data I/O 24*.
400025...400089	Unused
400090...400100	Error code access. See section *Error code registers (holding registers 400090…400100)* (page 536).
400101...465536	Parameter read/write. Parameters are mapped to register addresses according to parameter *58.33 Addressing mode*.

The Transparent profile

The Transparent profile enables a customizable access to the drive.

The contents of the control word are user-definable. The control word received from the fieldbus is visible in parameter *06.05 EFB transparent control word*, and can be used to control the drive using pointer parameters and/or application programming.

The status word to be sent to the fieldbus controller is selected by parameter *58.30 EFB status word transparent source*. This can be, for example, the user-configurable status word in *06.50 User status word 1*.

The Transparent profile involves no data conversion of the control or status word. Whether references or actual values are scaled depends on the setting of parameters *58.26*…*58.29*. The references received from the fieldbus are visible in parameters *03.09 EFB reference 1* and *03.10 EFB reference 2*.

The Modbus holding register addresses for the Transparent profile are as with the ABB Drives profile (see page *529*).

Modbus function codes

The table below shows the Modbus function codes supported by the embedded fieldbus interface.

Code	Function name	Description
01h	Read Coils	Reads the 0/1 status of coils (0X references).
02h	Read Discrete Inputs	Reads the 0/1 status of discrete inputs (1X references).
03h	Read Holding Registers	Reads the binary contents of holding registers (4X references).
05h	Write Single Coil	Forces a single coil (0X reference) to 0 or 1.
06h	Write Single Register	Writes a single holding register (4X reference).
08h	Diagnostics	Provides a series of tests for checking the communication, or for checking various internal error conditions. Supported subcodes: • 00h Return Query Data: Echo/loopback test. • 01h Restart Comm Option: Restarts and initializes the EFB, clears communications event counters. • 04h Force Listen Only Mode • 0Ah Clear Counters and Diagnostic Register • 0Bh Return Bus Message Count • 0Ch Return Bus Comm. Error Count • 0Dh Return Bus Exception Error Count • 0Eh Return Slave Message Count • 0Fh Return Slave No Response Count • 10h Return Slave NAK (negative acknowledge) Count • 11h Return Slave Busy Count • 12h Return Bus Character Overrun Count • 14h Clear Overrun Counter and Flag
0Bh	Get Comm Event Counter	Returns a status word and an event count.
0Fh	Write Multiple Coils	Forces a sequence of coils (0X references) to 0 or 1.
10h	Write Multiple Registers	Writes the contents of a contiguous block of holding registers (4X references).
16h	Mask Write Register	Modifies the contents of a 4X register using a combination of an AND mask, an OR mask, and the register’s current contents.
17h	Read/Write Multiple Registers	Writes the contents of a contiguous block of 4X registers, then reads the contents of another group of registers (the same or different than those written) in a server device.

Code	Function name	Description
2Bh / 0Eh	Encapsulated Interface Transport	Supported subcodes: • 0Eh Read Device Identification: Allows reading the identification and other information. Supported ID codes (access type): • 00h: Request to get the basic device identification (stream access) • 04h: Request to get one specific identification object (individual access) Supported Object IDs: • 00h: Vendor Name (“ABB”) • 01h: Product Code (for example, “AINFX”) • 02h: Major Minor Revision (combination of contents of parameters *07.05 Firmware version* and *58.02 Protocol ID*). • 03h: Vendor URL (“www.abb.com”) • 04h: Product name (for example, “ACS880”)

Exception codes

The table below shows the Modbus exception codes supported by the embedded fieldbus interface.

Code	Name	Description
01h	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the server.
02h	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the server.
03h	ILLEGAL DATA VALUE	The requested Quantity of Registers is larger than the drive can handle. **Note:** This error does not mean that a value written to a drive parameter is outside the valid range.
04h	SLAVE DEVICE FAILURE	The value written to a drive parameter is outside the valid range. See section *Error code registers (holding registers 400090…400100)* on page *536*.
06h	SLAVE DEVICE BUSY	The server is engaged in processing a long-duration program command.

Coils (0xxxx reference set)

Coils are 1-bit read/write values. Control Word bits are exposed with this data type. The table below summarizes the Modbus coils (0xxxx reference set).

Reference	ABB drives profile	Transparent profile
00001	OFF1_CONTROL	Control Word bit 0
00002	OFF2_CONTROL	Control Word bit 1
00003	OFF3_CONTROL	Control Word bit 2
00004	INHIBIT_OPERATION	Control Word bit 3
00005	RAMP_OUT_ZERO	Control Word bit 4
00006	RAMP_HOLD	Control Word bit 5
00007	RAMP_IN_ZERO	Control Word bit 6
00008	RESET	Control Word bit 7
00009	JOGGING_1	Control Word bit 8
00010	JOGGING_2	Control Word bit 9
00011	REMOTE_CMD	Control Word bit 10
00012	EXT_CTRL_LOC	Control Word bit 11
00013	User-defined (0)	Control Word bit 12
00014	User-defined (1)	Control Word bit 13
00015	User-defined (2)	Control Word bit 14
00016	User-defined (3)	Control Word bit 15
00017	Reserved	Control Word bit 16
00018	Reserved	Control Word bit 17
00019	Reserved	Control Word bit 18
00020	Reserved	Control Word bit 19
00021	Reserved	Control Word bit 20
00022	Reserved	Control Word bit 21
00023	Reserved	Control Word bit 22
00024	Reserved	Control Word bit 23
00025	Reserved	Control Word bit 24
00026	Reserved	Control Word bit 25
00027	Reserved	Control Word bit 26
00028	Reserved	Control Word bit 27
00029	Reserved	Control Word bit 28
00030	Reserved	Control Word bit 29
00031	Reserved	Control Word bit 30
00032	Reserved	Control Word bit 31
00033	Reserved	*10.99 RO/DIO control word*, bit 0
00034	Reserved	*10.99 RO/DIO control word*, bit 1

Reference	ABB drives profile	Transparent profile
00035	Reserved	*10.99 RO/DIO control word*, bit 2
00036	Reserved	*10.99 RO/DIO control word*, bit 3
00037	Reserved	*10.99 RO/DIO control word*, bit 4
00038	Reserved	*10.99 RO/DIO control word*, bit 5
00039	Reserved	*10.99 RO/DIO control word*, bit 6
00040	Reserved	*10.99 RO/DIO control word*, bit 7
00041	Reserved	*10.99 RO/DIO control word*, bit 8
00042	Reserved	*10.99 RO/DIO control word*, bit 9

Discrete inputs (1xxxx reference set)

Discrete inputs are 1-bit read-only values. Status Word bits are exposed with this data type. The table below summarizes the Modbus discrete inputs (1xxxx reference set).

Reference	ABB drives profile	Transparent profile
10001	RDY_ON	Status Word bit 0
10002	RDY_RUN	Status Word bit 1
10003	RDY_REF	Status Word bit 2
10004	TRIPPED	Status Word bit 3
10005	OFF_2_STA	Status Word bit 4
10006	OFF_3_STA	Status Word bit 5
10007	SWC_ON_INHIB	Status Word bit 6
10008	ALARM	Status Word bit 7
10009	AT_SETPOINT	Status Word bit 8
10010	REMOTE	Status Word bit 9
10011	ABOVE_LIMIT	Status Word bit 10
10012	User-defined (0)	Status Word bit 11
10013	User-defined (1)	Status Word bit 12
10014	User-defined (2)	Status Word bit 13
10015	User-defined (3)	Status Word bit 14
10016	Reserved	Status Word bit 15
10017	Reserved	Status Word bit 16
10018	Reserved	Status Word bit 17
10019	Reserved	Status Word bit 18
10020	Reserved	Status Word bit 19
10021	Reserved	Status Word bit 20
10022	Reserved	Status Word bit 21
10023	Reserved	Status Word bit 22
10024	Reserved	Status Word bit 23

Reference	ABB drives profile	Transparent profile
10025	Reserved	Status Word bit 24
10026	Reserved	Status Word bit 25
10027	Reserved	Status Word bit 26
10028	Reserved	Status Word bit 27
10029	Reserved	Status Word bit 28
10030	Reserved	Status Word bit 29
10031	Reserved	Status Word bit 30
10032	Reserved	Status Word bit 31
10033	Reserved	*10.02 DI delayed status*, bit 0
10034	Reserved	*10.02 DI delayed status*, bit 1
10035	Reserved	*10.02 DI delayed status*, bit 2
10036	Reserved	*10.02 DI delayed status*, bit 3
10037	Reserved	*10.02 DI delayed status*, bit 4
10038	Reserved	*10.02 DI delayed status*, bit 5
10039	Reserved	*10.02 DI delayed status*, bit 6
10040	Reserved	*10.02 DI delayed status*, bit 7
10041	Reserved	*10.02 DI delayed status*, bit 8
10042	Reserved	*10.02 DI delayed status*, bit 9
10043	Reserved	*10.02 DI delayed status*, bit 10
10044	Reserved	*10.02 DI delayed status*, bit 11
10045	Reserved	*10.02 DI delayed status*, bit 12
10046	Reserved	*10.02 DI delayed status*, bit 13
10047	Reserved	*10.02 DI delayed status*, bit 14
10048	Reserved	*10.02 DI delayed status*, bit 15

Error code registers (holding registers 400090…400100)

These registers contain information about the last query. The error register is cleared when a query has finished successfully.

Reference	Name	Description
89	Reset Error Registers	1 = Reset internal error registers (91…95).
90	Error Function Code	Function code of the failed query.
91	Error Code	Set when exception code 04h is generated (see table above). • 00h No error • 02h Low/High limit exceeded • 03h Faulty Index: Unavailable index of an array parameter • 05h Incorrect Data Type: Value does not match the data type of the parameter • 65h General Error: Undefined error when handling query
92	Failed Register	The last register (discrete input, coil, or holding register) that failed to be read or written.
93	Last Register Written Successfully	The last register that was written successfully.
94	Last Register Read Successfully	The last register that was read successfully.

10

Fieldbus control through a fieldbus adapter

What this chapter contains

This chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) through an optional fieldbus adapter module.

The fieldbus control interface of the drive is described first, followed by a configuration example.

System overview

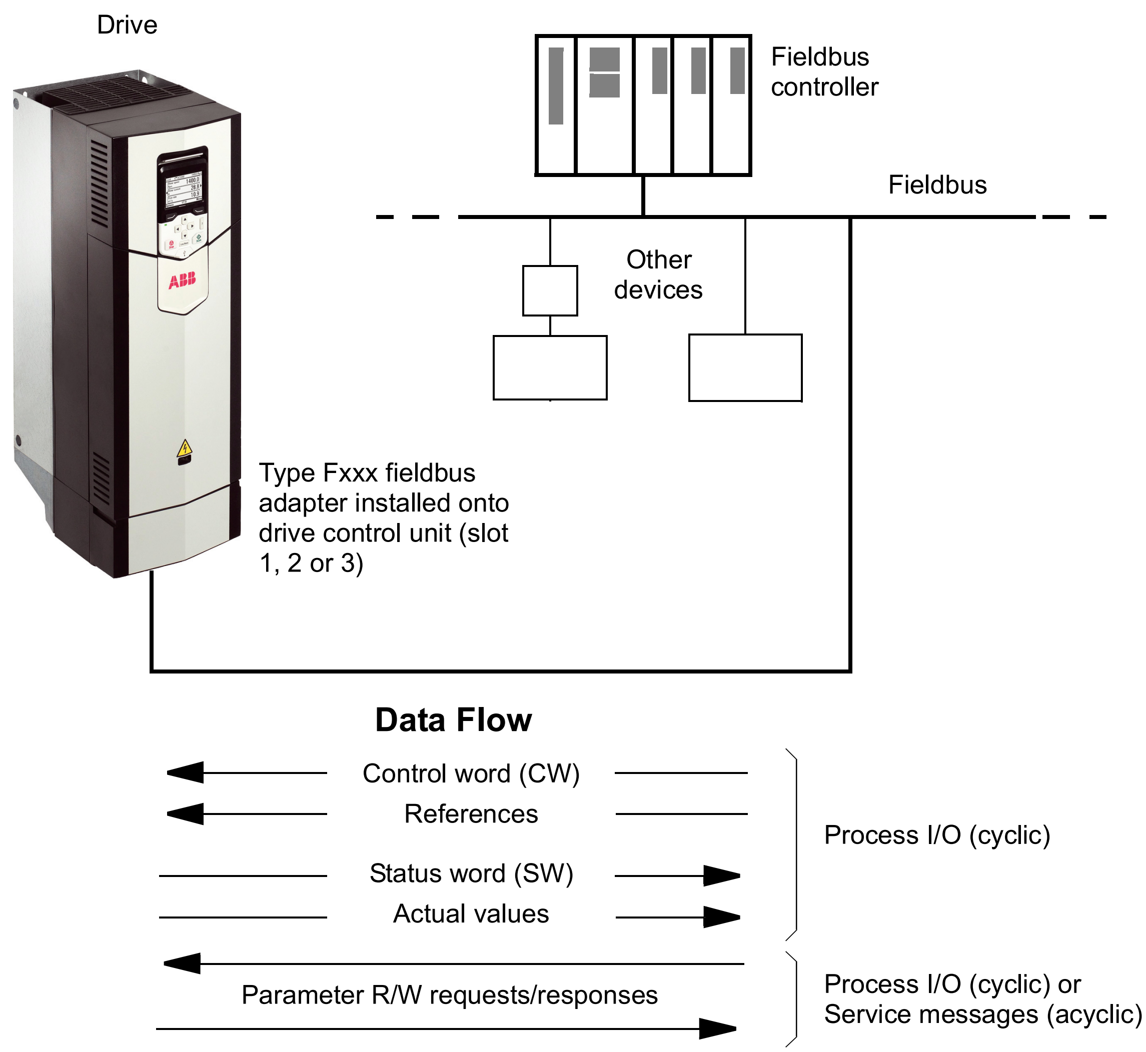
The drive can be connected to an external control system through an optional fieldbus adapter mounted onto the control unit of the drive. The drive actually has two independent interfaces for fieldbus connection, called “fieldbus adapter A” (FBA A) and “fieldbus adapter B” (FBA B). The drive can be configured to receive all of its control information through the fieldbus interface(s), or the control can be distributed between the fieldbus interface(s) and other available sources such as digital and analog inputs, depending on how control locations EXT1 and EXT2 are configured.

Note: The text and examples in this chapter describe the configuration of one fieldbus adapter (FBA A) by parameters *50.01*…*50.21* and parameter groups 51…53. The second adapter (FBA B), if present, is configured in a similar fashion by parameters *50.31*…*50.51* and parameter groups 54…56. It is recommended that the FBA B interface is only used for monitoring.

Fieldbus adapters are available for various communication systems and protocols, for example

- CANopen (FCAN-01 adapter)
- ControlNet (FCNA-01 adapter)
- DeviceNet (FDNA-01 adapter)
- EtherCAT® (FECA-01 adapter)
- EtherNet/IP™ (FENA-11 or FENA-21 adapter)
- Modbus/RTU (FSCA-01 adapter)
- Modbus/TCP (FENA-11 or FENA-21 adapter)
- POWERLINK (FEPL-02 adapter)
- PROFIBUS DP (FPBA-01 adapter)
- PROFINET IO (FENA-11 or FENA-21 adapter).

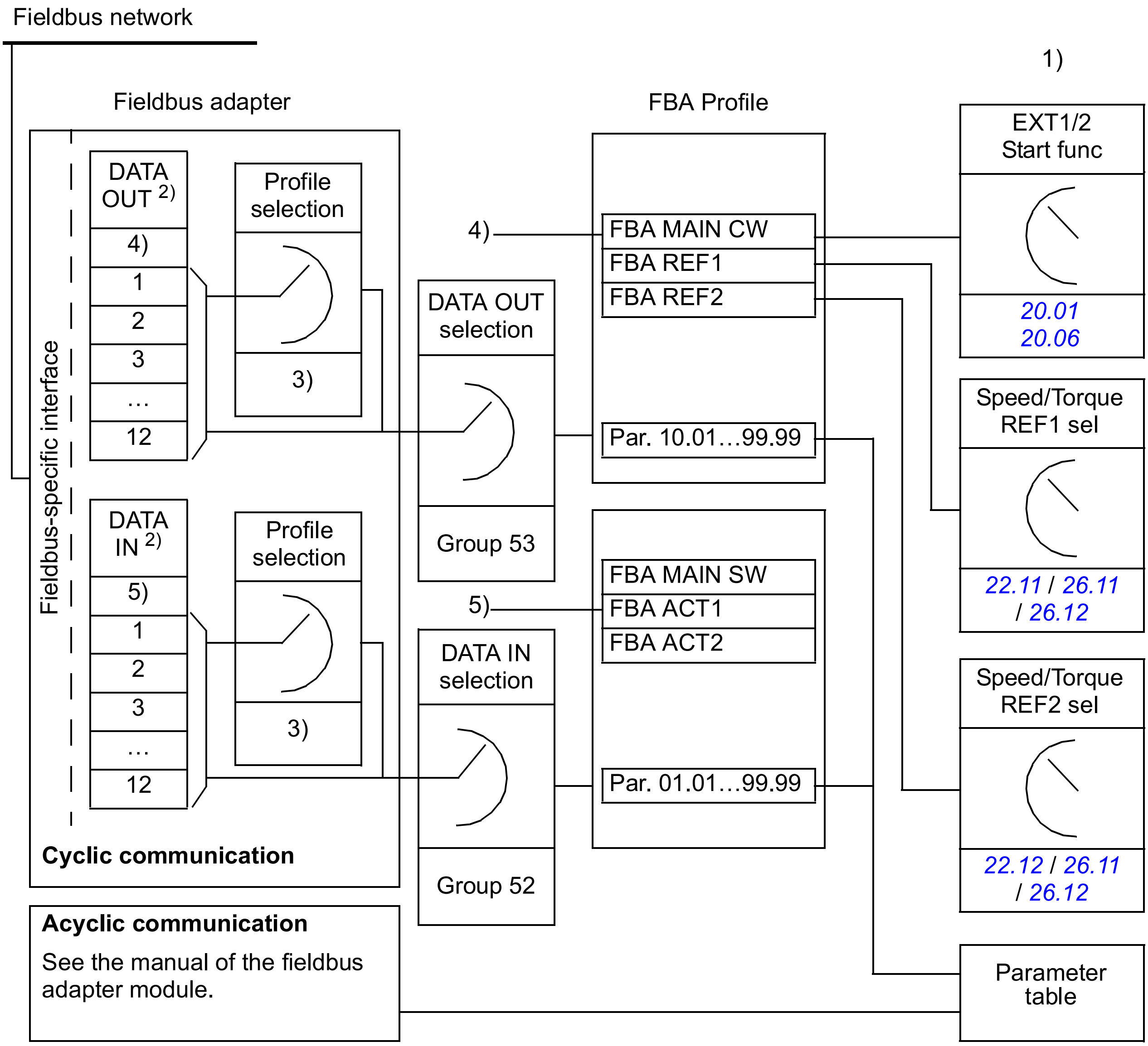
Note: Fieldbus adapters with the suffix "M" (eg. FPBA-01-M) are not supported.



Basics of the fieldbus control interface

The cyclic communication between a fieldbus system and the drive consists of 16- or 32-bit input and output data words. The drive is able to support a maximum of 12 data words (16 bits) in each direction.

Data transmitted from the drive to the fieldbus controller is defined by parameters *52.01 FBA A data in1* … *52.12 FBA A data in12*. The data transmitted from the fieldbus controller to the drive is defined by parameters *53.01 FBA A data out1* … *53.12 FBA A data out12*.



1) See also other parameters which can be controlled from fieldbus.
2) The maximum number of data words used is protocol-dependent.
3) Profile/instance selection parameters. Fieldbus module specific parameters. For more information, see the *User's Manual* of the appropriate fieldbus adapter module.
4) With DeviceNet, the control part is transmitted directly.
5) With DeviceNet, the actual value part is transmitted directly.

Control word and Status word

The Control word is the principal means for controlling the drive from a fieldbus system. It is sent by the fieldbus master station to the drive through the adapter module. The drive switches between its states according to the bit-coded instructions in the Control word, and returns status information to the master in the Status word.

For the ABB Drives communication profile, the contents of the Control word and the Status word are detailed on pages *543* and *544* respectively. The drive states are presented in the state diagram (page *545*).

When a transparent communication profile is selected eg. by parameter group *51 FBA A settings*, the control word received from the PLC is available in *06.03 FBA A transparent control word*. The individual bits of the word can then be used for drive control through bit pointer parameters. The source of the status word, for example *06.50 User status word 1*, can be selected in *50.09 FBA A SW transparent source*.

Debugging the network words

If parameter *50.12 FBA A debug mode* is set to *Fast*, the Control word received from the fieldbus is shown by parameter *50.13 FBA A control word*, and the Status word transmitted to the fieldbus network by *50.16 FBA A status word*. This "raw" data is very useful to determine if the fieldbus master is transmitting the correct data before handing control to the fieldbus network.

References

References are 16-bit words containing a sign bit and a 15-bit integer. A negative reference (indicating reversed direction of rotation) is formed by calculating the two's complement from the corresponding positive reference.

ABB drives can receive control information from multiple sources including analog and digital inputs, the drive control panel and a fieldbus adapter module. In order to have the drive controlled through the fieldbus, the module must be defined as the source for control information such as reference. This is done using the source selection parameters in groups *22 Speed reference selection*, *26 Torque reference chain* and *28 Frequency reference chain*.

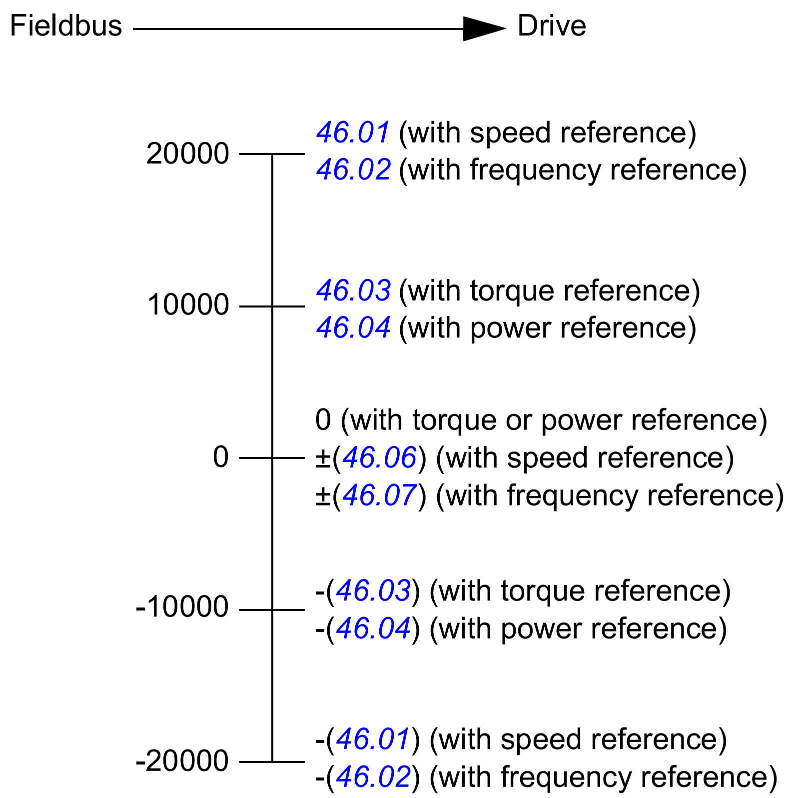
Debugging the network words

If parameter *50.12 FBA A debug mode* is set to *Fast*, the references received from the fieldbus are displayed by *50.14 FBA A reference 1* and *50.15 FBA A reference 2*.

Scaling of references

Note: The scalings described below are for the ABB Drives communication profile. Fieldbus-specific communication profiles may use different scalings. For more information, see the manual of the fieldbus adapter.

The references are scaled as defined by parameters *46.01…46.07*; which scaling is in use depends on the setting of *50.04 FBA A ref1 type* and *50.05 FBA A ref2 type*.



The scaled references are shown by parameters *03.05 FB A reference 1* and *03.06 FB A reference 2*.

Actual values

Actual values are 16-bit words containing information on the operation of the drive. The types of the monitored signals are selected by parameters *50.07 FBA A actual 1 type* and *50.08 FBA A actual 2 type*.

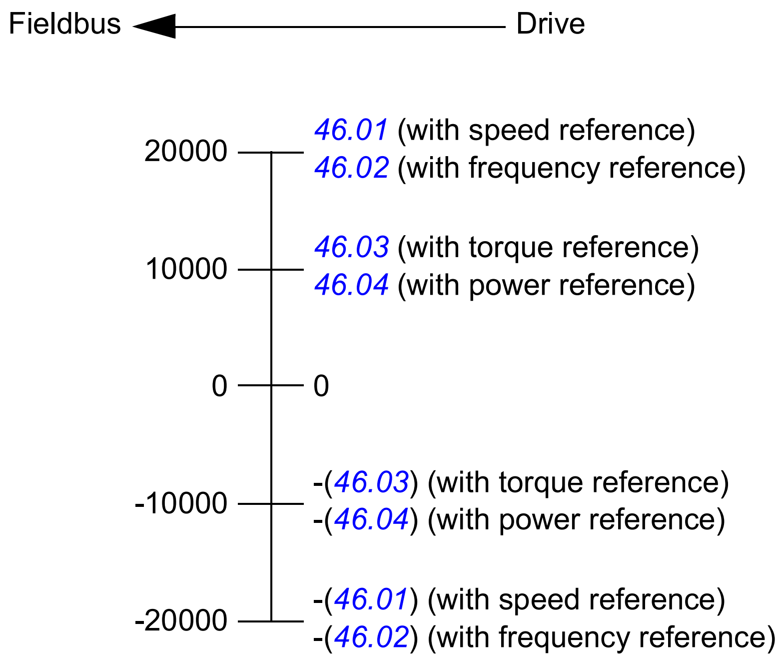
Debugging the network words

If parameter *50.12 FBA A debug mode* is set to *Fast*, the actual values sent to the fieldbus are displayed by *50.17 FBA A actual value 1* and *50.18 FBA A actual value 2*.

Scaling of actual values

Note: The scalings described below are for the ABB Drives communication profile. Fieldbus-specific communication profiles may use different scalings. For more information, see the manual of the fieldbus adapter.

The actual values are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of parameters *50.07 FBA A actual 1 type* and *50.08 FBA A actual 2 type*.


Fieldbus
Drive
20000
10000
0
-10000
-20000
46.01 (with speed reference)
46.02 (with frequency reference)
46.03 (with torque reference)
46.04 (with power reference)
0
-(46.03) (with torque reference)
-(46.04) (with power reference)
-(46.01) (with speed reference)
-(46.02) (with frequency reference)

Contents of the fieldbus Control word (ABB Drives profile)

The upper case boldface text refers to the states shown in the state diagram (page *545*).

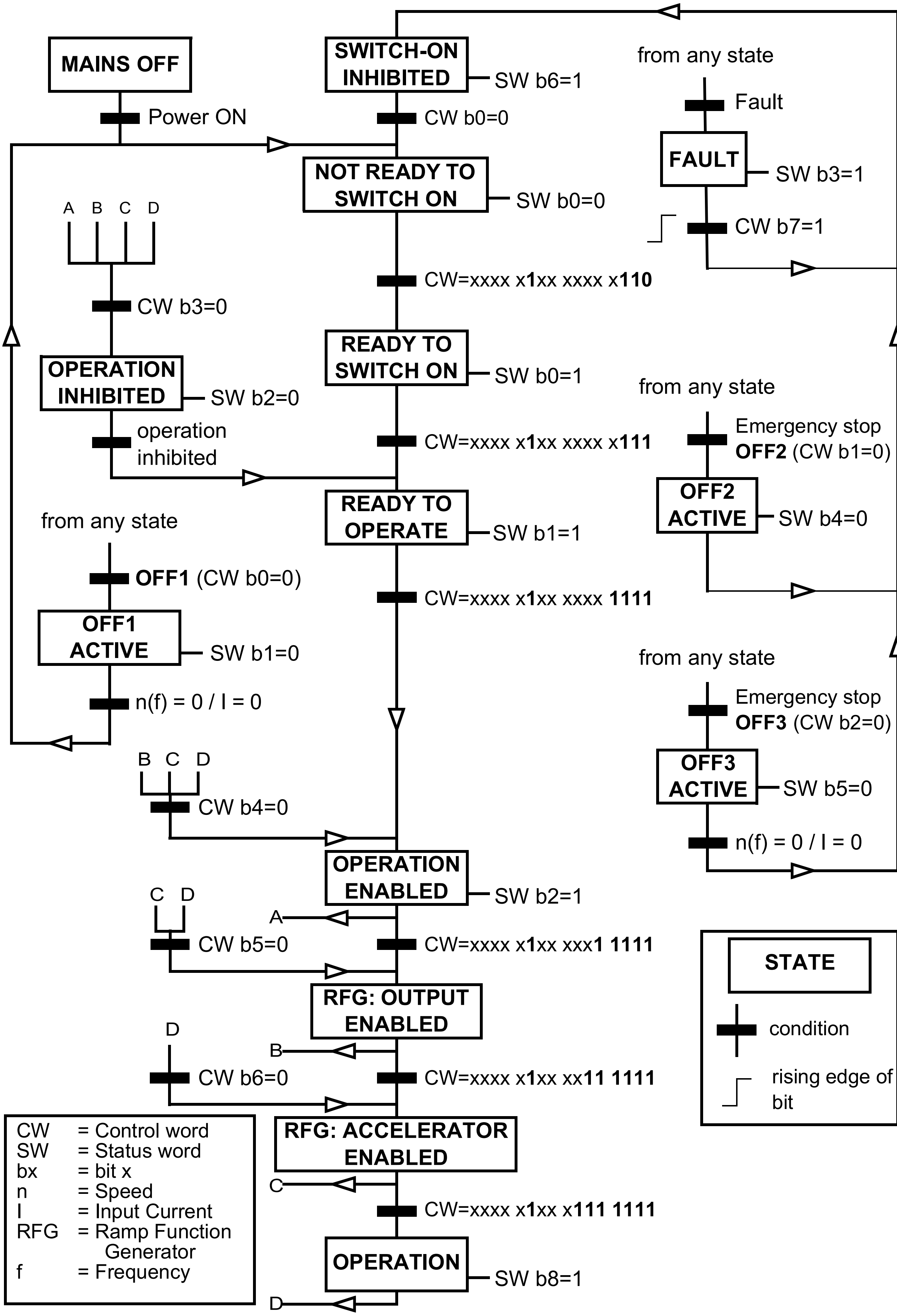
Bit	Name	Value	STATE/Description
0	Off1 control	1	Proceed to **READY TO OPERATE**.
		0	Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	Off2 control	1	Continue operation (OFF2 inactive).
		0	Emergency OFF, coast to a stop. Proceed to **OFF2 ACTIVE**, proceed to **SWITCH-ON INHIBITED**.
2	Off3 control	1	Continue operation (OFF3 inactive).
		0	Emergency stop, stop within time defined by drive parameter. Proceed to **OFF3 ACTIVE**; proceed to **SWITCH-ON INHIBITED**. **WARNING:** Ensure motor and driven machine can be stopped using this stop mode.
3	Run	1	Proceed to **OPERATION ENABLED**. **Note:** Run enable signal must be active. If the drive is set to receive the Run enable signal from the fieldbus, this bit activates the signal.
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	Ramp out zero	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**.
		0	Force Ramp function generator output to zero. The drive will immediately decelerate to zero speed (observing the torque limits).
5	Ramp hold	1	Enable ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**.
		0	Halt ramping (Ramp Function Generator output held).
6	Ramp in zero	1	Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp function generator input to zero.
7	Reset	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source of the reset signal by drive parameters.
		0	Continue normal operation.
8	Inching 1	1	Accelerate to inching (jogging) setpoint 1. **Notes:** • Bits 4…6 must be 0. • See also section *Jogging* (page *55*).
		0	Inching (jogging) 1 disabled.
9	Inching 2	1	Accelerate to inching (jogging) setpoint 2. See notes at bit 8.
		0	Inching (jogging) 2 disabled.
10	Remote cmd	1	Fieldbus control enabled.
		0	Control word and reference not getting through to the drive, except for bits 0…2.
11	Ext ctrl loc	1	Select External Control Location EXT2. Effective if control location is parameterized to be selected from fieldbus.
		0	Select External Control Location EXT1. Effective if control location is parameterized to be selected from fieldbus.
12 to 15	Reserved.		

Contents of the fieldbus Status word (ABB Drives profile)

The upper case boldface text refers to the states shown in the state diagram (page *545*).

Bit	Name	Value	STATE/Description
0	Ready to switch ON	1	**READY TO SWITCH ON**.
		0	**NOT READY TO SWITCH ON**.
1	Ready run	1	**READY TO OPERATE**.
		0	**OFF1 ACTIVE**.
2	Ready ref	1	**OPERATION ENABLED**.
		0	**OPERATION INHIBITED**.
3	Tripped	1	**FAULT**.
		0	No fault.
4	Off 2 inactive	1	OFF2 inactive.
		0	**OFF2 ACTIVE**.
5	Off 3 inactive	1	OFF3 inactive.
		0	**OFF3 ACTIVE**.
6	Switch-on inhibited	1	**SWITCH-ON INHIBITED**.
		0	–
7	Warning	1	Warning active.
		0	No warning active.
8	At setpoint	1	**OPERATING**. Actual value equals reference = is within tolerance limits (see parameters *46.21*…*46.23*).
		0	Actual value differs from reference = is outside tolerance limits.
9	Remote	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	Above limit	-	See parameter *06.29 MSW bit 10 sel*.
11	User bit 0	-	See parameter *06.30 MSW bit 11 sel*.
12	User bit 1	-	See parameter *06.31 MSW bit 12 sel*.
13	User bit 2	-	See parameter *06.32 MSW bit 13 sel*.
14	User bit 3	-	See parameter *06.33 MSW bit 14 sel*.
15	Reserved		

The state diagram (ABB Drives profile)



Setting up the drive for fieldbus control

1. Install the fieldbus adapter module mechanically and electrically according to the instructions given in the *User's manual* of the module.
2. Power up the drive.
3. Enable the communication between the drive and the fieldbus adapter module with parameter *50.01 FBA A enable*.
4. With *50.02 FBA A comm loss func*, select how the drive should react to a fieldbus communication break.
   Note: This function monitors both the communication between the fieldbus master and the adapter module and the communication between the adapter module and the drive.
5. With *50.03 FBA A comm loss t out*, define the time between communication break detection and the selected action.
6. Select application-specific values for the rest of the parameters in group *50 Fieldbus adapter (FBA)*, starting from *50.04*. Examples of appropriate values are shown in the tables below.
7. Set the fieldbus adapter module configuration parameters in group *51 FBA A settings*. As a minimum, set the required node address and the control profile.
8. Define the process data transferred to and from the drive in parameter groups *52 FBA A data in* and *53 FBA A data out*.
   Note: Depending on the communication protocol and profile being used, the Control word and Status word may already be configured to be sent/received by the communication system.
9. Save the valid parameter values to permanent memory by setting parameter *96.07 Parameter save manually* to *Save*.
10. Validate the settings made in parameter groups 51, 52 and 53 by setting parameter *51.27 FBA A par refresh* to *Refresh*.
11. Configure control locations EXT1 and EXT2 to allow control and reference signals to come from the fieldbus. Examples of appropriate values are shown in the tables below.

Parameter setting example: FPBA (PROFIBUS DP)

This example shows how to configure a basic speed control application that uses the PROFIdrive communication profile with PPO Type 2. The start/stop commands and reference are according to the PROFIdrive profile, speed control mode.

The reference values sent over the fieldbus have to be scaled within the drive so they have the desired effect. The reference value ±16384 (4000h) corresponds to the range of speed set in parameter *46.01 Speed scaling* (both forward and reverse directions). For example, if *46.01* is set to 480 rpm, then 4000h sent over fieldbus will request 480 rpm.

Direction	PZD1	PZD2	PZD3	PZD4	PZD5	PZD6
Out	Control word	Speed reference	Acc time 1		Dec time 1	
In	Status word	Speed actual value	Motor current		DC voltage	

The table below gives the recommended drive parameter settings.

Drive parameter	Setting for ACS880 drives	Description
50.01 FBA A enable	**1…3** = [slot number]	Enables communication between the drive and the fieldbus adapter module.
50.04 FBA A ref1 type	**4** = *Speed*	Selects the fieldbus A reference 1 type and scaling.
50.07 FBA A actual 1 type	**0** = *Auto*	Selects the actual value type/source and scaling according to the currently active control mode (as displayed by parameter *19.01*).
51.01 FBA A type	**1** = FPBA[1)]	Displays the type of the fieldbus adapter module.
51.02 Node address	3[2)]	Defines the PROFIBUS node address of the fieldbus adapter module.
51.03 Baud rate	12000[1)]	Displays the current baud rate on the PROFIBUS network in kbit/s.
51.04 MSG type	**1** = PPO1[1)]	Displays the telegram type selected by the PLC configuration tool.
51.05 Profile	**0** = PROFIdrive	Selects the Control word according to the PROFIdrive profile (speed control mode).
51.07 RPBA mode	**0** = Disabled	Disables the RPBA emulation mode.
52.01 FBA data in1	**4** = SW 16bit[1)]	Status word
52.02 FBA data in2	**5** = Act1 16bit	Actual value 1
52.03 FBA data in3	01.07[2)]	Motor current
52.05 FBA data in5	01.11[2)]	DC voltage
53.01 FBA data out1	**1** = CW 16bit[1)]	Control word
53.02 FBA data out2	**2** = Ref1 16bit	Reference 1 (speed)

Drive parameter	Setting for ACS880 drives	Description
53.03 FBA data out3	23.12[2)]	Acceleration time 1
53.05 FBA data out5	23.13[2)]	Deceleration time 1
51.27 FBA A par refresh	**1** = *Refresh*	Validates the configuration parameter settings.
19.12 Ext1 control mode	**2** = *Speed*	Selects speed control as the control mode 1 for external control location EXT1.
20.01 Ext1 commands	**12** = *Fieldbus A*	Selects fieldbus adapter A as the source of the start and stop commands for external control location EXT1.
20.02 Ext1 start trigger type	**1** = *Level*	Selects a level-triggered start signal for external control location EXT1.
22.11 Speed ref1 source	**4** = *FB A ref1*	Selects fieldbus A reference 1 as the source for speed reference 1.

[1)] Read-only or automatically detected/set

[2)] Example

The start sequence for the parameter example above is given below.

Control word:

- 477h (1143 decimal) –> READY TO SWITCH ON
- 47Fh (1151 decimal) –> OPERATING (Speed mode)

11

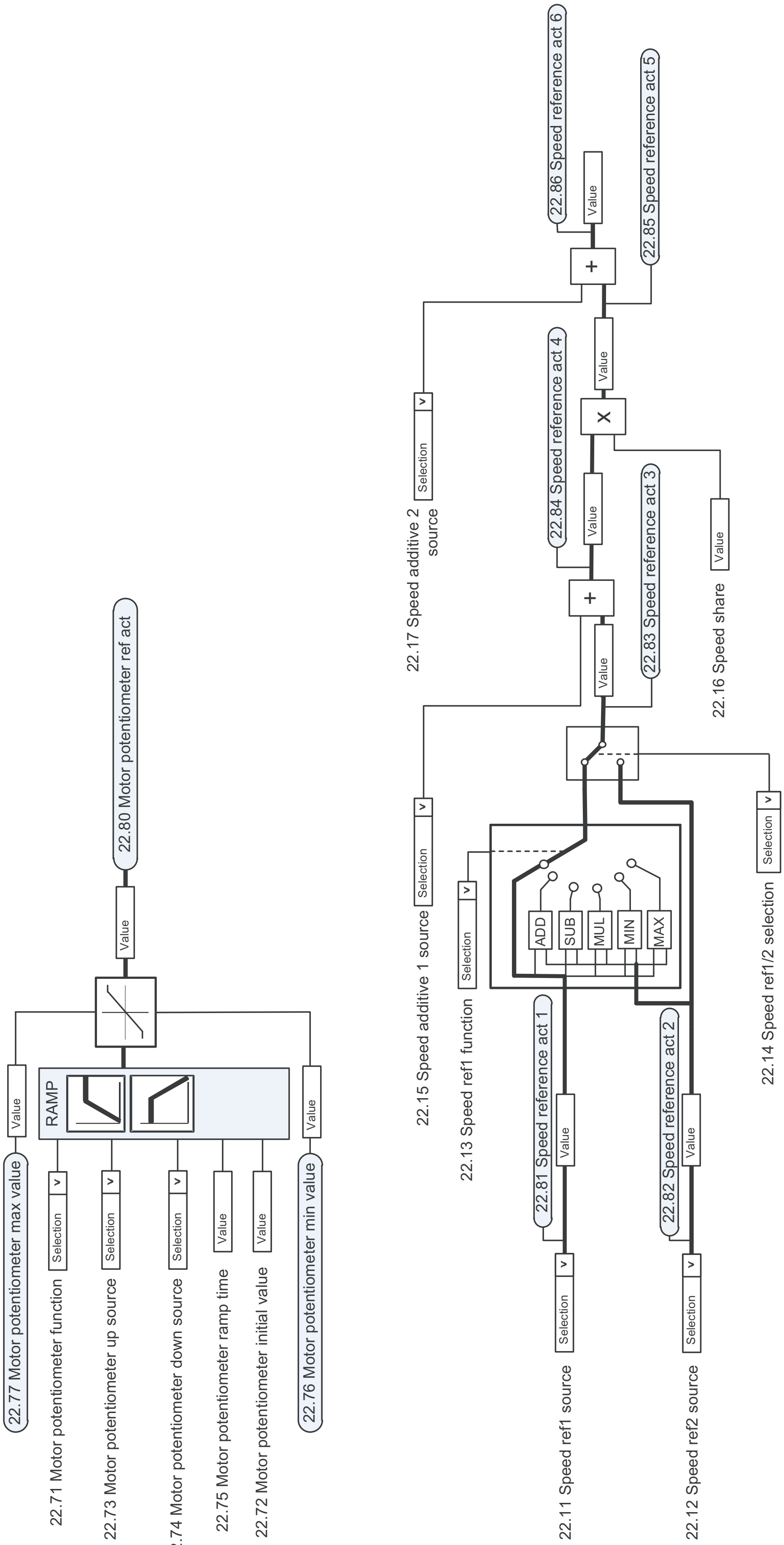
Control chain diagrams

What this chapter contains

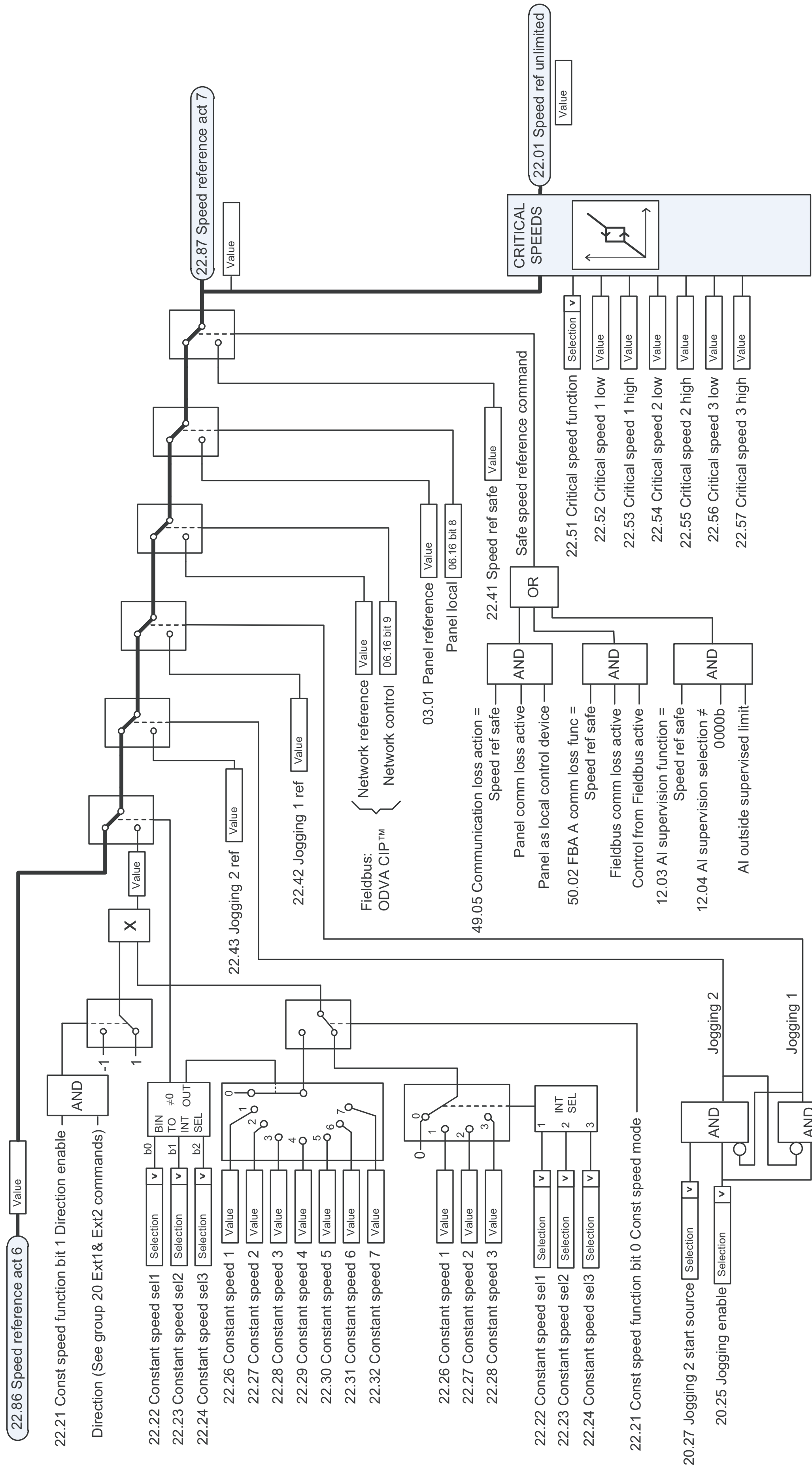
The chapter presents the reference chains of the drive. The control chain diagrams can be used to trace how parameters interact and where parameters have an effect within the drive parameter system.

For a more general diagram, see section *Operating modes of the drive* (page 22).

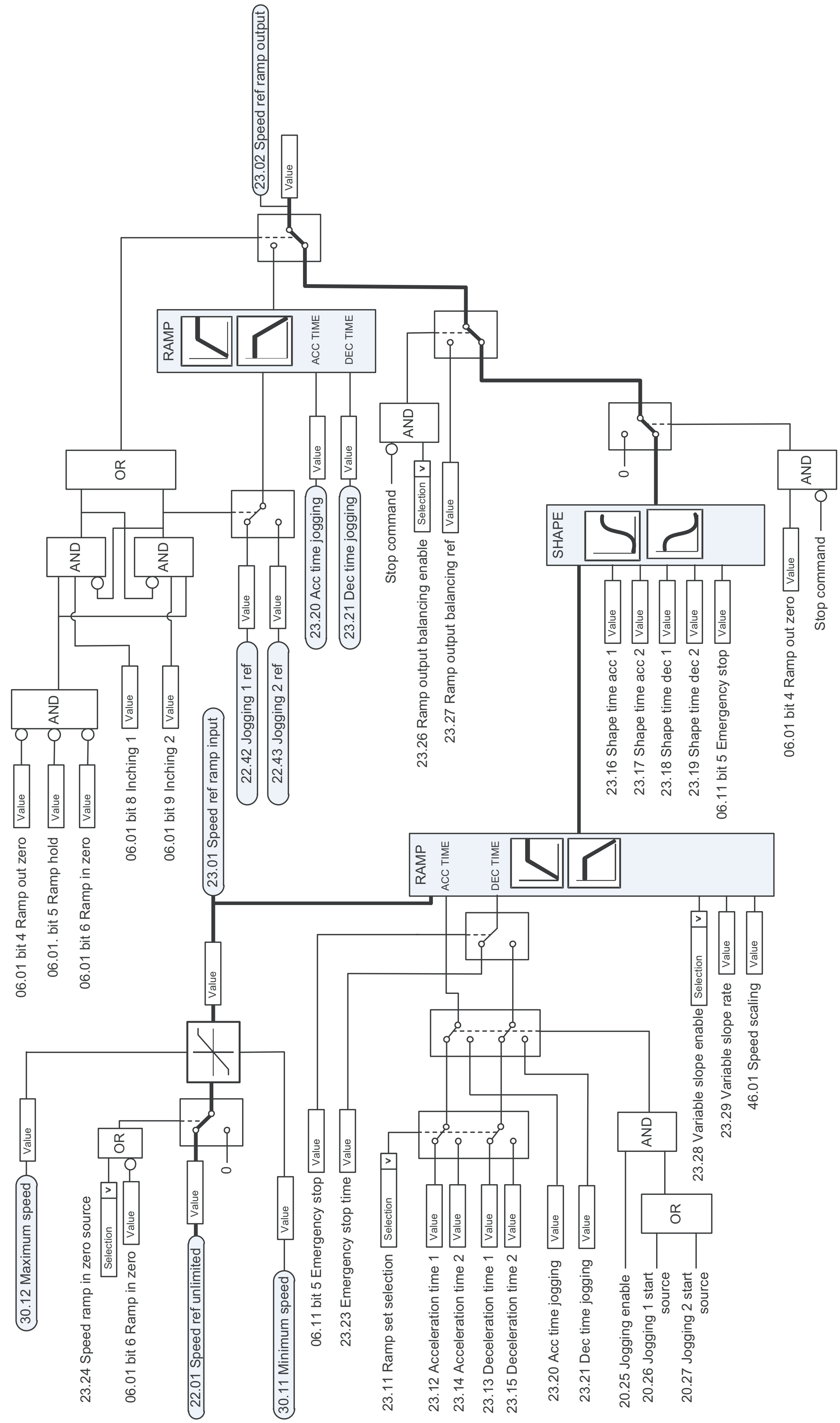
Speed reference source selection I



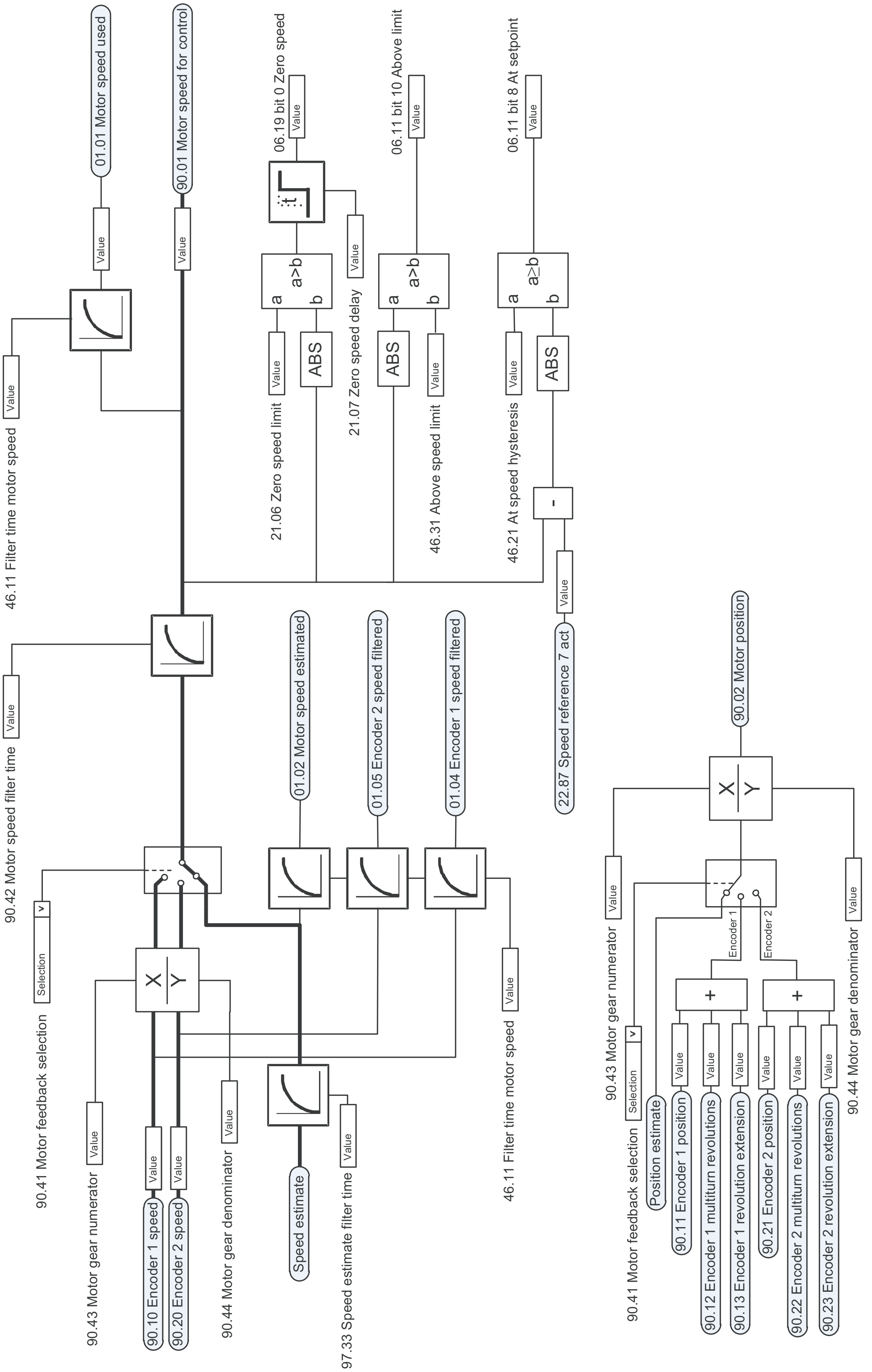
Speed reference source selection II



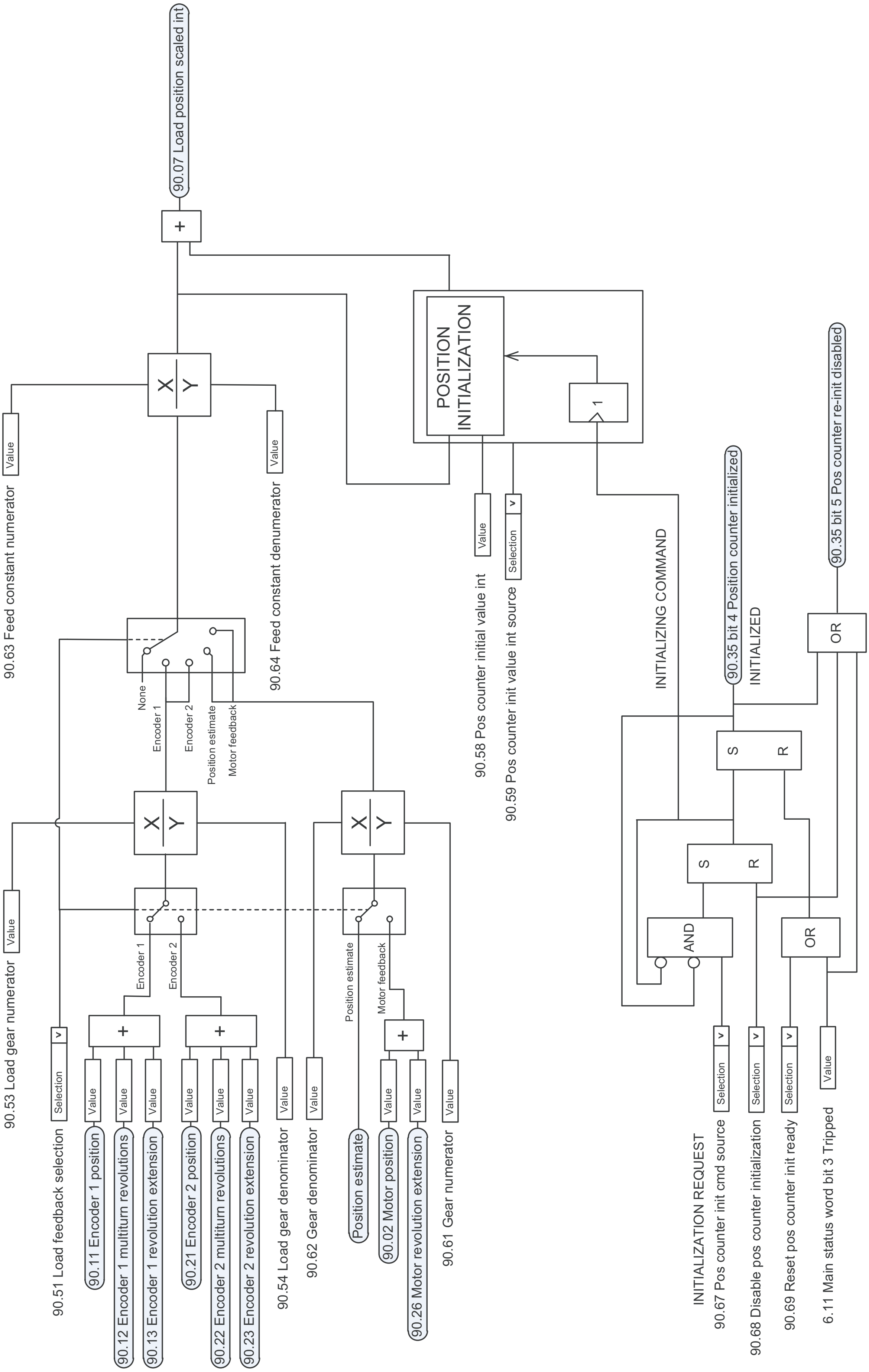
Speed reference ramping and shaping



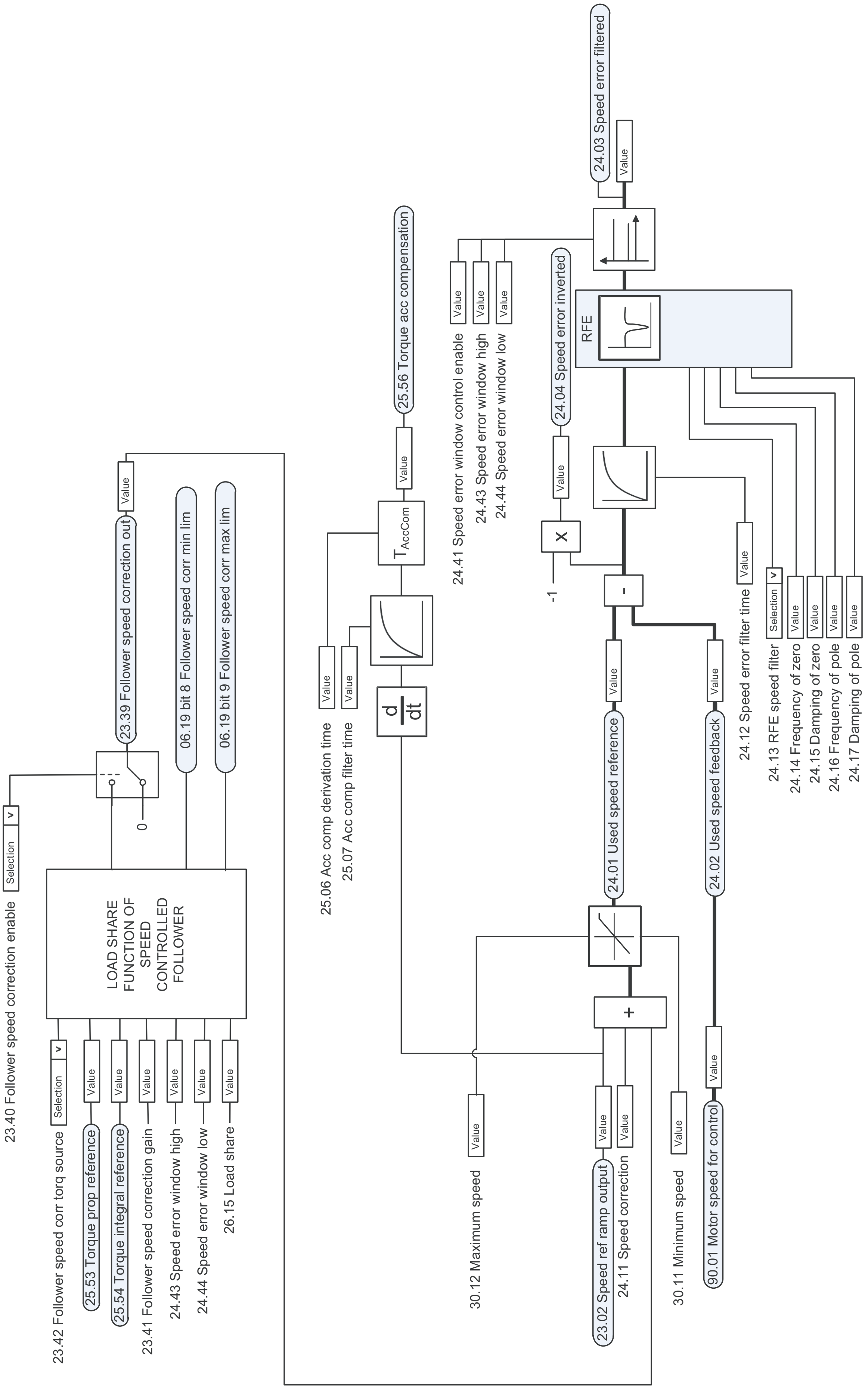
Motor feedback configuration



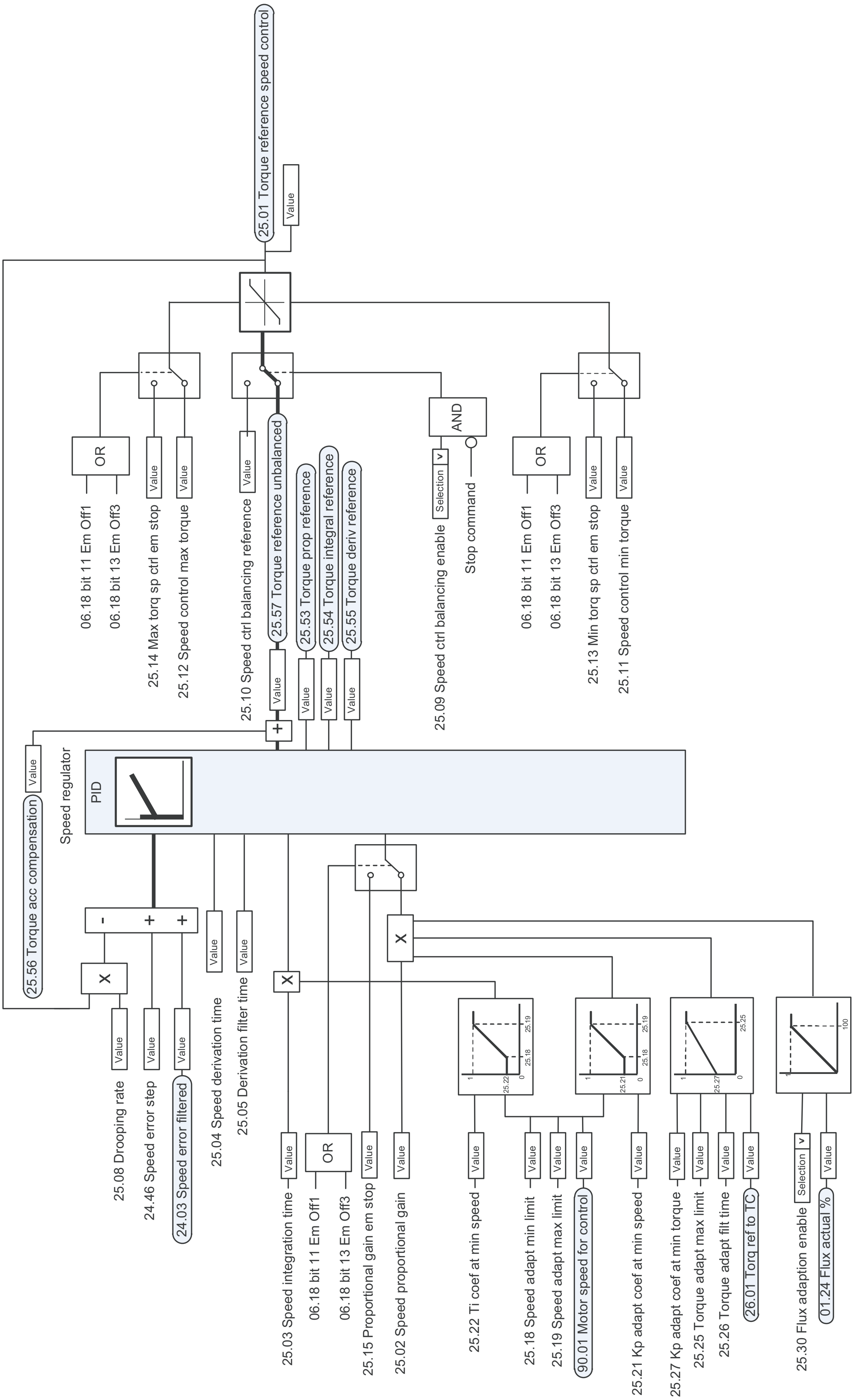
Load feedback and position counter configuration



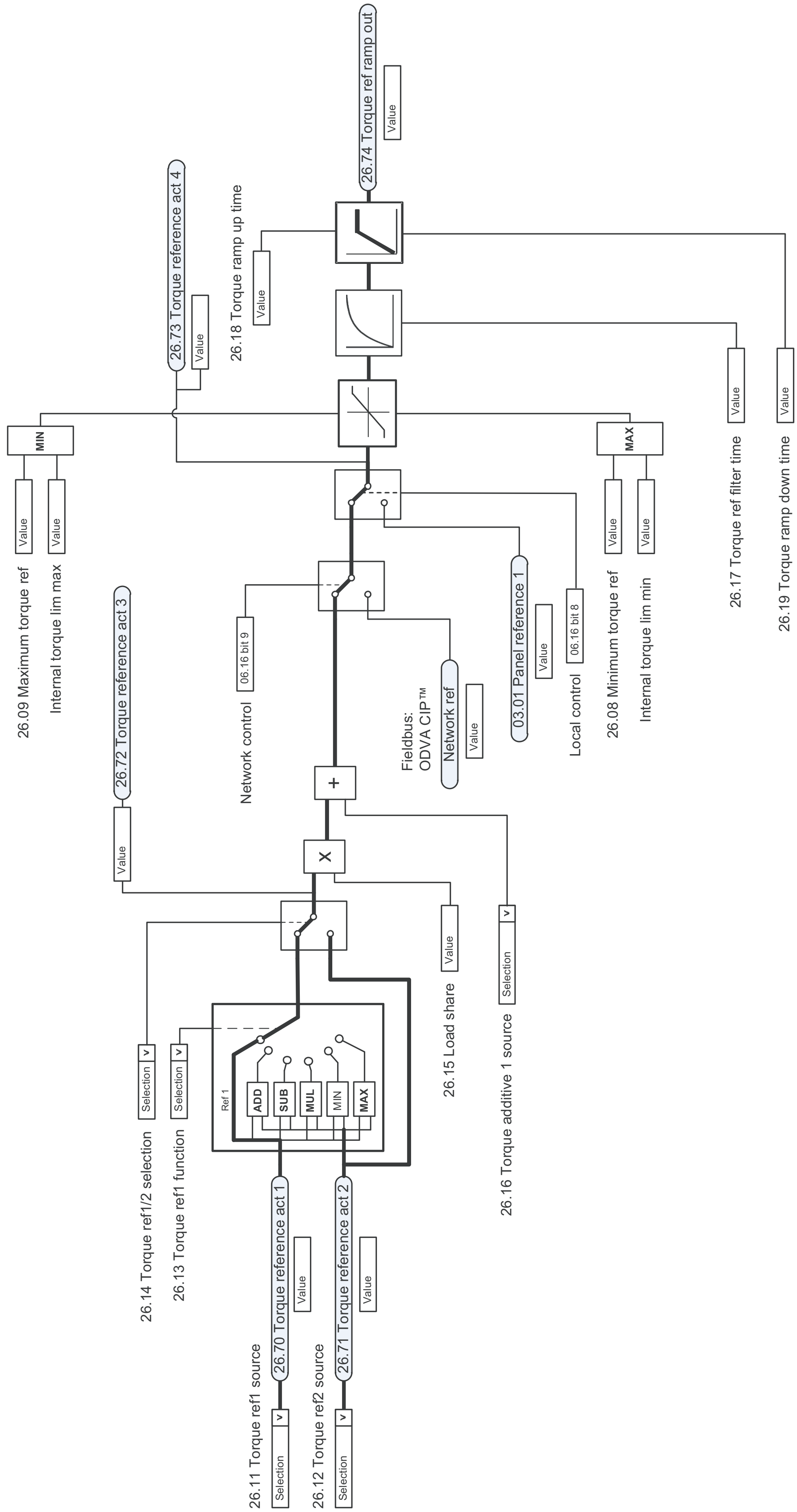
Speed error calculation



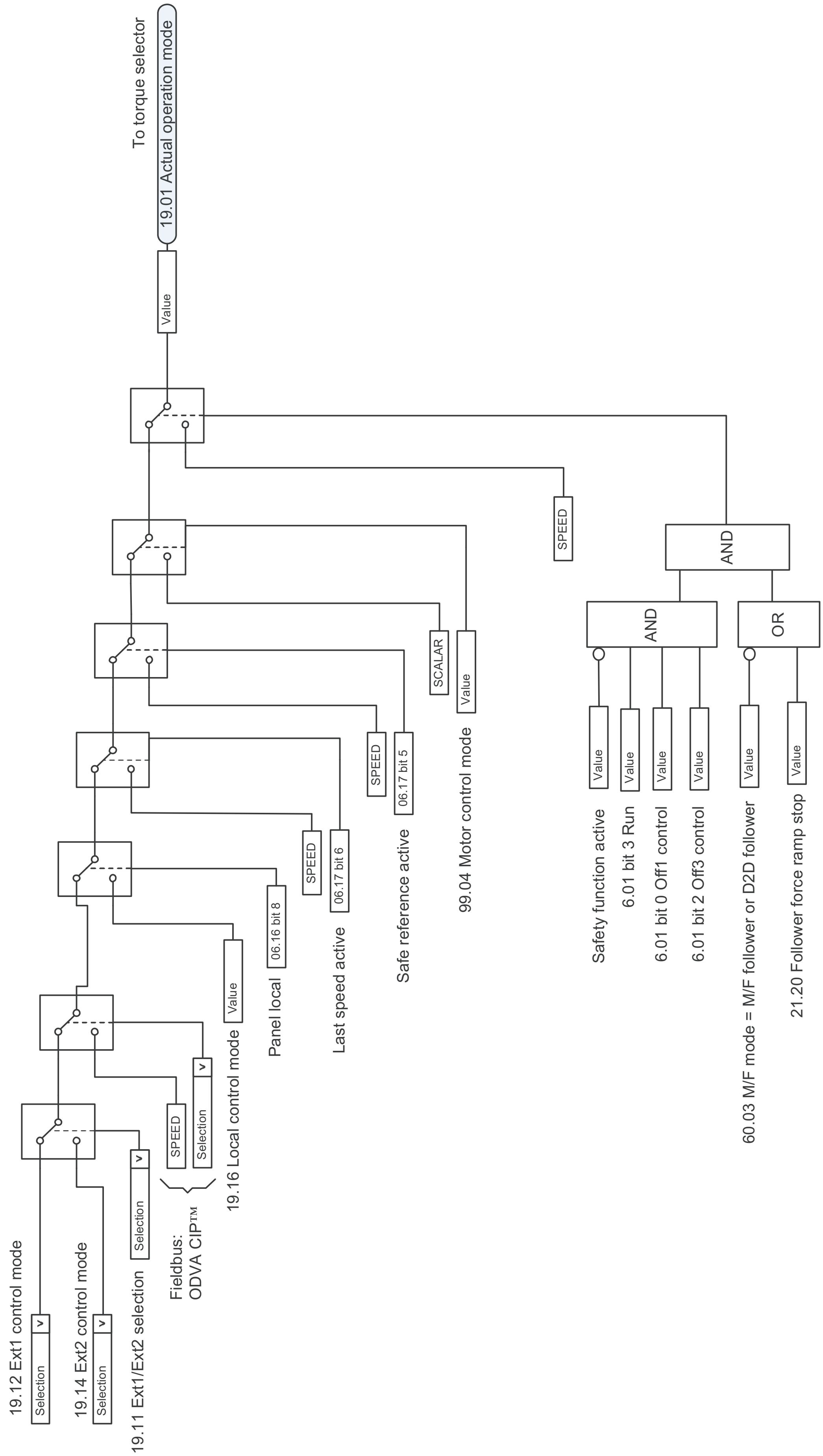
Speed controller



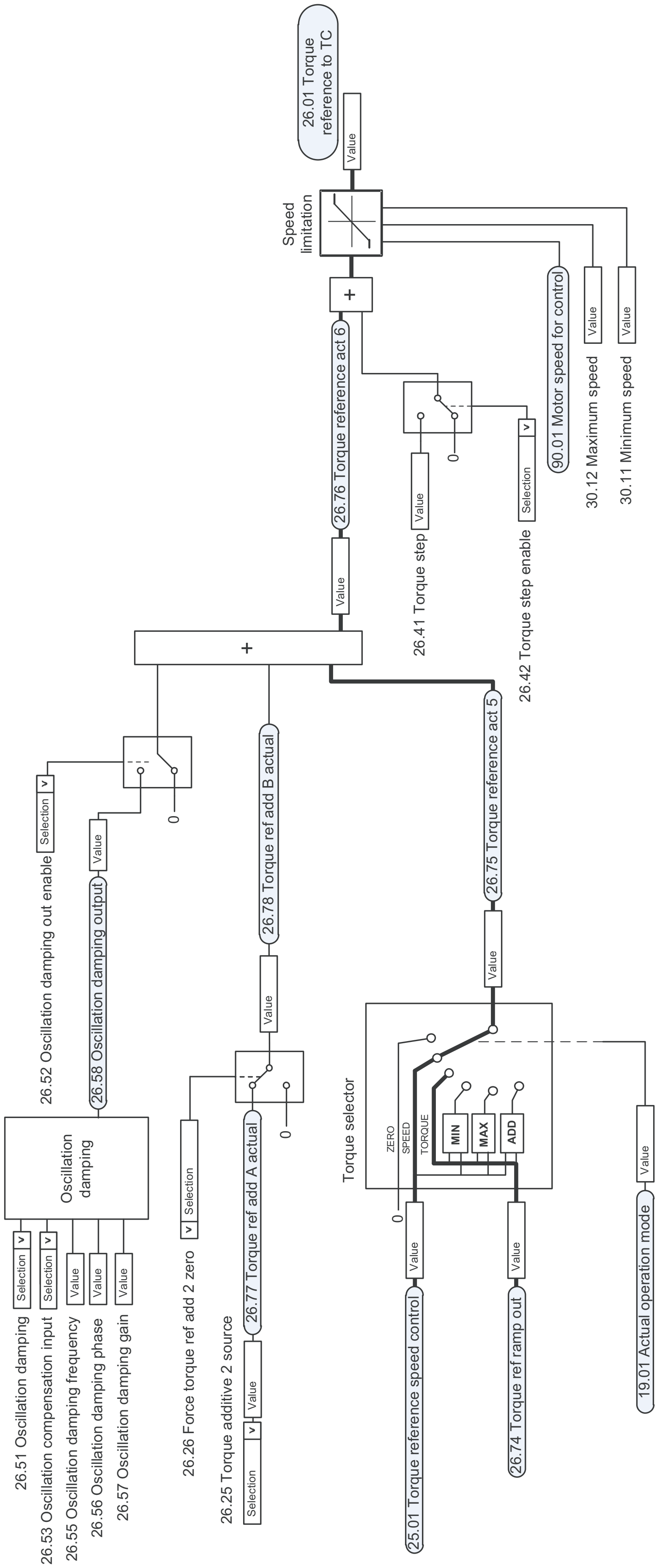
Torque reference source selection and modification



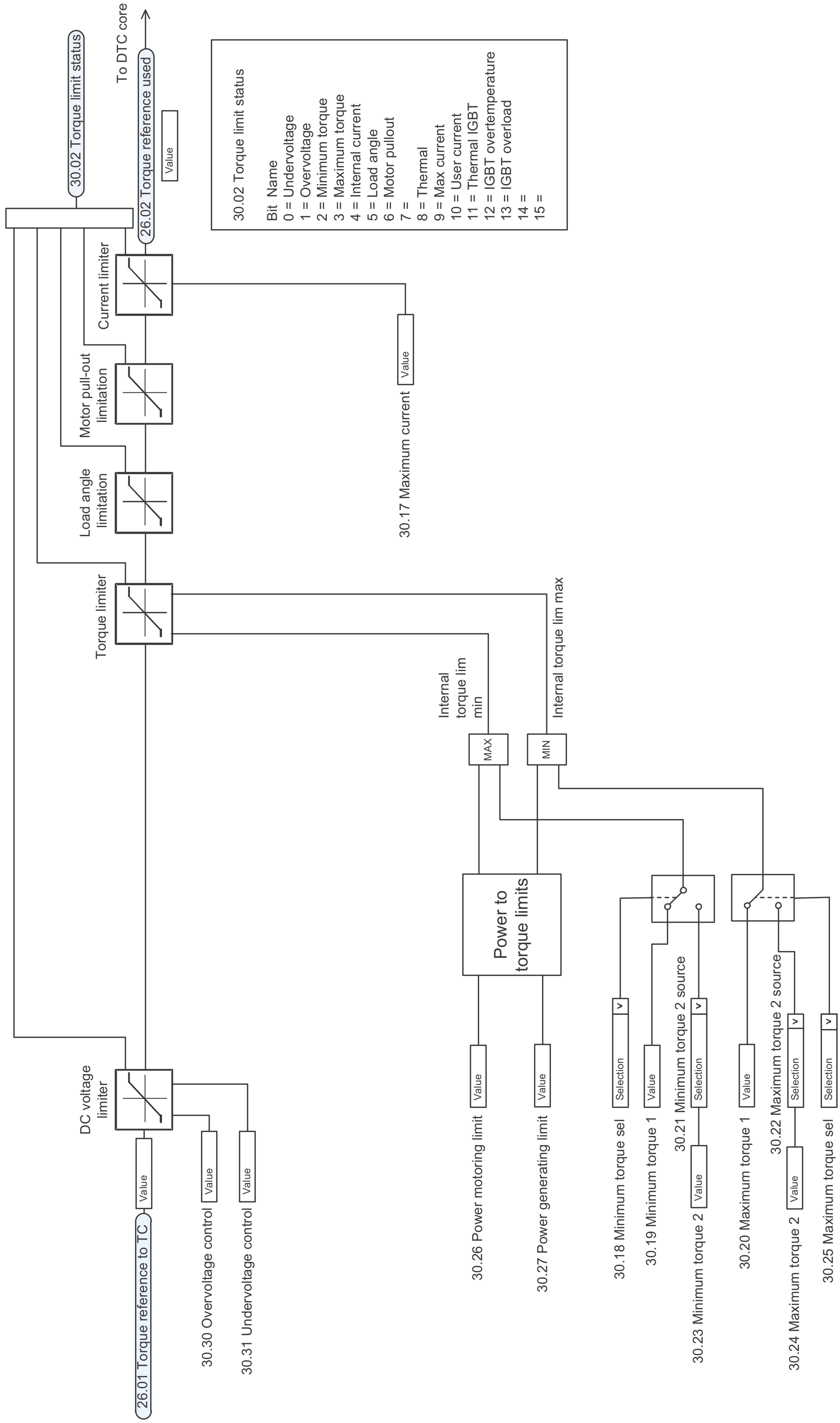
Operating mode selection



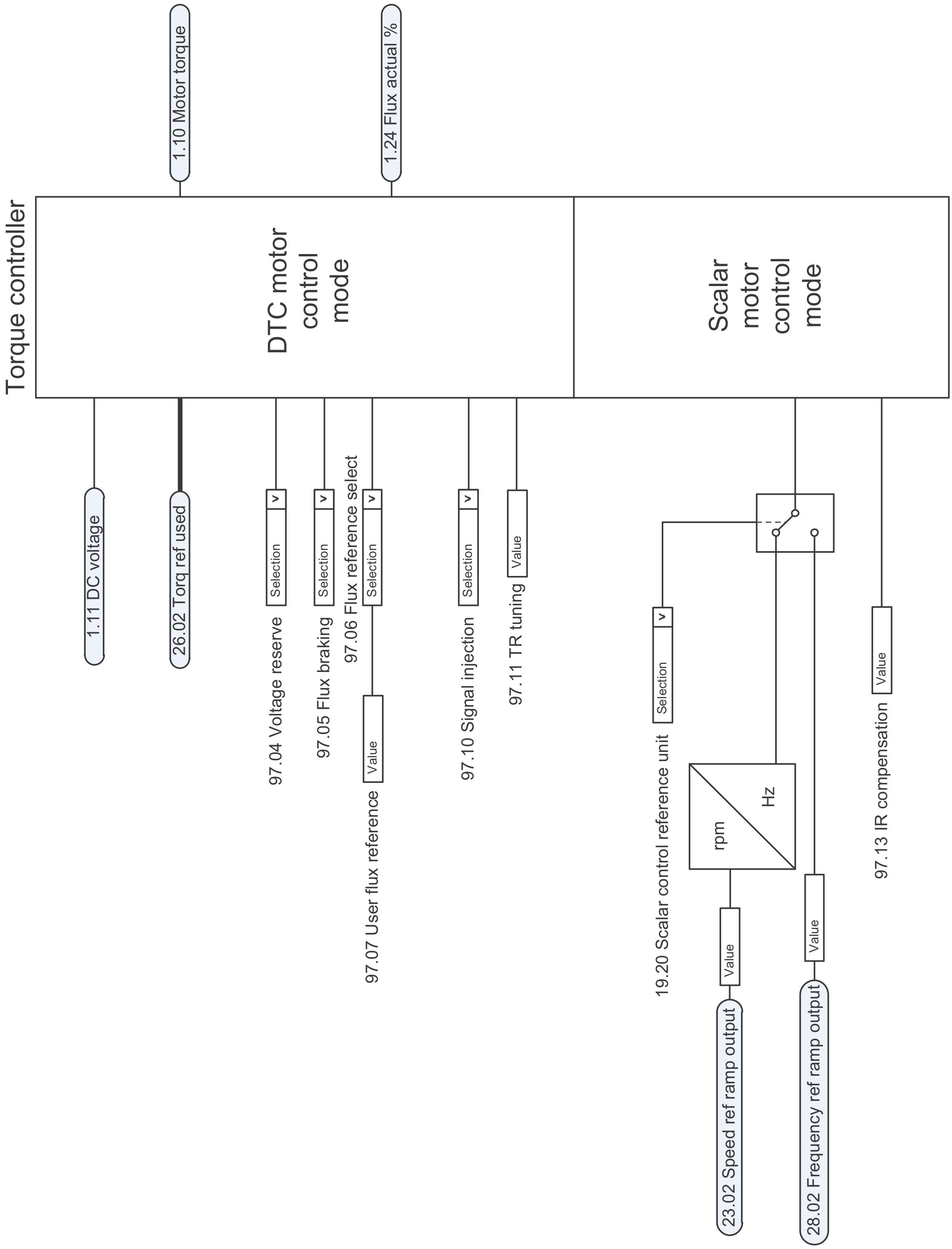
Reference selection for torque controller



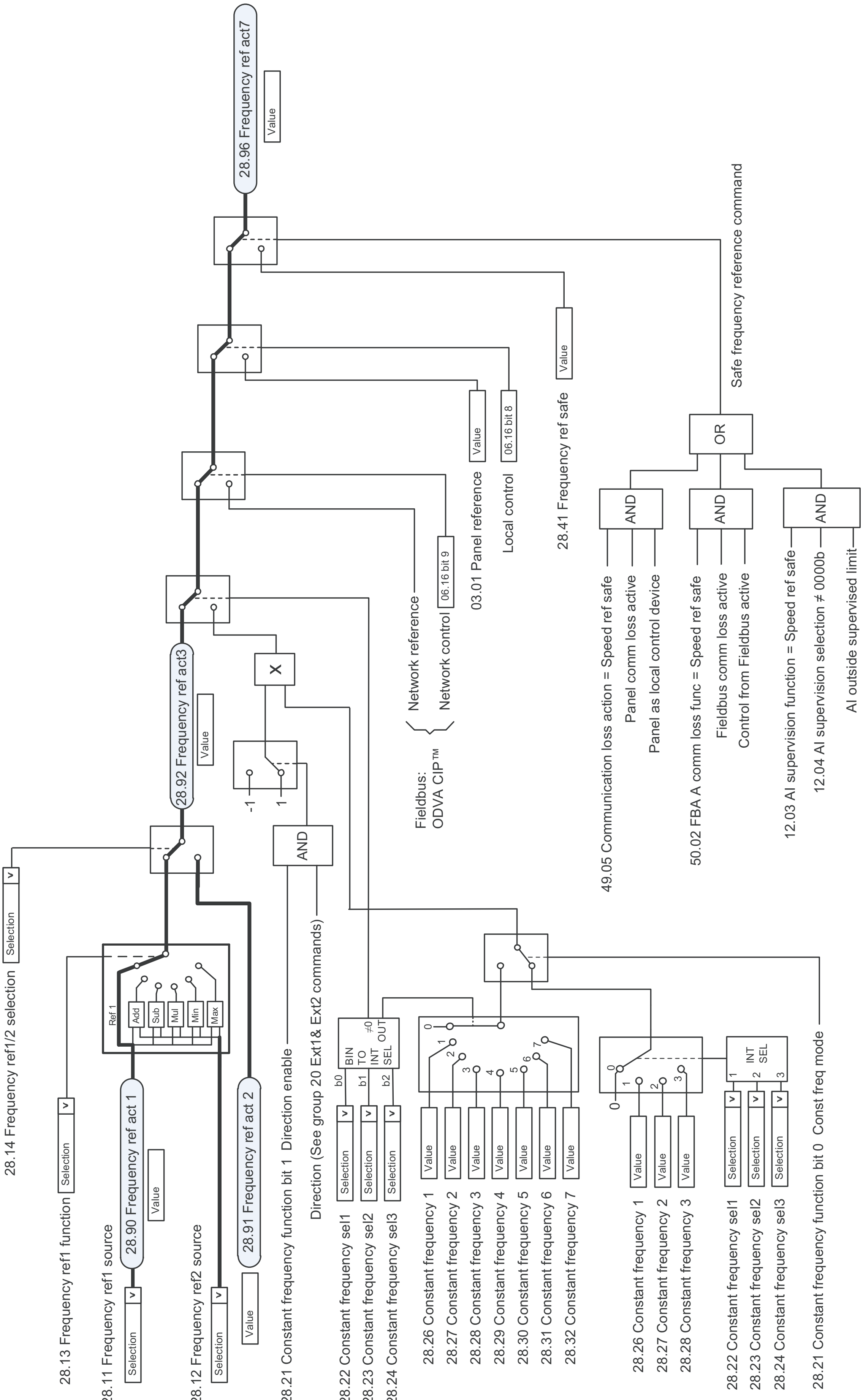
Torque limitation



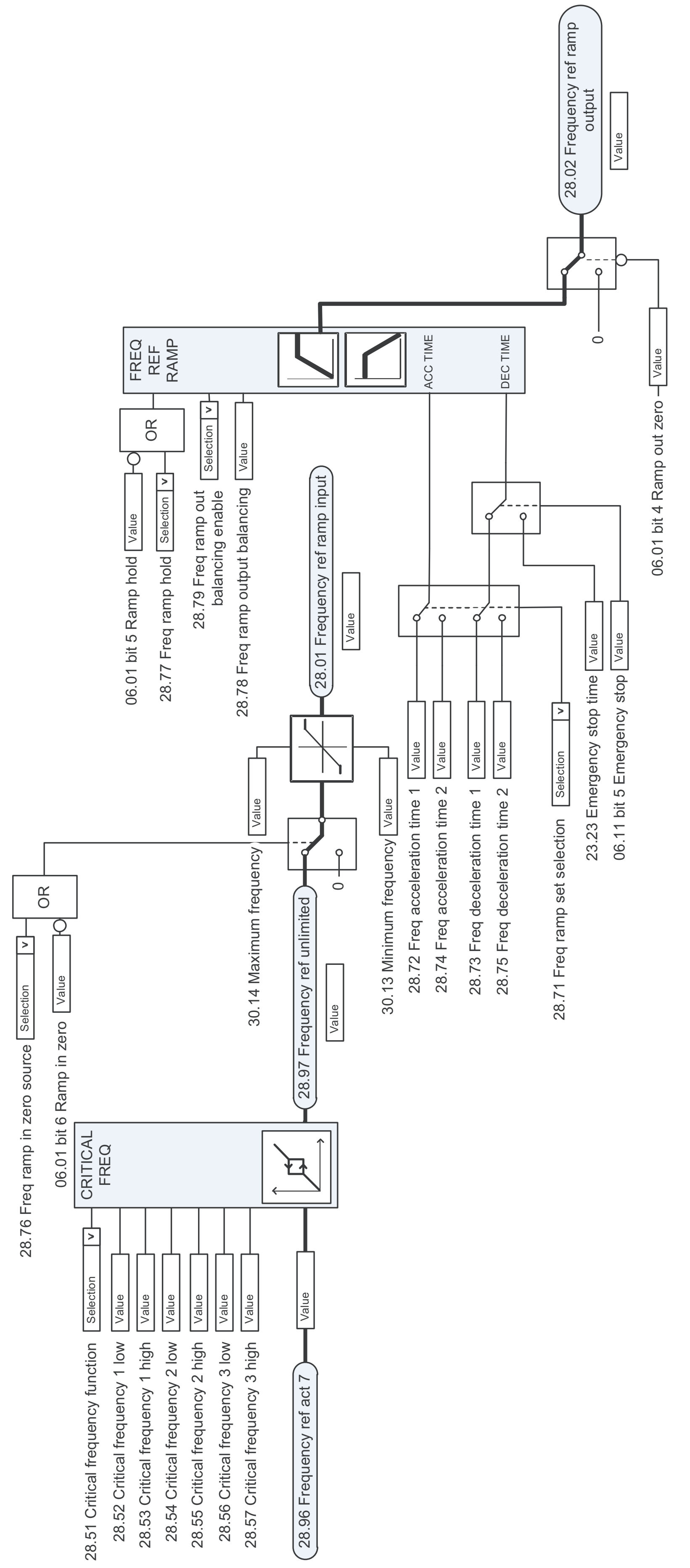
Torque controller



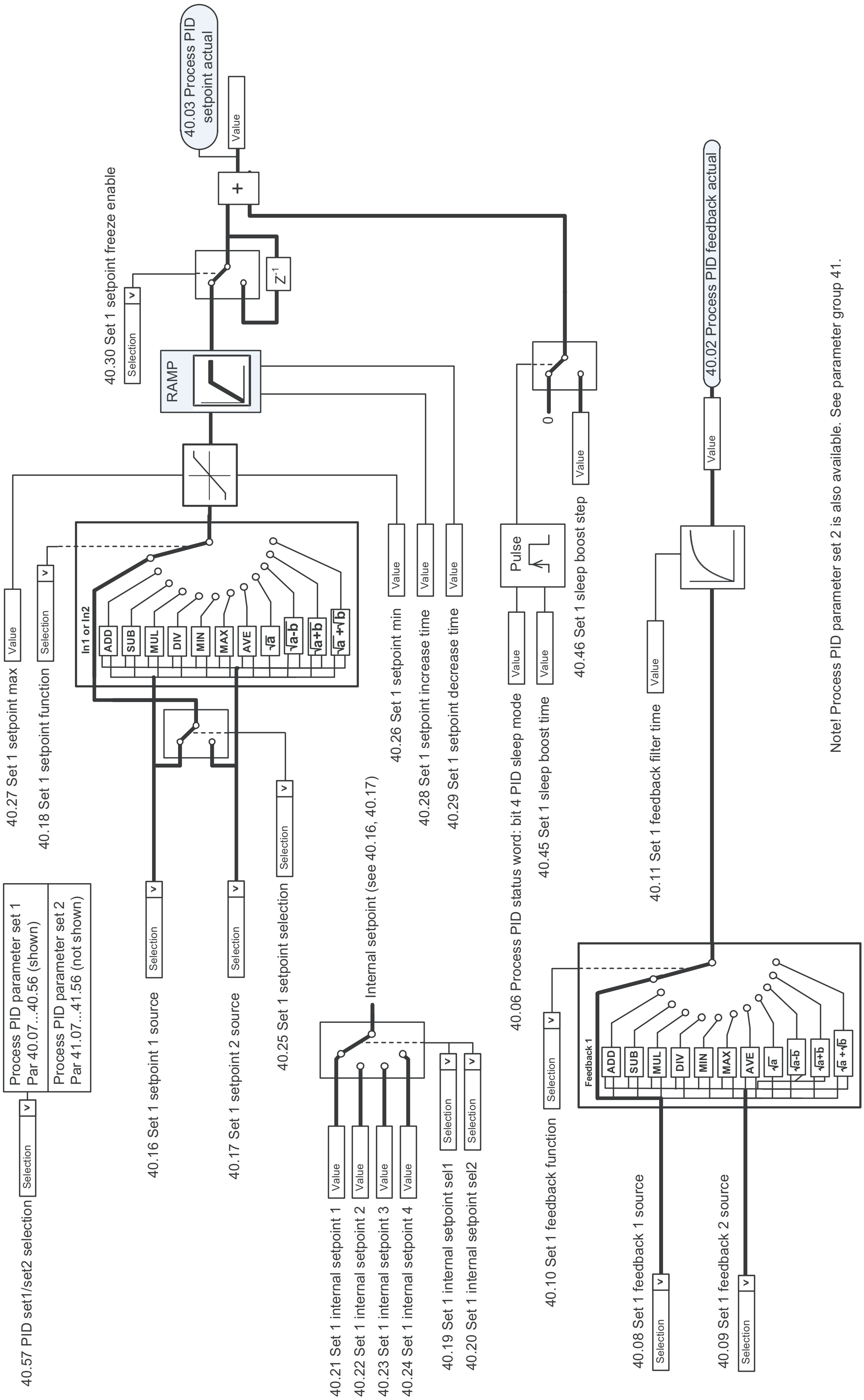
Frequency reference selection



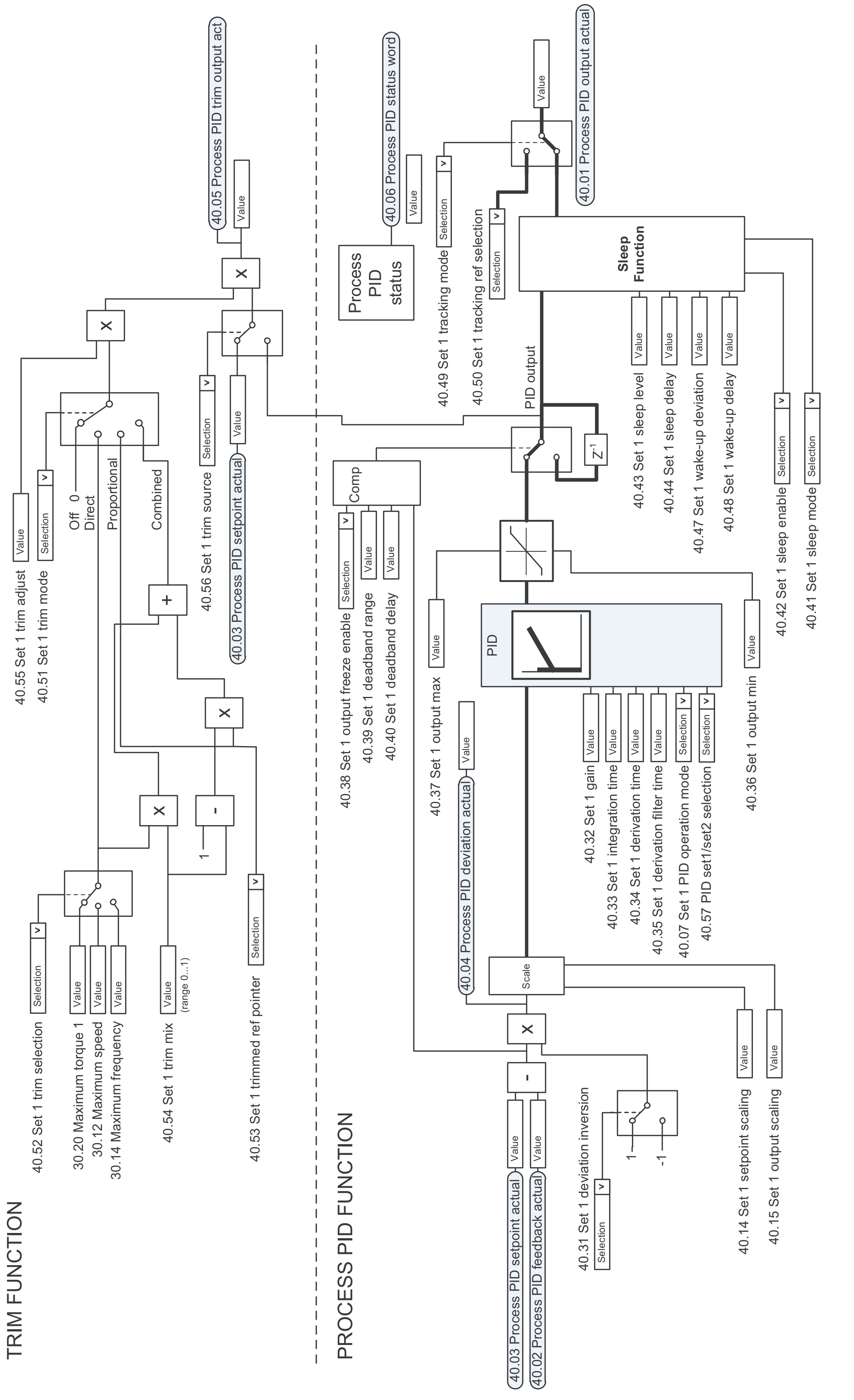
Frequency reference modification



Process PID setpoint and feedback source selection

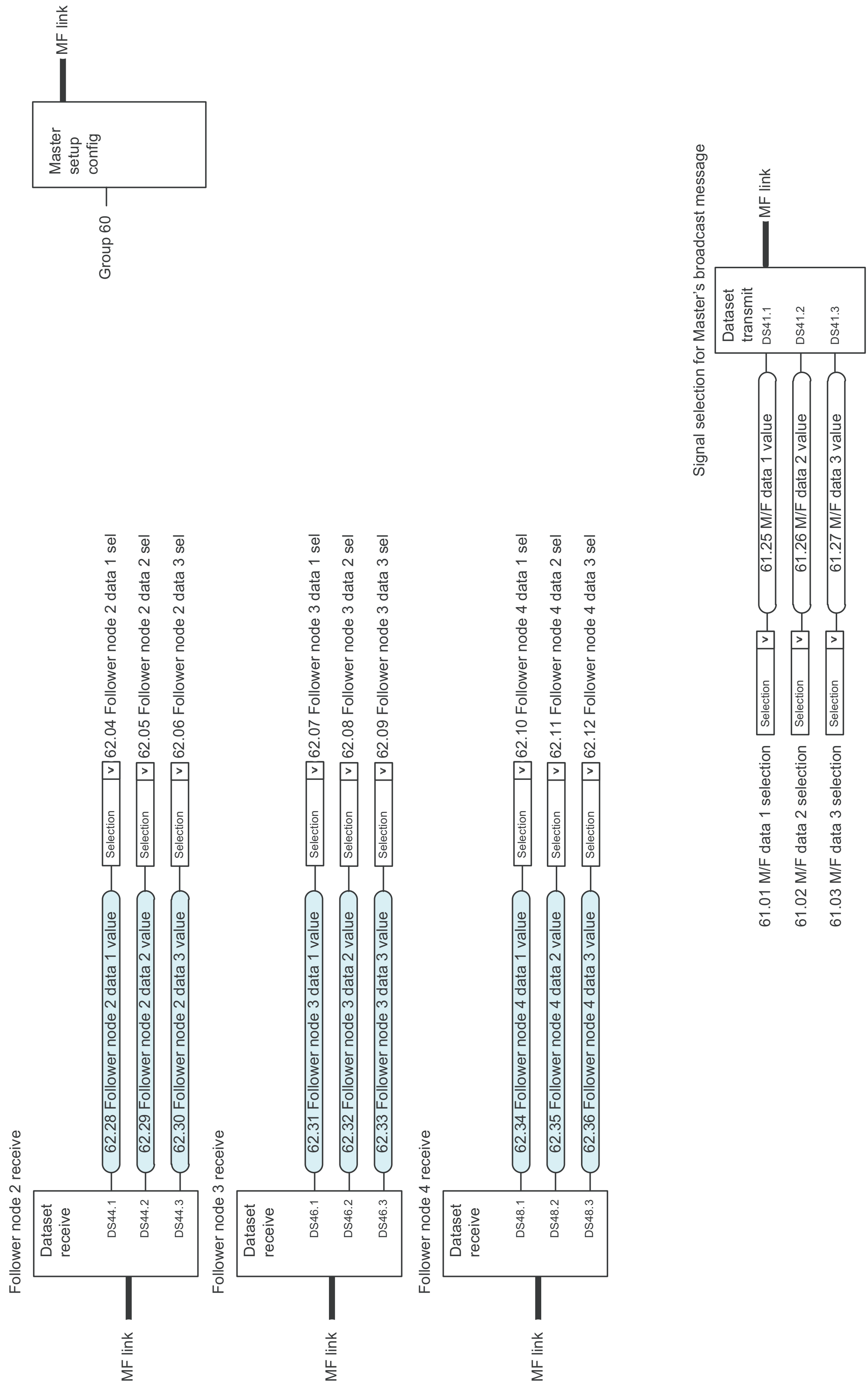


Process PID controller

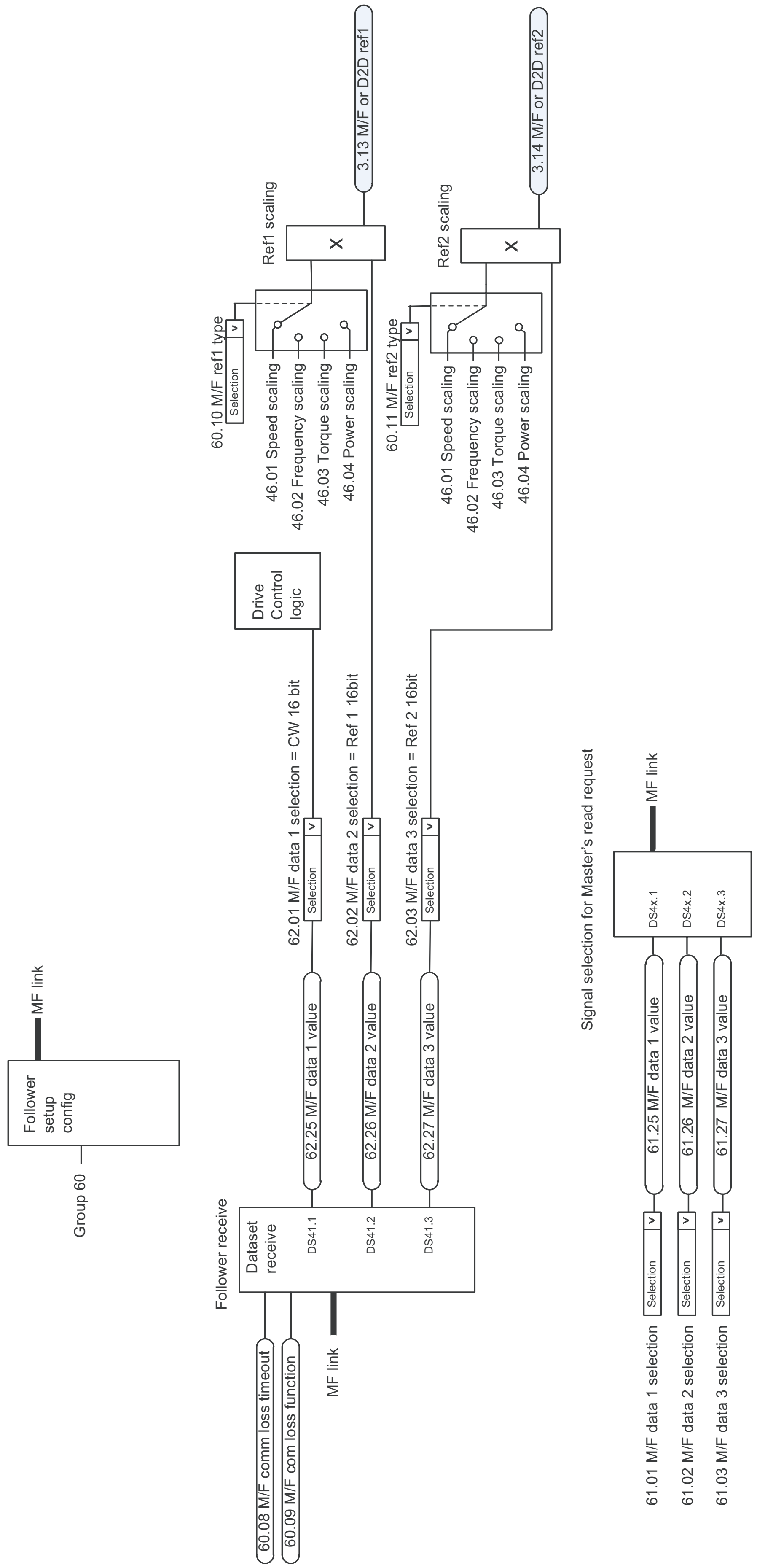


Note! Process PID parameter set 2 is also available. See parameter group 41.

Master/Follower communication I (Master)



Master/Follower communication II (Follower)



Further information

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/searchchannels.

Product training

For information on ABB product training, navigate to new.abb.com/service/training.

Providing feedback on ABB Drives manuals

Your comments on our manuals are welcome. Navigate to new.abb.com/drives/manuals-feedback-form.

Document library on the Internet

You can find manuals and other product documents in PDF format on the Internet at www.abb.com/drives/documents.

Contact us

www.abb.com/drives
www.abb.com/drivespartners

3AUA0000085967 Rev P (EN) EFFECTIVE: 2016-06-27

ABB machinery drives

User's manual
ACS355 drives

Power and productivity
for a better world™

List of related manuals

Drive manuals and guides	Code (English)
ACS355 user's manual	3AUA0000066143
ACS355 drives with IP66/67 / UL Type 4x enclosure supplement	3AUA0000066066
ACS355 quick installation guide	3AUA0000092940
ACS355 common DC application guide	3AUA0000070130

Option manuals and guides	
FCAN-01 CANopen adapter module user's manual	3AFE68615500
FDNA-01 DeviceNet adapter module user's manual	3AFE68573360
FECA-01 EtherCAT® adapter module user's manual	3AUA0000068940
FENA-01/-11/-21 Ethernet adapter module user's manual	3AUA0000093568
FEPL-02 Ethernet POWERLINK adapter module user's manual	3AUA0000123527
FLON-01 LONWORKS® adapter module user's manual	3AUA0000041017
FMBA-01 Modbus adapter module user's manual	3AFE68586704
FPBA-01 PROFIBUS DP adapter module user's manual	3AFE68573271
FRSA-00 RS-485 adapter board user's manual	3AFE68640300
MFDT-01 FlashDrop user's manual	3AFE68591074
MPOT-01 potentiometer module instructions for installation and use	3AFE68591082
MREL-01 output relay module user's manual	3AUA0000035974
MTAC-01 pulse encoder interface module user's manual	3AFE68591091
MUL1-R1 installation instructions for ACS150, ACS310, ACS320, ACS350 and ACS355	3AFE68642868
MUL1-R3 installation instructions for ACS310, ACS320, ACS350 and ACS355	3AFE68643147
MUL1-R4 installation instructions for ACS310, ACS320, ACS350 and ACS355	3AUA0000025916
SREA-01 Ethernet adapter module quick start-up guide	3AUA0000042902
SREA-01 Ethernet adapter module user's manual	3AUA0000042896
ACS355 and AC500-eCo application guide	2CDC125152M0201
AC500-eCo PLC and ACS355 quick installation guide	2CDC125145M0201

Maintenance manuals and guides	
Guide for capacitor reforming in ACS50, ACS55, ACS150, ACS310, ACS350, ACS355, ACS550, ACH550 and R1-R4 OINT/SINT boards	3AFE68735190

You can find manuals and other product documents in PDF format on the Internet. See section *Document library on the Internet* on the inside of the back cover. For manuals not available in the Document library, contact your local ABB representative.

User’s manual

ACS355

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4. Mechanical installation

6. Electrical installation

8. Start-up, control with I/O and ID run

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10. Application macros

11. Program features

12. Actual signals and parameters

13. Fieldbus control with embedded fieldbus

14. Fieldbus control with fieldbus adapter

15. Fault tracing

16. Maintenance and hardware diagnostics

17. Technical data

18. Dimension drawings

19. Appendix: Resistor braking

20. Appendix: Extension modules

21. Appendix: Safe torque off (STO)

22. Appendix: Permanent magnet synchronous motors (PMSMs)

Further information

1

Safety

What this chapter contains

The chapter contains safety instructions which you must follow when installing, operating and servicing the drive. If ignored, physical injury or death may follow, or damage may occur to the drive, motor or driven equipment. Read the safety instructions before you work on the drive.

Use of warnings

Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment, and advise on how to avoid the danger. The following warning symbols are used in this manual:

Electricity warning warns of hazards from electricity which can cause physical injury and/or damage to the equipment.

General warning warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment.

Safety in installation and maintenance

These warnings are intended for all who work on the drive, motor cable or motor.

Electrical safety

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment.

Only qualified electricians are allowed to install and maintain the drive!

- Never work on the drive, motor cable or motor when input power is applied. After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.

  Always ensure by measuring with a multimeter (impedance at least 1 Mohm) that

  1. there is no voltage between the drive input phases U1, V1 and W1 and the ground
  2. there is no voltage between terminals BRK+ and BRK- and the ground.
- Do not work on the control cables when power is applied to the drive or to the external control circuits. Externally supplied control circuits may carry dangerous voltage even when the input power of the drive is switched off.
- Do not make any insulation or voltage withstand tests on the drive.
- Disconnect the internal EMC filter when installing the drive on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system), otherwise the system will be connected to ground potential through the EMC filter capacitors. This may cause danger or damage the drive. See page *50*. **Note:** When the internal EMC filter is disconnected, the drive is not EMC compatible without an external filter.
- Disconnect the internal EMC filter when installing the drive on a corner-grounded TN system, otherwise the drive will be damaged. See page *50*. **Note:** When the internal EMC filter is disconnected, the drive is not EMC compatible without an external filter.
- All ELV (extra low voltage) circuits connected to the drive must be used within a zone of equipotential bonding, ie, within a zone where all simultaneously accessible conductive parts are electrically connected to prevent hazardous voltages appearing between them. This is accomplished by a proper factory grounding.

Note:

- Even when the motor is stopped, dangerous voltage is present at the power circuit terminals U1, V1, W1 and U2, V2, W2 and BRK+ and BRK-.

Permanent magnet synchronous motor drives

These are additional warnings concerning permanent magnet synchronous motor drives. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

WARNING! Do not work on the drive when the permanent magnet synchronous motor is rotating. Also, when the supply power is switched off and the inverter is stopped, a rotating permanent magnet synchronous motor feeds power to the intermediate circuit of the drive and the supply connections become live.

Before installation and maintenance work on the drive:

- Stop the motor.
- Ensure that there is no voltage on the drive power terminals according to step 1 or 2, or if possible, according to the both steps.
  1. Disconnect the motor from the drive with a safety switch or by other means. Measure that there is no voltage present on the drive input or output terminals (U1, V1, W1, U2, V2, W2, BRK+, BRK-).
  2. Ensure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, is able to rotate the motor directly or through any mechanical connection like felt, nip, rope, etc. Measure that there is no voltage present on the drive input or output terminals (U1, V1, W1, U2, V2, W2, BRK+, BRK-). Ground the drive output terminals temporarily by connecting them together as well as to the PE.

General safety

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment.

- The drive is not field repairable. Never attempt to repair a malfunctioning drive; contact your local ABB representative or Authorized Service Center for replacement.
- Make sure that dust from drilling does not enter the drive during the installation. Electrically conductive dust inside the drive may cause damage or lead to malfunction.
- Ensure sufficient cooling.

Safe start-up and operation

These warnings are intended for all who plan the operation, start up or operate the drive.

Electrical safety

Permanent magnet synchronous motor drives

These warnings concern permanent magnet synchronous motor drives. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

WARNING! It is not recommended to run the permanent magnet synchronous motor over 1.2 times the rated speed. Motor overspeed may lead to overvoltage which may permanently damage the drive.

General safety

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment.

- Before adjusting the drive and putting it into service, make sure that the motor and all driven equipment are suitable for operation throughout the speed range provided by the drive. The drive can be adjusted to operate the motor at speeds above and below the speed provided by connecting the motor directly to the power line.
- Do not activate automatic fault reset functions if dangerous situations can occur. When activated, these functions will reset the drive and resume operation after a fault.
- Do not control the motor with an AC contactor or disconnecting device (disconnecting means); use instead the control panel start and stop keys and or external commands (I/O or fieldbus). The maximum allowed number of charging cycles of the DC capacitors (ie, power-ups by applying power) is two per minute and the maximum total number of chargings is 15 000.

Note:

- If an external source for start command is selected and it is ON, the drive will start immediately after an input voltage break or fault reset unless the drive is configured for 3-wire (a pulse) start/stop.
- When the control location is not set to local (LOC not shown on the display), the stop key on the control panel will not stop the drive. To stop the drive using the control panel, first press the LOC/REM key LOC REM and then the stop key .

2

Introduction to the manual

What this chapter contains

The chapter describes applicability, target audience and purpose of this manual. It describes the contents of this manual and refers to a list of related manuals for more information. The chapter also contains a flowchart of steps for checking the delivery, installing and commissioning the drive. The flowchart refers to chapters/sections in this manual.

Applicability

The manual is applicable to the ACS355 drive firmware version 5.100 or later. See parameter *3301 FIRMWARE* on page *261*.

Target audience

The reader is expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

The manual is written for readers worldwide. Both SI and imperial units are shown. Special US instructions for installations in the United States are given.

Purpose of the manual

This manual provides information needed for planning the installation, installing, commissioning, using and servicing the drive.

Contents of this manual

The manual consists of the following chapters:

- *Safety* (page *17*) gives safety instructions you must follow when installing, commissioning, operating and servicing the drive.
- *Introduction to the manual* (this chapter, page *21*) describes applicability, target audience, purpose and contents of this manual. It also contains a quick installation and commissioning flowchart.
- *Operation principle and hardware description* (page *27*) describes the operation principle, layout, power connections and control interfaces, type designation label and type designation information in short.
- *Mechanical installation* (page *33*) tells how to check the installation site, unpack, check the delivery and install the drive mechanically.
- *Planning the electrical installation* (page *39*) tells how to check the compatibility of the motor and the drive and select cables, protections and cable routing.
- *Electrical installation* (page *49*) tells how to check the insulation of the assembly and the compatibility with IT (ungrounded) and corner-grounded TN systems as well as connect power cables and control cables.
- *Installation checklist* (page *59*) contains a checklist for checking the mechanical and electrical installation of the drive.
- *Start-up, control with I/O and ID run* (page *61*) tells how to start up the drive as well as how to start, stop, change the direction of the motor rotation and adjust the motor speed through the I/O interface.
- *Control panels* (page *75*) describes the control panel keys, LED indicators and display fields and tells how to use the panel for control, monitoring and changing the settings.
- *Application macros* (page *107*) gives a brief description of each application macro together with a wiring diagram showing the default control connections. It also explains how to save a user macro and how to recall it.
- *Program features* (page *121*) describes program features with lists of related user settings, actual signals, and fault and alarm messages.
- *Actual signals and parameters* (page *179*) describes actual signals and parameters. It also lists the default values for the different macros.
- *Fieldbus control with embedded fieldbus* (page *313*) tells how the drive can be controlled by external devices over a communication network using embedded fieldbus.
- *Fieldbus control with fieldbus adapter* (page *339*) tells how the drive can be controlled by external devices over a communication network using a fieldbus adapter.
- *Fault tracing* (page *349*) tells how to reset faults and view fault history. It lists all alarm and fault messages including the possible cause and corrective actions.
- *Maintenance and hardware diagnostics* (page *369*) contains preventive

maintenance instructions and LED indicator descriptions.

- *Technical data* (page *373*) contains technical specifications of the drive, eg, ratings, sizes and technical requirements as well as provisions for fulfilling the requirements for CE and other marks.
- *Dimension drawings* (page *395*) shows dimension drawings of the drive.
- *Appendix: Resistor braking* (page *405*) tells how to select the brake resistor.
- *Appendix: Extension modules* (page *411*) describes common features and mechanical installation of the optional extension modules: MPOW-01 auxiliary power extension module, MTAC-01 pulse encoder interface module and MREL-01 output relay module. Specific features and electrical installation for the MPOW-01 are also described; for information on the MTAC-01 and MREL-01, refer to the corresponding user’s manual.
- *Appendix: Safe torque off (STO)* (page *417*) describes STO features, installation and technical data.
- *Appendix: Permanent magnet synchronous motors (PMSMs)* (page *431*) describes the parameter settings needed for permanent magnet synchronous motors.
- *Further information* (inside of the back cover, page *435*) tells how to make product and service inquiries, get information on product training, provide feedback on ABB Drives manuals and how to find documents on the Internet.

Related documents

See *List of related manuals* on page *2* (inside of the front cover).

Categorization by frame size

The ACS355 is manufactured in frame sizes R0…R4. Some instructions and other information which only concern certain frame sizes are marked with the symbol of the frame size (R0…R4). To identify the frame size of your drive, see the table in section *Ratings* on page *374*.

Quick installation and commissioning flowchart

Task	See
Identify the frame size of your drive: R0…R4.	*Operation principle and hardware description*: *Type designation key* on page *31* *Technical data*: *Ratings* on page *374*
Plan the installation: select the cables, etc. Check the ambient conditions, ratings and required cooling air flow.	*Planning the electrical installation* on page *39* *Technical data* on page *373*
Unpack and check the drive.	*Mechanical installation: Unpacking* on page *35*
If the drive will be connected to an IT (ungrounded) or corner-grounded system, check that the internal EMC filter is not connected.	*Operation principle and hardware description*: *Type designation key* on page *31* *Electrical installation*: *Checking the compatibility with IT (ungrounded) and corner-grounded TN systems* on page *50*
Install the drive on a wall or in a cabinet.	*Mechanical installation* on page *33*
Route the cables.	*Planning the electrical installation*: *Routing the cables* on page *45*
Check the insulation of the input cable and the motor and the motor cable.	*Electrical installation*: *Checking the insulation of the assembly* on page *49*
Connect the power cables.	*Electrical installation*: *Connecting the power cables* on page *51*
Connect the control cables.	*Electrical installation*: *Connecting the control cables* on page *53*
Check the installation.	*Installation checklist* on page *59*
Commission the drive.	*Start-up, control with I/O and ID run* on page *61*

Terms and abbreviations

Term/abbreviation	Explanation
ACS-CP-A	Assistant control panel, advanced operator keypad for communication with the drive
ACS-CP-C	Basic control panel, basic operator keypad for communication with the drive
ACS-CP-D	Assistant control panel for Asian languages, advanced operator keypad for communication with the drive
Brake chopper	Conducts the surplus energy from the intermediate circuit of the drive to the brake resistor when necessary. The chopper operates when the DC link voltage exceeds a certain maximum limit. The voltage rise is typically caused by deceleration (braking) of a high inertia motor.
Brake resistor	Dissipates the drive surplus braking energy conducted by the brake chopper to heat. Essential part of the brake circuit. See *Brake chopper*.
Capacitor bank	See *DC link capacitors*.
Control board	Circuit board in which the control program runs.
CRC	Cyclic redundancy check
DC link	DC circuit between rectifier and inverter
DC link capacitors	Energy storage which stabilizes the intermediate circuit DC voltage.
DCU	Drive control unit
Drive	Frequency converter for controlling AC motors
EMC	Electromagnetic compatibility
EFB	Embedded fieldbus
ESP	Enhanced Sequence Program
FBA	Fieldbus adapter
FCAN	Optional CANopen adapter module
FDNA	Optional DeviceNet adapter module
FECA	Optional EtherCAT adapter module
FENA	Optional Ethernet adapter module for EtherNet/IP, Modbus TCP and PROFINET IO protocols
FLON	Optional LONWORKS® adapter module
FMBA	Optional Modbus RTU adapter module
FPBA	Optional PROFIBUS DP adapter module
Frame (size)	Refers to drive physical size, for example R1 and R2. To determine the frame size of a drive, refer to the rating table in chapter *Technical data* on page *373*.
FRSA	RSA-485 adapter board
I/O	Input/Output
ID run	Identification run
IGBT	Insulated gate bipolar transistor
Intermediate circuit	See *DC link*.

Term/abbreviation	Explanation
Inverter	Converts direct current and voltage to alternating current and voltage.
IT system	Type of supply system that has no (low-impedance) connection to ground/earth.
LRFI	Series of optional EMC filters
LSW	Least significant word
Macro	Pre-defined default values of parameters in drive control program. Each macro is intended for a specific application. See *Parameter*.
MFDT-01	FlashDrop, a tool for configuring an unpowered drive
MMP	Manual motor protector
MPOT	Potentiometer module
MPOW	Auxiliary power extension module
MREL	Relay output module
MSW	Most significant word
MTAC	Pulse encoder interface module
MUL1-R1	Option kit for R1 frame sizes for compliance with NEMA 1
MUL1-R3	Option kit for R3 frame sizes for compliance with NEMA 1
MUL1-R4	Option kit for R4 frame sizes for compliance with NEMA 1
Parameter	User-adjustable operation instruction to the drive, or signal measured or calculated by the drive
PLC	Programmable logic controller
PMSM	Permanent magnet synchronous motor
PROFIBUS, PROFIBUS DP, PROFINET IO	Registered trademarks of PI - PROFIBUS & PROFINET International
R1, R2, ...	*Frame (size)*
RCD	Residual current device
Rectifier	Converts alternating current and voltage to direct current and voltage.
RFI	Radio-frequency interference
RTU	Remote terminal unit
SIL	Safety integrity level. See *Appendix: Safe torque off (STO)* on page *417*.
SREA-01	Ethernet adapter module
STO	Safe torque off. See *Appendix: Safe torque off (STO)* on page *417*.
TN system	Type of supply system that provides a direct connection to ground/earth.

3

Operation principle and hardware description

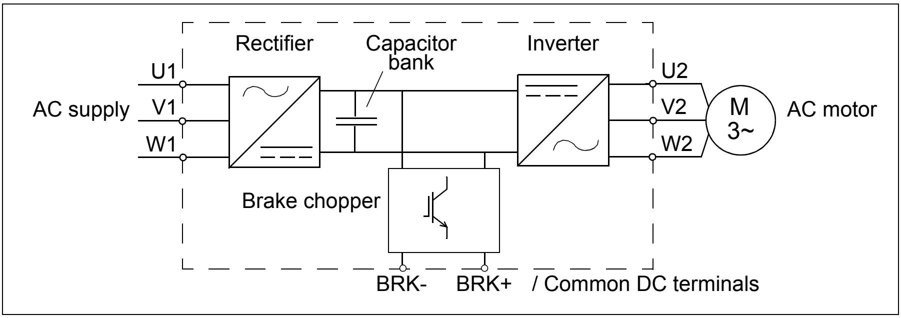
What this chapter contains

The chapter briefly describes the operation principle, layout, type designation label and type designation information. It also shows a general diagram of power connections and control interfaces.

Operation principle

The ACS355 is a wall or cabinet mountable drive for controlling asynchronous AC induction motors and permanent magnet synchronous motors.

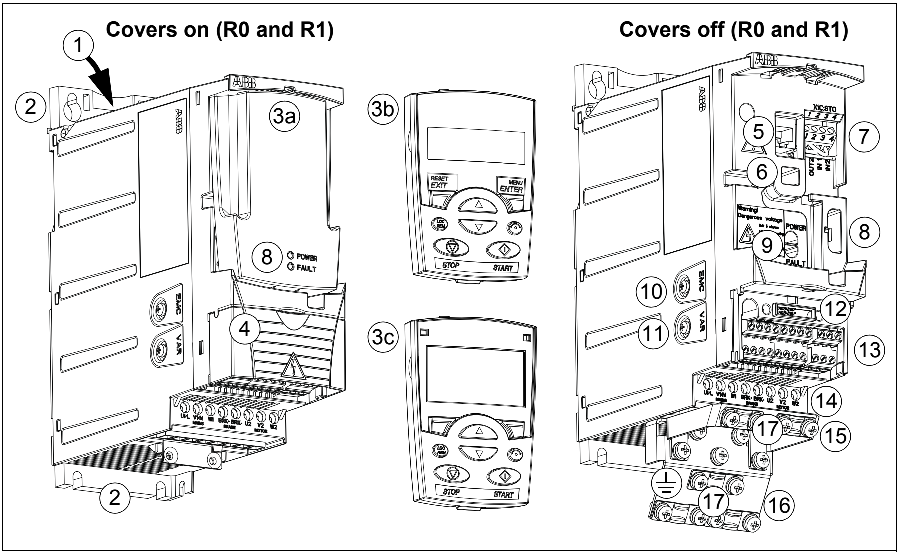
The figure below shows the simplified main circuit diagram of the drive. The rectifier converts three-phase AC voltage to DC voltage. The capacitor bank of the intermediate circuit stabilizes the DC voltage. The inverter converts the DC voltage back to AC voltage for the AC motor. The brake chopper connects the external brake resistor to the intermediate DC circuit when the voltage in the circuit exceeds its maximum limit.



Product overview

Layout

The layout of the drive is presented below. The construction of the different frame sizes R0…R4 varies to some extent.

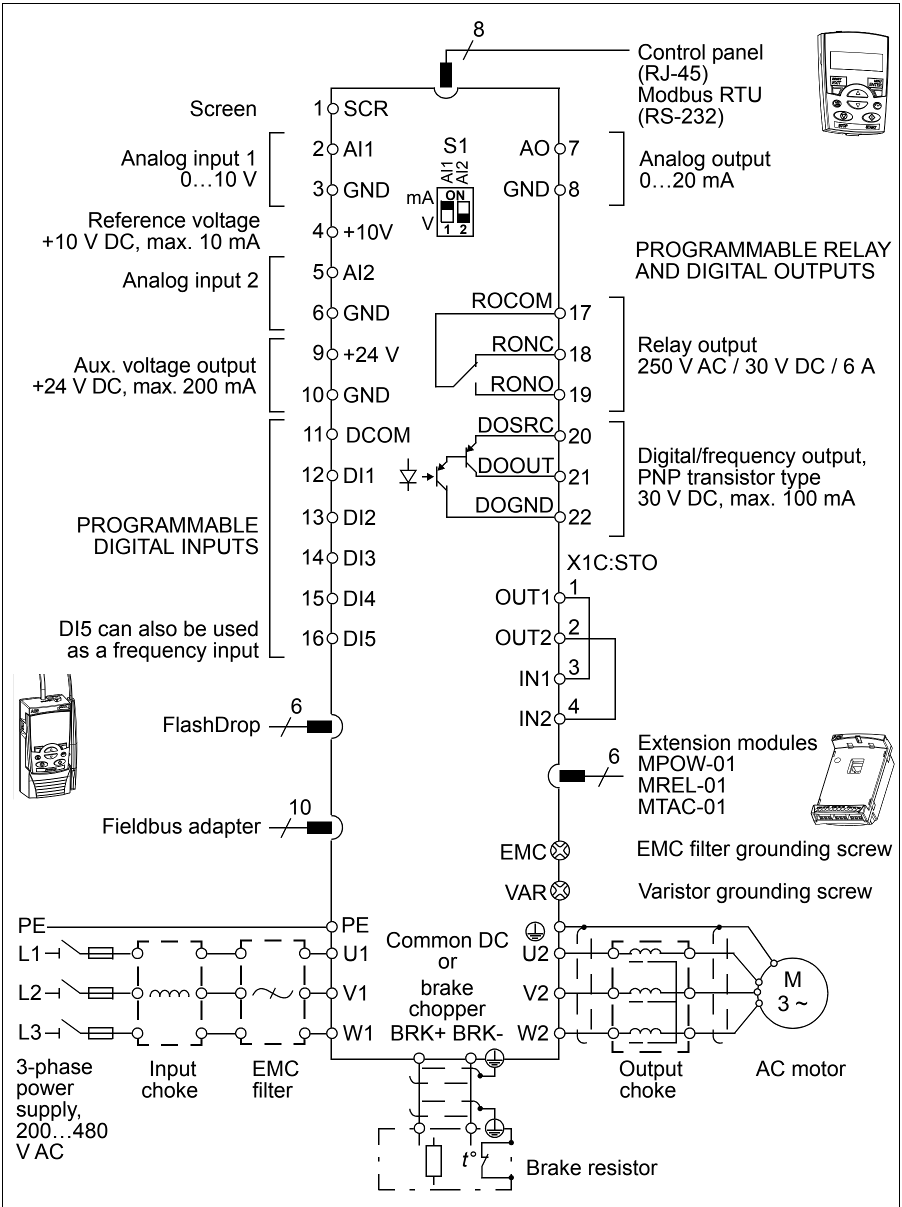


1	Cooling outlet through top cover
2	Mounting holes
3	Panel cover (a) / basic control panel (b) / assistant control panel (c)
4	Terminal cover (or optional potentiometer unit MPOT-01)
5	Panel connection
6	Option connection
7	STO (Safe torque off) connection
8	FlashDrop connection
9	Power OK and Fault LEDs. See section *LEDs* on page *372*.

10	EMC filter grounding screw (EMC). **Note:** The screw is on the front in frame size R4.
11	Varistor grounding screw (VAR)
12	Fieldbus adapter (serial communication) connection
13	I/O connections
14	Input power connection (U1, V1, W1), brake resistor connection (BRK+, BRK-) and motor connection (U2, V2, W2).
15	I/O clamping plate
16	Clamping plate
17	Clamps

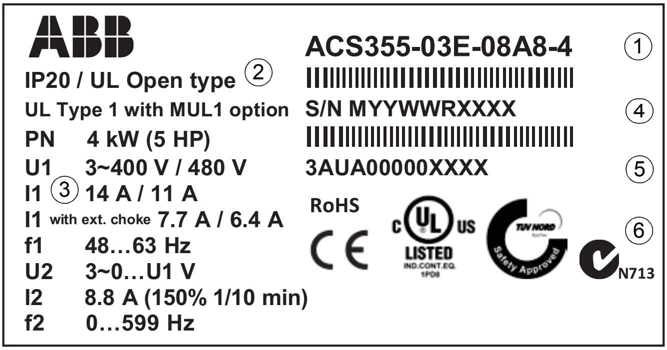
Overview of power and control connections

The diagram gives an overview of connections. I/O connections are parameterable. See chapter *Application macros* on page *107* for I/O connections for the different macros and chapter *Electrical installation* on page *49* for installation in general.



Type designation label

The type designation label is attached to the left side of the drive. An example label and explanation of the label contents are shown below.



1	Type designation, see section *Type designation key* on page *31*
2	Degree of protection by enclosure (IP and UL/NEMA)
3	Nominal ratings, see section *Ratings* on page *374*.
4	Serial number of format MYYWWRXXXX, where M: Manufacturer YY: 10, 11, 12, … for 2010, 2011, 2012, … WW: 01, 02, 03, … for week 1, week 2, week 3, … R: A, B, C, … for product revision number XXXX: Integer starting every week from 0001
5	ABB MRP code of the drive
6	CE marking and C-Tick, C-UL US, RoHS and TÜV NORD marks (the label of your drive shows the valid markings)

Type designation key

The type designation contains information on the specifications and configuration of the drive. You find the type designation on the type designation label attached to the drive. The first digits from the left express the basic configuration, for example ACS355-03E-07A3-4. The optional selections are given after that, separated by + signs, for example +J404. The explanations of the type designation selections are described below.

ACS355-03E-07A3-4+J404+...

ACS355 product series

1-phase/3-phase
01 = 1-phase input
03 = 3-phase input

Configuration
E = EMC filter connected, 50 Hz frequency
U = EMC filter disconnected, 60 Hz frequency
See section *Differences between the default values in E and U type drives*.

Output current rating
In format xxAy, where xx indicates the integer part and y the fractional part, eg, 07A3 means 7.3 A.
For more information, see section *Ratings* on page *374*.

Input voltage range
2 = 200…240 V AC
4 = 380…480 V AC

Options

B063 = IP66/IP67/UL Type 4x enclosure (product variant)
J400 = ACS-CP-A assistant control panel [1)]
J404 = ACS-CP-C basic control panel [1)]
J402 = MPOT-01 potentiometer
K451 = FDNA-01 DeviceNet
K452 = FLON-01 LONWORKS®
K454 = FPBA-01 PROFIBUS DP
K457 = FCAN-01 CANopen
K458 = FMBA-01 Modbus RTU
K466 = FENA-01EtherNet/IP / Modbus TCP/PROFINET IO
K469 = FECA-01 EtherCAT
K470 = FEPL-02 Ethernet POWERLINK
K473 = FENA-11EtherNet/IP / Modbus TCP/PROFINET IO
K475 = FENA-21EtherNet/IP / Modbus TCP/PROFINET IO
H376 = Cable gland kit (IP66/IP67/UL Type 4x)
F278 = Input switch kit
C169 = Pressure compensation valve

Extension modules
G406 = MPOW-01 auxiliary power extension module
L502 = MTAC-01 pulse encoder interface module
L511 = MREL-01 output relay module

1) The ACS355 is compatible with panels that have the following panel revisions and panel firmware versions. To find out the revision and firmware version of your panel, see page *76*.

Panel type	Type code	Panel revision	Panel firmware version
Basic control panel	ACS-CP-C	M or later	1.13 or later
Assistant control panel	ACS-CP-A	F or later	2.04 or later
Assistant control panel (Asia)	ACS-CP-D	Q or later	2.04 or later

Note that unlike the other panels, the ACS-CP-D is ordered with a separate material code.

4

Mechanical installation

What this chapter contains

The chapter tells how to check the installation site, unpack, check the delivery and install the drive mechanically.

Checking the installation site

The drive may be installed on the wall or in a cabinet. Check the enclosure requirements for the need to use the NEMA 1 option in wall installations (see chapter *Technical data* on page *373*).

The drive can be installed in three different ways, depending on the frame size:

a) back mounting (all frame sizes)

b) side mounting (frame sizes R0…R2)

c) DIN rail mounting (all frame sizes).

The drive must be installed in an upright position.

Check the installation site according to the requirements below. Refer to chapter *Dimension drawings* on page *395* for frame details.

Requirements for the installation site

Operation conditions

See chapter *Technical data* on page *373* for the allowed operation conditions of the drive.

Wall

The wall should be as close to vertical and even as possible, of non-flammable material and strong enough to carry the weight of the drive.

Floor

The floor/material below the installation should be non-flammable.

Free space around the drive

The required free space for cooling above and below the drive is 75 mm (3 in). No free space is required on the sides of the drive, so drives can be mounted immediately next to each other.

Required tools

To install the drive, you need the following tools:

- screwdrivers (as appropriate for the mounting hardware used)
- wire stripper
- tape measure
- drill (if the drive will be installed with screws/bolts)
- mounting hardware: screws or bolts (if the drive will be installed with screws/bolts). For the number of screws/bolts, see *With screws* on page *36*.

Unpacking

The drive (1) is delivered in a package that also contains the following items (frame size R1 shown in the figure):

- plastic bag (2) including clamping plate (also used for I/O cables in frame sizes R3 and R4), I/O clamping plate (for frame sizes R0…R2), fieldbus option ground plate, clamps and screws
- panel cover (3)
- mounting template, integrated into the package (4)
- user’s manual (5)
- possible options (fieldbus, potentiometer, extension module, all with instructions, basic control panel or assistant control panel).

Checking the delivery

Check that there are no signs of damage. Notify the shipper immediately if damaged components are found.

Before attempting installation and operation, check the information on the type designation label of the drive to verify that the drive is of the correct type. See section *Type designation label* on page 30.

Installing

The instructions in this manual cover drives with the IP20 degree of protection. To comply with NEMA 1, use the MUL1-R1, MUL1-R3 or MUL1-R4 option kit, which is delivered with multilingual installation instructions (3AFE68642868, 3AFE68643147 or 3AUA0000025916, respectively).

To obtain a higher degree of protection, the drive must be installed inside a cabinet. If there are sand, dust or other impurities in the operating environment, a typical minimum requirement for the installation cabinet is IP54 degree of protection.

Install the drive

Install the drive with screws or on a DIN rail as appropriate.

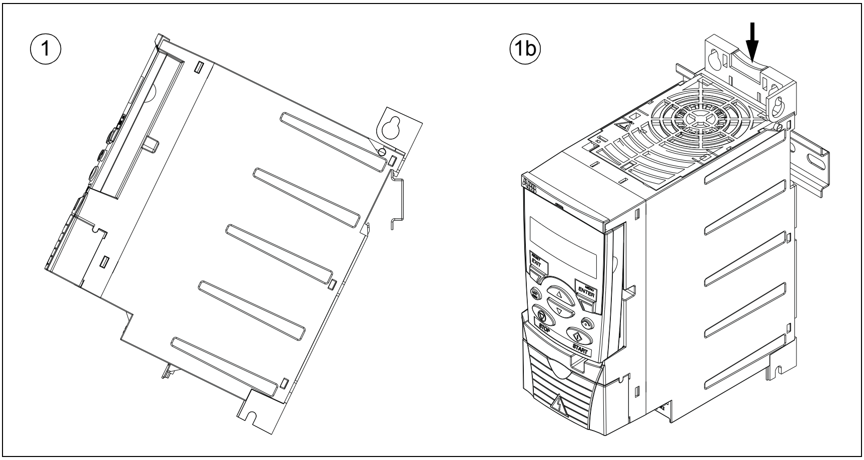
Note: Make sure that dust from drilling does not enter the drive during the installation.

With screws

1. Mark the hole locations using for example the mounting template cut out from the package. The locations of the holes are also shown in the drawings in chapter *Dimension drawings* on page *395*. The number and location of the holes used depend on how the drive is installed:
   a) back mounting (frame sizes R0…R4): four holes
   b) side mounting (frame sizes R0…R2): three holes; one of the bottom holes is located in the clamping plate.
2. Fix the screws or bolts to the marked locations.
3. Position the drive onto the screws on the wall.
4. Tighten the screws in the wall securely.

On DIN rail

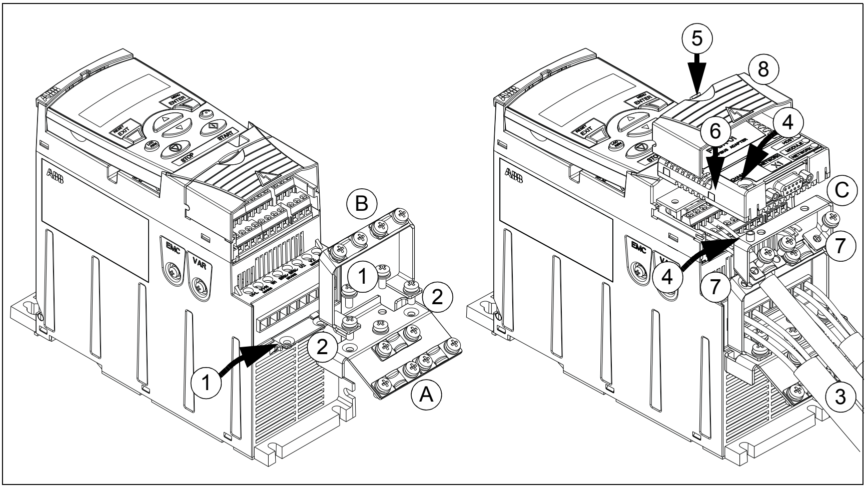
1. Click the drive to the rail.
   To detach the drive, press the release lever on top of the drive (1b).



Fasten clamping plates

Note: Make sure that you do not throw the clamping plates away as they are required for proper grounding of the power and control cables as well as the fieldbus option.

1. Fasten the clamping plate (A) to the plate at the bottom of the drive with the provided screws.
2. For frame sizes R0…R2, fasten the I/O clamping plate (B) to the clamping plate with the provided screws.



Attach the optional fieldbus module

1. Connect the power and control cables as instructed in chapter *Electrical installation* on page *49*.
2. Place the fieldbus module on the option ground plate (C) and tighten the grounding screw on the left corner of the fieldbus module. This fastens the module to the option ground plate (C).
3. If the terminal cover is not already removed, push the recess in the cover and simultaneously slide the cover off the frame.
4. Snap the fieldbus module attached to the option ground plate (C) in position so that the module is plugged to the connection on the drive front and the screw holes in the option ground plate (C) and the I/O clamping plate (B) are aligned.
5. Fasten the option ground plate (C) to the I/O clamping plate (B) with the provided screws.
6. Slide the terminal cover back in place.

5

Planning the electrical installation

What this chapter contains

The chapter contains the instructions that you must follow when checking the compatibility of the motor and drive, and selecting cables, protections, cable routing and way of operation for the drive.

Note: The installation must always be designed and made according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations. Furthermore, if the recommendations given by ABB are not followed, the drive may experience problems that the warranty does not cover.

Implementing the AC power line connection

See the requirements in section *Electric power network specification* on page *385*. Use a fixed connection to the AC power line.

WARNING! As the leakage current of the device typically exceeds 3.5 mA, a fixed installation is required according to IEC 61800-5-1.

Using an input choke

An input choke is required in case of unstable supply networks. An input choke can also be used for decreasing the input current.

Selecting the supply disconnecting device (disconnecting means)

Install a hand-operated supply disconnecting device (disconnecting means) between the AC power source and the drive. The disconnecting device must be of a type that can be locked to the open position for installation and maintenance work.

European union

To meet the European Union Directives, according to standard EN 60204-1, Safety of Machinery, the disconnecting device must be one of the following types:

- a switch-disconnector of utilization category AC-23B (EN 60947-3)
- a disconnector having an auxiliary contact that in all cases causes switching devices to break the load circuit before the opening of the main contacts of the disconnector (EN 60947-3)
- a circuit breaker suitable for isolation in accordance with EN 60947-2.

Other regions

The disconnecting device must conform to the applicable safety regulations.

Checking the compatibility of the motor and drive

Check that the 3-phase AC induction motor and the drive are compatible according to the rating table in section *Ratings* on page *374*. The table lists the typical motor power for each drive type.

Only one permanent magnet synchronous motor can be connected to the inverter output.

Checking the compatibility of the drive when multiple motors are connected to the drive

The drive is selected based on the sum of the connected motor powers. Typically, overdimensioning of the drive and the use of external output chokes is recommended.

When one drive controls several motors, only scalar control is possible. Motor parameters (P_N, I_{2N}) are given as the sum of the nominal values of the motors. Nominal speed is given as an average of the motors. It is recommended to limit the maximum current according to the actual need and it should not exceed $1.1 \cdot I_{2N}$ (parameter *2003 MAX CURRENT*).

When multiple motors are connected, the sum of the output cable lengths must not exceed the maximum allowed cable length (see *Maximum recommended motor cable length* on page *386*). If motor contactors are used, switching the contactors during run is not recommended.

When more than 4 motors need to be controlled by one drive, contact your local ABB representative.

Selecting the power cables

General rules

Dimension the input power and motor cables **according to local regulations**.

- The input power and the motor cables must be able to carry the corresponding load currents. See section *Ratings* on page *374* for the rated currents.
- The cable must be rated for at least 70 °C (158 °F) maximum permissible temperature of the conductor in continuous use. For US, see section *Additional US requirements* on page *43*.
- The conductivity of the PE conductor must be equal to that of the phase conductor (same cross-sectional area).
- 600 V AC cable is accepted for up to 500 V AC.
- Refer to chapter *Technical data* on page *373* for the EMC requirements.

A symmetrical shielded motor cable (see the figure below) must be used to meet the EMC requirements of the CE and C-Tick marks.

A four-conductor system is allowed for input cabling, but a shielded symmetrical cable is recommended.

Compared to a four-conductor system, the use of a symmetrical shielded cable reduces electromagnetic emission of the whole drive system as well as motor bearing currents and wear.

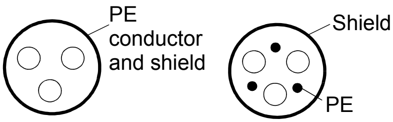
Alternative power cable types

Power cable types that can be used with the drive are presented below.

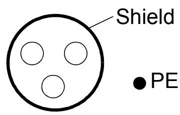
Motor cables

(recommended for input cables also)

Symmetrical shielded cable: three phase conductors, a concentric or otherwise symmetrically constructed PE conductor and a shield

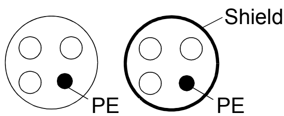


Note: A separate PE conductor is required if the conductivity of the cable shield is not sufficient for the purpose.



Allowed as input cables

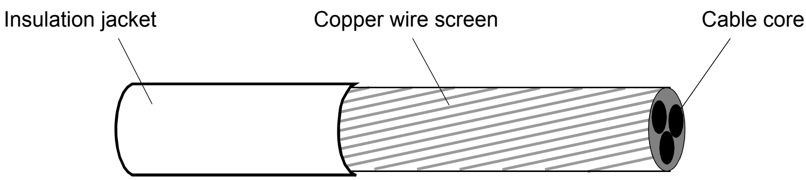
A four-conductor system: three phase conductors and a protective conductor



Motor cable shield

To function as a protective conductor, the shield must have the same cross-sectional area as the phase conductors when they are made of the same metal.

To effectively suppress radiated and conducted radio-frequency emissions, the shield conductivity must be at least 1/10 of the phase conductor conductivity. The requirements are easily met with a copper or aluminum shield. The minimum requirement of the motor cable shield of the drive is shown below. It consists of a concentric layer of copper wires. The better and tighter the shield, the lower the emission level and bearing currents.



Additional US requirements

Type MC continuous corrugated aluminum armor cable with symmetrical grounds or shielded power cable is recommended for the motor cables if metallic conduit is not used.

The power cables must be rated for 75 °C (167 °F).

Conduit

Where conduits must be coupled together, bridge the joint with a ground conductor bonded to the conduit on each side of the joint. Bond the conduits also to the drive enclosure. Use separate conduits for input power, motor, brake resistors and control wiring. Do not run motor wiring from more than one drive in the same conduit.

Armored cable / shielded power cable

Six-conductor (three phases and three ground) type MC continuous corrugated aluminum armor cable with symmetrical grounds is available from the following suppliers (trade names in parentheses):

- Anixter Wire & Cable (Philsheath)
- BICC General Corp (Philsheath)
- Rockbestos Co. (Gardex)
- Oaknite (CLX).

Shielded power cable is available from the following suppliers:

- Belden
- LAPPKABEL (ÖLFLEX)
- Pirelli.

Selecting the control cables

General rules

All analog control cables and the cable used for the frequency input must be shielded.

Use a double-shielded twisted pair cable (Figure a, for example JAMAK by Draka NK Cables) for analog signals. Employ one individually shielded pair for each signal. Do not use common return for different analog signals.

A double-shielded cable is the best alternative for low-voltage digital signals, but a single-shielded or unshielded twisted multipair cable (Figure b) is also usable. However, for frequency input, always use a shielded cable.

Double-shielded twisted multipair cable

Single-shielded twisted multipair cable

Run analog and digital signals in separate cables.

Relay-controlled signals, providing their voltage does not exceed 48 V, can be run in the same cables as digital input signals. It is recommended that the relay-controlled signals are run as twisted pairs.

Never mix 24 V DC and 115/230 V AC signals in the same cable.

Relay cable

The cable type with braided metallic screen (for example ÖLFLEX by LAPPKABEL) has been tested and approved by ABB.

Control panel cable

In remote use, the cable connecting the control panel to the drive must not exceed 3 m (10 ft). The cable type tested and approved by ABB is used in control panel option kits.

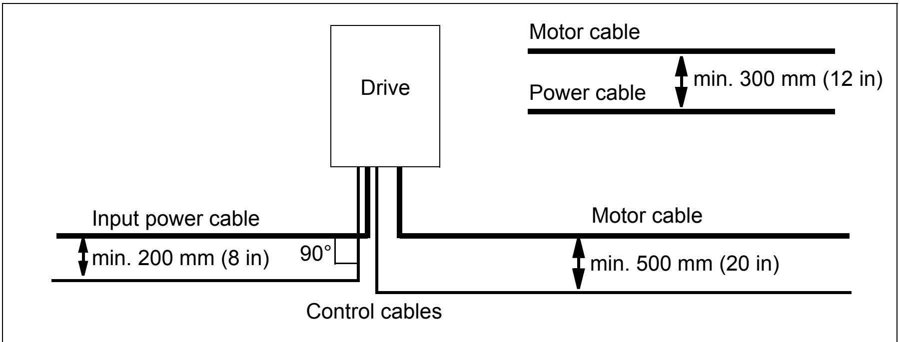
Routing the cables

Route the motor cable away from other cable routes. Motor cables of several drives can be run in parallel installed next to each other. It is recommended that the motor cable, input power cable and control cables are installed on separate trays. Avoid long parallel runs of motor cables with other cables to decrease electromagnetic interference caused by the rapid changes in the drive output voltage.

Where control cables must cross power cables make sure that they are arranged at an angle as near to 90 degrees as possible.

The cable trays must have good electrical bonding to each other and to the grounding electrodes. Aluminum tray systems can be used to improve local equalizing of potential.

A diagram of the cable routing is shown below.



Control cable ducts

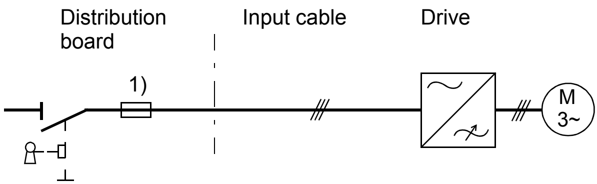
Not allowed unless the 24 V cable is insulated for 230 V or insulated with an insulation sleeving for 230 V.

Lead 24 V and 230 V control cables in separate ducts inside the cabinet.

Protecting the drive, input power cable, motor and motor cable in short-circuit situations and against thermal overload

Protecting the drive and input power cable in short-circuit situations

Arrange the protection according to the following guidelines.

Circuit diagram	Short-circuit protection
	Protect the drive and input cable with fuses. See footnote 1).

[1)] Size the fuses or manual motor protectors (MMP) according to instructions given in chapter *Technical data* on page *373*. The fuses or MMPs will protect the input cable in short-circuit situations, restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive.

Protecting the motor and motor cable in short-circuit situations

The drive protects the motor and motor cable in a short-circuit situation when the motor cable is dimensioned according to the nominal current of the drive. No additional protection devices are needed.

Protecting the drive, motor cable and input power cable against thermal overload

The drive protects itself and the input and motor cables against thermal overload when the cables are dimensioned according to the nominal current of the drive. No additional thermal protection devices are needed.

WARNING! If the drive is connected to multiple motors, a separate thermal overload switch must be used for protecting each cable and motor. These devices may require a separate fuse to cut off the short-circuit current.

Protecting the motor against thermal overload

According to regulations, the motor must be protected against thermal overload and the current must be switched off when overload is detected. The drive includes a motor thermal protection function that protects the motor and switches off the current when necessary. It is also possible to connect a motor temperature measurement to the drive. The user can tune both the thermal model and the temperature measurement function further by parameters.

The most common temperature sensors are:

- motor sizes IEC 180…225: thermal switch (for example Klixon)
- motor sizes IEC 200…250 and larger: PTC or Pt100.

For more information on the thermal model, see section *Motor thermal protection* on page *148*. For more information on the temperature measurement function, see section *Motor temperature measurement through the standard I/O* on page *157*.

Implementing the Safe torque off (STO) function

See *Appendix: Safe torque off (STO)* on page *417*.

Using residual current devices (RCD) with the drive

ACS355-01x drives are suitable to be used with residual current devices of Type A, ACS355-03x drives with residual current devices of Type B. For ACS355-03x drives, other measures for protection in case of direct or indirect contact, such as separation from the environment by double or reinforced insulation or isolation from the supply system by a transformer, can also be applied.

Using a safety switch between the drive and the motor

It is recommended to install a safety switch between the permanent magnet synchronous motor and the drive output. This is needed to isolate the motor from the drive during maintenance work on the drive.

Implementing a bypass connection

WARNING! Never connect the supply power to the drive output terminals U2, V2 and W2. Power line voltage applied to the output can result in permanent damage to the drive.

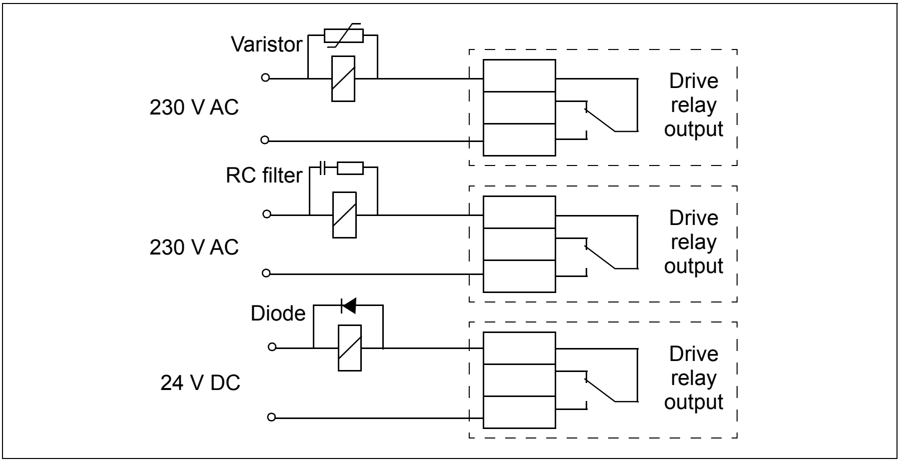
If frequent bypassing is required, employ mechanically connected switches or contactors to ensure that the motor terminals are not connected to the AC power line and drive output terminals simultaneously.

Protecting the contacts of relay outputs

Inductive loads (relays, contactors, motors) cause voltage transients when switched off.

Equip inductive loads with noise attenuating circuits (varistors, RC filters [AC] or diodes [DC]) in order to minimize the EMC emission at switch-off. If not suppressed, the disturbances may connect capacitively or inductively to other conductors in the control cable and form a risk of malfunction in other parts of the system.

Install the protective component as close to the inductive load as possible. Do not install protective components at the I/O terminal block.



6

Electrical installation

What this chapter contains

The chapter tells how to check the insulation of the assembly and the compatibility with IT (ungrounded) and corner-grounded TN systems as well as connect power cables and control cables.

WARNING! The work described in this chapter may only be carried out by a qualified electrician. Follow the instructions in chapter *Safety* on page *17*. Ignoring the safety instructions can cause injury or death.

Make sure that the drive is disconnected from the input power during installation. If the drive is already connected to the input power, wait for 5 minutes after disconnecting the input power.

Checking the insulation of the assembly

Drive

Do not make any voltage tolerance or insulation resistance tests (for example hi-pot or megger) on any part of the drive as testing can damage the drive. Every drive has been tested for insulation between the main circuit and the chassis at the factory. Also, there are voltage-limiting circuits inside the drive which cut down the testing voltage automatically.

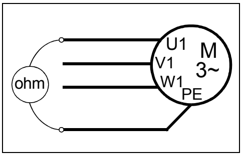
Input power cable

Check the insulation of the input power cable according to local regulations before connecting to the drive.

Motor and motor cable

Check the insulation of the motor and motor cable as follows:

1. Check that the motor cable is connected to the motor and disconnected from the drive output terminals U2, V2 and W2.
2. Measure the insulation resistance between each phase conductor and the Protective Earth conductor using a measuring voltage of 500 V DC. The insulation resistance of an ABB motor must exceed 100 Mohm (reference value at 25 °C or 77 °F). For the insulation resistance of other motors, please consult the manufacturer's instructions.



Note: Moisture inside the motor casing will reduce the insulation resistance. If moisture is suspected, dry the motor and repeat the measurement.

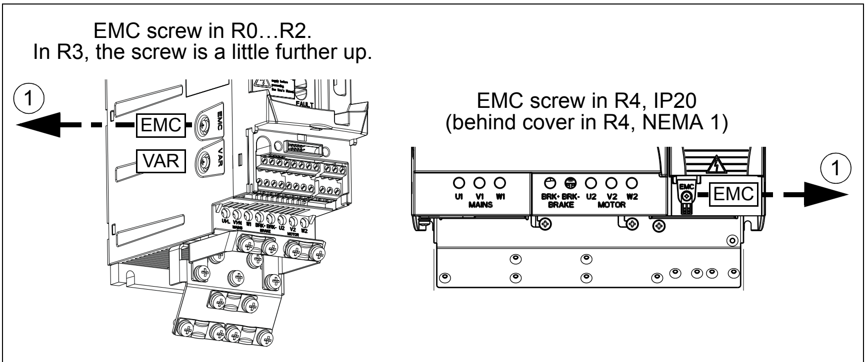
Checking the compatibility with IT (ungrounded) and corner-grounded TN systems

WARNING! Disconnect the internal EMC filter when installing the drive on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system), otherwise the system will be connected to ground potential through the EMC filter capacitors. This may cause danger or damage the drive.

Disconnect the internal EMC filter when installing the drive on a corner-grounded TN system, otherwise the drive will be damaged

Note: When the internal EMC filter is disconnected, the drive is not EMC compatible without an external filter.

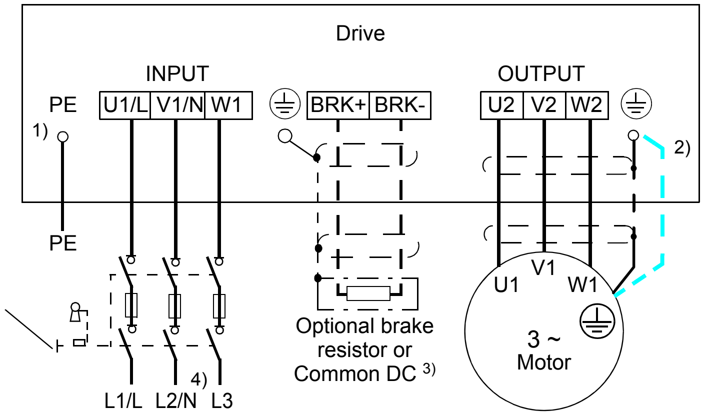
1. If you have an IT (ungrounded) or corner-grounded TN system, disconnect the internal EMC filter by removing the EMC screw. For 3-phase U-type drives (with type designation ACS355-03U-), the EMC screw is already removed at the factory and replaced by a plastic one.



Connecting the power cables

Connection diagram

For alternatives, see section *Selecting the supply disconnecting device (disconnecting means)* on page *40*.



1) Ground the other end of the PE conductor at the distribution board.

2) Use a separate grounding cable if the conductivity of the cable shield is insufficient (smaller than the conductivity of the phase conductor) and there is no symmetrically constructed grounding conductor in the cable. See section *Selecting the power cables* on page *41*.

3) For more information on Common DC, see *ACS355 Common DC application guide* (3AUA0000070130 [EN]).

4) In one-phase installations, connect the neutral cable here.

Note:

Do not use an asymmetrically constructed motor cable.

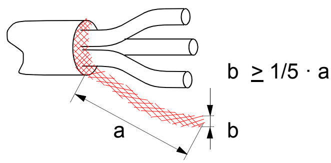
If there is a symmetrically constructed grounding conductor in the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends.

Route the motor cable, input power cable and control cables separately. For more information, see section *Routing the cables* on page *45*.

Grounding of the motor cable shield at the motor end

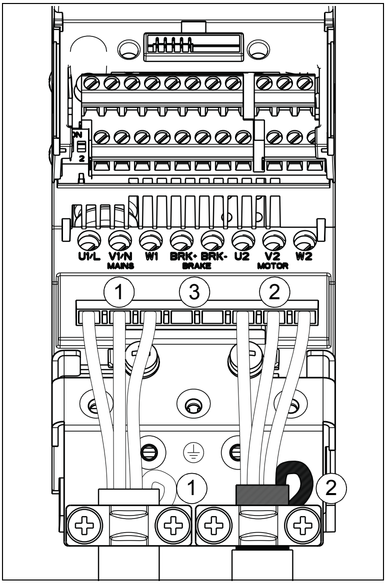
For minimum radio frequency interference:

- ground the cable by twisting the shield as follows: flattened width ≥ 1/5 · length
- or ground the cable shield 360 degrees at the lead-through of the motor terminal box.



Connection procedure

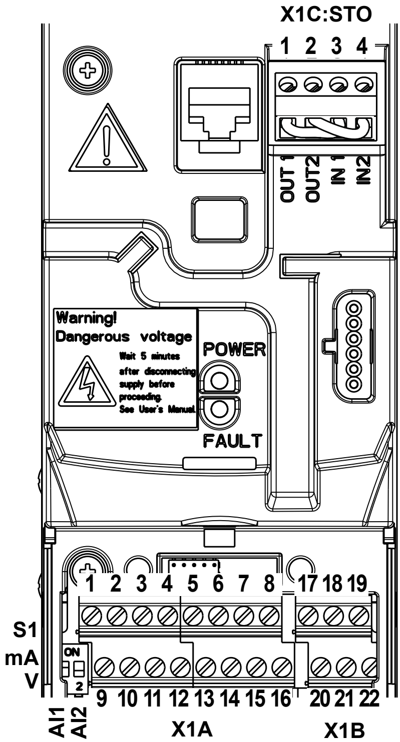
1. Strip the input power cable. Ground the bare shield of the cable (if any) 360 degrees under the grounding clamp. Fasten the grounding conductor (PE) of the input power cable under the grounding clamp. Connect the phase conductors to the U1, V1 and W1 terminals. Use a tightening torque of 0.8 N·m (7 lbf·in) for frame sizes R0…R2, 1.7 N·m (15 lbf·in) for R3 and 2.5 N·m (22 lbf·in) for R4.
3. Strip the input power cable. Ground the bare shield of the cable (if any) 360 degrees under the grounding clamp. Twist the shield to form as short a pigtail as possible. Fasten the twisted shield under the grounding clamp. Connect the phase conductors to the U2, V2 and W2 terminals. Use a tightening torque of 0.8 N·m (7 lbf·in) for frame sizes R0…R2, 1.7 N·m (15 lbf·in) for R3 and 2.5 N·m (22 lbf·in) for R4.
2. Connect the optional brake resistor to the BRK+ and BRK- terminals with a shielded cable using the same procedure as for the motor cable in the previous step.
3. Secure the cables outside the drive mechanically.



Connecting the control cables

I/O terminals

The figure below shows the I/O terminals. Tightening torque is 0.4 N·m / 3.5 lbf·in.



X1A:
1: SCR
2: AI1
3: GND
4: +10 V
5: AI2
6: GND
7: AO
8: GND
9: +24 V
10: GND
11: DCOM
12: DI1
13: DI2
14: DI3
15: DI4
16: DI5 digital or frequency input

X1B:
17: ROCOM
18: RONC
19: RONO
20: DOSRC
21: DOOUT
22: DOGND

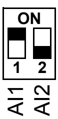
X1C:STO
1: OUT1
2: OUT2
3: IN1
4: IN2

S1: Selects voltage or current as the signal types for analog inputs AI1 and AI2.

Voltage and current selection for analog inputs

Switch S1 selects voltage (0 [2]…10 V / -10…10 V) or current (0 [4]…20 mA / -20…20 mA) as the signal types for analog inputs AI1 and AI2. The factory settings are unipolar voltage for AI1 (0 [2]…10 V) and unipolar current for AI2 (0 [4]…20 mA), which correspond to the default usage in the application macros. The switch is located to the left of I/O terminal 9 (see the I/O terminal figure above).

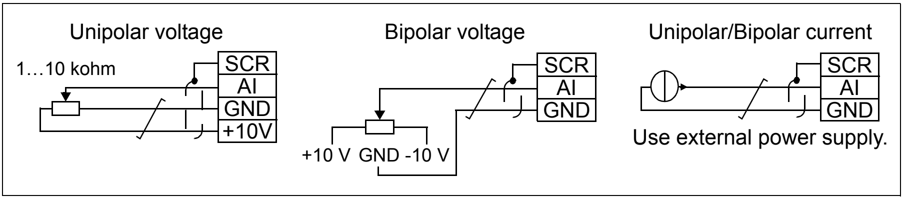
S1



Top position (ON): I (0 [4]…20 mA, default for AI2; or -20…20 mA)
Bottom position (OFF): U (0 [2]…10 V, default for AI1; or -10…10 V)

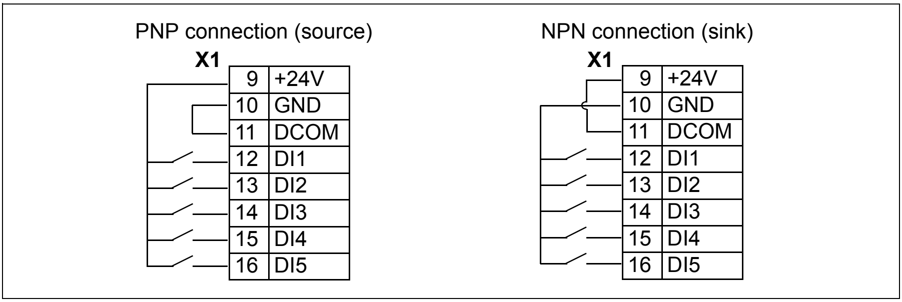
Voltage and current connection for analog inputs

Bipolar voltage (-10…10 V) and current (-20…20 mA) are also possible. If a bipolar connection is used instead of a unipolar one, see section *Programmable analog inputs* on page *132* for how to set parameters accordingly.



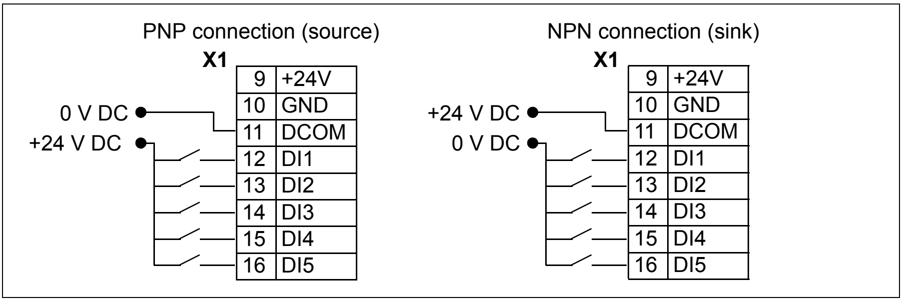
PNP and NPN configuration for digital inputs

You can wire the digital input terminals in either a PNP or NPN configuration.



External power supply for digital inputs

For using an external +24 V supply for the digital inputs, see the figure below.



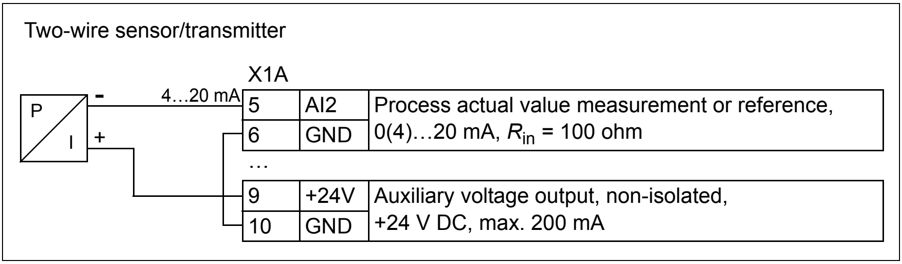
Frequency input

If DI5 is used as a frequency input, see section *Frequency input* on page *135* for how to set parameters accordingly.

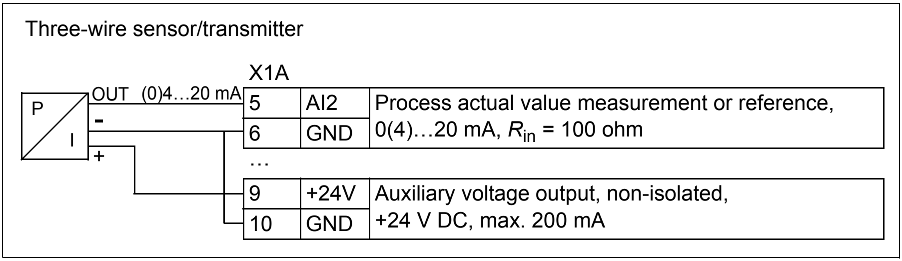
Connection examples of two-wire and three-wire sensors

Hand/Auto, PID control, and Torque control macros (see section *Application macros*, pages *114*, *115* and *116*, respectively) use analog input 2 (AI2). The macro wiring diagrams on these pages use an externally powered sensor (connections not shown). The figures below give examples of connections using a two-wire or three-wire sensor/transmitter supplied by the drive auxiliary voltage output.

Note: Maximum capability of the auxiliary 24 V (200 mA) output must not be exceeded.



Note: The sensor is supplied through its current output and the drive feeds the supply voltage (+24 V). Thus the output signal must be 4…20 mA, not 0…20 mA.

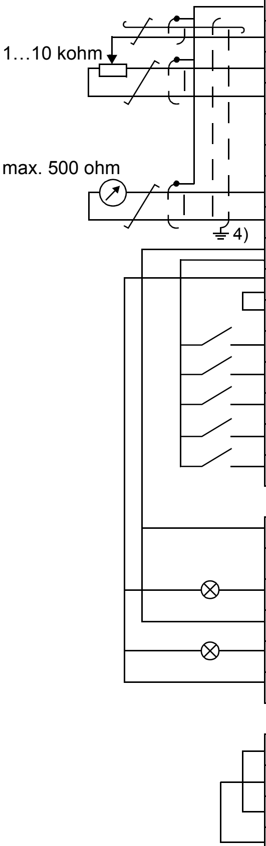


Default I/O connection diagram

The default connection of the control signals depends on the application macro in use, which is selected with parameter *9902 APPLIC MACRO*.

The default macro is the ABB standard macro. It provides a general purpose I/O configuration with three constant speeds. Parameter values are the default values given in section *Default values with different macros* on page *180*. For information on other macros, see chapter *Application macros* on page *107*.

The default I/O connections for the ABB standard macro are given in the figure below.



X1A

1	SCR	Signal cable shield (screen)
2	AI1	**Output frequency reference**: 0…10 V [1)]
3	GND	Analog input circuit common
4	+10V	Reference voltage: +10 V DC, max. 10 mA
5	AI2	Not in use by default. 0…10 V
6	GND	Analog input circuit common
7	AO	**Output frequency value**: 0…20 mA
8	GND	Analog output circuit common
9	+24V	Auxiliary voltage output: +24 V DC, max. 200 mA
10	GND	Auxiliary voltage output common
11	DCOM	Digital input common
12	DI1	**Stop (0) / Start (1)**
13	DI2	**Forward (0) / Reverse (1)**
14	DI3	**Constant speed selection** [2)]
15	DI4	**Constant speed selection** [2)]
16	DI5	**Acceleration and deceleration selection** [3)]

X1B

17	ROCOM	Relay output 1
18	RONC	**No fault [Fault (-1)]**
19	RONO	
20	DOSRC	Digital output, max. 100 mA
21	DOOUT	**No fault [Fault (-1)]**
22	DOGND	

X1C:STO

1	OUT1	STO (Safe torque off) connection
2	OUT2	
3	IN1	
4	IN2	

1) AI1 is used as a speed reference if vector mode is selected.

2) See parameter group *12 CONSTANT SPEEDS*:

DI3	DI4	Operation (parameter)
0	0	Set speed through AI1
1	0	Speed 1 (*1202*)
0	1	Speed 2 (*1203*)
1	1	Speed 3 (*1204*)

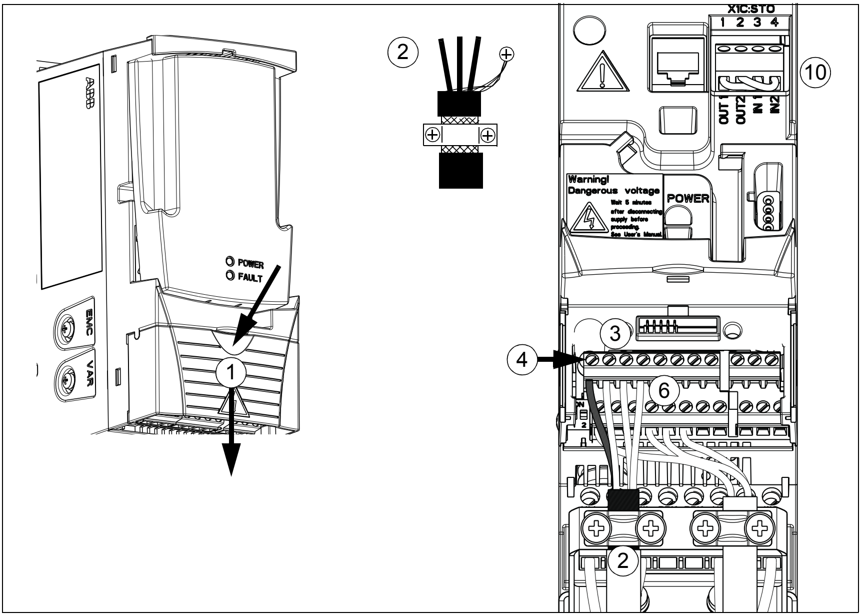
3) 0 = ramp times according to parameters *2202* and *2203*.
1 = ramp times according to parameters *2205* and *2206*.

4) 360 degree grounding under a clamp.

Tightening torque: 0.4 N·m / 3.5 lbf·in.

Connection procedure

1. Remove the terminal cover by simultaneously pushing the recess and sliding the cover off the frame.
2. *Analog signals*: Strip the outer insulation of the analog signal cable 360 degrees and ground the bare shield under the clamp.
3. Connect the conductors to the appropriate terminals. Use a tightening torque of 0.4 N·m (3.5 lbf·in).
4. Twist the grounding conductors of each pair in the analog signal cable together and connect the bundle to the SCR terminal (terminal 1).
5. *Digital signals*: Strip the outer insulation of the digital signal cable 360 degrees and ground the bare shield under the clamp.
6. Connect the conductors of the cable to the appropriate terminals. Use a tightening torque of 0.4 N·m (3.5 lbf·in).
7. For double-shielded cables, twist also the grounding conductors of each pair in the cable together and connect the bundle to the SCR terminal (terminal 1).
8. Secure all cables outside the drive mechanically.
9. Unless you need to install the optional fieldbus module (see section *Attach the optional fieldbus module* on page *38*), slide the terminal cover back in place.
10. Connect STO conductors to the appropriate terminals. Use a tightening torque of 0.4 N·m (3.5 lbf·in).



7

Installation checklist

What this chapter contains

This chapter contains a list for checking the mechanical and electrical installation of the drive.

Checking the installation

Check the mechanical and electrical installation of the drive before start-up. Go through the checklist below together with another person. Read chapter *Safety* on page *17* of this manual before you work on the drive.

	Check
MECHANICAL INSTALLATION	
☐	The ambient operating conditions are within allowed limits. (See *Mechanical installation: Checking the installation site* on page *33* as well as *Technical data: Losses, cooling data and noise* on page *382* and *Ambient conditions* on page *389*.)
☐	The drive is fixed properly on an even vertical non-flammable wall. (See *Mechanical installation* on page *33*.)
☐	The cooling air will flow freely. (See *Mechanical installation*: *Free space around the drive* on page *34*.)
☐	The motor and the driven equipment are ready for start. (See *Planning the electrical installation*: *Checking the compatibility of the motor and drive* on page *40* as well as *Technical data: Motor connection data* on page *385*.)
ELECTRICAL INSTALLATION (See *Planning the electrical installation* on page *39* and *Electrical installation* on page *49*.)	
☐	For ungrounded and corner-grounded systems: The internal EMC filter is disconnected (EMC screw removed).
☐	The capacitors are reformed if the drive has been stored over a year.

	Check
☐	The drive is grounded properly.
☐	The input power voltage matches the drive nominal input voltage.
☐	The input power connections at U1/L, V1/N and W1 are OK and tightened with the correct torque.
☐	Appropriate input power fuses and disconnector are installed.
☐	The motor connections at U2, V2 and W2 are OK and tightened with the correct torque.
☐	The motor cable, input power cable and control cables are routed separately.
☐	The external control (I/O) connections are OK.
☐	Safe torque off (STO) connections, operation and reaction are OK.
☐	The input power voltage cannot be applied to the output of the drive (with a bypass connection).
☐	Terminal cover and, for NEMA 1, hood and connection box, are in place.

8

Start-up, control with I/O and ID run

What this chapter contains

The chapter tells how to:

- perform the start-up
- start, stop, change the direction of the motor rotation and adjust the speed of the motor through the I/O interface
- perform an Identification run for the drive.

Using the control panel to do these tasks is explained briefly in this chapter. For details on how to use the control panel, refer to chapter *Control panels* on page *75*.

Starting up the drive

WARNING! The start-up may only be carried out by a qualified electrician.

The safety instructions given in chapter *Safety* on page *17* must be followed during the start-up procedure.

The drive will start up automatically at power-up if the external run command is on and the drive is in the remote control mode.

Check that the starting of the motor does not cause any danger. **De-couple the driven machine** if:

- there is a risk of damage in case of incorrect direction of rotation, or
- an ID run needs to be performed during the drive start-up. ID run is essential only in applications that require the ultimate in motor control accuracy.

- Check the installation. See the checklist in chapter *Installation checklist* on page *59*.

How you start up the drive depends on the control panel you have, if any.

- **If you have no control panel**, follow the instructions given in section *Starting up the drive without a control panel* on page *62*.
- **If you have a basic control panel** (ACS-CP-C), follow the instructions given in section *Performing a manual start-up* on page *63.*
- **If you have an assistant control panel** (ACS-CP-A, ACS-CP-D), you can either run the Start-up assistant (see section *Performing a guided start-up* on page *68*) or perform a manual start-up (see section *Performing a manual start-up* on page *63*).

  The Start-up assistant, which is included in the assistant control panel only, guides you through all essential settings to be done. In the manual start-up, the drive gives no guidance; you go through the very basic settings by following the instructions given in section *Performing a manual start-up* on page *63*.

Starting up the drive without a control panel

POWER-UP	
☐	Apply input power and wait for a moment.
☐	Check that the red LED is not lit and the green LED is lit but not blinking.
The drive is now ready for use.	

Performing a manual start-up

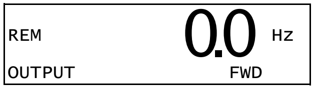
For the manual start-up, you can use the basic control panel or the assistant control panel. The instructions below are valid for both control panels, but the displays shown are the basic control panel displays, unless the instruction applies to the assistant control panel only.

Before you start, ensure that you have the motor nameplate data on hand.

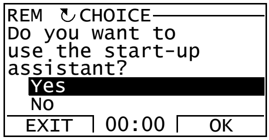
POWER-UP

☐ Apply input power.

The basic control panel powers up into the Output mode.



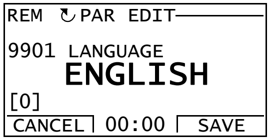
The assistant control panel asks if you want to run the Start-up assistant. If you press EXIT, the Start-up assistant is not run, and you can continue with manual start-up in a similar manner as described below for the basic control panel.



MANUAL ENTRY OF START-UP DATA (parameter group 99)

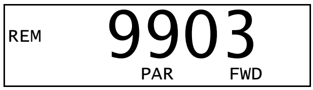
☐ If you have an assistant control panel, select the language (the basic control panel does not support languages). See parameter *9901* for the values of the available language alternatives.

For instructions on how to set parameters with the assistant control panel, see section *Assistant control panel* on page *86*.



☐ Select the motor type (*9903*).

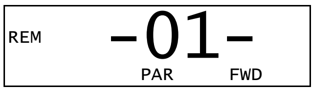
- 1 (*AM*): Asynchronous motor
- 2 (*PMSM*): Permanent magnet synchronous motor.



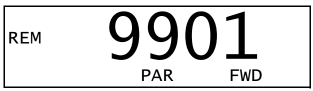
Setting of parameter *9903* is shown below as an example of parameter setting with the basic control panel. You find more detailed instructions in section *Basic control panel* on page *76*.

1. To go to the Main menu, press if the bottom line shows OUTPUT; otherwise press repeatedly until you see MENU at the bottom.

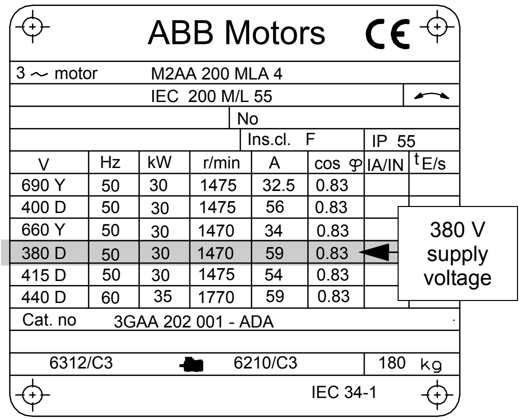
2. Press keys / until you see “PAr”, and press .



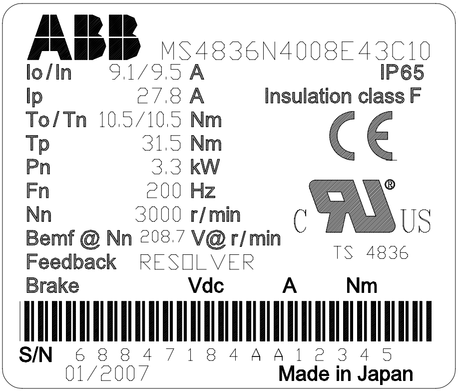
3. Find the appropriate parameter group with keys / and press .



	4. Find the appropriate parameter in the group with keys ▲/▼.	REM 9903 PAR FWD
	5. Press and hold for about two seconds until the parameter value is shown with **SET** under the value.	REM 1 PAR SET FWD
	6. Change the value with keys ▲/▼. The value changes faster while you keep the key pressed down.	REM 2 PAR SET FWD
	7. Save the parameter value by pressing .	REM 9903 PAR FWD
☐	Select the application macro (parameter *9902*) according to how the control cables are connected. The default value 1 (*ABB STANDARD*) is suitable in most cases.	REM 9902 PAR FWD
☐	Select the motor control mode (parameter *9904*). 1 (*VECTOR: SPEED*) is suitable in most cases. 2 (*VECTOR: TORQ*) is suitable for torque control applications. 3 (*SCALAR: FREQ*) is recommended • for multimotor drives when the number of the motors connected to the drive is variable • when the nominal motor current is less than 20% of the nominal current of the drive • when the drive is used for test purposes with no motor connected. 3 (*SCALAR: FREQ*) is not recommended for permanent magnet synchronous motors.	REM 9904 PAR FWD
☐	Enter the motor data from the motor nameplate. Asynchronous motor nameplate example:	**Note:** Set the motor data to exactly the same value as on the motor nameplate. For example, if the motor nominal speed is 1470 rpm on the nameplate, setting the value of parameter *9908 MOTOR NOM SPEED* to 1500 rpm results in the wrong operation of the drive.



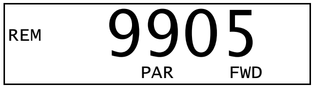
Permanent magnet synchronous motor nameplate example:



- motor nominal voltage (parameter *9905*).

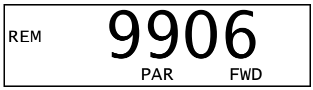
  For permanent magnet synchronous motors, enter the back emf voltage at nominal speed here. Otherwise use nominal voltage and perform ID run.

  If the voltage is given as voltage per rpm, eg, 60 V per 1000 rpm, the voltage for 3000 rpm nominal speed is 3 · 60 V = 180 V.

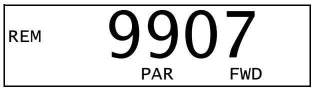


- nominal motor current (parameter *9906*)

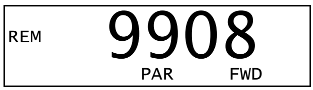
  Allowed range: 0.2…2.0 · I_{2N} A



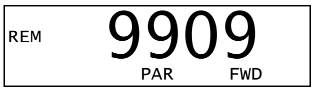
- motor nominal frequency (parameter *9907*)



- motor nominal speed (parameter *9908*)



- motor nominal power (parameter *9909*)



☐ Select the motor identification method (parameter *9910*).

The default value 0 (*OFF/IDMAGN*) using the identification magnetization is suitable for most applications. It is applied in this basic start-up procedure. Note however that this requires that parameter *9904* is set to 1 (*VECTOR: SPEED*) or 2 (*VECTOR: TORQ*).

If your selection is 0 (*OFF/IDMAGN*), move to the next step.

Value 1 (*ON*) should be selected if:

- the operation point is near zero speed, and/or
- operation at torque range above the motor nominal torque over a wide speed range and without any measured speed feedback is required.

If you decide to perform the ID run (value 1 [*ON*]), continue by following the separate instructions given on page *71* in section *ID run procedure* and then return to step *DIRECTION OF THE MOTOR ROTATION* on page *66*.

IDENTIFICATION MAGNETIZATION WITH ID RUN SELECTION 0 (*OFF/IDMAGN*)

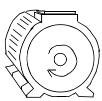
☐ Press key to switch to local control (LOC shown on the left).

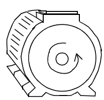
Press to start the drive. The motor model is now calculated by magnetizing the motor for 10 to 15 s at zero speed.

DIRECTION OF THE MOTOR ROTATION

☐ Check the direction of the motor rotation.

- If the drive is in remote control (REM shown on the left), switch to local control by pressing .
- To go to the Main menu, press if the bottom line shows OUTPUT; otherwise press repeatedly until you see MENU at the bottom.
- Press keys / until you see “rEF” and press .
- Increase the frequency reference from zero to a small value with key .
- Press to start the motor.
- Check that the actual direction of the motor is the same as indicated on the display (FWD means forward and REV reverse).
- Press to stop the motor.


forward direction


reverse direction

To change the direction of the motor rotation:

	• Invert the phases by changing the value of parameter *9914* to the opposite, ie, from 0 (*NO*) to 1 (*YES*), or vice versa. • Verify your work by applying input power and repeating the check as described above.	LOC 9914 PAR FWD
	SPEED LIMITS AND ACCELERATION/DECELERATION TIMES	
☐	Set the minimum speed (parameter *2001*).	LOC 2001 PAR FWD
☐	Set the maximum speed (parameter *2002*).	LOC 2002 PAR FWD
☐	Set the acceleration time 1 (parameter *2202*). **Note:** Set also acceleration time 2 (parameter *2205*) if two acceleration times will be used in the application.	LOC 2202 PAR FWD
☐	Set the deceleration time 1 (parameter *2203*). **Note:** Set also deceleration time 2 (parameter *2206*) if two deceleration times will be used in the application.	LOC 2203 PAR FWD
	SAVING A USER MACRO AND FINAL CHECK	
☐	The start-up is now completed. However, it might be useful at this stage to set the parameters required by your application and save the settings as a user macro as instructed in section *User macros* on page *119*.	LOC 9902 PAR FWD
☐	Check that the drive state is OK. <u>Basic control panel</u>: Check that there are no faults or alarms shown on the display. If you want to check the LEDs on the front of the drive, switch first to remote control (otherwise a fault is generated) before removing the panel and verifying that the red LED is not lit and the green LED is lit but not blinking. <u>Assistant control panel</u>: Check that there are no faults or alarms shown on the display and that the panel LED is green and does not blink.	
	The drive is now ready for use.	

Performing a guided start-up

To be able to perform the guided start-up, you need the assistant control panel. Guided start-up is applicable to AC induction motors.

Before you start, ensure that you have the motor nameplate data on hand.

	POWER-UP	
☐	Apply input power. The control panel first asks if you want to use the Start-up assistant. • Press OK (when **Yes** is highlighted) to run the Start-up assistant. • Press EXIT if you do not want to run the Start-up assistant. • Press key ▼ to highlight **No** and then press OK if you want to make the panel ask (or not ask) the question about running the Start-up assistant again the next time you switch on the power to the drive.	REM ↻CHOICE Do you want to use the start-up assistant? Yes No EXIT 00:00 OK REM ↻CHOICE Show start-up assistant on next boot? Yes No EXIT 00:00 OK
	SELECTING THE LANGUAGE	
☐	If you decided to run the Start-up assistant, the display then asks you to select the language. Scroll to the desired language with keys ▲/▼ and press SAVE to accept. If you press EXIT, the Start-up assistant is stopped.	REM ↻PAR EDIT 9901 LANGUAGE ENGLISH [0] EXIT 00:00 SAVE
	STARTING THE GUIDED SET-UP	
☐	The Start-up assistant now guides you through the set-up tasks, starting with the motor set-up. Set the motor data to exactly the same value as on the motor nameplate. Scroll to the desired parameter value with keys ▲/▼ and press SAVE to accept and continue with the Start-up assistant. **Note:** At any time, if you press EXIT, the Start-up assistant is stopped and the display goes to the Output mode.	REM ↻PAR EDIT 9905 MOTOR NOM VOLT 220 V EXIT 00:00 SAVE
☐	The basic start-up is now completed. However, it might be useful at this stage to set the parameters required by your application and continue with the application set-up as suggested by the Start-up assistant.	REM ↻CHOICE Do you want to continue with application setup? Continue Skip EXIT 00:00 OK

☐ Select the application macro according to which the control cables are connected.

```
REM  ↻PAR EDIT
9902 APPLIC MACRO
ABB  STANDARD
[1]
 EXIT    00:00    SAVE
```

Continue with the application set-up. After completing a set-up task, the Start-up assistant suggests the next one.

- Press OK (when **Continue** is highlighted) to continue with the suggested task.
- Press key ▼ to highlight **Skip** and then press OK to move to the following task without doing the suggested task.
- Press EXIT to stop the Start-up assistant.

```
REM  ↻CHOICE
Do you want to
continue with
EXT1 reference setup?
 Continue
 Skip
 EXIT    00:00    OK
```

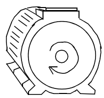
DIRECTION OF THE MOTOR ROTATION

☐ Press LOC/REM to switch to local control (LOC shown on the left).

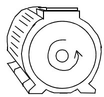
- If the drive is in remote control (REM shown on the status line), switch to local control by pressing LOC/REM.
- If you are not in the Output mode, press EXIT repeatedly until you get there.

```
LOC  ↻              xx.xHz
      xx.x  Hz
      x .x  A
      xx.x  %
 DIR     00:00    MENU
```

- Increase the frequency reference from zero to a small value with key ▲.
- Press ◇ to start the motor.
- Check that the actual direction of the motor is the same as indicated on the display (↻ means forward and ↺ reverse).
- Press ◇ to stop the motor.



forward direction



reverse direction

To change the direction of the motor rotation:

- Invert the phases by changing the value of parameter *9914* to the opposite, ie, from 0 (*NO*) to 1 (*YES*), or vice versa.
- Verify your work by applying input power and repeating the check as described above.

```
LOC  ↻PAR EDIT
9914 PHASE INVERSION
         YES
[1]
CANCEL   00:00    SAVE
```

FINAL CHECK

☐ After the whole set-up is completed, check that there are no faults or alarms shown on the display and the panel LED is green and does not blink.

The drive is now ready for use.

Controlling the drive through the I/O interface

The table below instructs how to operate the drive through the digital and analog inputs when:

- the motor start-up is performed, and
- the default (standard) parameter settings are valid.

Displays of the basic control panel are shown as an example.

PRELIMINARY SETTINGS	
If you need to change the direction of rotation, check that parameter *1003 DIRECTION* is set to 3 (*REQUEST*).	
Ensure that the control connections are wired according to the connection diagram given for the ABB standard macro.	See section *Default I/O connection diagram* on page *55*.
Ensure that the drive is in remote control. Press key LOC REM to switch between remote and local control.	In remote control, the panel display shows text REM.
STARTING AND CONTROLLING THE SPEED OF THE MOTOR	
Start by switching digital input DI1 on. Basic control panel: Text FWD starts flashing fast and stops after the setpoint is reached Assistant control panel: The arrow starts rotating. It is dotted until the setpoint is reached.	REM 0.0 Hz OUTPUT FWD
Regulate the drive output frequency (motor speed) by adjusting the voltage of analog input AI1.	REM 50.0 Hz OUTPUT FWD
CHANGING THE DIRECTION OF THE MOTOR ROTATION	
Reverse direction: Switch digital input DI2 on.	REM 50.0 Hz OUTPUT REV
Forward direction: Switch digital input DI2 off.	REM 50.0 Hz OUTPUT FWD
STOPPING THE MOTOR	
Switch digital input DI1 off. The motor stops. Basic control panel: Text FWD starts flashing slowly. Assistant control panel: The arrow stops rotating.	REM 0.0 Hz OUTPUT FWD

Performing the ID run

The drive estimates motor characteristics automatically when the drive is started for the first time and after any motor parameter (group *99 START-UP DATA*) is changed. This is valid when parameter *9910 ID RUN* has value 0 (*OFF/IDMAGN*).

In most applications there is no need to perform a separate ID run. The ID run should be selected if:

- vector control mode is used (parameter *9904* = 1 [*VECTOR: SPEED*] or 2 [*VECTOR: TORQ*]), and
- operation point is near zero speed and/or
- operation at torque range above the motor nominal torque, over a wide speed range, and without any measured speed feedback (ie, without a pulse encoder) is needed or
- permanent magnet synchronous motor is used and the back emf voltage is unknown.

Note: If motor parameters (group *99 START-UP DATA*) are changed after the ID run, it must be repeated.

ID run procedure

The general parameter setting procedure is not repeated here. For basic control panel, see page *76* and for assistant control panel, see page *86* in chapter *Control panels*. The ID run cannot be performed without a control panel.

PRE-CHECK	
WARNING! The motor will run at up to approximately 50…80% of the nominal speed during the ID run. The motor will rotate in the forward direction. **Ensure that it is safe to run the motor before performing the ID run!**	
☐	De-couple the motor from the driven equipment.
☐	If parameter values (group *01 OPERATING DATA* to group *98 OPTIONS*) are changed before the ID run, check that the new settings meet the following conditions:
☐	*2001 MINIMUM SPEED* < 0 rpm
☐	*2002 MAXIMUM SPEED* > 80% of the motor rated speed
☐	*2003 MAX CURRENT* > I_{2N}
☐	*2017 MAX TORQUE 1* > 50% or *2018 MAX TORQUE 2* > 50%, depending on which limit is in use according to parameter *2014 MAX TORQUE SEL*.
☐	Check that the Run enable signal is on (parameter *1601*).
☐	Ensure that the panel is in local control (LOC shown at the top). Press key LOC/REM to switch between local and remote control.

	ID RUN WITH THE BASIC CONTROL PANEL	
☐	Change parameter *9910 ID RUN* to 1 (*ON*). Save the new setting by pressing .	LOC 9910 PAR FWD LOC 1 PAR SET FWD
☐	If you want to monitor actual values during the ID run, go to the Output mode by pressing repeatedly until you get there.	LOC 0.0 Hz OUTPUT FWD
☐	Press to start the ID run. The panel keeps switching between the display that was shown when you started the run and the alarm display presented on the right. In general, it is recommended not to press any control panel keys during the ID run. However, you can stop the ID run at any time by pressing .	LOC A2019 FWD
☐	After the ID run is completed, the alarm display is not shown any more. If the ID run fails, the fault display presented on the right is shown.	LOC F0011 FWD
	ID RUN WITH THE ASSISTANT CONTROL PANEL	
☐	Change parameter *9910 ID RUN* to 1 (*ON*). Save the new setting by pressing SAVE.	REM ↻PAR EDIT 9910 ID RUN ON [1] CANCEL 00:00 SAVE
☐	If you want to monitor actual values during the ID run, go to the Output mode by pressing EXIT repeatedly until you get there.	LOC ↻ 50.0Hz 0.0 Hz 0.0 A 0.0 % DIR 00:00 MENU
☐	Press to start the ID run. The panel keeps switching between the display that was shown when you started the run Run and the alarm display presented on the right. In general, it is recommended not to press any control panel keys during the ID run. However, you can stop the ID run at any time by pressing .	LOC ↻ALARM ALARM 2019 ID RUN 00:00

☐	After the ID run is completed, the alarm display is not shown any more. If the ID run fails, the fault display presented on the right is shown.	LOC ↻ FAULT **FAULT 11** ID RUN FAIL 00:00

9

Control panels

What this chapter contains

The chapter describes the control panel keys, LED indicators and display fields. It also instructs in using the panel in control, monitoring and changing the settings.

About control panels

Use a control panel to control the ACS355, read status data, and adjust parameters. The drive works with either of two different control panel types:

- Basic control panel – This panel (described in section *Basic control panel* on page *76*) provides basic tools for manual entry of parameter values.
- Assistant control panel – This panel (described in section *Assistant control panel* on page *86*) includes pre-programmed assistants to automate the most common parameter setups. The panel provides language support. It is available with different language sets.

Applicability

The manual is applicable to panels with the panel revisions and the panel firmware versions given in the table below.

Panel type	Type code	Panel revision	Panel firmware version
Basic control panel	ACS-CP-C	M or later	1.13 or later
Assistant control panel	ACS-CP-A	F or later	2.04 or later
Assistant control panel (Asia)	ACS-CP-D	Q or later	2.04 or later

To find out the panel revision, see the label on the back of the panel. An example label and explanation of the label contents are shown below.

1	Panel type code
2	Serial number of format MYYWWRXXXX, where M: Manufacturer YY: 09, 10, 11, …, for 2009, 2010, 2011, … WW: 01, 02, 03, … for week 1, week 2, week 3, … R: A, B, C, … for panel revision XXXX: Integer starting every week from 0001
3	RoHS mark (the label of your drive shows the valid markings)

To find out the panel firmware version of your assistant control panel, see page *90*. For the basic control panel, see page *79*.

See parameter *9901 LANGUAGE* to find out the languages supported by the different assistant control panels.

Basic control panel

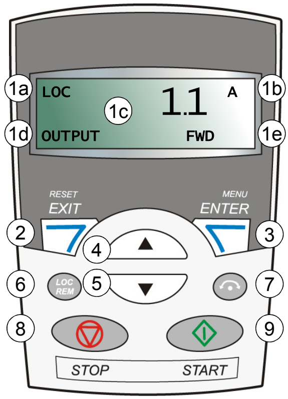
Features

The basic control panel features:

- numeric control panel with an LCD display
- copy function – parameters can be copied to the control panel memory for later transfer to other drives or for backup of a particular system.

Overview

The following table summarizes the key functions and displays on the basic control panel.



No.	Use
1	LCD display – Divided into five areas: a. Upper left – Control location: LOC: drive control is local, that is, from the control panel REM: drive control is remote, such as the drive I/O or fieldbus. b. Upper right – Unit of the displayed value. c. Center – Variable; in general, shows parameter and signal values, menus or lists. Shows also fault and alarm codes. d. Lower left and center – Panel operation state: OUTPUT: Output mode PAR: Parameter mode MENU: Main menu. FAULT: Fault mode. e. Lower right – Indicators: FWD (forward) / REV (reverse): direction of the motor rotation Flashing slowly: stopped Flashing rapidly: running, not at setpoint Steady: running, at setpoint SET: Displayed value can be modified (in the Parameter and Reference modes).
2	RESET/EXIT – Exits to the next higher menu level without saving changed values. Resets faults in the Output and Fault modes.
3	MENU/ENTER – Enters deeper into menu level. In the Parameter mode, saves the displayed value as the new setting.
4	Up – • Scrolls up through a menu or list. • Increases a value if a parameter is selected. • Increases the reference value in the Reference mode. • Holding the key down changes the value faster.
5	Down – • Scrolls down through a menu or list. • Decreases a value if a parameter is selected. • Decreases the reference value in the Reference mode. • Holding the key down changes the value faster.
6	LOC/REM – Changes between local and remote control of the drive.
7	DIR – Changes the direction of the motor rotation.
8	STOP – Stops the drive in local control.
9	START – Starts the drive in local control.

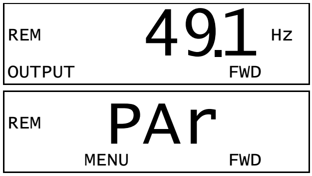
Operation

You operate the control panel with the help of menus and keys. You select an option, eg, operation mode or parameter, by scrolling the and arrow keys until the option is visible in the display and then pressing the key.

With the key, you return to the previous operation level without saving the made changes.

The basic control panel has five panel modes: *Output mode*, *Reference mode*, *Parameter mode*, *Copy mode* and Fault mode. The operation in the first four modes is described in this chapter. When a fault or alarm occurs, the panel goes automatically to the Fault mode showing the fault or alarm code. You can reset the fault or alarm in the Output or Fault mode (see chapter *Fault tracing* on page *349*).

After the power is switched on, the panel is in the Output mode, where you can start, stop, change the direction, switch between local and remote control and monitor up to three actual values (one at a time). To do other tasks, go first to the Main menu and select the appropriate mode.



How to do common tasks

The table below lists common tasks, the mode in which you can perform them and the page number where the steps to do the task are described in detail.

Task	Mode	Page
How to find out the panel firmware version	At power up	*79*
How to switch between local and remote control	Any	*79*
How to start and stop the drive	Any	*79*
How to change the direction of the motor rotation	Any	*80*
How to browse the monitored signals	Output	*80*
How to set the speed, frequency or torque reference	Reference	*81*
How to change the value of a parameter	Parameter	*82*
How to select the monitored signals	Parameter	*83*
How to reset faults and alarms	Output, Fault	*349*
How to copy parameters from the drive to the control panel	Copy	*85*
How to restore parameters from the control panel to the drive	Copy	*85*

How to find out the panel firmware version

Step	Action	Display
1.	If the power is switched on, switch it off.	
2.	Keep key pressed down while you switch on the power and read the panel firmware version shown on the display. When you release the key, the panel goes to the Output mode.	X.XX

How to start, stop and switch between local and remote control

You can start, stop and switch between local and remote control in any mode. To be able to start or stop the drive, the drive must be in local control.

Step	Action	Display
1.	• To switch between remote control (REM shown on the left) and local control (LOC shown on the left), press LOC REM. **Note:** Switching to local control can be disabled with parameter *1606 LOCAL LOCK*. After pressing the key, the display briefly shows message “LoC” or “rE”, as appropriate, before returning to the previous display. The very first time the drive is powered up, it is in remote control (REM) and controlled through the drive I/O terminals. To switch to local control (LOC) and control the drive using the control panel, press LOC REM. The result depends on how long you press the key: • If you release the key immediately (the display flashes “LoC”), the drive stops. Set the local control reference as instructed on page *81*. • If you press the key for about two seconds (release when the display changes from “LoC” to “LoC r”), the drive continues as before. The drive copies the current remote values for the run/stop status and the reference, and uses them as the initial local control settings.	LOC 49.1 Hz OUTPUT FWD LOC LoC FWD
	• To stop the drive in local control, press .	Text FWD or REV on the bottom line starts flashing slowly.
	• To start the drive in local control, press .	Text FWD or REV on the bottom line starts flashing rapidly. It stops flashing when the drive reaches the setpoint.

How to change the direction of the motor rotation

You can change the direction of the motor rotation in any mode.

Step	Action	Display
1.	If the drive is in remote control (REM shown on the left), switch to local control by pressing LOC/REM. The display briefly shows message "LoC" before returning to the previous display.	LOC 49.1 Hz OUTPUT FWD
2.	To change the direction from forward (FWD shown at the bottom) to reverse (REV shown at the bottom), or vice versa, press . **Note**: Parameter *1003 DIRECTION* must be set to 3 (*REQUEST*).	LOC 49.1 Hz OUTPUT REV

Output mode

In the Output mode, you can:

- monitor actual values of up to three group *01 OPERATING DATA* signals, one signal at a time
- start, stop, change the direction and switch between local and remote control.

You get to the Output mode by pressing until the display shows text OUTPUT at the bottom.

The display shows the value of one group *01 OPERATING DATA* signal. The unit is shown on the right. Page *83* tells how to select up to three signals to be monitored in the Output mode. The table below shows how to view them one at a time.

REM 49.1 Hz
OUTPUT FWD

How to browse the monitored signals

Step	Action	Display
1.	If more than one signals have been selected to be monitored (see page *83*), you can browse them in the Output mode. To browse the signals forward, press key ▲ repeatedly. To browse them backward, press key ▼ repeatedly.	REM 49.1 Hz OUTPUT FWD REM 0.5 A OUTPUT FWD REM 10.7 % OUTPUT FWD

Reference mode

In the Reference mode, you can:

- set the speed, frequency or torque reference
- start, stop, change the direction and switch between local and remote control.

How to set the speed, frequency or torque reference

Step	Action	Display
1.	Go to the Main menu by pressing [key] if you are in the Output mode, otherwise by pressing [key] repeatedly until you see MENU at the bottom.	REM PAr MENU FWD
2.	If the drive is in remote control (REM shown on the left), switch to local control by pressing LOC/REM. The display briefly shows “LoC” before switching to local control. **Note**: With group *11 REFERENCE SELECT*, you can allow the reference modification in remote control (REM).	LOC PAr MENU FWD
3.	If the panel is not in the Reference mode (“rEF” not visible), press key ▲ or ▼ until you see “rEF” and then press [key]. Now the display shows the current reference value with SET under the value.	LOC rEF MENU FWD LOC 49.1 Hz SET FWD
4.	• To increase the reference value, press ▲. • To decrease the reference value, press ▼. The value changes immediately when you press the key. It is stored in the drive permanent memory and restored automatically after power switch-off.	LOC 50.0 Hz SET FWD

Parameter mode

In the Parameter mode, you can:

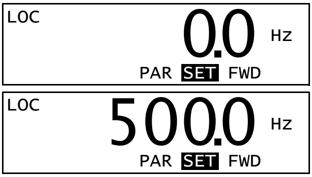
- view and change parameter values
- select and modify the signals shown in the Output mode
- start, stop, change the direction and switch between local and remote control.

How to select a parameter and change its value

Step	Action	Display
1.	Go to the Main menu by pressing if you are in the Output mode, otherwise by pressing repeatedly until you see MENU at the bottom.	LOC rEF MENU FWD
2.	If the panel is not in the Parameter mode ("PAr" not visible), press key or until you see "PAr" and then press . The display shows the number of one of the parameter groups.	LOC PAr MENU FWD LOC -01- PAR FWD
3.	Use keys and to find the desired parameter group.	LOC -11- PAR FWD
4.	Press . The display shows one of the parameters in the selected group.	LOC 1101 PAR FWD
5.	Use keys and to find the desired parameter.	LOC 1103 PAR FWD
6.	Press and hold for about two seconds until the display shows the value of the parameter with SET underneath indicating that changing of the value is now possible. **Note:** When SET is visible, pressing keys and simultaneously changes the displayed value to the default value of the parameter.	LOC 1 PAR SET FWD
7.	Use keys and to select the parameter value. When you have changed the parameter value, SET starts flashing. • To save the displayed parameter value, press . • To cancel the new value and keep the original, press .	LOC 2 PAR SET FWD LOC 1103 PAR FWD

How to select the monitored signals

Step	Action	Display
1.	You can select which signals are monitored in the Output mode and how they are displayed with group *34 PANEL DISPLAY* parameters. See page *82* for detailed instructions on changing parameter values. By default, the display shows three signals. Signal 1: *0102 SPEED* for macros 3-wire, Alternate, Motor potentiometer, Hand/Auto and PID control; *0103 OUTPUT FREQ* for macros ABB standard and Torque control Signal 2: *0104 CURRENT* Signal 3: *0105 TORQUE*. To change the default signals, select up to three signals from group *01 OPERATING DATA* to be shown. Signal 1: Change the value of parameter *3401 SIGNAL1 PARAM* to the index of the signal parameter in group *01 OPERATING DATA* (= number of the parameter without the leading zero), eg, 105 means parameter *0105 TORQUE*. Value 100 means that no signal is displayed. Repeat for signals 2 (*3408 SIGNAL2 PARAM*) and 3 (*3415 SIGNAL3 PARAM*). For example, if *3401* = 0 and *3415* = 0, browsing is disabled and only the signal specified by *3408* appears in the display. If all three parameters are set to 0, ie, no signals are selected for monitoring, the panel displays text “n.A”.	LOC 103 PAR SET FWD LOC 104 PAR SET FWD LOC 105 PAR SET FWD
2.	Specify the decimal point location, or use the decimal point location and unit of the source signal (setting 9 [*DIRECT*]). Bar graphs are not available for basic control panel. For details, see parameter *3404*. Signal 1: parameter *3404 OUTPUT1 DSP FORM* Signal 2: parameter *3411 OUTPUT2 DSP FORM* Signal 3: parameter *3418 OUTPUT3 DSP FORM*.	LOC 9 PAR SET FWD
3.	Select the units to be displayed for the signals. This has no effect if parameter *3404*/*3411*/*3418* is set to 9 (*DIRECT*). For details, see parameter *3405*. Signal 1: parameter *3405 OUTPUT1 UNIT* Signal 2: parameter *3412 OUTPUT2 UNIT* Signal 3: parameter *3419 OUTPUT3 UNIT*.	LOC 3 PAR SET FWD

Step	Action	Display
4.	Select the scalings for the signals by specifying the minimum and maximum display values. This has no effect if parameter *3404*/*3411*/*3418* is set to 9 (*DIRECT*). For details, see parameters *3406* and *3407*. Signal 1: parameters *3406 OUTPUT1 MIN* and *3407 OUTPUT1 MAX* Signal 2: parameters *3413 OUTPUT2 MIN* and *3414 OUTPUT2 MAX* Signal 3: parameters *3420 OUTPUT3 MIN* and *3421 OUTPUT3 MAX*.	

Copy mode

The basic control panel can store a full set of drive parameters and up to three user sets of drive parameters to the control panel. Uploading and downloading can be performed in local control. The control panel memory is non-volatile.

In the Copy mode, you can do the following:

- Copy all parameters from the drive to the control panel (uL – Upload). This includes all defined user sets of parameters and internal (not adjustable by the user) parameters such as those created by the ID run.
- Restore the full parameter set from the control panel to the drive (dL A – Download all). This writes all parameters, including the internal non-user-adjustable motor parameters, to the drive. It does not include the user sets of parameters.

  Note: Only use this function to restore a drive, or to transfer parameters to systems that are identical to the original system.
- Copy a partial parameter set from the control panel to a drive (dL P – Download partial). The partial set does not include user sets, internal motor parameters, parameters *9905*…*9909*, *1605*, *1607*, *5201*, nor any group *51 EXT COMM MODULE* and *53 EFB PROTOCOL* parameters.

  The source and target drives and their motor sizes do not need to be the same.
- Copy user set 1 parameters from the control panel to the drive (dL u1 – Download user set 1). A user set includes group *99 START-UP DATA* parameters and the internal motor parameters.

  The function is only shown on the menu when user set 1 has been first saved using parameter *9902 APPLIC MACRO* (see section *User macros* on page *119*) and then uploaded to panel.
- Copy user set 2 parameters from the control panel to the drive (dL u2 – Download user set 2). As dL u1 – Download user set 1 above.
- Copy user set 3 parameters from the control panel to the drive (dL u3 – Download user set 2). As dL u1 – Download user set 1 above.
- Start, stop, change the direction and switch between local and remote control.

How to upload and download parameters

For the upload and download functions available, see above. Note that the drive has to be in local control for uploading and downloading.

Step	Action	Display
1.	Go to the Main menu by pressing if you are in the Output mode, otherwise by pressing repeatedly until you see MENU at the bottom. – If REM is shown on the left, press first LOC/REM to switch to local control.	LOC PAr MENU FWD
2.	If the panel is not in the Copy mode ("CoPY" not visible), press key ▲ or ▼ until you see "CoPY".	LOC CoPY MENU FWD
	Press .	LOC uL MENU FWD
3.	To upload all parameters (including user sets) from the drive to the control panel, step to "uL" with keys ▲ and ▼.	LOC uL MENU FWD
	Press . During the transfer, the display shows the transfer status as a percentage of completion.	LOC uL 50 % FWD
	To perform downloads, step to the appropriate operation (here "dL A", Download all, is used as an example) with keys ▲ and ▼.	LOC dL A MENU FWD
	Press . During the transfer, the display shows the transfer status as a percentage of completion.	LOC dL 50 % FWD

Basic control panel alarm codes

In addition to the faults and alarms generated by the drive (see chapter *Fault tracing* on page *349*), the basic control panel indicates control panel alarms with a code of form A5xxx. See section *Alarms generated by the basic control panel* on page *354* for a list of the alarm codes and descriptions.

Assistant control panel

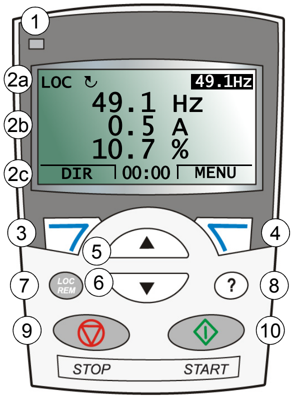
Features

The assistant control panel features:

- alphanumeric control panel with an LCD display
- language selection for the display
- Start-up assistant to ease drive commissioning
- copy function – parameters can be copied to the control panel memory for later transfer to other drives or for backup of a particular system.
- context-sensitive help
- real time clock.

Overview

The following table summarizes the key functions and displays on the assistant control panel.



No.	Use
1	Status LED – Green for normal operation. If LED is flashing, or red, see section *LEDs* on page *372*.
2	LCD display – Divided into three main areas: a. Status line – variable, depending on the mode of operation, see section *Status line* on page *88*. b. Center – variable; in general, shows signal and parameter values, menus or lists. Shows also faults and alarms. c. Bottom line – shows current functions of the two soft keys and, if enabled, the clock display.
3	Soft key 1 – Function depends on the context. The text in the lower left corner of the LCD display indicates the function.
4	Soft key 2 – Function depends on the context. The text in the lower right corner of the LCD display indicates the function.
5	Up – • Scrolls up through a menu or list displayed in the center of the LCD display. • Increments a value if a parameter is selected. • Increments the reference value if the upper right corner is highlighted. Holding the key down changes the value faster.
6	Down – • Scrolls down through a menu or list displayed in the center of the LCD display. • Decrements a value if a parameter is selected. • Decrements the reference value if the upper right corner is highlighted. Holding the key down changes the value faster.
7	LOC/REM – Changes between local and remote control of the drive.
8	Help – Displays context-sensitive information when the key is pressed. The information displayed describes the item currently highlighted in the center of the display.
9	STOP – Stops the drive in local control.
10	START – Starts the drive in local control.

Status line

The top line of the LCD display shows the basic status information of the drive.

No.	Field	Alternatives	Significance
1	Control location	LOC	Drive control is local, that is, from the control panel.
		REM	Drive control is remote, such as the drive I/O or fieldbus.
2	State	↻	Forward shaft direction
		↺	Reverse shaft direction
		Rotating arrow	Drive is running at setpoint.
		Dotted rotating arrow	Drive is running but not at setpoint.
		Stationary arrow	Drive is stopped.
		Dotted stationary arrow	Start command is present, but the motor is not running, eg, because start enable is missing.
3	Panel operation mode		• Name of the current mode • Name of the list or menu shown • Name of the operation state, eg, PAR EDIT.
4	Reference value or number of the selected item		• Reference value in the Output mode • Number of the highlighted item, eg, mode, parameter group or fault.

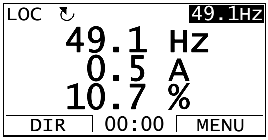
Operation

You operate the control panel with menus and keys. The keys include two context-sensitive soft keys, whose current function is indicated by the text shown in the display above each key.

You select an option, eg, operation mode or parameter, by scrolling the and arrow keys until the option is highlighted (in reverse video) and then pressing the relevant soft key. With the right soft key you usually enter a mode, accept an option or save the changes. The left soft key is used to cancel the made changes and return to the previous operation level.

The assistant control panel has nine panel modes: *Output mode*, *Parameter mode*, *Assistants mode*, *Changed parameters mode*, *Fault logger mode*, *Time and date mode*, *Parameter backup mode*, *I/O settings mode* and Fault mode. The operation in the first eight modes is described in this chapter. When a fault or alarm occurs, the panel goes automatically to the Fault mode showing the fault or alarm. You can reset it in the Output or Fault mode (see chapter *Fault tracing* on page *349*).

Initially, the panel is in the Output mode, where you can start, stop, change the direction, switch between local and remote control, modify the reference value and monitor up to three actual values.



To do other tasks, go first to the Main menu and select the appropriate mode on the menu. The status line (see section *Status line* on page *88*) shows the name of the current menu, mode, item or state.

How to do common tasks

The table below lists common tasks, the mode in which you can perform them and the page number where the steps to do the task are described in detail.

Task	Mode	Page
How to get help	Any	*90*
How to find out the panel version	At power up	*90*
How to adjust the display contrast	Output	*93*
How to switch between local and remote control	Any	*91*
How to start and stop the drive	Any	*92*
How to change the direction of the motor rotation	Output	*92*
How to set the speed, frequency or torque reference	Output	*93*
How to change the value of a parameter	Parameters	*94*
How to select the monitored signals	Parameters	*95*
How to do guided tasks (specification of related parameter sets) with assistants	Assistants	*96*
How to view and edit changed parameters	Changed parameters	*98*
How to view faults	Fault logger	*99*
How to reset faults and alarms	Output, Fault	*349*
How to show/hide the clock, change date and time formats, set the clock and enable/disable automatic clock transitions according to the daylight saving changes	Time and date	*100*
How to copy parameters from the drive to the control panel	Parameter backup	*103*
How to restore parameters from the control panel to the drive	Parameter backup	*103*
How to view backup information	Parameter backup	*104*
How to edit and change parameter settings related to I/O terminals	I/O settings	*105*

How to get help

Step	Action	Display
1.	Press ? to read the context-sensitive help text for the item that is highlighted.	LOC ↻PAR GROUPS——10 01 OPERATING DATA 03 FB ACTUAL SIGNALS 04 FAULT HISTORY 10 START/STOP/DIR 11 REFERENCE SELECT EXIT 00:00 SEL
	If help text exists for the item, it is shown on the display.	LOC ↻HELP This group defines external sources (EXT1 and EXT2) for commands that enable start, stop and EXIT 00:00
2.	If the whole text is not visible, scroll the lines with keys ▲ and ▼.	LOC ↻HELP external sources (EXT1 and EXT2) for commands that enable start, stop and direction changes. EXIT 00:00
3.	After reading the text, return to the previous display by pressing EXIT.	LOC ↻PAR GROUPS——10 01 OPERATING DATA 03 FB ACTUAL SIGNALS 04 FAULT HISTORY 10 START/STOP/DIR 11 REFERENCE SELECT EXIT 00:00 SEL

How to find out the panel version

Step	Action	Display
1.	If the power is switched on, switch it off.	
2.	Keep key ? pressed down while you switch on the power and read the information. The display shows the following panel information: Panel SW: panel firmware version ROM CRC: panel ROM check sum Flash Rev: flash content version Flash content comment. When you release the ? key, the panel goes to the Output mode.	PANEL VERSION INFO Panel SW: x.xx Rom CRC: xxxxxxxxxx Flash Rev: x.xx xxxxxxxxxxxxxxxxxxxx

How to start, stop and switch between local and remote control

You can start, stop and switch between local and remote control in any mode. To be able to start or stop the drive, the drive must be in local control.

Step	Action	Display

1.	• To switch between remote control (REM shown on the status line) and local control (LOC shown on the status line), press LOC REM.
	
	Note: Switching to local control can be disabled with parameter *1606 LOCAL LOCK*.
	
	The very first time the drive is powered up, it is in remote control (REM) and controlled through the drive I/O terminals. To switch to local control (LOC) and control the drive using the control panel, press LOC REM. The result depends on how long you press the key:
	• If you release the key immediately (the display flashes “Switching to the local control mode”), the drive stops. Set the local control reference as instructed on page *93*.
	• If you press the key for about two seconds, the drive continues as before. The drive copies the current remote values for the run/stop status and the reference, and uses them as the initial local control settings.
		`LOC ↻MESSAGE`
		`Switching to the`
		`local control mode.`
		`00:00`

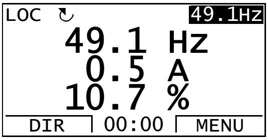
	• To stop the drive in local control, press .	The arrow (↻ or ↺) on the status line stops rotating.
	• To start the drive in local control, press .	The arrow (↻ or ↺) on the status line starts rotating. It is dotted until the drive reaches the setpoint.

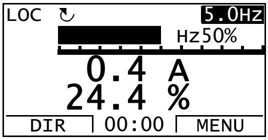
Output mode

In the Output mode, you can:

- monitor actual values of up to three signals in group *01 OPERATING DATA*
- change the direction of the motor rotation
- set the speed, frequency or torque reference
- adjust the display contrast
- start, stop, change the direction and switch between local and remote control.

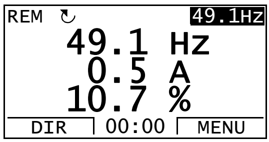
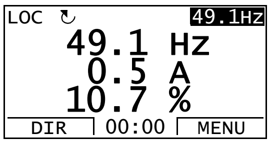
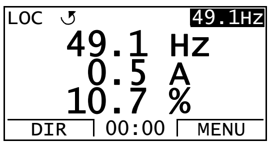
You get to the Output mode by pressing EXIT repeatedly.





The top right corner of the display shows the reference value. The center can be configured to show up to three signal values or bar graphs. If just one or two signals are selected for display, the number and name of each displayed signal are shown in addition to the value or bar graph. See page *95* for instructions on selecting and modifying the monitored signals.

How to change the direction of the motor rotation

Step	Action	Display
1.	If you are not in the Output mode, press EXIT repeatedly until you get there.	
2.	If the drive is in remote control (REM shown on the status line), switch to local control by pressing LOC/REM. The display briefly shows a message about changing the mode and then returns to the Output mode.	
3.	To change the direction from forward (↻ shown on the status line) to reverse (↺ shown on the status line), or vice versa, press DIR. **Note**: Parameter *1003 DIRECTION* must be set to 3 (*REQUEST*).	

How to set the speed, frequency or torque reference

Step	Action	Display
1.	If you are not in the Output mode, press EXIT repeatedly until you get there.	REM ↻ 49.1Hz 49.1 Hz 0.5 A 10.7 % DIR 00:00 MENU
2.	If the drive is in remote control (REM shown on the status line), switch to local control by pressing LOC/REM. The display briefly shows a message about changing the mode and then returns to the Output mode. **Note**: With group *11 REFERENCE SELECT*, you can allow the reference modification in remote control.	LOC ↻ 49.1Hz 49.1 Hz 0.5 A 10.7 % DIR 00:00 MENU
3.	• To increase the highlighted reference value shown in the top right corner of the display, press ▲. The value changes immediately. It is stored in the drive permanent memory and restored automatically after power switch-off. • To decrease the value, press ▼.	LOC ↻ 50.0Hz 50.0 Hz 0.5 A 10.7 % DIR 00:00 MENU

How to adjust the display contrast

Step	Action	Display
1.	If you are not in the Output mode, press EXIT repeatedly until you get there.	LOC ↻ 49.1Hz 49.1 Hz 0.5 A 10.7 % DIR 00:00 MENU
2.	• To increase the contrast, press keys MENU and ▲ simultaneously. • To decrease the contrast, press keys MENU and ▼ simultaneously.	LOC ↻ 49.1Hz 49.1 Hz 0.5 A 10.7 % DIR 00:00 MENU

Parameters mode

In the Parameters mode, you can:

- view and change parameter values
- start, stop, change the direction and switch between local and remote control.

How to select a parameter and change its value

Step	Action	Display
1.	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing repeatedly EXIT until you get to the Main menu.	LOC ↻MAIN MENU 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT 00:00 ENTER
2.	Go to the Parameters mode by selecting PARAMETERS on the menu with keys ▲ and ▼, and pressing ENTER.	LOC ↻PAR GROUPS 01 01 OPERATING DATA 03 FB ACTUAL SIGNALS 04 FAULT HISTORY 10 START/STOP/DIR 11 REFERENCE SELECT EXIT 00:00 SEL
3.	Select the appropriate parameter group with keys ▲ and ▼.	LOC ↻PAR GROUPS 99 99 START-UP DATA 01 OPERATING DATA 03 FB ACTUAL SIGNALS 04 FAULT HISTORY 10 START/STOP/DIR EXIT 00:00 SEL
	Press SEL.	LOC ↻PARAMETERS 9901 LANGUAGE ENGLISH 9902 APPLIC MACRO 9903 MOTOR TYPE 9904 MOTOR CTRL MODE EXIT 00:00 EDIT
4.	Select the appropriate parameter with keys ▲ and ▼. The current value of the parameter is shown below the selected parameter.	LOC ↻PARAMETERS 9901 LANGUAGE 9902 APPLIC MACRO ABB STANDARD 9903 MOTOR TYPE 9904 MOTOR CTRL MODE EXIT 00:00 EDIT
	Press EDIT.	LOC ↻PAR EDIT 9902 APPLIC MACRO ABB STANDARD [1] CANCEL 00:00 SAVE
5.	Specify a new value for the parameter with keys ▲ and ▼. Pressing the key once increments or decrements the value. Holding the key down changes the value faster. Pressing the keys simultaneously replaces the displayed value with the default value.	LOC ↻PAR EDIT 9902 APPLIC MACRO 3-WIRE [2] CANCEL 00:00 SAVE
6.	• To save the new value, press SAVE. • To cancel the new value and keep the original, press CANCEL.	LOC ↻PARAMETERS 9901 LANGUAGE 9902 APPLIC MACRO 3-WIRE 9903 MOTOR TYPE 9904 MOTOR CTRL MODE EXIT 00:00 EDIT

How to select the monitored signals

Step	Action	Display
1.	You can select which signals are monitored in the Output mode and how they are displayed with group *34 PANEL DISPLAY* parameters. See page *94* for detailed instructions on changing parameter values. By default, the display shows three signals. Signal 1: *0102 SPEED* for macros 3-wire, Alternate, Motor potentiometer, Hand/Auto and PID control; *0103 OUTPUT FREQ* for macros ABB standard and Torque control Signal 2: *0104 CURRENT* Signal 3: *0105 TORQUE*. To change the default signals, select up to three signals from group *01 OPERATING DATA* to be shown. Signal 1: Change the value of parameter *3401 SIGNAL1 PARAM* to the index of the signal parameter in group *01 OPERATING DATA* (= number of the parameter without the leading zero), eg, 105 means parameter *0105 TORQUE*. Value 0 means that no signal is displayed. Repeat for signals 2 (*3408 SIGNAL2 PARAM*) and 3 (*3415 SIGNAL3 PARAM*).	LOC ↻PAR EDIT 3401 SIGNAL1 PARAM OUTPUT FREQ [103] CANCEL 00:00 SAVE LOC ↻PAR EDIT 3408 SIGNAL2 PARAM CURRENT [104] CANCEL 00:00 SAVE LOC ↻PAR EDIT 3415 SIGNAL3 PARAM TORQUE [105] CANCEL 00:00 SAVE
2.	Select how you want the signals to be displayed: as a decimal number or a bar graph. For decimal numbers, you can specify the decimal point location, or use the decimal point location and unit of the source signal (setting 9 [*DIRECT*]). For details, see parameter *3404*. Signal 1: parameter *3404 OUTPUT1 DSP FORM* Signal 2: parameter *3411 OUTPUT2 DSP FORM* Signal 3: parameter *3418 OUTPUT3 DSP FORM*.	LOC ↻PAR EDIT 3404 OUTPUT1 DSP FORM DIRECT [9] CANCEL 00:00 SAVE
3.	Select the units to be displayed for the signals. This has no effect if parameter *3404*/*3411*/*3418* is set to 9 (*DIRECT*). For details, see parameter *3405*. Signal 1: parameter *3405 OUTPUT1 UNIT* Signal 2: parameter *3412 OUTPUT2 UNIT* Signal 3: parameter *3419 OUTPUT3 UNIT*.	LOC ↻PAR EDIT 3405 OUTPUT1 UNIT Hz [3] CANCEL 00:00 SAVE
4.	Select the scalings for the signals by specifying the minimum and maximum display values. This has no effect if parameter *3404*/*3411*/*3418* is set to 9 (*DIRECT*). For details, see parameters *3406* and *3407*. Signal 1: parameters *3406 OUTPUT1 MIN* and *3407 OUTPUT1 MAX* Signal 2: parameters *3413 OUTPUT2 MIN* and *3414 OUTPUT2 MAX* Signal 3: parameters *3420 OUTPUT3 MIN* and *3421 OUTPUT3 MAX*.	LOC ↻PAR EDIT 3406 OUTPUT1 MIN 0.0 Hz CANCEL 00:00 SAVE LOC ↻PAR EDIT 3407 OUTPUT1 MAX 500.0 Hz CANCEL 00:00 SAVE

Assistants mode

When the drive is first powered up, the Start-up assistant guides you through the setup of the basic parameters. The Start-up assistant is divided into assistants, each of which is responsible for the specification of a related parameter set, for example Motor set-up or PID control. The Start-up assistant activates the assistants one after the other. You may also use the assistants independently. For more information on the tasks of the assistants, see section *Start-up assistant* on page *121*.

In the Assistants mode, you can:

- use assistants to guide you through the specification of a set of basic parameters
- start, stop, change the direction and switch between local and remote control.

How to use an assistant

The table below shows the basic operation sequence which leads you through assistants. The Motor set-up assistant is used as an example.

Step	Action	Display
1.	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing repeatedly EXIT until you get to the Main menu.	LOC ↻MAIN MENU 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT 00:00 ENTER
2.	Go to the Assistants mode by selecting ASSISTANTS on the menu keys ▲ and ▼, and pressing ENTER.	LOC ↻ASSISTANTS 1 Start-up assistant Motor Set-up Application Speed control EXT1 Speed control EXT2 EXIT 00:00 SEL
3.	Select the assistant with keys ▲ and ▼, and press SEL. If you select any other assistant than the Start-up assistant, it guides you through the task of specification of its parameter set as shown in steps *4.* and *5.* below. After that you can select another assistant on the Assistants menu or exit the Assistants mode. The Motor set-up assistant is used here as an example. If you select the Start-up assistant, it activates the first assistant, which guides you through the task of specification of its parameter set as shown in steps *4.* and *5.* below. The Start-up assistant then asks if you want to continue with the next assistant or skip it – select the appropriate answer with keys ▲ and ▼, and press SEL. If you choose to skip, the Start-up assistant asks the same question about the next assistant, and so on.	LOC ↻PAR EDIT 9905 MOTOR NOM VOLT 200 V EXIT 00:00 SAVE LOC ↻CHOICE Do you want to continue with application setup? Continue Skip EXIT 00:00 OK

Step	Action	Display
4.	• To specify a new value, press keys ▲ and ▼. • To ask for information on the requested parameter, press key ?. Scroll the help text with keys ▲ and ▼. Close the help by pressing EXIT.	LOC ↻PAR EDIT 9905 MOTOR NOM VOLT 240 V EXIT 00:00 SAVE LOC ↻HELP Set as given on the motor nameplate. Voltage value must correspond to motor D/Y connection. EXIT 00:00
5.	• To accept the new value and continue to the setting of the next parameter, press SAVE. • To stop the assistant, press EXIT.	LOC ↻PAR EDIT 9906 MOTOR NOM CURR 1.2 A EXIT 00:00 SAVE

Changed parameters mode

In the Changed parameters mode, you can:

- view a list of all parameters that have been changed from the macro default values
- change these parameters
- start, stop, change the direction and switch between local and remote control.

How to view and edit changed parameters

Step	Action	Display
1.	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing repeatedly EXIT until you get to the Main menu.	LOC ↻MAIN MENU 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT 00:00 ENTER
2.	Go to the Changed parameters mode by selecting CHANGED PAR on the menu with keys ▲ and ▼, and pressing ENTER.	LOC ↻CHANGED PAR 1202 CONST SPEED 1 10.0 Hz 1203 CONST SPEED 2 1204 CONST SPEED 3 9902 APPLIC MACRO EXIT 00:00 EDIT
3.	Select the changed parameter on the list with keys ▲ and ▼. The value of the selected parameter is shown below it. Press EDIT to modify the value.	LOC ↻PAR EDIT 1202 CONST SPEED 1 10.0 Hz CANCEL 00:00 SAVE
4.	Specify a new value for the parameter with keys ▲ and ▼. Pressing the key once increments or decrements the value. Holding the key down changes the value faster. Pressing the keys simultaneously replaces the displayed value with the default value.	LOC ↻PAR EDIT 1202 CONST SPEED 1 15.0 Hz CANCEL 00:00 SAVE
5.	• To accept the new value, press SAVE. If the new value is the default value, the parameter is removed from the list of changed parameters. • To cancel the new value and keep the original, press CANCEL.	LOC ↻CHANGED PAR 1202 CONST SPEED 1 15.0 Hz 1203 CONST SPEED 2 1204 CONST SPEED 3 9902 APPLIC MACRO EXIT 00:00 EDIT

Fault logger mode

In the Fault logger mode, you can:

- view the drive fault history of maximum ten faults (after a power off, only the three latest faults are kept in the memory)
- see the details of the three latest faults (after a power off, the details of only the most recent fault is kept in the memory)
- read the help text for the fault
- start, stop, change the direction and switch between local and remote control.

How to view faults

Step	Action	Display
1.	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing repeatedly EXIT until you get to the Main menu.	LOC ↻MAIN MENU 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT 00:00 ENTER
2.	Go to the Fault logger mode by selecting FAULT LOGGER on the menu with keys ▲ and ▼, and pressing ENTER. The display shows the fault log starting with the latest fault. The number on the row is the fault code according to which the causes and corrective actions are listed in chapter *Fault tracing* on page 349.	LOC ↻FAULT LOGGER 1 10: PANEL LOSS 19.03.05 13:04:57 6: DC UNDERVOLT 7: AI1 LOSS EXIT 00:00 DETAIL
3.	To see the details of a fault, select it with keys ▲ and ▼, and press DETAIL.	LOC ↻PANEL LOSS DI STATUS AT FLT 00000 bin FAULT TIME 1 13:04:57 FAULT TIME 2 EXIT 00:00 DIAG
4.	To show the help text, press DIAG. Scroll the help text with keys ▲ and ▼. After reading the help, press OK to return to the previous display.	LOC ↻DIAGNOSTICS Check: comm lines and connections, parameter 3002, parameters in groups 10 and 11. EXIT 00:00 OK

Time and date mode

In the Time and date mode, you can:

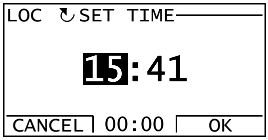
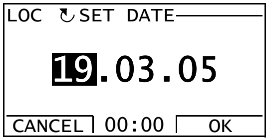
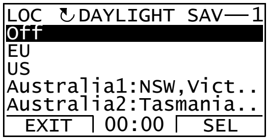
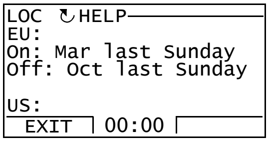
- show or hide the clock
- change date and time display formats
- set the date and time
- enable or disable automatic clock transitions according to the daylight saving changes
- start, stop, change the direction and switch between local and remote control.

The assistant control panel contains a battery to ensure the function of the clock when the panel is not powered by the drive.

How to show or hide the clock, change display formats, set the date and time and enable or disable clock transitions due to daylight saving changes

Step	Action	Display
1.	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing repeatedly EXIT until you get to the Main menu.	LOC ↻MAIN MENU 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT 00:00 ENTER
2.	Go to the Time and date mode by selecting TIME & DATE on the menu with keys ▲ and ▼, and pressing ENTER.	LOC ↻TIME & DATE 1 CLOCK VISIBILITY TIME FORMAT DATE FORMAT SET TIME SET DATE EXIT 00:00 SEL
3.	• To show (hide) the clock, select CLOCK VISIBLILITY on the menu, press SEL, select Show clock (Hide clock) and press SEL, or, if you want to return to the previous display without making changes, press EXIT.	LOC ↻CLOCK VISIB 1 Show clock Hide clock EXIT 00:00 SEL
	• To specify the date format, select DATE FORMAT on the menu, press SEL and select a suitable format. Press OK to save or CANCEL to cancel your changes.	LOC ↻DATE FORMAT 1 dd.mm.yy mm/dd/yy dd.mm.yyyy mm/dd/yyyy CANCEL 00:00 OK
	• To specify the time format, select TIME FORMAT on the menu, press SEL and select a suitable format. Press OK to save or CANCEL to cancel your changes.	LOC ↻TIME FORMAT 1 24-hour 12-hour CANCEL 00:00 SEL

Step	Action	Display

	• To set the time, select SET TIME on the menu and press SEL. Specify the hours with keys ▲ and ▼, and press OK.Then specify the minutes. Press OK to save or CANCEL to cancel your changes.
	• To set the date, select SET DATE on the menu and press SEL. Specify the first part of the date (day or month depending on the selected date format) with keys ▲ and ▼, and press OK. Repeat for the second part. After specifying the year, press OK. To cancel your changes, press CANCEL.
	• To enable or disable the automatic clock transitions according to the daylight saving changes, select DAYLIGHT SAVING on the menu and press SEL.
	Pressing ? opens the help that shows the beginning and end dates of the period during which daylight saving time is used in each country or area whose daylight saving changes you can select to be followed. Scroll the help text with keys ▲ and ▼.
	  • To disable automatic clock transitions according to the daylight saving changes, select Off and press SEL.
	  • To enable automatic clock transitions, select the country or area whose daylight saving changes are followed and press SEL.
	  • To return to the previous display without making changes, press EXIT.
		
		
		
		

Parameter backup mode

The Parameter backup mode is used to export parameters from one drive to another or to make a backup of the drive parameters. Uploading to the panel stores all drive parameters, including up to three user sets, to the assistant control panel. The full set, partial parameter set (application) and user sets can then be downloaded from the control panel to another drive or the same drive. Uploading and downloading can be performed in local control.

The control panel memory is non-volatile and does not depend on the panel battery.

In the Parameter backup mode, you can:

- Copy all parameters from the drive to the control panel (UPLOAD TO PANEL). This includes all defined user sets of parameters and internal (not adjustable by the user) parameters such as those created by the ID run.
- View the information about the backup stored to the control panel with UPLOAD TO PANEL (BACKUP INFO). This includes, for example, the type and rating of the drive where the backup was made. It is useful to check this information when you are going to copy the parameters to another drive with DOWNLOAD FULL SET to ensure that the drives match.
- Restore the full parameter set from the control panel to the drive (DOWNLOAD FULL SET). This writes all parameters, including the internal non-user-adjustable motor parameters, to the drive. It does not include the user sets of parameters.

  Note: Only use this function to restore a drive from a backup or to transfer parameters to systems that are identical to the original system.
- Copy a partial parameter set (part of the full set) from the control panel to a drive (DOWNLOAD APPLICATION). The partial set does not include user sets, internal motor parameters, parameters *9905*…*9909*, *1605*, *1607*, *5201*, nor any group *51 EXT COMM MODULE* and *53 EFB PROTOCOL* parameters.

  The source and target drives and their motor sizes do not need to be the same.
- Copy user set 1 parameters from the control panel to the drive (DOWNLOAD USER SET1). A user set includes group *99 START-UP DATA* parameters and the internal motor parameters.

  The function is only shown on the menu when user set 1 has been first saved using parameter *9902 APPLIC MACRO* (see section *user macros* on page *119*) and then uploaded to the control panel with UPLOAD TO PANEL.
- Copy user set 2 parameters from the control panel to the drive (DOWNLOAD USER SET2). As DOWNLOAD USER SET1 above.
- Copy user set 3 parameters from the control panel to the drive (DOWNLOAD USER SET3). As DOWNLOAD USER SET1 above.
- Start, stop, change the direction and switch between local and remote control.

How to upload and download parameters

For the upload and download functions available, see above. Note that the drive has to be in local control for uploading and downloading.

Step	Action	Display
1.	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing repeatedly EXIT until you get to the Main menu. – If REM is shown on the status line, press first LOC/REM to switch to local control.	LOC ↻MAIN MENU 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT 00:00 ENTER
2.	Go to the Par backup mode by selecting PAR BACKUP on the menu with keys ▲ and ▼, and pressing ENTER.	LOC ↻PAR BACKUP 1 UPLOAD TO PANEL BACKUP INFO DOWNLOAD FULL SET DOWNLOAD APPLICATION DOWNLOAD USER SET1 EXIT 00:00 SEL
3.	• To copy all parameters (including user sets and internal parameters) from the drive to the control panel, select UPLOAD TO PANEL on the Par backup menu with keys ▲ and ▼, and press SEL. During the transfer, the display shows the transfer status as a percentage of completion. Press ABORT if you want to stop the operation.	LOC ↻PAR BACKUP Copying parameters 50% ABORT 00:00
	After the upload is completed, the display shows a message about the completion. Press OK to return to the Par backup menu.	LOC ↻MESSAGE Parameter upload successful OK 00:00
	• To perform downloads, select the appropriate operation (here DOWNLOAD FULL SET is used as an example) on the Par backup menu with keys ▲ and ▼, and press SEL. The display shows the transfer status as a percentage of completion. Press ABORT if you want to stop the operation.	LOC ↻PAR BACKUP Downloading parameters (full set) 50% ABORT 00:00
	After the download is completed, the display shows a message about the completion. Press OK to return to the Par backup menu.	LOC ↻MESSAGE Parameter download successfully completed. OK 00:00

How to view information about the backup

Step	Action	Display
1.	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing repeatedly EXIT until you get to the Main menu.	LOC ↻MAIN MENU 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT 00:00 ENTER
2.	Go to the Par backup mode by selecting PAR BACKUP on the menu with keys ▲ and ▼, and pressing ENTER.	LOC ↻PAR BACKUP 1 UPLOAD TO PANEL BACKUP INFO DOWNLOAD FULL SET DOWNLOAD APPLICATION DOWNLOAD USER SET1 EXIT 00:00 SEL
3.	Select BACKUP INFO on the Par backup menu with keys ▲ and ▼, and press SEL. The display shows the following information about the drive where the backup was made: DRIVE TYPE: type of the drive *DRIVE RATING*: rating of the drive in format XXXYZ, where XXX: Nominal current rating. If present, an “A” indicates a decimal point, eg, 9A7 means 9.7 A. Y: 2 = 200 V 4 = 400 V Z: i = European loading package n = US loading package *FIRMWARE*: firmware version of the drive. You can scroll the information with keys ▲ and ▼.	LOC ↻BACKUP INFO DRIVE TYPE ACS355 3304 DRIVE RATING 9A74i 3301 FIRMWARE EXIT 00:00 LOC ↻BACKUP INFO ACS355 3304 DRIVE RATING 9A74i 3301 FIRMWARE 241A hex EXIT 00:00
4.	Press EXIT to return to the Par backup menu.	LOC ↻PAR BACKUP 1 UPLOAD TO PANEL BACKUP INFO DOWNLOAD FULL SET DOWNLOAD APPLICATION DOWNLOAD USER SET1 EXIT 00:00 SEL

I/O settings mode

In the I/O settings mode, you can:

- check the parameter settings related to any I/O terminal
- edit the parameter setting. For example, if “1103: REF1” is listed under Ain1 (Analog input 1), that is, parameter *1103 REF1 SELECT* has value *AI1*, you can change its value to, eg, *AI2*. You cannot, however, set the value of parameter *1106 REF2 SELECT* to *AI1*.
- start, stop, change the direction and switch between local and remote control.

How to edit and change parameter settings related to I/O terminals

Step	Action	Display
1.	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing repeatedly EXIT until you get to the Main menu.	LOC ↻MAIN MENU 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT 00:00 ENTER
2.	Go to the I/O settings mode by selecting I/O SETTINGS on the menu with keys ▲ and ▼, and pressing ENTER.	LOC ↻I/O SETTINGS 1 DIGITAL INPUTS (DI) ANALOG INPUTS (AI) RELAY OUTPUTS (ROUT) ANALOG OUTPUTS (AOUT) PANEL EXIT 00:00 SEL
3.	Select the I/O group, eg, DIGITAL INPUTS, with keys ▲ and ▼, and press SEL. After a brief pause, the display shows the current settings for the selection.	LOC ↻I/O SETTINGS -DI1- 1001:START/STOP (E1) -DI2- 1001:DIR (E1) -DI3- EXIT 00:00
4.	Select the setting (line with a parameter number) with keys ▲ and ▼, and press EDIT.	LOC ↻PAR EDIT 1001 EXT1 COMMANDS DI1,2 [2] CANCEL 00:00 SAVE
5.	Specify a new value for the setting with keys ▲ and ▼. Pressing the key once increments or decrements the value. Holding the key down changes the value faster. Pressing the keys simultaneously replaces the displayed value with the default value.	LOC ↻PAR EDIT 1001 EXT1 COMMANDS DI1P,2P [3] CANCEL 00:00 SAVE
6.	• To save the new value, press SAVE. • To cancel the new value and keep the original, press CANCEL.	LOC ↻I/O SETTINGS -DI1- 1001:START PLS(E1) -DI2- 1001:STOP PLS (E1) -DI3- EXIT 00:00

10

Application macros

What this chapter contains

The chapter describes the application macros. For each macro, there is a wiring diagram showing the default control connections (digital and analog I/O). The chapter also explains how to save a user macro and how to recall it.

Overview of macros

Application macros are pre-programmed parameter sets. While starting up the drive, the user typically selects one of the macros - the one that is best suited for the purpose - with parameter *9902 APPLIC MACRO*, makes the essential changes and saves the result as a user macro.

The ACS355 has eight standard macros and three user macros. The table below contains a summary of the macros and describes suitable applications.

Macro	Suitable applications
ABB standard	Ordinary speed control applications where no, one, two or three constant speeds are used. Start/stop is controlled with one digital input (level start and stop). It is possible to switch between two acceleration and deceleration times.
3-wire	Ordinary speed control applications where no, one, two or three constant speeds are used. The drive is started and stopped with push buttons.
Alternate	Speed control applications where no, one, two or three constant speeds are used. Start, stop and direction are controlled by two digital inputs (combination of the input states determines the operation).
Motor potentiometer	Speed control applications where no or one constant speed is used. The speed is controlled by two digital inputs (increase / decrease / keep unchanged).

Macro	Suitable applications
Hand/Auto	Speed control applications where switching between two control devices is needed. Some control signal terminals are reserved for one device, the rest for the other. One digital input selects between the terminals (devices) in use.
PID control	Process control applications, for example different closed loop control systems such as pressure control, level control and flow control. It is possible to switch between process and speed control: Some control signal terminals are reserved for process control, others for speed control. One digital input selects between process and speed control.
Torque control	Torque control applications. It is possible to switch between torque and speed control: Some control signal terminals are reserved for torque control, others for speed control. One digital input selects between torque and speed control.
AC500 Modbus	Applications that require a complex control logic and when several drives are connected together through a Modbus link. AC500-eCo PLC is used for controlling and monitoring the system.
User	The user can save the customized standard macro, ie, the parameter settings including group *99 START-UP DATA*, and the results of the motor Identification run into the permanent memory, and recall the data at a later time. For example, three user macros can be used when switching between three different motors is required.

Summary of the I/O connections of the application macros

The following table gives the summary of the default I/O connections of all application macros.

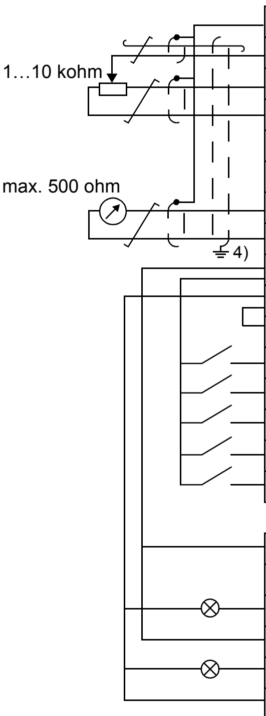
Input/ output	**Macro**						
	ABB standard	**3-wire**	**Alternate**	**Motor potentiom.**	**Hand/Auto**	**PID control**	**Torque control**
AI1 (0…10 V)	Freq. ref.	Speed ref.	Speed ref.	-	Speed ref. (Hand)	Proc. ref. (PID) / Freq. ref. (Hand)	Speed ref. (Speed)
AI2 (0…20 mA)	-	-	-	-	Speed ref. (Auto)	Process value	Torque ref. (Torque)
AO	Output freq.	Speed	Speed	Speed	Speed	Speed	Speed
DI1	Stop/Start	Start (pulse)	Start (fwd)	Stop/Start	Stop/Start (Hand)	Stop/Start (PID)	Stop/Start (Speed)
DI2	Fwd/Rev	Stop (pulse)	Start (rev)	Fwd/Rev	Fwd/Rev (Hand)	PID/Hand	Fwd/Rev
DI3	Const. speed input 1	Fwd/Rev	Const. speed input 1	Speed ref. up	Hand/Auto	Const. speed 1	Speed/ Torque
DI4	Const. speed input 2	Const. speed input 1	Const. speed input 2	Speed ref. down	Fwd/Rev (Auto)	Run enable	Const. speed 1
DI5	Ramp pair selection	Const. speed input 2	Ramp pair selection	Const. speed 1	Stop/Start (Auto)	Stop/Start (Hand)	Ramp pair selection
RO	Fault (-1)	Fault (-1)	Fault (-1)	Fault (-1)	Fault (-1)	Fault (-1)	Fault (-1)
DO	Fault (-1)	Fault (-1)	Fault (-1)	Fault (-1)	Fault (-1)	Fault (-1)	Fault (-1)

ABB standard macro

This is the default macro. It provides a general purpose I/O configuration with three constant speeds. Parameter values are the default values given in section *Parameters* on page *191*.

If you use other than the default connections presented below, see section *I/O terminals* on page *53*.

Default I/O connections



X1A

1	SCR	Signal cable shield (screen)
2	AI1	**Output frequency reference**: 0…10 V 1)
3	GND	Analog input circuit common
4	+10V	Reference voltage: +10 V DC, max. 10 mA
5	AI2	Not in use by default. 0…10 V
6	GND	Analog input circuit common
7	AO	**Output frequency value**: 0…20 mA
8	GND	Analog output circuit common
9	+24V	Auxiliary voltage output: +24 V DC, max. 200 mA
10	GND	Auxiliary voltage output common
11	DCOM	Digital input common
12	DI1	**Stop (0) / Start (1)**
13	DI2	**Forward (0) / Reverse (1)**
14	DI3	**Constant speed selection** 2)
15	DI4	**Constant speed selection** 2)
16	DI5	**Acceleration and deceleration selection** 3)

X1B

17	ROCOM	Relay output 1 **No fault [Fault (-1)]**
18	RONC	
19	RONO	
20	DOSRC	Digital output, max. 100 mA **No fault [Fault (-1)]**
21	DOOUT	
22	DOGND	

1) AI1 is used as a speed reference if vector mode is selected.

2) See parameter group *12 CONSTANT SPEEDS*:

DI3	DI4	Operation (parameter)
0	0	Set speed through AI1
1	0	Speed 1 (*1202*)
0	1	Speed 2 (*1203*)
1	1	Speed 3 (*1204*)

3) 0 = ramp times according to parameters *2202* and *2203*.
1 = ramp times according to parameters *2205* and *2206*.

4) 360 degree grounding under a clamp.

Tightening torque: 0.4 N·m / 3.5 lbf·in.

Safe torque off connections (X1C:STO; not shown in the diagram) are jumpered by default.

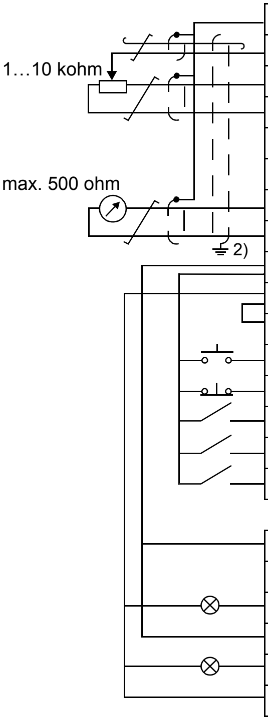
3-wire macro

This macro is used when the drive is controlled using momentary push-buttons. It provides three constant speeds. To enable the macro, set the value of parameter *9902 APPLIC MACRO* to 2 (*3-WIRE*).

For the parameter default values, see section *Default values with different macros* on page *180*. If you use other than the default connections presented below, see section *I/O terminals* on page *53*.

Note: When the stop input (DI2) is deactivated (no input), the control panel start and stop buttons are disabled.

Default I/O connections



X1A

1	SCR	Signal cable shield (screen)
2	AI1	**Motor speed reference**: 0…10 V
3	GND	Analog input circuit common
4	+10V	Reference voltage: +10 V DC, max. 10 mA
5	AI2	Not in use by default. 0…10 V
6	GND	Analog input circuit common
7	AO	**Motor speed value**: 0…20 mA
8	GND	Analog output circuit common
9	+24V	Auxiliary voltage output: +24 V DC, max. 200 mA
10	GND	Auxiliary voltage output common
11	DCOM	Digital input common
12	DI1	**Start (pulse)**
13	DI2	**Stop (pulse)**
14	DI3	**Forward (0) / Reverse (1)**
15	DI4	**Constant speed selection** 1)
16	DI5	**Constant speed selection** 1)

X1B

17	ROCOM	Relay output 1 **No fault [Fault (-1)]**
18	RONC	
19	RONO	
20	DOSRC	Digital output, max. 100 mA **No fault [Fault (-1)]**
21	DOOUT	
22	DOGND	

1) See parameter group *12 CONSTANT SPEEDS*:

DI4	DI5	Operation (parameter)
0	0	Set speed through AI1
1	0	Speed 1 (*1202*)
0	1	Speed 2 (*1203*)
1	1	Speed 3 (*1204*)

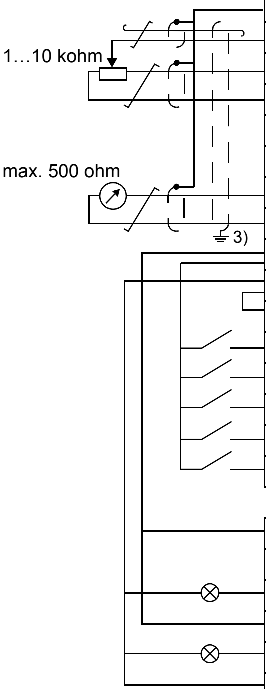
2) 360 degree grounding under a clamp.
Tightening torque: 0.4 N·m / 3.5 lbf·in.
Safe torque off connections (X1C:STO; not shown in the diagram) are jumpered by default.

Alternate macro

This macro provides an I/O configuration adapted to a sequence of DI control signals used when alternating the rotation direction of the motor. To enable the macro, set the value of parameter *9902 APPLIC MACRO* to 3 (*ALTERNATE*).

For the parameter default values, see section *Default values with different macros* on page *180*. If you use other than the default connections presented below, see section *I/O terminals* on page *53*.

Default I/O connections



X1A

1	SCR	Signal cable shield (screen)
2	AI1	**Motor speed reference**: 0…10 V
3	GND	Analog input circuit common
4	+10V	Reference voltage: +10 V DC, max. 10 mA
5	AI2	Not in use by default. 0…10 V
6	GND	Analog input circuit common
7	AO	**Motor speed value**: 0…20 mA
8	GND	Analog output circuit common
9	+24V	Auxiliary voltage output: +24 V DC, max. 200 mA
10	GND	Auxiliary voltage output common
11	DCOM	Digital input common
12	DI1	**Start forward**: If DI1 = DI2, the drive stops.
13	DI2	**Start reverse**
14	DI3	**Constant speed selection** 1)
15	DI4	**Constant speed selection** 1)
16	DI5	**Acceleration and deceleration selection** 2)

X1B

17	ROCOM	Relay output 1 **No fault [Fault (-1)]**
18	RONC	
19	RONO	
20	DOSRC	Digital output, max. 100 mA **No fault [Fault (-1)]**
21	DOOUT	
22	DOGND	

1) See parameter group *12 CONSTANT SPEEDS*:

DI3	DI4	Operation (parameter)
0	0	Set speed through AI1
1	0	Speed 1 (*1202*)
0	1	Speed 2 (*1203*)
1	1	Speed 3 (*1204*)

2) 0 = ramp times according to parameters *2202* and *2203*.
1 = ramp times according to parameters *2205* and *2206*.

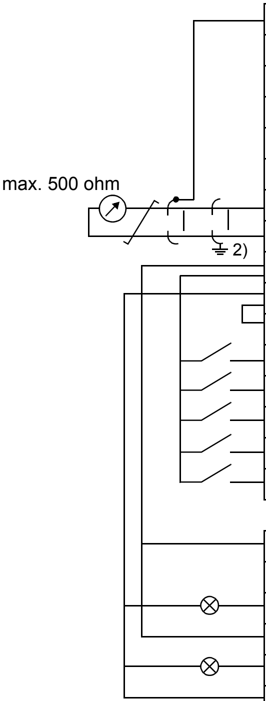
3) 360 degree grounding under a clamp.
Tightening torque: 0.4 N·m / 3.5 lbf·in.
Safe torque off connections (X1C:STO; not shown in the diagram) are jumpered by default.

Motor potentiometer macro

This macro provides a cost-effective interface for PLCs that vary the speed of the motor using only digital signals. To enable the macro, set the value of parameter *9902 APPLIC MACRO* to 4 (*MOTOR POT*).

For the parameter default values, see section *Default values with different macros* on page *180*. If you use other than the default connections presented below, see section *I/O terminals* on page *53*.

Default I/O connections



X1A

1	SCR	Signal cable shield (screen)
2	AI1	Not in use by default. 0…10 V
3	GND	Analog input circuit common
4	+10V	Reference voltage: +10 V DC, max. 10 mA
5	AI2	Not in use by default. 0…10 V
6	GND	Analog input circuit common
7	AO	**Motor speed value**: 0…20 mA
8	GND	Analog output circuit common
9	+24V	Auxiliary voltage output: +24 V DC, max. 200 mA
10	GND	Auxiliary voltage output common
11	DCOM	Digital input common
12	DI1	**Stop (0) / Start (1)**
13	DI2	**Forward (0) / Reverse (1)**
14	DI3	**Speed reference up** [1]
15	DI4	**Speed reference down** [1]
16	DI5	**Constant speed 1:** parameter *1202*

X1B

17	ROCOM	Relay output 1 **No fault [Fault (-1)]**
18	RONC	
19	RONO	
20	DOSRC	Digital output, max. 100 mA **No fault [Fault (-1)]**
21	DOOUT	
22	DOGND	

[1] If DI3 and DI4 are both active or inactive, the speed reference is unchanged.
The existing speed reference is stored during stop and power down.

[2] 360 degree grounding under a clamp.
Tightening torque: 0.4 N·m / 3.5 lbf·in.
Safe torque off connections (X1C:STO; not shown in the diagram) are jumpered by default.

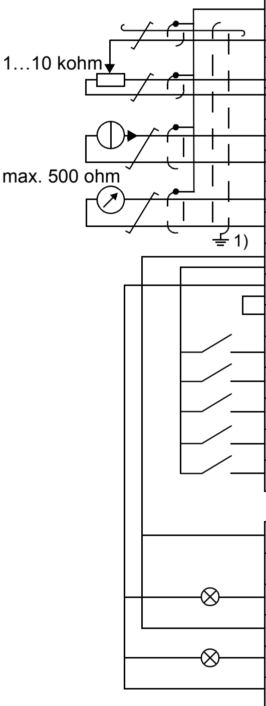
Hand/Auto macro

This macro can be used when switching between two external control devices is needed. To enable the macro, set the value of parameter *9902 APPLIC MACRO* to 5 (*HAND/AUTO*).

For the parameter default values, see section *Default values with different macros* on page *180*. If you use other than the default connections presented below, see section *I/O terminals* on page *53*.

Note: Parameter *2108 START INHIBIT* must remain in the default setting 0 (*OFF*).

Default I/O connections



Terminal	Name	Description
X1A		
1	SCR	Signal cable shield (screen)
2	AI1	**Motor speed reference (Hand)**: 0…10 V
3	GND	Analog input circuit common
4	+10V	Reference voltage: +10 V DC, max. 10 mA
5	AI2	**Motor speed reference (Auto)**: 0…20 mA [2)]
6	GND	Analog input circuit common
7	AO	**Motor speed value**: 0…20 mA
8	GND	Analog output circuit common
9	+24V	Auxiliary voltage output: +24 V DC, max. 200 mA
10	GND	Auxiliary voltage output common
11	DCOM	Digital input common
12	DI1	**Stop (0) / Start (1) (Hand)**
13	DI2	**Forward (0) / Reverse (1) (Hand)**
14	DI3	**Hand (0) / Auto (1) control selection**
15	DI4	**Forward (0) / Reverse (1) (Auto)**
16	DI5	**Stop (0) / Start (1) (Auto)**
X1B		
17	ROCOM	Relay output 1 **No fault [Fault (-1)]**
18	RONC	
19	RONO	
20	DOSRC	Digital output, max. 100 mA **No fault [Fault (-1)]**
21	DOOUT	
22	DOGND	

1) 360 degree grounding under a clamp.

2) The signal source is powered externally. See the manufacturer's instructions. To use sensors supplied by the drive aux. voltage output, see page *55*.

Tightening torque: 0.4 N·m / 3.5 lbf·in.

Safe torque off connections (X1C:STO; not shown in the diagram) are jumpered by default.

PID control macro

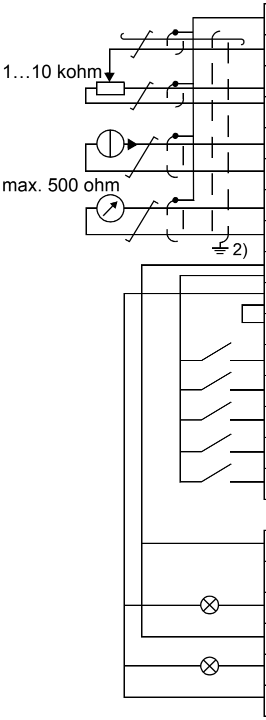
This macro provides parameter settings for closed-loop control systems such as pressure control, flow control, etc. Control can also be switched to speed control using a digital input. To enable the macro, set the value of parameter *9902 APPLIC MACRO* to 6 (*PID CONTROL*).

For the parameter default values, see section *Default values with different macros* on page *180*. If you use other than the default connections presented below, see section *I/O terminals* on page *53*.

Note: The default I/O connections described below are applicable to firmware version 5.050 or later. For the default values in earlier firmware versions, see Revision A of this user's manual.

Note: Parameter *2108 START INHIBIT* must remain in the default setting 0 (*OFF*).

Default I/O connections



X1A

1	SCR	Signal cable shield (screen)
2	AI1	**Proc. ref. (PID) / Motor freq. ref. (Hand)**: 0…10 V [1)]
3	GND	Analog input circuit common
4	+10V	Reference voltage: +10 V DC, max. 10 mA
5	AI2	**Process actual value**: 4…20 mA [3)]
6	GND	Analog input circuit common
7	AO	**Motor speed value**: 0…20 mA
8	GND	Analog output circuit common
9	+24V	Auxiliary voltage output: +24 V DC, max. 200 mA
10	GND	Auxiliary voltage output common
11	DCOM	Digital input common
12	DI1	**Stop (0) / Start (1) (PID)**
13	DI2	**PID (0) / Hand (1) control selection**
14	DI3	**Constant speed 1**: parameter *1202*
15	DI4	**Run enable**
16	DI5	**Stop (0) / Start (1) (Hand)**

X1B

17	ROCOM	Relay output 1 **No fault [Fault (-1)]**
18	RONC	
19	RONO	
20	DOSRC	Digital output, max. 100 mA **No fault [Fault (-1)]**
21	DOOUT	
22	DOGND	

1) Hand: 0…10 V -> speed reference.
PID: 0…10 V -> 0…100% PID setpoint.

2) 360 degree grounding under a clamp.

3) The signal source is powered externally. See the manufacturer's instructions. To use sensors supplied by the drive aux. voltage output, see page *55*.

Tightening torque: 0.4 N·m / 3.5 lbf·in.

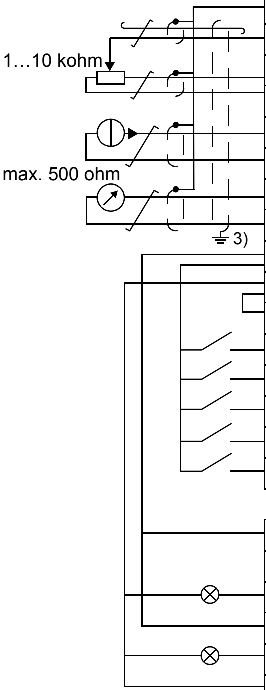
Safe torque off connections (X1C:STO; not shown in the diagram) are jumpered by default.

Torque control macro

This macro provides parameter settings for applications that require torque control of the motor. Control can also be switched to speed control using a digital input. To enable the macro, set the value of parameter *9902 APPLIC MACRO* to 8 (*TORQUE CTRL*).

For the parameter default values, see section *Default values with different macros* on page *180*. If you use other than the default connections presented below, see section *I/O terminals* on page *53*.

Default I/O connections



X1A

1	SCR	Signal cable shield (screen)
2	AI1	**Motor speed reference (Speed)**: 0…10 V
3	GND	Analog input circuit common
4	+10V	Reference voltage: +10 V DC, max. 10 mA
5	AI2	**Motor torque reference (Torque)**: 4…20 mA [4)]
6	GND	Analog input circuit common
7	AO	**Motor speed value**: 0…20 mA
8	GND	Analog output circuit common
9	+24V	Auxiliary voltage output: +24 V DC, max. 200 mA
10	GND	Auxiliary voltage output common
11	DCOM	Digital input common
12	DI1	**Stop (0) / Start (1) (Speed)**
13	DI2	**Forward (0) / Reverse (1)** [1)]
14	DI3	**Speed (0) / Torque (1) control selection**
15	DI4	**Constant speed 1**: parameter *1202*
16	DI5	**Acceleration and deceleration selection** [2)]

X1B

17	ROCOM	Relay output 1 **No fault [Fault (-1)]**
18	RONC	
19	RONO	
20	DOSRC	Digital output, max. 100 mA **No fault [Fault (-1)]**
21	DOOUT	
22	DOGND	

1) Speed control: Changes rotation direction.
Torque control: Changes torque direction.

2) 0 = ramp times according to parameters *2202* and *2203*.
1 = ramp times according to parameters *2205* and *2206*.

3) 360 degree grounding under a clamp.

4) The signal source is powered externally. See the manufacturer's instructions. To use sensors supplied by the drive aux. voltage output, see page *55*.

Tightening torque: 0.4 N·m / 3.5 lbf·in.

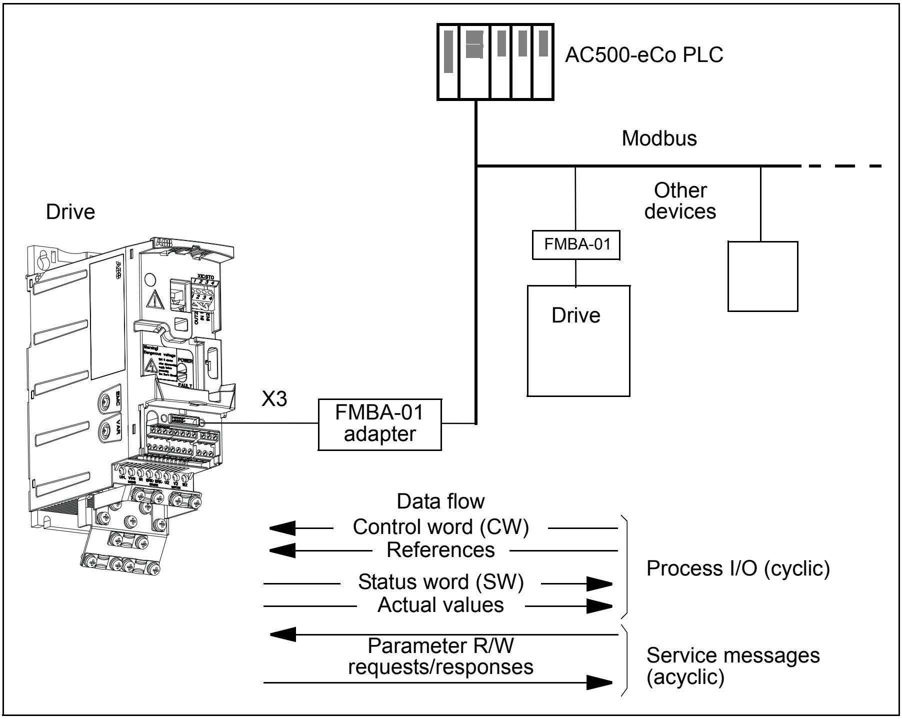
Safe torque off connections (X1C:STO; not shown in the diagram) are jumpered by default.

AC500 Modbus macro

The AC500 Modbus application macro configures the ACS355 drive communication and control parameters to be applicable with the pre-engineered Starter kit for AC500-eCo PLC and ACS355 drive over STD Modbus connection (FMBA-01 adapter).

The macro is available in ACS355 drives with firmware version 5.03C or later.

To activate the macro, set parameter *9902 APPLIC MACRO* to AC500 MODBUS (10).



The AC500 Modbus application macro default values for the drive parameters correspond to the ABB standard macro (parameter *9902*, value 1 (*ABB STANDARD*), see section *ABB standard macro* on page *110*), with the following differences:

No.	Name	Default value
1001	*EXT1 COMMANDS*	10 (*COMM*)
1102	*EXT1/EXT2 SEL*	8 (*COMM*)
1103	*REF1 SELECT*	8 (*COMM*)
1604	*FAULT RESET SEL*	8 (*COMM*)
2201	*ACC/DEC 1/2 SEL*	0 (*NOT SEL*)
3018	*COMM FAULT FUNC*	1 (*FAULT*)
5302	*EFB STATION ID*	2
5303	*EFB BAUD RATE*	192 (*19.2 kb/s*)
5304	*EFB PARITY*	1 (*8 NONE 1*)
5305	*EFB CTRL PROFILE*	2 (*ABB DRV FULL*)
5310	*EFB PAR 10*	101
5311	*EFB PAR 11*	303
5312	*EFB PAR 12*	305
9802	*COMM PROT SEL*	1 (*STD MODBUS*)

Note: The default slave address of the drive is 2 (parameter *5303 EFB STATION ID*), but if several drives are used, the address must be unique for each drive.

For more information regarding the Starter kit configuration, please refer to *AC500-eCo and ACS355 quick installation guide* (2CDC125145M0201 [English]), and *ACS355 and AC500-eCo application guide* (2CDC125152M0201 [English]).

User macros

In addition to the standard application macros, it is possible to create three user macros. The user macro allows the user to save the parameter settings, including group *99 START-UP DATA*, and the results of the motor identification into the permanent memory and recall the data at a later time. The panel reference is also saved if the macro is saved and loaded in local control. The remote control setting is saved into the user macro, but the local control setting is not.

The steps below show how to create and recall User macro 1. The procedure for the other two macros is identical, only the parameter *9902 APPLIC MACRO* values are different.

To create User macro 1:

- Adjust the parameters. Perform the motor identification if it is needed in the application but it is not done yet.
- Save the parameter settings and the results of the motor identification to the permanent memory by changing parameter *9902 APPLIC MACRO* to -1 (*USER S1 SAVE*).
- Press SAVE (assistant control panel) or MENU ENTER (basic control panel) to save.

To recall User macro 1:

- Change parameter *9902 APPLIC MACRO* to 0 (*USER S1 LOAD*).
- Press SAVE (assistant control panel) or MENU ENTER (basic control panel) to load.

The user macro can also be switched through digital inputs (see parameter *1605 USER PAR SET CHG*).

Note: User macro load restores the parameter settings, including group *99 START-UP DATA* and the results of the motor identification. Check that the settings correspond to the motor used.

Hint: The user can, for example, switch the drive between three motors without having to adjust the motor parameters and to repeat the motor identification every time the motor is changed. The user needs only to adjust the settings and perform the motor identification once for each motor and then to save the data as three user macros. When the motor is changed, only the corresponding user macro needs to be loaded, and the drive is ready to operate.

11

Program features

What this chapter contains

The chapter describes program features. For each feature, there is a list of related user settings, actual signals, and fault and alarm messages.

Start-up assistant

Introduction

The Start-up assistant (requires the assistant control panel) guides the user through the start-up procedure, helping to enter the requested data (parameter values) to the drive. The Start-up assistant also checks that the entered values are valid, ie, within the allowed range.

The Start-up assistant calls other assistants, each of which guides the user through the task of specifying a related parameter set. At the first start, the drive suggests entering the first task, Language select, automatically. The user may activate the tasks either one after the other as the Start-up assistant suggests, or independently. The user may also adjust the drive parameters in the conventional way without using the assistant at all.

See section *Assistants mode* on page 96 for how to start the Start-up assistant or other assistants.

Default order of the tasks

Depending on the selection made in the Application task (parameter *9902 APPLIC MACRO*), the Start-up assistant decides which consequent tasks it suggests. The default tasks are shown in the table below.

Application selection	Default tasks
ABB STANDARD	Language select, Motor set-up, Application, Option modules, Speed control EXT1, Speed control EXT2, Start/Stop control, Timed functions, Protections, Output signals
3-WIRE	Language select, Motor set-up, Application, Option modules, Speed control EXT1, Speed control EXT2, Start/Stop control, Timed functions, Protections, Output signals
ALTERNATE	Language select, Motor set-up, Application, Option modules, Speed control EXT1, Speed control EXT2, Start/Stop control, Timed functions, Protections, Output signals
MOTOR POT	Language select, Motor set-up, Application, Option modules, Speed control EXT1, Speed control EXT2, Start/Stop control, Timed functions, Protections, Output signals
HAND/AUTO	Language select, Motor set-up, Application, Option modules, Speed control EXT1, Speed control EXT2, Start/Stop control, Timed functions, Protections, Output signals
PID CONTROL	Language select, Motor set-up, Application, Option modules, PID control, Speed control EXT2, Start/Stop control, Timed functions, Protections, Output signals
TORQUE CTRL	Language select, Motor set-up, Application, Option modules, Speed control EXT2, Start/Stop control, Timed functions, Protections, Output signals
AC500 MODBUS	Language select, Motor set-up, Application, Option modules, Speed control EXT1, Speed control EXT2, Start/Stop control, Timed functions, Protections, Output signals

List of the tasks and the relevant drive parameters

Depending on the selection made in the Application task (parameter *9902 APPLIC MACRO*), the Start-up assistant decides which consequent tasks it suggests.

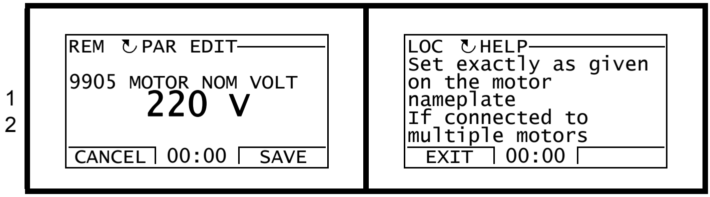
Name	Description	Set parameters
Language select	Selecting the language	*9901*
Motor set-up	Setting the motor data Performing the motor identification. (If the speed limits are not in the allowed range: Setting the limits.)	*9904*…*9909* *9910*
Application	Selecting the application macro	*9902*, parameters associated to the macro
Option modules	Activating the option modules	Group *35 MOTOR TEMP MEAS*, group *52 PANEL COMM* *9802*
Speed control EXT1	Selecting the source for the speed reference (If AI1 is used: Setting analog input AI1 limits, scale, inversion) Setting the reference limits Setting the speed (frequency) limits Setting the acceleration and deceleration times	*1103* (*1301*…*1303*, *3001*) *1104*, *1105* *2001*, *2002* (*2007*, *2008*) *2202*, *2203*
Speed control EXT2	Selecting the source for the speed reference (If AI1 is used: Setting analog input AI1 limits, scale, inversion) Setting the reference limits	*1106* (*1301*…*1303*, *3001*) *1107*, *1108*
Torque control	Selecting the source for the torque reference (If AI1 is used: Setting analog input AI1 limits, scale, inversion) Setting the reference limits	*1106* (*1301*…*1303*, *3001*) *1107*, *1108*
PID control	Selecting the source for the process reference (If AI1 is used: Setting analog input AI1 limits, scale, inversion) Setting the reference limits Setting the speed (frequency) limits Setting the source and limits for the process actual value	*1106* (*1301*…*1303*, *3001*) *1107*, *1108* *2001*, *2002* (*2007*, *2008*) *4016*, *4018*, *4019*

Name	Description	Set parameters
Start/Stop control	Selecting the source for start and stop signals of the two external control locations, EXT1 and EXT2	*1001*, *1002*
	Selecting between EXT1 and EXT2	*1102*
	Defining the direction control	*1003*
	Defining the start and stop modes	*2101…2103*
	Selecting the use of Run enable signal	*1601*
Protections	Setting the current and torque limits	*2003*, *2017*
Output signals	Selecting the signals indicated through relay output RO1 and, if MREL-01 output relay module is in use, RO2…RO4.	Group *14 RELAY OUTPUTS*
	Selecting the signals indicated through analog output AO	Group *15 ANALOG OUTPUTS*
	Setting the minimum, maximum, scaling and inversion	
Timed functions	Setting the timed functions	Group *36 TIMED FUNCTIONS*
	Selecting the timed start/stop control for external control locations EXT1 and EXT2	*1001*, *1002*
	Selecting timed EXT1/EXT2 control	*1102*
	Activation of timed constant speed 1	*1201*
	Selecting timed function status indicated through relay output RO1 or, if MREL-01 output relay module is in use, RO2…RO4.	*1401…1403*, *1410*
	Selecting timed PID1 parameter set 1/2 control	*4027*

Contents of the assistant displays

There are two types of displays in the Start-up assistant: Main displays and information displays. The main displays prompt the user to feed in information. The assistant steps through the main displays. The information displays contain help texts for the main displays. The figure below shows a typical example of both and explanations of the contents.

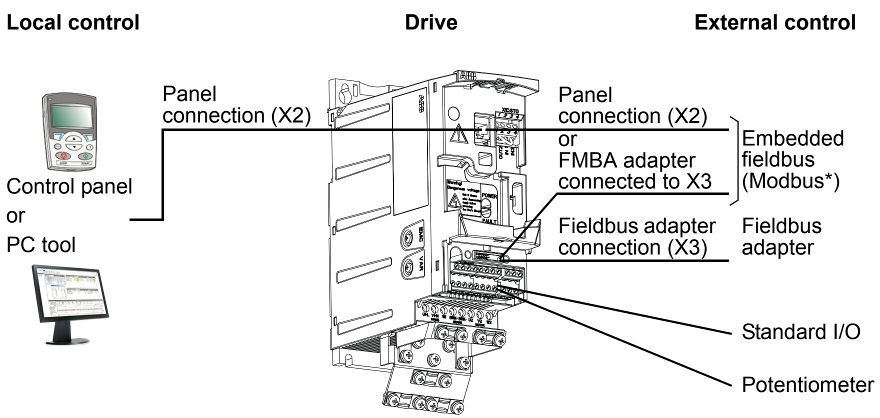
Main display **Information display**



1	Parameter	Help text …
2	Feed-in field	… help text continued

Local control vs. external control

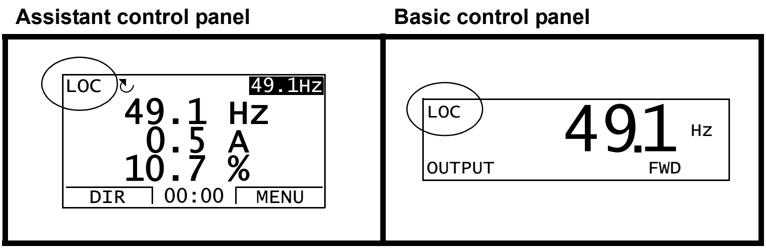
The drive can receive start, stop and direction commands and reference values from the control panel or through digital and analog inputs. Embedded fieldbus or an optional fieldbus adapter enables control over an open fieldbus link. A PC equipped with the DriveWindow Light 2 PC tool can also control the drive.



* With SREA-01 Ethernet adapter module it is possible to use Modbus TCP/IP with the Ethernet. For more information, see *SREA-01 Ethernet adapter module user's manual* (3AUA0000042896 [English]).

Local control

The control commands are given from the control panel keypad when the drive is in local control. LOC indicates local control on the panel display.

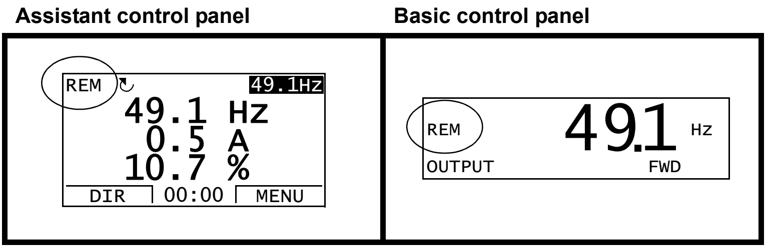


The control panel always overrides the external control signal sources when used in local control.

External control

When the drive is in external (remote) control, the commands are given through the standard I/O terminals (digital and analog inputs) and/or the fieldbus interface. In addition, it is also possible to set the control panel as the source for the external control.

External control is indicated with REM on the panel display.



The user can connect the control signals to two external control locations, *EXT1* or *EXT2*. Depending on the user selection, either one is active at a time. This function operates on a 2 ms time level.

Settings

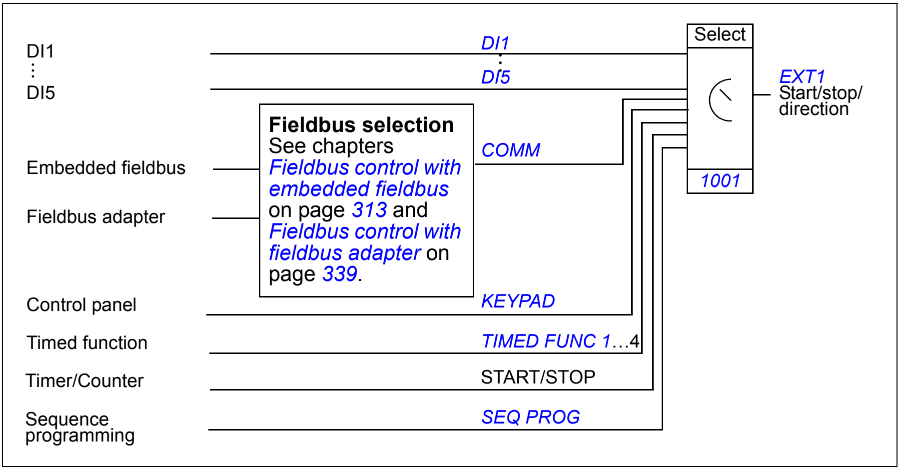
Panel key	**Additional information**
LOC/REM	Selection between local and external (remote) control
Parameter	
1102	Selection between *EXT1* and *EXT2*
1001/*1002*	Start, stop, direction source for *EXT1*/*EXT2*
1103/*1106*	Reference source for *EXT1*/*EXT2*

Diagnostics

Actual signal	**Additional information**
0111/*0112*	*EXT1*/*EXT2* reference

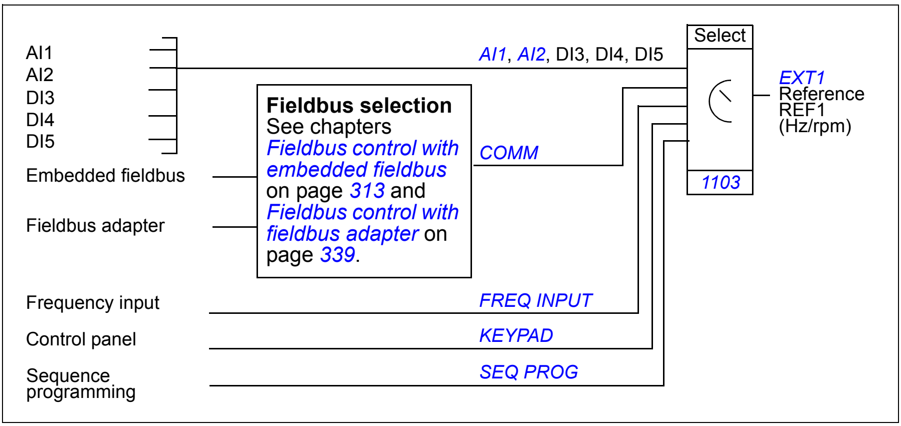
Block diagram: Start, stop, direction source for *EXT1*

The figure below shows the parameters that select the interface for start, stop, and direction for external control location *EXT1*.



Block diagram: Reference source for *EXT1*

The figure below shows the parameters that select the interface for the speed reference of external control location *EXT1*.



Reference types and processing

The drive can accept a variety of references in addition to the conventional analog input and control panel signals.

- The drive reference can be given with two digital inputs: One digital input increases the speed, the other decreases it.
- The drive can form a reference out of two analog input signals by using mathematical functions: addition, subtraction, multiplication and division.
- The drive can form a reference out of an analog input signal and a signal received through a serial communication interface by using mathematical functions: addition and multiplication.
- The drive reference can be given with frequency input.
- In external control location EXT1/2, the drive can form a reference out of an analog input signal and a signal received through Sequence programming by using a mathematical function: addition.

It is possible to scale the external reference so that the signal minimum and maximum values correspond to a speed other than the minimum and maximum speed limits.

Settings

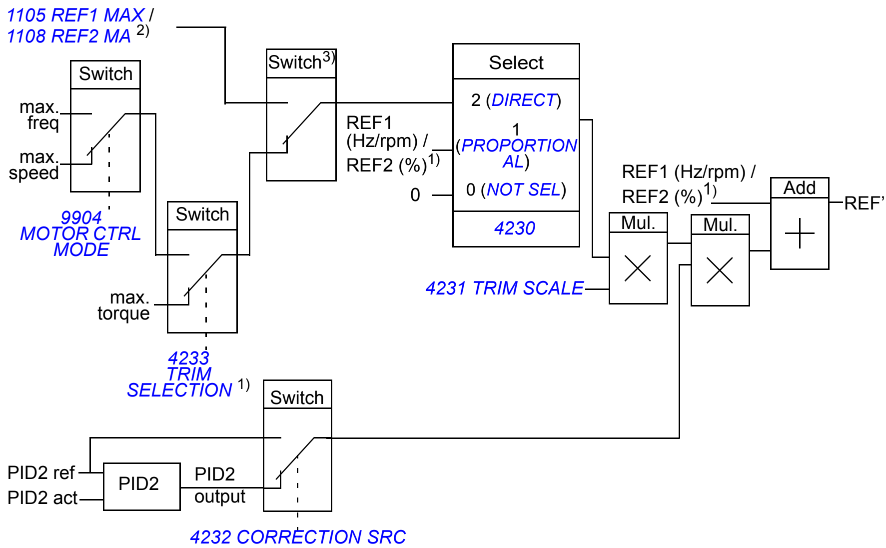
Parameter	**Additional information**
Group *11 REFERENCE SELECT*	External reference source, type and scaling
Group *20 LIMITS*	Operating limits
Group *22 ACCEL/DECEL*	Speed reference acceleration/deceleration ramps
Group *24 TORQUE CONTROL*	Torque reference ramp times
Group *32 SUPERVISION*	Reference supervision

Diagnostics

Actual signal	**Additional information**
0111/*0112*	REF1/REF2 reference
Group *03 FB ACTUAL SIGNALS*	References in different stages of the reference processing chain

Reference trimming

In reference trimming, the external reference is corrected depending on the measured value of a secondary application variable. The block diagram below illustrates the function.



REF1 (Hz/rpm) / REF2 (%) = Drive reference before trimming
REF' = Drive reference after trimming
max. speed = par. *2002* (or *2001* if the absolute value is greater)
max. freq = par. *2008* (or *2007* if the absolute value is greater)
max. torque = par. *2014* (or *2013* if the absolute value is greater)
PID2 ref = par. *4210*
PID2 act = par. *4214*…*4221*

1) **Note:** Torque reference trimming is only for external reference REF2 (%)

2) REF1 or REF2 depending on which is active. See parameter *1102*.

3) When par. *4232* = *PID2REF*, the maximum trimming reference is defined by parameter *1105* when REF1 is active and by parameter *1108* when REF2 is active.
When par. *4232* = *PID2OUTPUT*, the maximum trimming reference is defined by parameter *2002* if parameter *9904* value is *VECTOR: SPEED* or *VECTOR: TORQ* and by parameter *2008* value if parameter *9904* value is *SCALAR: FREQ*.

Settings

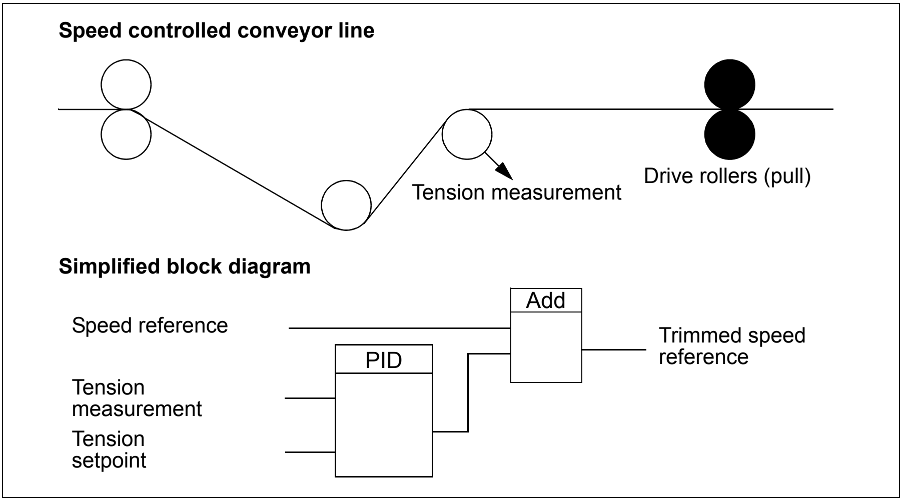
Parameter	Additional information
1102	REF1/2 selection
4230 …*4232*	Trimming function settings
4201 …*4229*	PID control settings
Group *20 LIMITS*	Drive operation limits

Example

The drive runs a conveyor line. It is speed controlled but the line tension also needs to be taken into account: If the measured tension exceeds the tension setpoint, the speed will be slightly decreased, and vice versa.

To accomplish the desired speed correction, the user

- activates the trimming function and connects the tension setpoint and the measured tension to it.
- tunes the trimming to a suitable level.



Programmable analog inputs

The drive has two programmable analog voltage/current inputs. The inputs can be inverted, filtered and the maximum and minimum values can be adjusted. The update cycle for the analog input is 8 ms (12 ms cycle once per second). The cycle time is shorter when information is transferred to the application program (8 ms -> 2 ms).

Settings

Parameter	**Additional information**
Group *11 REFERENCE SELECT*	AI as reference source
Group *13 ANALOG INPUTS*	Analog input processing
3001, *3021*, *3022*, *3107*	AI loss supervision
Group *35 MOTOR TEMP MEAS*	AI in motor temperature measurement
Groups *40 PROCESS PID SET 1* …*42 EXT / TRIM PID*	AI as PID process control reference or actual value source
8420, *8425*, *8426* *8430*, *8435*, *8436* … *8490*, *8495*, *8496*	AI as Sequence programming reference or trigger signal

Diagnostics

Actual signal	**Additional information**
0120, *0121*	Analog input values
1401	AI1/AI2 signal loss through RO 1
1402/*1403*/*1410*	AI1/AI2 signal loss through RO 2…4. With option MREL-01 only.
Alarm	
AI1 LOSS / *AI2 LOSS*	AI1/AI2 signal below limit *3021 AI1 FAULT LIMIT* / *3022 AI2 FAULT LIMIT*
Fault	
AI1 LOSS / *AI2 LOSS*	AI1/AI2 signal below limit *3021 AI1 FAULT LIMIT* / *3022 AI2 FAULT LIMIT*
PAR AI SCALE	Incorrect AI signal scaling (*1302* < *1301* or *1305* < *1304*)

Programmable analog output

One programmable current output (0…20 mA) is available. Analog output signal can be inverted, filtered and the maximum and minimum values can be adjusted. The analog output signals can be proportional to motor speed, output frequency, output current, motor torque, motor power, etc. The update cycle for the analog output is 2 ms.

Analog output can be controlled with Sequence programming. It is also possible to write a value to an analog output through a serial communication link.

Settings

Parameter	**Additional information**
Group *15 ANALOG OUTPUTS*	AO value selection and processing
Group *35 MOTOR TEMP MEAS*	AO in motor temperature measurement
8423/*8433*/…/*8493*	AO control with Sequence programming

Diagnostics

Actual signal	**Additional information**
0124	AO value
0170	AO control values defined by Sequence programming
Fault	
PAR AO SCALE	Incorrect AO signal scaling (*1503* < *1502*)

Programmable digital inputs

The drive has five programmable digital inputs. The update time for the digital inputs is 2 ms.

One digital input (DI5) can be programmed as a frequency input. See section *Frequency input* on page *135*.

Settings

Parameter	Additional information
Group *10 START/STOP/DIR*	DI as start, stop, direction
Group *11 REFERENCE SELECT*	DI in reference selection, or reference source
Group *12 CONSTANT SPEEDS*	DI in constant speed selection
Group *16 SYSTEM CONTROLS*	DI as external Run enable, fault reset or user macro change signal
Group *19 TIMER & COUNTER*	DI as timer or counter control signal source
2013, *2014*	DI as torque limit source
2109	DI as external emergency stop command source
2201	DI as acceleration and deceleration ramp selection signal
2209	DI as zero ramp force signal
3003	DI as external fault source
Group *35 MOTOR TEMP MEAS*	DI in motor temperature measurement
3601	DI as timed function enable signal source
3622	DI as booster activation signal source
4010/*4110*/*4210*	DI as PID controller reference signal source
4022/*4122*	DI as sleep function activation signal in PID1
4027	DI as PID1 parameter set 1/2 selection signal source
4228	DI as external PID2 function activation signal source
Group *84 SEQUENCE PROG*	DI as Sequence programming control signal source

Diagnostics

Actual signal	Additional information
0160	DI status
0414	DI status at the time the latest fault occurred

Programmable relay output

The drive has one programmable relay output. It is possible to add three additional relay outputs with the optional MREL-01 output relay module. For more information, see *MREL-01 output relay module user's manual* (3AUA0000035974 [English]).

With a parameter setting it is possible to choose what information to indicate through the relay output: Ready, running, fault, alarm, etc. The update time for the relay output is 2 ms.

A value can be written to a relay output through a serial communication link.

Settings

Parameter	**Additional information**
Group *14 RELAY OUTPUTS*	RO value selections and operation times
8423	RO control with Sequence programming

Diagnostics

Actual signal	**Additional information**
0134	RO Control word through fieldbus control
0162	RO 1 status
0173	RO 2…4 status. With option MREL-01 only.

Frequency input

Digital input DI5 can be programmed as a frequency input. Frequency input (0…16000 Hz) can be used as the external reference signal source. The update time for the frequency input is 50 ms. Update time is shorter when information is transferred to the application program (50 ms -> 2 ms).

Settings

Parameter	**Additional information**
Group *18 FREQ IN & TRAN OUT*	Frequency input minimum and maximum values and filtering
1103/*1106*	External reference REF1/2 through frequency input
4010, *4110*, *4210*	Frequency input as PID reference source

Diagnostics

Actual signal	**Additional information**
0161	Frequency input value

Transistor output

The drive has one programmable transistor output. The output can be used either as a digital output or frequency output (0…16000 Hz). The update time for the transistor/frequency output is 2 ms.

Settings

Parameter	Additional information
Group *18 FREQ IN & TRAN OUT*	Transistor output settings
8423	Transistor output control with Sequence programming

Diagnostics

Actual signal	Additional information
0163	Transistor output status
0164	Transistor output frequency

Actual signals

Several actual signals are available:

- Drive output frequency, current, voltage and power
- Motor speed and torque
- Intermediate circuit DC voltage
- Active control location (LOCAL, EXT1 or EXT2)
- Reference values
- Drive temperature
- Operating time counter (h), kWh counter
- Digital I/O and analog I/O status
- PID controller actual values.

Three signals can be shown simultaneously on the assistant control panel display (one signal on the basic control panel display). It is also possible to read the values through the serial communication link or through the analog outputs.

Settings

Parameter	Additional information
1501	Selection of an actual signal to AO
1808	Selection of an actual signal to frequency output
Group *32 SUPERVISION*	Actual signal supervision
Group *34 PANEL DISPLAY*	Selection of an actual signals to be displayed on the control panel

Diagnostics

Actual signal	Additional information
Groups *01 OPERATING DATA* … *04 FAULT HISTORY*	Lists of actual signals

Motor identification

The performance of vector control is based on an accurate motor model determined during the motor start-up.

A motor Identification magnetization is automatically performed the first time the start command is given. During this first start-up, the motor is magnetized at zero speed for several seconds to allow the motor model to be created. This identification method is suitable for most applications.

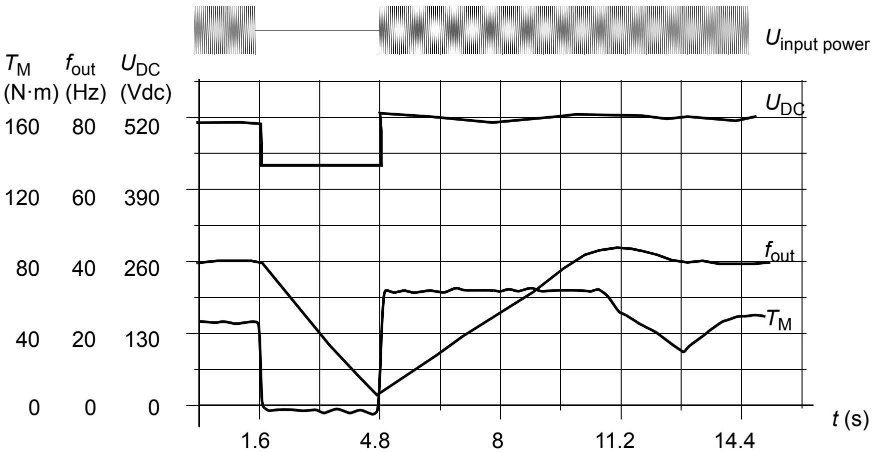
In demanding applications a separate Identification run (ID run) can be performed.

Settings

Parameter *9910 ID RUN*

Power loss ride-through

If the incoming supply voltage is cut off, the drive will continue to operate by utilizing the kinetic energy of the rotating motor. The drive will be fully operational as long as the motor rotates and generates energy to the drive. The drive can continue the operation after the break if the main contactor remained closed.



U_{DC} = Intermediate circuit voltage of the drive, f_{out} = Output frequency of the drive, T_M = Motor torque

Loss of supply voltage at nominal load (f_{out} = 40 Hz). The intermediate circuit DC voltage drops to the minimum limit. The controller keeps the voltage steady as long as the input power is switched off. The drive runs the motor in generator mode. The motor speed falls but the drive is operational as long as the motor has enough kinetic energy.

Settings

Parameter *2006 UNDERVOLT CTRL*

DC magnetizing

When DC magnetizing is activated, the drive automatically magnetizes the motor before starting. This feature guarantees the highest possible break-away torque, up to 180% of the motor nominal torque. By adjusting the premagnetizing time, it is possible to synchronize the motor start and, eg, a mechanical brake release. The Automatic start feature and DC magnetizing cannot be activated at the same time.

Settings

Parameters *2101 START FUNCTION* and *2103 DC MAGN TIME*

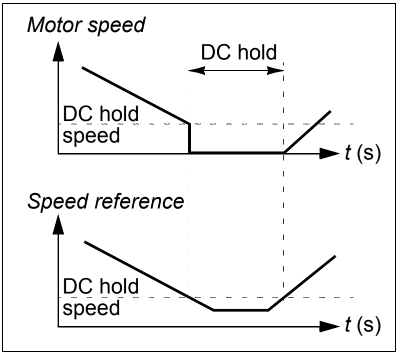
Maintenance trigger

A maintenance trigger can be activated to show a notice on the panel display when, eg, drive power consumption has exceeded the defined trigger point.

Settings

Parameter group *29 MAINTENANCE TRIG*

DC hold

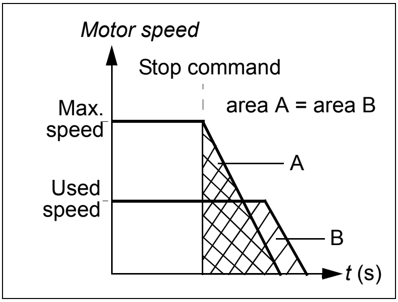


With the motor DC hold feature, it is possible to lock the rotor at zero speed. When both the reference and the motor speed fall below the preset DC hold speed, the drive stops the motor and starts to inject DC into the motor. When the reference speed again exceeds the DC hold speed, the normal drive operation resumes.

Settings

Parameters *2101*…*2106*

Speed compensated stop



Speed compensation stop is available, for example, for applications where a conveyor needs to travel a certain distance after receiving the stop command. At maximum speed, the motor is stopped normally along the defined deceleration ramp. Below maximum speed, stop is delayed by running the drive at current speed before the motor is ramped to a stop. As shown in the figure, the distance traveled after the stop command is the same in both cases, that is, area A equals area B.

Speed compensation can be restricted to forward or reverse rotating direction.

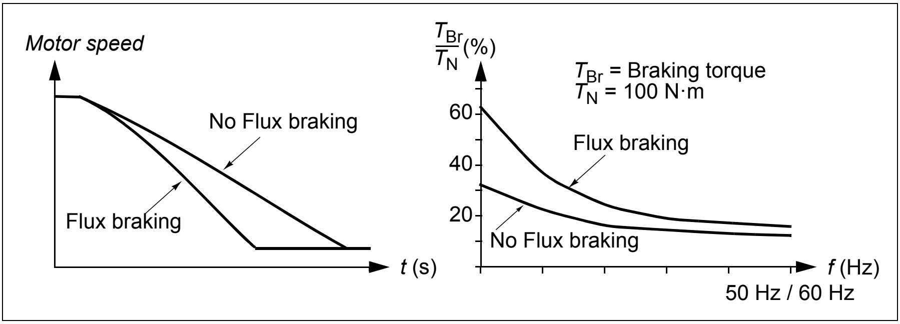
Note: The speed compensated stop feature is active only when the used speed is more than 10% of the maximum speed.

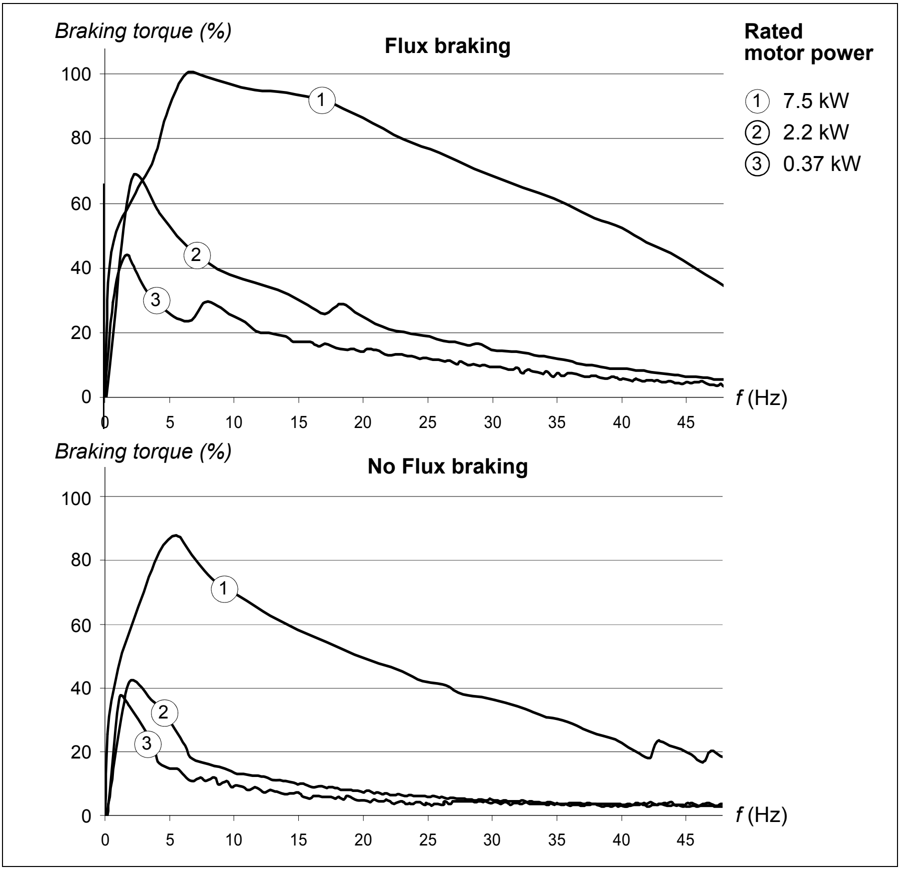
Settings

Parameter *2102 STOP FUNCTION*

Flux braking

The drive can provide greater deceleration by raising the level of magnetization in the motor. By increasing the motor flux, the energy generated by the motor during braking can be converted to motor thermal energy.





The drive monitors the motor status continuously, also during the Flux braking. Therefore, Flux braking can be used both for stopping the motor and for changing the speed. The other benefits of Flux braking are:

- The braking starts immediately after a stop command is given. The function does not need to wait for the flux reduction before it can start the braking.
- The cooling of the motor is efficient. The stator current of the motor increases during the Flux braking, not the rotor current. The stator cools much more efficiently than the rotor.

Settings

Parameter *2602 FLUX BRAKING*

Flux optimization

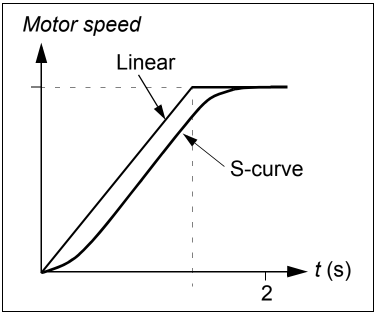
Flux optimization reduces the total energy consumption and motor noise level when the drive operates below the nominal load. The total efficiency (motor and the drive) can be improved by 1% to 10%, depending on the load torque and speed.

Settings

Parameter *2601 FLUX OPT ENABLE*

Acceleration and deceleration ramps

Two user-selectable acceleration and deceleration ramps are available. It is possible to adjust the acceleration/deceleration times and the ramp shape. Switching between the two ramps can be controlled through a digital input or fieldbus.



The available ramp shape alternatives are Linear and S-curve.

Linear shape is suitable for drives requiring steady or slow acceleration/deceleration.

S-curve shape is ideal for conveyors carrying fragile loads, or other applications where a smooth transition is required when changing the speed.

Settings

Parameter group *22 ACCEL/DECEL*

Sequence programming offers eight additional ramp times. See section *Sequence programming* on page *169*.

Critical speeds

Critical speeds function is available for applications where it is necessary to avoid certain motor speeds or speed bands because of, eg, mechanical resonance problems. The user can define three critical speeds or speed bands.

Settings

Parameter group *25 CRITICAL SPEEDS*

Constant speeds

It is possible to define seven positive constant speeds. Constant speeds are selected with digital inputs. Constant speed activation overrides the external speed reference.

Constant speed selections are ignored if

- torque control is active, or
- PID reference is being followed, or
- drive is in local control mode.

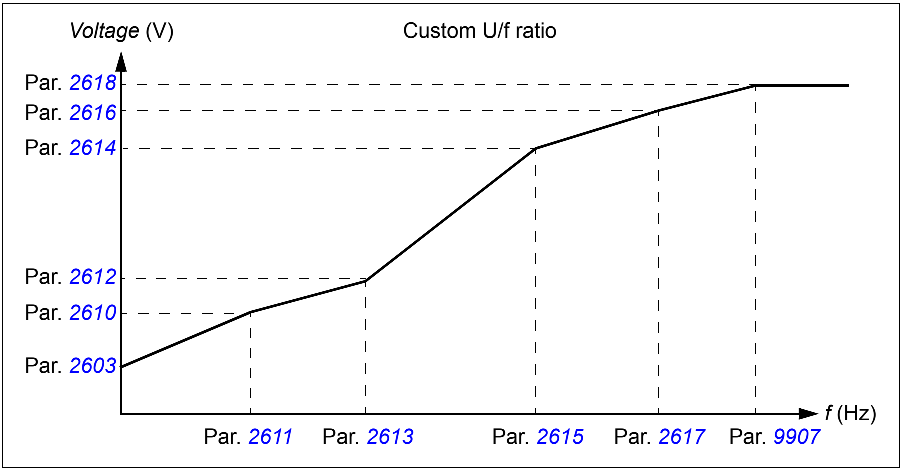
This function operates on a 2 ms time level.

Settings

Parameter	Additional information
Group *12 CONSTANT SPEEDS*	Constant speed settings
1207	Constant speed 6. Used also for jogging function. See section *Jogging* on page *162*.
1208	Constant speed 7. Used also for fault functions (see group *30 FAULT FUNCTIONS*) and for jogging function (see section *Jogging* on page *162*).

Custom U/f ratio

The user can define a U/f curve (output voltage as a function of frequency). This custom ratio is used only in special applications where linear and squared U/f ratio are not sufficient (eg, when motor break-away torque needs to be boosted).



Note: The U/f curve can be used in scalar control only, ie, when *9904 MOTOR CTRL MODE* setting is *SCALAR: FREQ*.

Note: The voltage and the frequency points of the U/f curve must fulfill the following requirements:

2610 < *2612* < *2614* < *2616* < *2618* and
2611 < *2613* < *2615* < *2617* < *9907*

WARNING! High voltage at low frequencies may result in poor performance or motor damage (overheating).

Settings

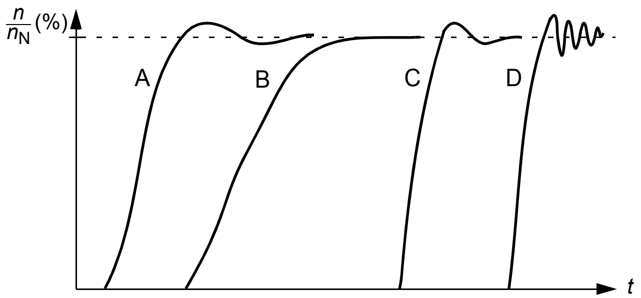
Parameter	Additional information
2605	Custom U/f ratio activation
2610…*2618*	Custom U/f ratio settings

Diagnostics

Fault	Additional information
PAR USER U/F	Incorrect U/f ratio

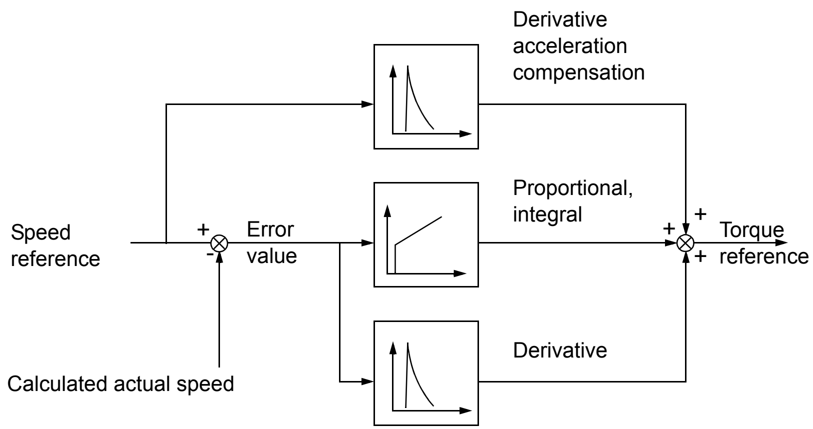
Speed controller tuning

It is possible to manually adjust the controller gain, integration time and derivation time, or let the drive perform a separate speed controller Autotune run (parameter *2305 AUTOTUNE RUN*). In Autotune run, the speed controller is tuned based on the load and inertia of the motor and the machine. The figure below shows speed responses at a speed reference step (typically, 1 to 20%).



A: Undercompensated
B: Normally tuned (autotuning)
C: Normally tuned (manually). Better dynamic performance than with B
D: Overcompensated speed controller

The figure below is a simplified block diagram of the speed controller. The controller output is the reference for the torque controller.



Note: The speed controller can be used in vector control, ie, when *9904 MOTOR CTRL MODE* setting is *VECTOR: SPEED* or *VECTOR: TORQ*.

Settings

Parameter groups *23 SPEED CONTROL* and *20 LIMITS*

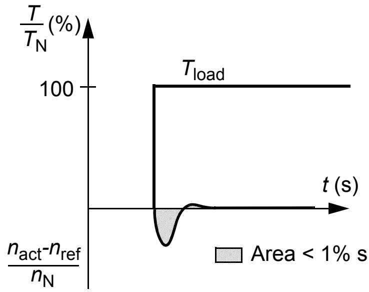
Diagnostics

Actual signal *0102 SPEED*

Speed control performance figures

The table below shows typical performance figures for speed control.

Speed control	No pulse encoder	With pulse encoder
Static accuracy	20% of motor nominal slip	2% of motor nominal slip
Dynamic accuracy	< 1% s with 100% torque step	< 1% s with 100% torque step

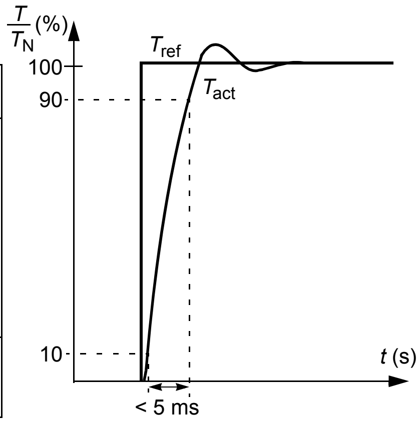


T_N = rated motor torque
n_N = rated motor speed
n_{act} = actual speed
n_{ref} = speed reference

Torque control performance figures

The drive can perform precise torque control without any speed feedback from the motor shaft. The table below shows typical performance figures for torque control.

Torque control	No pulse encoder	With pulse encoder
Non-linearity	± 5% with nominal torque (± 20% at the most demanding operating point)	± 5% with nominal torque
Torque step rise time	< 10 ms with nominal torque	< 10 ms with nominal torque



T_N = rated motor torque
T_{ref} = torque reference
T_{act} = actual torque

Scalar control

It is possible to select scalar control as the motor control method instead of vector control. In the scalar control mode, the drive is controlled with a frequency reference.

It is recommended to activate the scalar control mode in the following special applications:

- In multimotor drives: 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after the motor identification.
- If the nominal motor current is less than 20% of the nominal output current of the drive.
- When the drive is used for test purposes with no motor connected.

The scalar control mode is not recommended for permanent magnet synchronous motors.

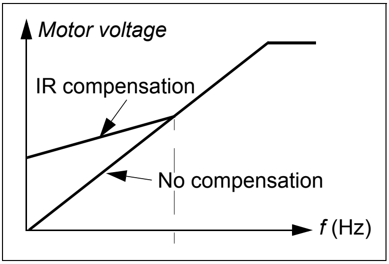
In the scalar control mode, some standard features are not available.

Settings

Parameter *9904 MOTOR CTRL MODE*

IR compensation for a scalar controlled drive

IR compensation is active only when the motor control mode is scalar (see section *Scalar control* on page *146*). When IR compensation is activated, the drive gives an extra voltage boost to the motor at low speeds. IR compensation is useful in applications that require high break-away torque. In vector control, no IR compensation is possible/needed.



Settings

Parameter *2603 IR COMP VOLT*

Programmable protection functions

AI<Min

AI<Min function defines the drive operation if an analog input signal falls below the set minimum limit.

Settings

Parameters *3001 AI<MIN FUNCTION*, *3021 AI1 FAULT LIMIT* and *3022 AI2 FAULT LIMIT*

Panel loss

Panel loss function defines the operation of the drive if the control panel selected as the control location for the drive stops communicating.

Settings

Parameter *3002 PANEL COMM ERR*

External fault

External faults (1 and 2) can be supervised by defining one digital input as a source for an external fault indication signal.

Settings

Parameters *3003 EXTERNAL FAULT 1* and *3004 EXTERNAL FAULT 2*

Stall protection

The drive protects the motor in a stall situation. It is possible to adjust the supervision limits (frequency, time) and choose how the drive reacts to the motor stall condition (alarm indication / fault indication & drive stop / no reaction).

Settings

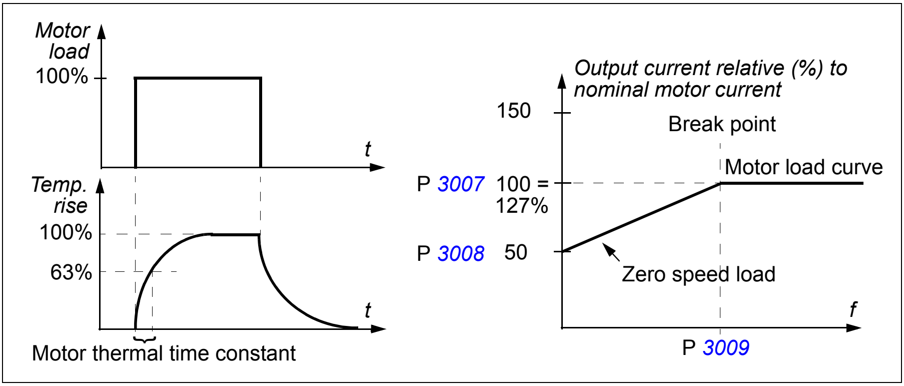
Parameters *3010 STALL FUNCTION*, *3011 STALL FREQUENCY* and *3012 STALL TIME*

Motor thermal protection

The motor can be protected against overheating by activating the Motor thermal protection function.

The drive calculates the temperature of the motor on the basis of the following assumptions:

- The motor is in the ambient temperature of 30 °C (86 °F) when power is applied to the drive.
- Motor temperature is calculated using either the user-adjustable or automatically calculated motor thermal time constant and motor load curve (see the figures below). The load curve should be adjusted if the ambient temperature exceeds 30 °C (86 °F).



Settings

Parameters *3005 MOT THERM PROT*, *3006 MOT THERM TIME*, *3007 MOT LOAD CURVE*, *3008 ZERO SPEED LOAD* and *3009 BREAK POINT FREQ*

Note: It is also possible to use the motor temperature measurement function. See section *Motor temperature measurement through the standard I/O* on page *157*.

Underload protection

Loss of motor load may indicate a process malfunction. The drive provides an underload function to protect the machinery and process in such a serious fault condition. Supervision limits - underload curve and underload time - can be specified as well as the action taken by the drive upon the underload condition (alarm indication / fault indication & drive stop / no reaction).

Settings

Parameters *3013 UNDERLOAD FUNC*, *3014 UNDERLOAD TIME* and *3015 UNDERLOAD CURVE*

Earth fault protection

The Earth fault protection detects earth faults in the motor or motor cable. The protection can be selected to be active during start and run or during start only.

An earth fault in the input power line does not activate the protection.

Settings

Parameter *3017 EARTH FAULT*

Incorrect wiring

Defines the operation when incorrect input power cable connection is detected.

Settings

Parameter *3023 WIRING FAULT*

Input phase loss

Input phase loss protection circuits supervise the input power cable connection status by detecting intermediate circuit ripple. If a phase is lost, the ripple increases.

Settings

Parameter *3016 SUPPLY PHASE*

Pre-programmed faults

Overcurrent

The overcurrent trip limit for the drive is 325% of the drive nominal current.

DC overvoltage

The DC overvoltage trip limit is 420 V (for 200 V drives) and 840 V (for 400 V drives).

DC undervoltage

The DC undervoltage trip limit is adaptive. See parameter *2006 UNDERVOLT CTRL*.

Drive temperature

The drive supervises the IGBT temperature. There are two supervision limits: Alarm limit and fault trip limit.

Short-circuit

If a short-circuit occurs, the drive will not start and a fault indication is given.

Internal fault

If the drive detects an internal fault, the drive is stopped and a fault indication is given.

Operation limits

The drive has adjustable limits for speed, current (maximum), torque (maximum) and DC voltage.

Settings

Parameter group *20 LIMITS*

Power limit

Power limitation is used to protect the input bridge and the DC intermediate circuit. If the maximum allowed power is exceeded, the drive torque is automatically limited. Maximum overload and continuous power limits depend on the drive hardware. For specific values, see chapter *Technical data* on page *373*.

Automatic resets

The drive can automatically reset itself after overcurrent, overvoltage, undervoltage, external and “analog input below a minimum” faults. The Automatic resets must be activated by the user.

Settings

Parameter	Additional information
Group *31 AUTOMATIC RESET*	Automatic reset settings

Diagnostics

Alarm	Additional information
AUTORESET	Automatic reset alarm

Supervisions

The drive monitors whether certain user selectable variables are within the user-defined limits. The user may set limits for speed, current etc. The supervision status can be indicated through relay or digital output.

The supervision functions operate on a 2 ms time level.

Settings

Parameter group *32 SUPERVISION*

Diagnostics

Actual signal	Additional information
1401	Supervision status through RO 1
1402/*1403*/*1410*	Supervision status through RO 2…4. With option MREL-01 only.
1805	Supervision status through DO
8425, *8426* / *8435*, *8436* /…/*8495*, *8496*	Sequence programming state change according to supervision functions

Parameter lock

The user can prevent parameter adjustment by activating the parameter lock.

Settings

Parameters *1602 PARAMETER LOCK* and *1603 PASS CODE*

PID control

There are two built-in PID controllers in the drive:

- Process PID (PID1) and
- External/Trim PID (PID2).

The PID controller can be used when the motor speed needs to be controlled based on process variables such as pressure, flow or temperature.

When the PID control is activated, a process reference (setpoint) is connected to the drive instead of a speed reference. An actual value (process feedback) is also brought back to the drive. The drive compares the reference and the actual values, and automatically adjusts the drive speed in order to keep the measured process quantity (actual value) at the desired level (reference).

The control operates on a 2 ms time level.

Process controller PID1

PID1 has two separate sets of parameters (*40 PROCESS PID SET 1*, *41 PROCESS PID SET 2*). Selection between parameter sets 1 and 2 is defined by a parameter.

In most cases when there is only one transducer signal wired to the drive, only parameter set 1 is needed. Two different parameter sets (1 and 2) are used, eg, when the load of the motor changes considerably in time.

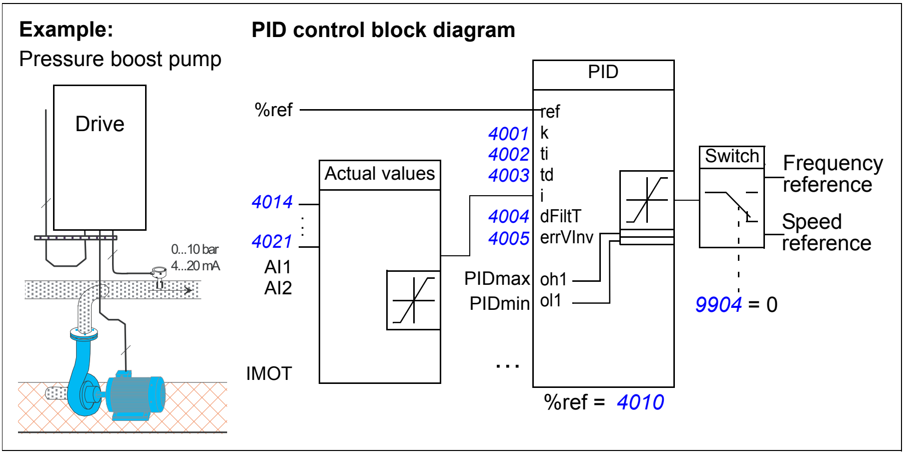
External/Trim controller PID2

PID2 (*42 EXT / TRIM PID*) can be used in two different ways:

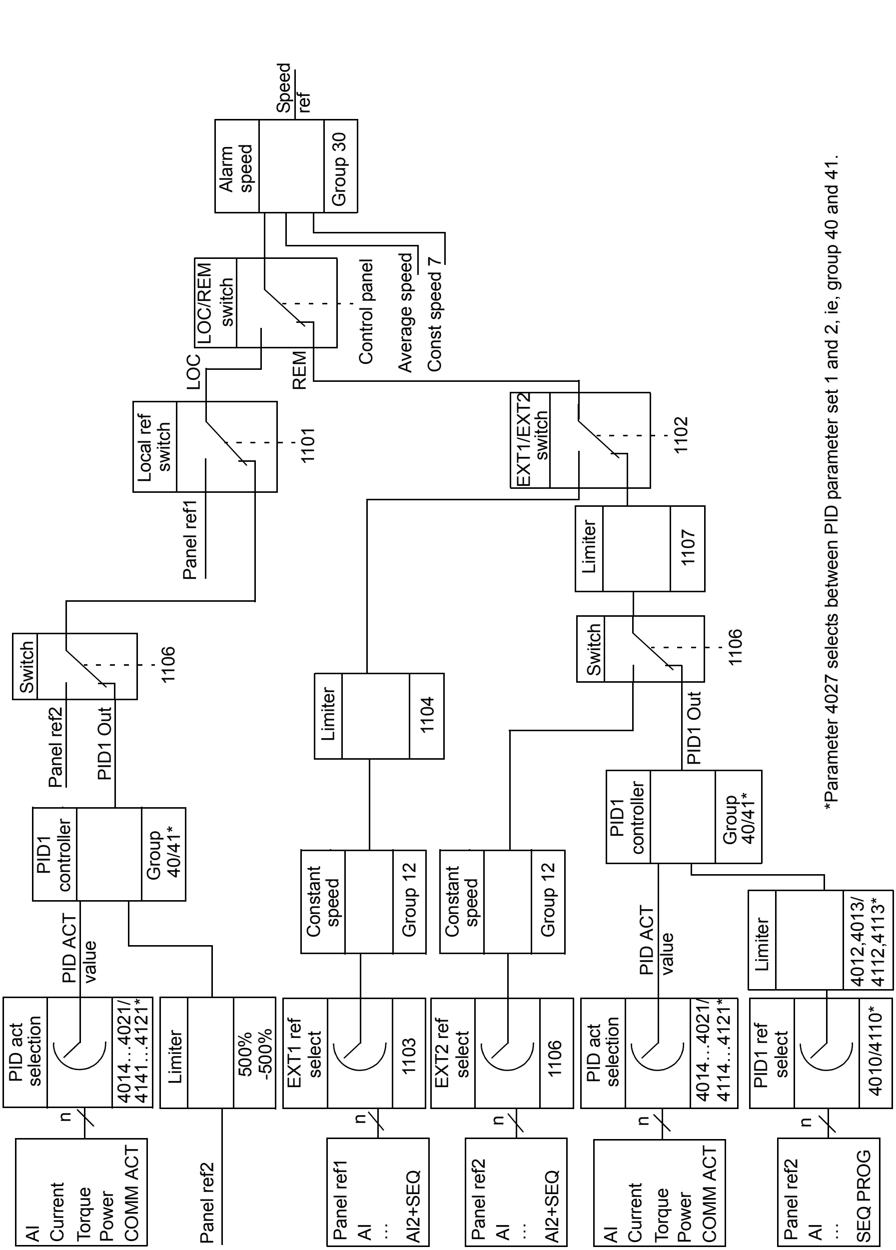
- External controller: Instead of using additional PID controller hardware, the user can connect PID2 output through drive analog output or fieldbus controller to control a field instrument like a damper or a valve.
- Trim controller: PID2 can be used to trim or fine tune the reference of the drive. See section *Reference trimming* on page *130*.

Block diagrams

The figure below shows an application example: The controller adjusts the speed of a pressure boost pump according to the measured pressure and the set pressure reference.



The following figure presents the speed/scalar control block diagram for process controller PID1.



*Parameter 4027 selects between PID parameter set 1 and 2, ie, group 40 and 41.

Settings

Parameter	Additional information
1101	Local control mode reference type selection
1102	*EXT1*/*EXT2* selection
1106	PID1 activation
1107	REF2 minimum limit
1501	PID2 output (external controller) connection to AO
9902	PID control macro selection
Groups *40 PROCESS PID SET 1*…*41 PROCESS PID SET 2*	PID1 settings
Group *42 EXT / TRIM PID*	PID2 settings

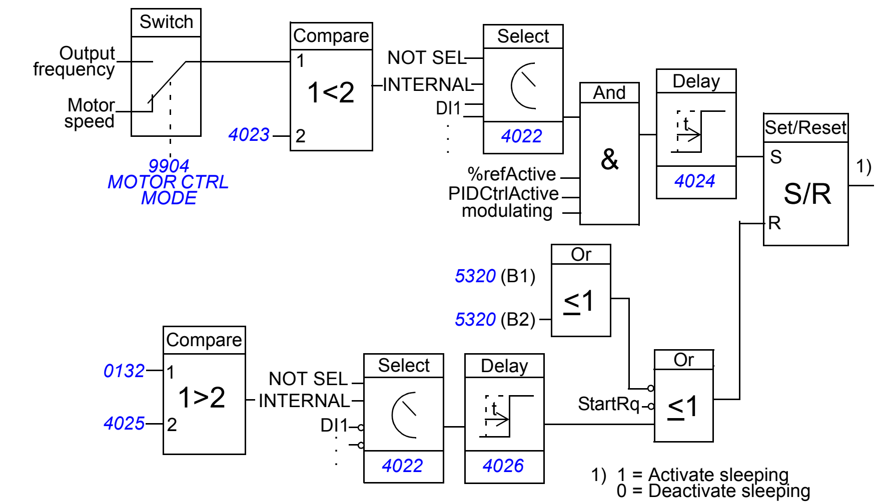
Diagnostics

Actual signal	Additional information
0126/*0127*	PID 1/2 output value
0128/*0129*	PID 1/2 setpoint value
0130/*0131*	PID 1/2 feedback value
0132/*0133*	PID 1/2 deviation
0170	AO value defined by Sequence programming

Sleep function for the process PID (PID1) control

The sleep function operates on a 2 ms time level.

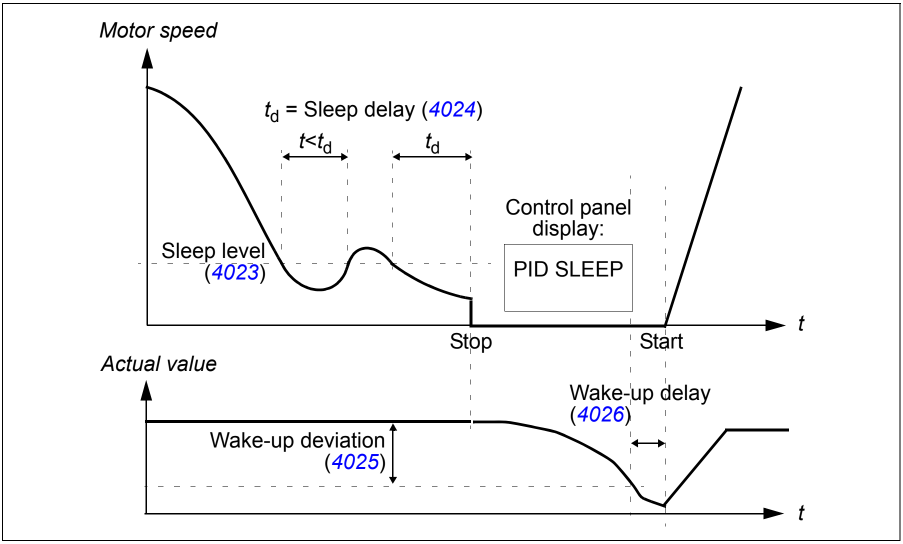
The block diagram below illustrates the sleep function enable/disable logic. The sleep function can be put into use only when the PID control is active.



Motor speed: Actual speed of the motor
%refActive: The % reference (EXT REF2) is in use. See parameter *1102 EXT1/EXT2 SEL*.
PIDCtrlActive: Parameter *9902 APPLIC MACRO* = *PID CONTROL*.
modulating: Drive IGBT control is operating.

Example

The time scheme below visualizes the operation of the sleep function.



Sleep function for a PID controlled pressure boost pump (when parameter *4022 SLEEP SELECTION* is set to *INTERNAL*): The water consumption falls at night. As a consequence, the PID process controller decreases the motor speed. However, due to natural losses in the pipes and the low efficiency of the centrifugal pump at low speeds, the motor does not stop but keeps rotating. The sleep function detects the slow rotation, and stops the unnecessary pumping after the sleep delay has passed. The drive shifts into sleep mode, still monitoring the pressure. The pumping restarts when the pressure falls under the allowed minimum level and the wake-up delay has passed.

Settings

Parameter	Additional information
9902	PID control activation
4022…*4026*, *4122*…*4126*	Sleep function settings

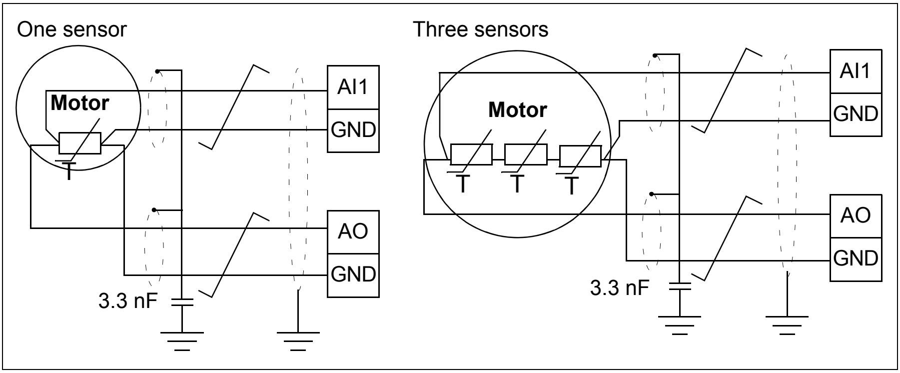
Diagnostics

Parameter	Additional information
1401	PID sleep function status through RO 1
1402/*1403*/*1410*	PID sleep function status through RO 2…4. With option MREL-01 only.
Alarm	**Additional information**
PID SLEEP	Sleep mode

Motor temperature measurement through the standard I/O

This section describes the temperature measurement of one motor when the drive I/O terminals are used as the connection interface.

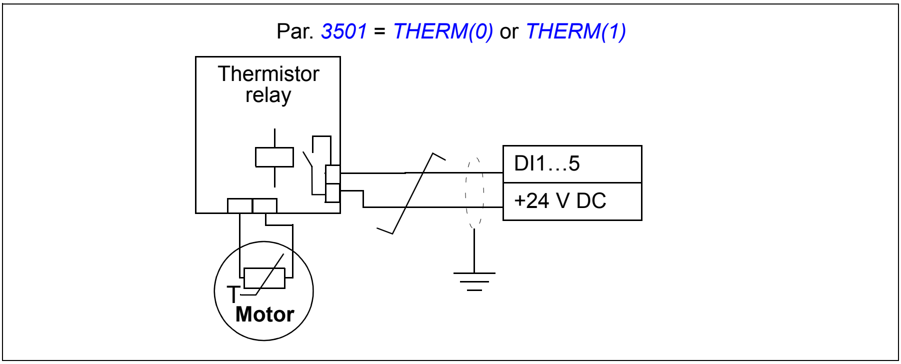
Motor temperature can be measured using Pt100 or PTC sensors connected to analog input and output.



WARNING! According to IEC 60664, the connection of the motor temperature sensor requires double or reinforced insulation between motor live parts and the sensor. Reinforced insulation entails a clearance and creepage distance of 8 mm (0.3 in) (400/500 V AC equipment).

If the assembly does not fulfill the requirement, the I/O board terminals must be protected against contact and they may not be connected to other equipment, or the temperature sensor must be isolated from the I/O terminals.

It is also possible to monitor motor temperature by connecting a PTC sensor and a thermistor relay between the +24 V DC voltage supply offered by the drive and a digital input. The figure below displays the connection.



WARNING! According to IEC 60664, the connection of the motor thermistor to the digital input requires double or reinforced insulation between motor live parts and the thermistor. Reinforced insulation entails a clearance and creeping distance of 8 mm (0.3 in) (400/500 V AC equipment).

If the thermistor assembly does not fulfill the requirement, the other I/O terminals of the drive must be protected against contact, or a thermistor relay must be used to isolate the thermistor from the digital input.

Settings

Parameter	Additional information
Group *13 ANALOG INPUTS*	Analog input settings
Group *15 ANALOG OUTPUTS*	Analog output settings
Group *35 MOTOR TEMP MEAS*	Motor temperature measurement settings
Other	
At the motor end the cable shield should be grounded through, eg, a 3.3 nF capacitor. If this is not possible, the shield is to be left unconnected.	

Diagnostics

Actual signal	Additional information
0145	Motor temperature
Alarm/Fault	**Additional information**
MOTOR TEMP/*MOT OVERTEMP*	Excessive motor temp

Control of a mechanical brake

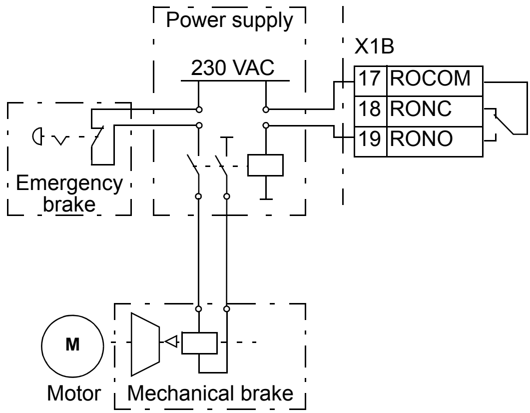
The mechanical brake is used for holding the motor and driven machinery at zero speed when the drive is stopped, or not powered.

Example

The figure below shows a brake control application example.

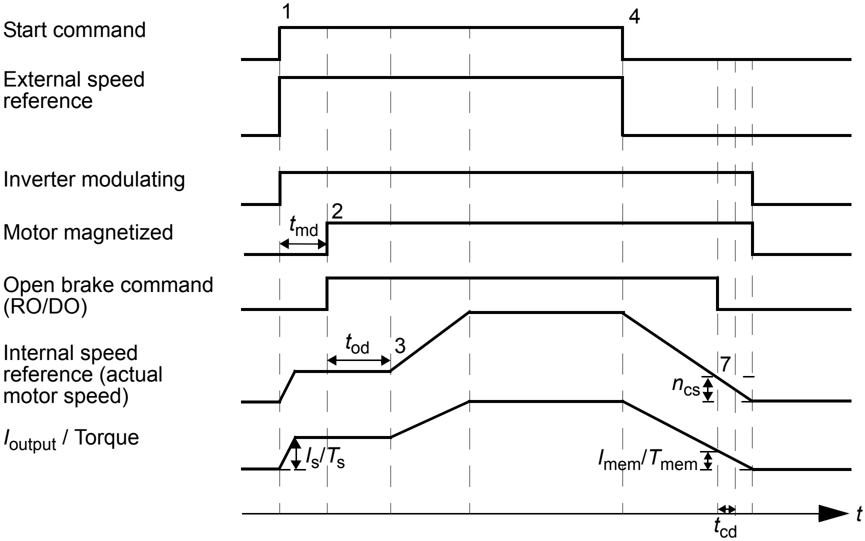
WARNING! Make sure that the machinery into which the drive with brake control function is integrated fulfills the personnel safety regulations. Note that the frequency converter (a Complete Drive Module or a Basic Drive Module, as defined in IEC 61800-2), is not considered a safety device mentioned in the European Machinery Directive and related harmonized standards. Thus, the personnel safety of the complete machinery must not be based on a specific frequency converter feature (such as the brake control function), but it has to be implemented as defined in the application specific regulations.

Brake control logic is integrated in the drive application program. The user has to take care of the power supply and wiring.
Brake on/off control is through relay output RO.



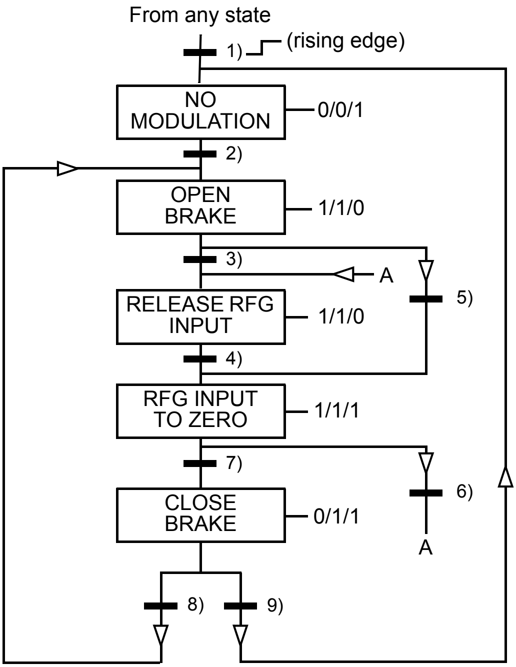
Operation time scheme

The time scheme below illustrates the operation of the brake control function. See also section *State shifts* on page *161*.



I_s/T_s	Brake open current/torque (parameter *4302 BRAKE OPEN LVL* or current/torque from parameter *0179 BRAKE TORQ MEM*)
I_{mem}/T_{mem}	Brake close current/torque (saved in parameter *0179 BRAKE TORQ MEM*)
t_{md}	Motor magnetizing delay (parameter *4305 BRAKE MAGN DELAY*)
t_{od}	Brake open delay (parameter *4301 BRAKE OPEN DLY*)
n_{cs}	Brake close speed (parameter *4303 BRAKE CLOSE LVL*)
t_{cd}	Mechanical brake close delay

State shifts



RFG = Ramp function generator in the speed control loop (reference handling).

<u>State</u> (Symbol $\boxed{\text{NN}}$ — X/Y/Z)

- NN: State name
- X/Y/Z: State outputs/operations

X = 1 Open the brake. The relay output set to brake on/off control energizes.

Y = 1 Forced start. The function keeps the internal Start on until the brake is closed in spite of the status of the external Start signal.

Z = 1 Ramp in zero. Forces the used speed reference (internal) to zero along a ramp.

<u>State change conditions</u> (Symbol ▬)

1) Brake control active 0 -> 1 OR Inverter is modulating = 0
2) Motor magnetised = 1 AND Drive running = 1
3) Brake is open AND Brake open delay passed AND Start = 1
4) Start = 0
5) Start = 0
6) Start = 1
7) |Actual motor speed| < Brake close speed AND Start = 0
8) Start = 1
9) Brake is closed AND Brake close delay passed = 1 AND Start = 0

Settings

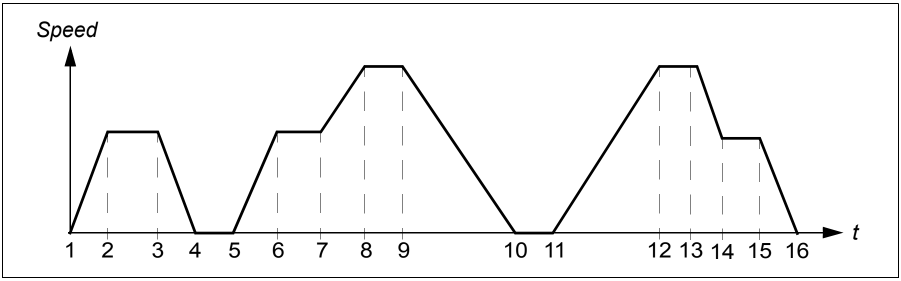
Parameter	Additional information
1401/*1805*	Mechanical brake activation through RO 1 / DO
1402/*1403*/*1410*	Mechanical brake activation through RO 2…4. With option MREL-01 only.
2112	Zero speed delay
Group *43 MECH BRK CONTROL*	Brake function settings

Jogging

The jogging function is typically used to control a cyclical movement of a machine section. One push button controls the drive through the whole cycle: When it is on, the drive starts, accelerates to a preset speed at a preset rate. When it is off, the drive decelerates to zero speed at a preset rate.

The figure and table below describe the operation of the drive. They also represent how the drive shifts to normal operation (= jogging inactive) when the drive start command is switched on. Jog cmd = State of the jogging input, Start cmd = State of the drive start command.

The function operates on a 2 ms time level



Phase	Jog cmd	Start cmd	Description
1-2	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
2-3	1	0	Drive runs at the jogging speed.
3-4	0	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.
4-5	0	0	Drive is stopped.
5-6	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
6-7	1	0	Drive runs at the jogging speed.
7-8	x	1	Normal operation overrides the jogging. Drive accelerates to the speed reference along the active acceleration ramp.
8-9	x	1	Normal operation overrides the jogging. Drive follows the speed reference.
9-10	0	0	Drive decelerates to zero speed along the active deceleration ramp.
10-11	0	0	Drive is stopped.
11-12	x	1	Normal operation overrides the jogging. Drive accelerates to the speed reference along the active acceleration ramp.
12-13	x	1	Normal operation overrides the jogging. Drive follows the speed reference.
13-14	1	0	Drive decelerates to the jogging speed along the deceleration ramp of the jogging function.
14-15	1	0	Drive runs at the jogging speed.
15-16	0	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.

x = state can be either 1 or 0

Note: The jogging is not operational when the drive start command is on.

Note: The jogging speed overrides the constant speeds.

Note: The jogging uses ramp stop even if parameter *2102 STOP FUNCTION* selection is *COAST*.

Note: The ramp shape time is set to zero during the jogging (ie, linear ramp).

Jogging function uses constant speed 7 as jogging speed and acceleration/deceleration ramp pair 2.

It is also possible to activate jogging function 1 or 2 through fieldbus. Jogging function 1 uses constant speed 7 and jogging function 2 uses constant speed 6. Both functions use acceleration/deceleration ramp pair 2.

Settings

Parameter	Additional information
1010	Jogging activation
1208	Jogging speed
1208/*1207*	Jogging speed for jogging function 1/2 activated through fieldbus
2112	Zero speed delay
2205, *2206*	Acceleration and deceleration times
2207	Acceleration and deceleration ramp shape time: Set to zero during the jogging (ie, linear ramp).

Diagnostics

Actual signal	Additional information
0302	Jogging 1/2 activation through fieldbus
1401	Jogging function status through RO 1
1402/*1403*/*1410*	Jogging function status through RO 2…4. With option MREL-01 only.
1805	Jogging function status through DO

Real-time clock and timed functions

Real-time clock

The real-time clock has the following features:

- four daily times
- four weekly times
- timed boost function, eg, a constant speed which is on for a certain pre-programmed time.
- timer enable with digital inputs
- timed constant speed selection
- timed relay activation.

For more information, see Group *36 TIMED FUNCTIONS* on page *269*.

Note: To be able to use the timed functions, the internal clock has to be set first. For information on the Time and date mode, see section *Time and date mode* on page *100*.

Note: The timed functions work only when the assistant control panel is connected to the drive.

Note: Removing the control panel for upload/download purposes does not affect the clock.

Note: Daylight saving changeover is automatic if activated.

Timed functions

A variety of drive functions can be time controlled, eg, start/stop and EXT1/EXT2 control. The drive offers

- four start and stop times (*START TIME 1*…*START TIME 4*, *STOP TIME 1*…*STOP TIME 4*)
- four start and stop days (*START DAY 1*…*START DAY 4*, *STOP DAY 1*…*STOP DAY 4*)
- four timed functions for collecting the selected time periods 1…4 together (*TIMED FUNC 1 SRC*…*TIMED FUNC 4 SRC*)
- booster time (an additional booster time connected to timed functions).

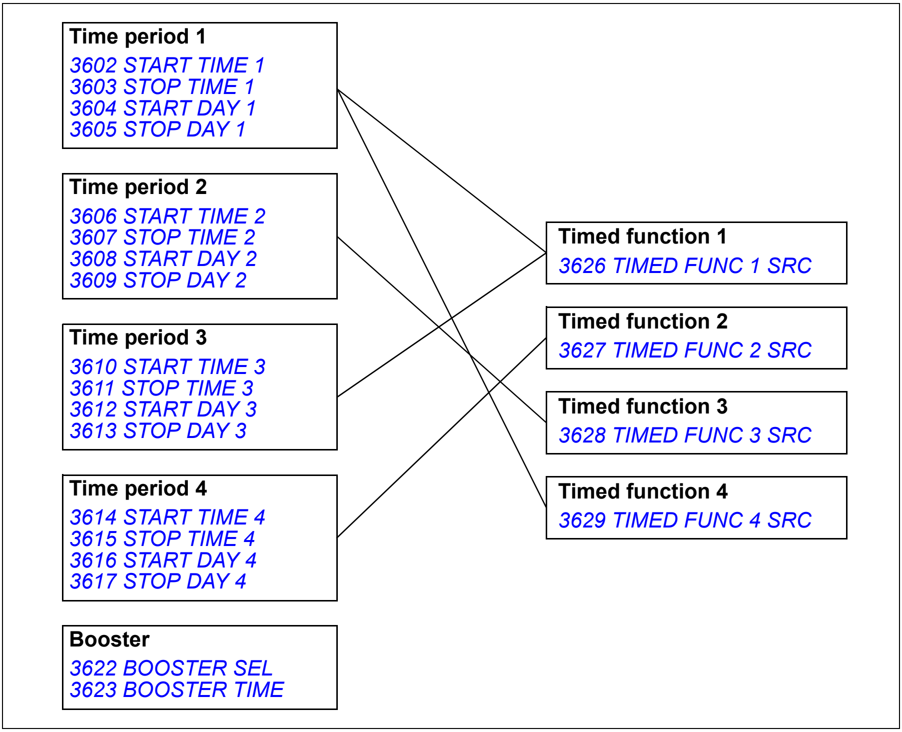
Configuring the timed functions

You can use the Timed functions assistant for easy configuring. For more information on the assistants, see section *Assistants mode* on page *96*.

Use the control panel to configure the timer in four stages:

1. Enable the timer.
   Configure how the timer is activated. The timer can be enabled from one of the digital inputs or inverted digital inputs.
2. Set the time period.
   Define the start and stop times and start and stop day when the timer operates. These constitute a time period.
3. Create the timer.
   Assign the selected time period to certain timer(s). Different time periods can be collected in a timer and connected to parameters. The timer can act as the source of start/stop and change direction commands, constant speed selection and relay activation signals. Time periods can be in multiple timed functions, but a parameter can only be connected to a single timer. It is possible to create up to four timers.
4. Connect selected parameters to the timer.
   A parameter can only be connected to one timer.

A timed function can be connected to multiple time periods.



A parameter which is triggered by a timed function can be connected to only one timed function at a time.

Timed function 1
3626 TIMED FUNC 1 SRC

Timed function 2
3627 TIMED FUNC 2 SRC

1001 EXT1 COMMANDS
1002 EXT2 COMMANDS
1102 EXT1/EXT2 SEL
1201 CONST SPEED SEL
1209 TIMED MODE SEL
1401 RELAY OUTPUT 1
1402 RELAY OUTPUT 2, *1403 RELAY OUTPUT 3*, *1410 RELAY OUTPUT 4* (with option MREL-01 only)
1805 DO SIGNAL
4027 PID 1 PARAM SET
4228 ACTIVATE
8402 SEQ PROG START
8406 SEQ LOGIC VAL 1
8425/35/45/55/65/75/85/95 *ST1 TRIG TO ST 2* … ST8 TRIG TO ST 2
8426/36/46/56/66/76/86/96 *ST1 TRIG TO ST N* … ST8 TRIG TO ST N

Example

Air conditioning is active on weekdays from 8:00 to 15:30 (8 a.m to 3:30 p.m) and on Sundays from 12:00 to 15:00 (12 to 3 p.m). By pressing the extension time switch, the air-conditioning is on for an extra hour.

Parameter	Setting
3601 TIMERS ENABLE	*DI1*
3602 START TIME 1	08:00:00
3603 STOP TIME 1	15:30:00
3604 START DAY 1	*MONDAY*
3605 STOP DAY 1	*FRIDAY*
3606 START TIME 2	12:00:00
3607 STOP TIME 2	15:00:00
3608 START DAY 2	*SUNDAY*
3609 STOP DAY 2	*SUNDAY*
3622 BOOSTER SEL	*DI5* (cannot be the same as parameter *3601* value)
3623 BOOSTER TIME	01:00:00
3626 TIMED FUNC 1 SRC	*T1+T2+B*

Settings

Parameter	Additional information
36 TIMED FUNCTIONS	Timed functions settings
1001, *1002*	Timed start/stop control
1102	Timed EXT1/EXT2 selection
1201	Timed constant speed 1 activation
1209	Timed speed selection
1401	Timed function status indicated through relay output RO 1
1402/*1403*/*1410*	Timed function status indicated through relay output RO 2…4. With option MREL-01 only.
1805	Timed function status indicated through digital output DO
4027	Timed PID1 parameter set 1/2 selection
4228	Timed external PID2 activation
8402	Timed Sequence programming activation
8425/*8435*/…/*8495* *8426*/*8436*/…/*8496*	Sequence programming state change trigger with timed function

Timer

Drive start and stop can be controlled with timer functions.

Settings

Parameter	Additional information
1001, *1002*	Start/stop signal sources
Group *19 TIMER & COUNTER*	Timer for start and stop

Diagnostics

Actual signal	Additional information
0165	Start/stop control time count

Counter

Drive start and stop can be controlled with counter functions. The counter function can also be used as state change trigger signal in Sequence programming. See section *Sequence programming* on page *169*.

Settings

Parameter	Additional information
1001, *1002*	Start/Stop signal sources
Group *19 TIMER & COUNTER*	Timer for start and stop
8425, *8426* / *8435*, *8436* /…/*8495*, *8496*	Counter signal as state change trigger in Sequence programming

Diagnostics

Actual signal	Additional information
0166	Start/stop control pulse count

Sequence programming

The drive can be programmed to perform a sequence where the drive shifts typically through 1…8 states. User defines the operation rules for the whole sequence and for each state. The rules of a particular state are effective when the Sequence program is active and the program has entered the state. The rules to be defined for each state are:

- Run, stop and direction commands for the drive (forward/reverse/stop)
- Acceleration and deceleration ramp time for the drive
- Source for the drive reference value
- State duration
- RO/DO/AO status
- Signal source for triggering the shift to the next state
- Signal source for triggering the shift to any state (1…8).

Every state can also activate drive outputs to give an indication to external devices.

Sequence programming allows state transitions either to the next state or to a selected state. State change can be activated with, eg, timed functions, digital inputs and supervision functions.

Sequence programming can be applied in simple mixer applications as well as in more complicated traverse applications.

The programming can be done with control panel or with a PC tool. The drive is supported by version 2.91 or later of the DriveWindow Light 2 PC tool which includes a graphical Sequence programming tool.

Note: By default all Sequence programming parameters can be changed even when the Sequence programming is active. It is recommended that after the Sequence programming parameters are set, parameters are locked with parameter *1602 PARAMETER LOCK*.

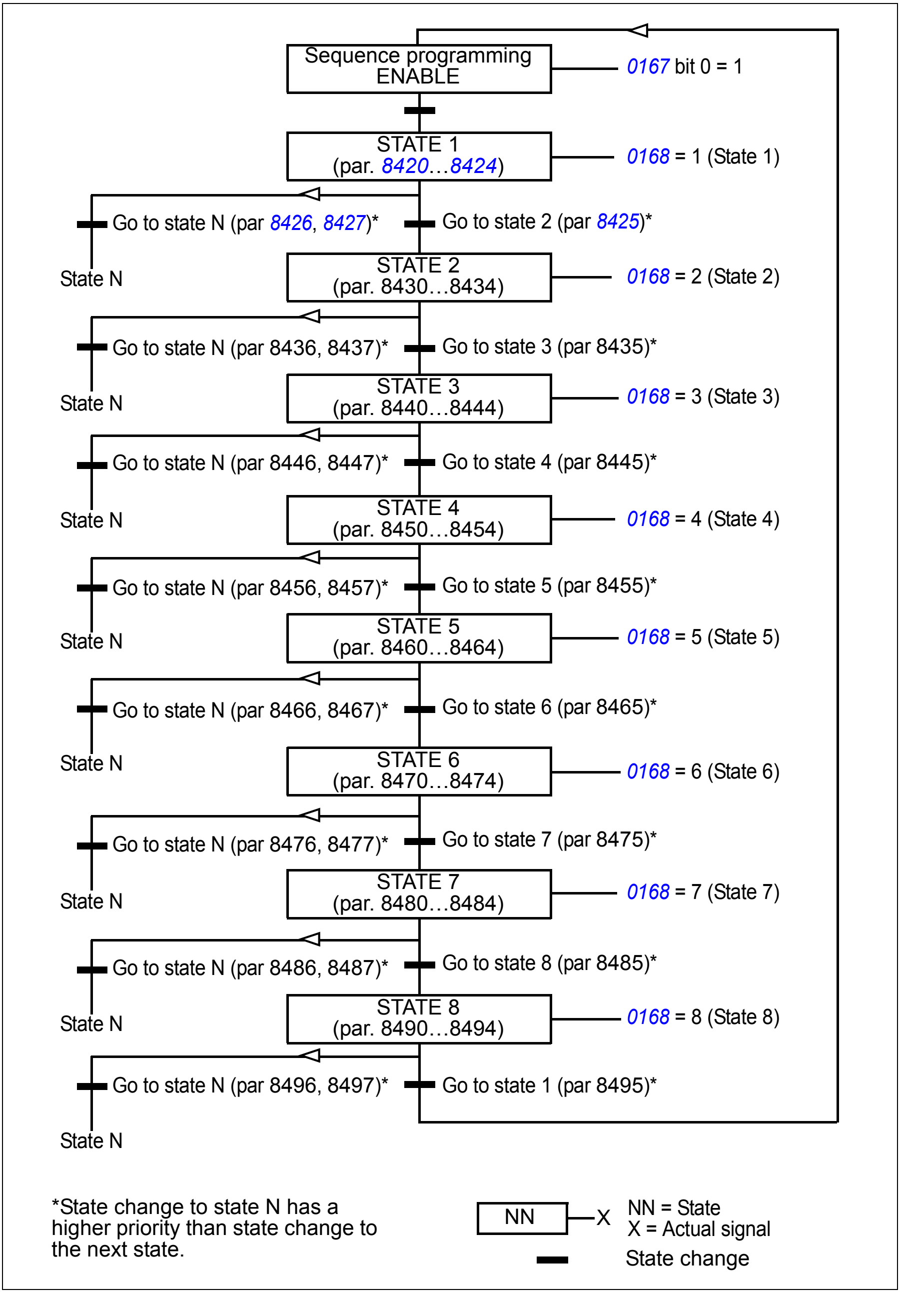
Settings

Parameter	Additional information
1001/*1002*	Start, stop and direction commands for EXT1/EXT2
1102	EXT1/EXT2 selection
1106	REF2 source
1201	Constant speed deactivation. Constant speed always overrides the Sequence programming reference.
1401	Sequence programming output through RO 1
1402/*1403*/*1410*	Sequence programming output through relay output RO 2…4. With option MREL-01 only.
1501	Sequence programming output through AO
1601	Run enable activation/deactivation
1805	Sequence programming output through DO
Group *19 TIMER & COUNTER*	State change according to counter limit
Group *32 SUPERVISION*	Timed state change
2201…*2207*	Acceleration/deceleration and ramp time settings
Group *32 SUPERVISION*	Supervision settings
4010/*4110*/*4210*	Sequence programming output as PID reference signal
Group *84 SEQUENCE PROG*	Sequence programming settings

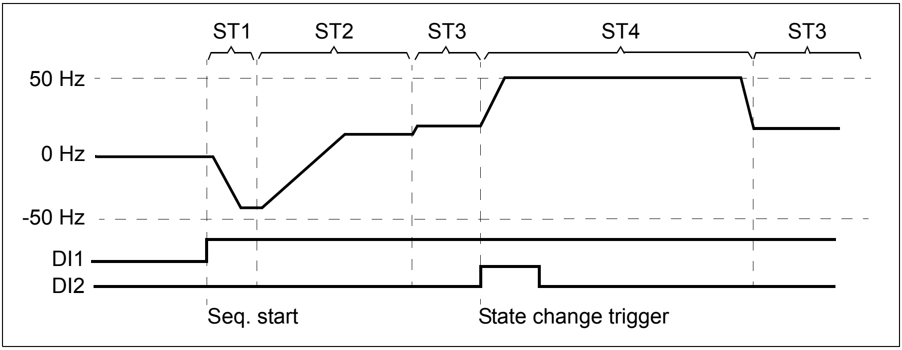
Diagnostics

Actual signal	Additional information
0167	Sequence programming status
0168	Sequence programming active state
0169	Current state time counter
0170	Analog output PID reference control values
0171	Executed sequence counter

State shifts



Example 1



Sequence programming is activated by digital input DI1.

ST1: Drive is started in reverse direction with -50 Hz reference and 10 s ramp time. State 1 is active for 40 s.

ST2: Drive is accelerated to 20 Hz with 60 s ramp time. State 2 is active for 120 s.

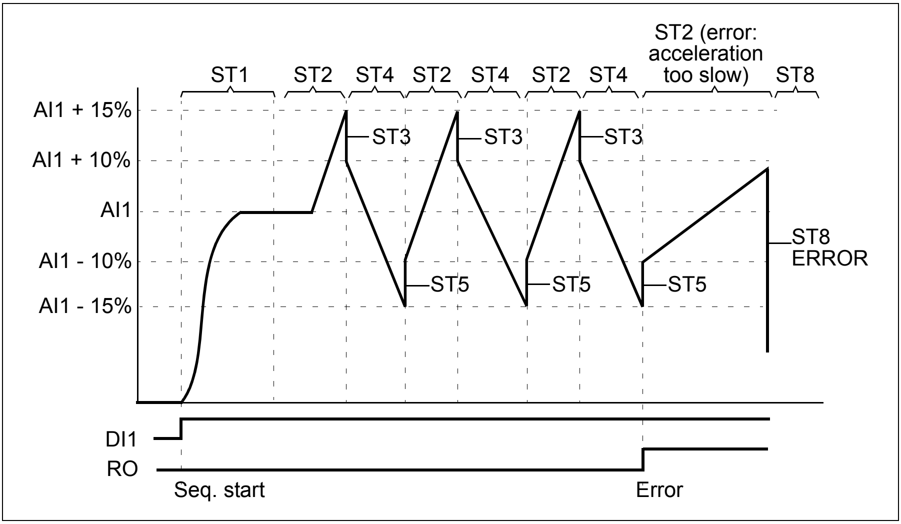
ST3: Drive is accelerated to 25 Hz with 5 s ramp time. State 3 is active until the Sequence programming is disabled or until booster start is activated by DI2.

ST4: Drive is accelerated to 50 Hz with 5 s ramp time. State 4 is active for 200 s and after that the state shifts back to state 3.

Parameter	Setting	Additional information
1002 EXT2 COMMANDS	*SEQ PROG*	Start, stop, direction commands for EXT2
1102 EXT1/EXT2 SEL	*EXT2*	EXT2 activation
1106 REF2 SELECT	*SEQ PROG*	Sequence programming output as REF2
1601 RUN ENABLE	*NOT SEL*	Deactivation of Run enable
2102 STOP FUNCTION	*RAMP*	Ramp stop
2201 ACC/DEC 1/2 SEL	*SEQ PROG*	Ramp as defined by parameter *8422*/…/*8452*.
8401 SEQ PROG ENABLE	*ALWAYS*	Sequence programming enabled
8402 SEQ PROG START	*DI1*	Sequence programming activation through digital input (DI1)
8404 SEQ PROG RESET	*DI1(INV)*	Sequence programming reset (ie, reset to state 1, when DI1 signal is lost (1 -> 0)

ST1		ST2		ST3		ST4		Additional information
Par.	Setting	Par.	Setting	Par.	Setting	Par.	Setting	
8420 ST1 REF SEL	100%	8430	40%	8440	50%	8450	100%	State reference
8421 ST1 COMMANDS	START REV	8431	START FRW	8441	START FRW	8451	START FRW	Run, direction and stop command
8422 ST1 RAMP	10 s	8432	60 s	8442	5 s	8452	5 s	Ramp time
8424 ST1 CHANGE DLY	40 s	8434	120 s	8444		8454	200 s	State change delay
8425 ST1 TRIG TO ST 2	CHANGE DLY	8435	CHANGE DLY	8445	DI2	8455		
8426 ST1 TRIG TO ST N	NOT SEL	8436	NOT SEL	8446	NOT SEL	8456	CHANGE DLY	State change trigger
8427 ST1 STATE N	-	8437	-	8447	-	8457	STATE 3	

Example 2



Drive is programmed for traverse control with 30 sequences.

Sequence programming is activated by digital input DI1

ST1: Drive is started in forward direction with AI1 (AI1 + 50% - 50%) reference and ramp pair 2. State shifts to the next state when reference is reached. All relay and analog outputs are cleared.

ST2: Drive is accelerated with AI1 + 15% (AI1 + 65% - 50%) reference and 1.5 s ramp time. State shifts to the next state when reference is reached. If reference is not reached within 2 s, state shifts to state 8 (error state).

ST3: Drive is decelerated with AI1 + 10% (AI1 + 60% - 50%) reference and 0 s ramp time[1)]. State shifts to the next state when reference is reached. If reference is not reached within 0.2 s, state shifts to state 8 (error state).

ST4: Drive is decelerated with AI1 - 15% (AI1 + 35% -50%) reference and 1.5 s ramp time. State shifts to the next state when reference is reached. If reference is not reached within 2 s, state shifts to state 8 (error state).[2)]

ST5: Drive is accelerated with AI1 -10% (AI1 + 40% -50%) reference and 0 s ramp time[1)]. State shifts to the next state when reference is reached. Sequence counter value is increased by 1. If sequence counter elapses, state shifts to state 7 (sequence completed).

ST6: Drive reference and ramp times are the same as in state 2. Drive state shifts immediately to state 2 (delay time is 0 s).

ST7 (sequence completed): Drive is stopped with ramp pair 1. Digital output DO is activated. If Sequence programming is deactivated by the falling edge of digital input DI1, state machine is reset to state 1. New start command can be activated by digital input DI1 or by digital inputs DI4 and DI5 (both inputs DI4 and DI5 must be simultaneously active).

ST8 (error state): Drive is stopped with ramp pair 1. Relay output RO is activated. If Sequence programming is deactivated by the falling edge of digital input DI1, state machine is reset to state 1. New start command can be activated by digital input DI1 or by digital inputs DI4 and DI5 (both inputs DI4 and DI5 must be simultaneously active).

[1)] 0 second ramp time = drive is accelerated/decelerated as rapidly as possible.

[2)] State reference must be between 0…100%, ie, scaled AI1 value must be between 15…85%. If AI1 = 0, reference = 0% + 35% -50% = -15% < 0%.

Parameter	Setting	Additional information
1002 EXT2 COMMANDS	*SEQ PROG*	Start, stop, direction commands for EXT2
1102 EXT1/EXT2 SEL	*EXT2*	EXT2 activation
1106 REF2 SELECT	*AI1+SEQ PROG*	Sequence programming output as REF2
1201 CONST SPEED SEL	*NOT SEL*	Deactivation of constant speeds
1401 RELAY OUTPUT 1	*SEQ PROG*	Relay output RO 1 control as defined by parameter *8423*/…/*8493*
1601 RUN ENABLE	*NOT SEL*	Deactivation of Run enable
1805 DO SIGNAL	*SEQ PROG*	Digital output DO control as defined by parameter *8423*/…/*8493*
2102 STOP FUNCTION	*RAMP*	Ramp stop
2201 ACC/DEC 1/2 SEL	*SEQ PROG*	Ramp as defined by parameter *8422*/…/*8452*.
2202 ACCELER TIME 1	1 s	Acceleration/deceleration ramp pair 1
2203 DECELER TIME 1	0 s	
2205 ACCELER TIME 2	20 s	Acceleration/deceleration ramp pair 2
2206 DECELER TIME 2	20 s	
2207 RAMP SHAPE 2	5 s	Shape of the acceleration/deceleration ramp 2
3201 SUPERV 1 PARAM	171	Sequence counter (signal *0171 SEQ CYCLE CNTR*) supervision
3202 SUPERV 1 LIM LO	30	Supervision low limit
3203 SUPERV 1 LIM HI	30	Supervision high limit
8401 SEQ PROG ENABLE	*EXT2*	Sequence programming enabled
8402 SEQ PROG START	*DI1*	Sequence programming activation through digital input (DI1)
8404 SEQ PROG RESET	*DI1(INV)*	Sequence programming reset (ie, reset to state 1, when DI1 signal is lost (1 -> 0)
8406 SEQ LOGIC VAL 1	*DI4*	Logic value 1
8407 SEQ LOGIC OPER 1	*AND*	Operation between logic value 1 and 2
8408 SEQ LOGIC VAL 2	*DI5*	Logic value 2
8415 CYCLE CNT LOC	*ST5 TO NEXT*	Sequence counter activation, ie, sequence count increases every time the state changes from state 5 to state 6.
8416 CYCLE CNT RST	*STATE 1*	Sequence counter reset during state transition to state 1

ST1		ST2		ST3		ST4		Additional information
Par.	Setting	Par.	Setting	Par.	Setting	Par.	Setting	
8420 ST1 REF SEL	50%	*8430*	65%	*8440*	60%	*8450*	35%	State reference
8421 ST1 COMMANDS	*START FRW*	*8431*	*START FRW*	*8441*	*START FRW*	*8451*	*START FRW*	Run, direction and stop commands
8422 ST1 RAMP	-0.2 (ramp pair 2)	*8432*	1.5 s	*8442*	0 s	*8452*	1.5 s	Acceleration/ deceleration ramp time
8423 ST1 OUT CONTROL	*R=0,D=0 ,AO=0*	*8433*	*AO=0*	*8443*	*AO=0*	*8453*	*AO=0*	Relay, digital and analog output control
8424 ST1 CHANGE DLY	0 s	*8434*	2 s	*8444*	0.2 s	*8454*	2 s	State change delay
8425 ST1 TRIG TO ST 2	*ENTER SETPNT*	*8435*	*ENTER SETPNT*	*8445*	*ENTER SETPNT*	*8455*	*ENTER SETPNT*	State change trigger
8426 ST1 TRIG TO ST N	*NOT SEL*	*8436*	*CHANG E DLY*	*8446*	*CHANG E DLY*	*8456*	*CHANG E DLY*	
8427 ST1 STATE N	*STATE 1*	*8437*	*STATE 8*	*8447*	*STATE 8*	*8457*	*STATE 8*	

ST5		ST6		ST7		ST8		Additional information
Par.	Setting	Par.	Setting	Par.	Setting	Par.	Setting	
8460 ST5 REF SEL	40%	*8470*	65%	*8480*	0%	*8490*	0%	State reference
8461 ST5 COMMANDS	*START FRW*	*8471*	*START FRW*	*8481*	*DRIVE STOP*	*8491*	*DRIVE STOP*	Run, direction and stop commands
8462 ST5 RAMP	0 s	*8472*	1.5 s	*8482*	-0.1 (ramp pair 1)	*8492*	-0.1 (ramp pair 1)	Acceleration/ deceleration ramp time
8463 ST5 OUT CONTROL	*AO=0*	*8473*	*AO=0*	*8483*	*DO=1*	*8493*	*RO=1*	Relay, digital and analog output control

ST5		ST6		ST7		ST8		Additional information
Par.	**Setting**	**Par.**	**Setting**	**Par.**	**Setting**	**Par.**	**Setting**	
8464 ST5 CHANGE DLY	0.2 s	*8474*	0 s	*8484*	0 s	*8494*	0 s	State change delay
8465 ST5 TRIG TO ST6	*ENTER SETPNT*	*8475*	*NOT SEL*	*8485*	*NOT SEL*	*8495*	*LOGIC VAL*	State change trigger
8466 ST5 TRIG TO ST N	*SUPRV1 OVER*	*8476*	*CHANG E DLY*	*8486*	*LOGIC VAL*	*8496*	*NOT SEL*	
8467 ST5 STATE N	*STATE 7*	*8477*	*STATE 2*	*8487*	*STATE 1*	*8497*	*STATE 1*	

Safe torque off (STO) function

See *Appendix: Safe torque off (STO)* on page *417*.

12

Actual signals and parameters

What this chapter contains

The chapter describes the actual signals and parameters and gives the fieldbus equivalent values for each signal/parameter. It also contains a table of the default values for the different macros.

Terms and abbreviations

Term	Definition
Actual signal	Signal measured or calculated by the drive. Can be monitored by the user. No user setting possible. Groups 01…04 contain actual signals.
Def	Parameter default value
Parameter	A user-adjustable operation instruction of the drive. Groups 10…99 contain parameters. **Note:** Parameter selections are shown on the basic control panel as integer values. For example, parameter *1001 EXT1 COMMANDS* selection *COMM* is shown as value 10 (which is equal to the fieldbus equivalent FbEq).
FbEq	Fieldbus equivalent: The scaling between the value and the integer used in serial communication.
E	Refers to types 01E- and 03E- with European parametrization
U	Refers to types 01U- and 03U- with US parametrization

Fieldbus addresses

For FCAN-01 CANopen adapter module, FDNA-01 DeviceNet adapter module, FECA-01 EtherCAT adapter module, FENA-01 Ethernet adapter module, FEPL-02 Ethernet POWERLINK adapter module, FMBA-01 Modbus adapter module, FLON-01 LonWorks® adapter module, and FPBA-01 PROFIBUS DP adapter module, see the user’s manual of the adapter module.

Fieldbus equivalent

Example: If *2017 MAX TORQUE 1* (see page *225*) is set from an external control system, an integer value of 1000 corresponds to 100.0%. All the read and sent values are limited to 16 bits (-32768…32767).

Storing the parameters

All parameter settings are stored automatically to the permanent memory of the drive. However, if an external +24 V DC power supply is used for the drive control unit, it is highly recommended to force a save using parameter *1607 PARAM SAVE* before powering down the control unit after any parameter changes.

Default values with different macros

When the application macro is changed (parameter *9902 APPLIC MACRO*), the software updates the parameter values to their default values. The table below shows the parameter default values for different macros. For other parameters, the default values are the same for all macros (shown in the parameter list starting on page *191*).

If you have made changes to the parameter values and want to restore the default values, you must first select another macro (parameter *9902 APPLIC MACRO*), save the change, select the original macro again and save. This restores the default parameter values of the original macro.

The default values for the AC500 Modbus application macro correspond to the ABB Standard macro with some differences, see section *AC500 Modbus macro* on page *117*.

Index Name/ Selection	ABB STANDARD	3-WIRE	ALTERNATE	MOTOR POT	HAND/ AUTO	PID CONTROL	TORQUE CONTROL
9902 APPLIC MACRO	1 = *ABB STANDARD*	2 = *3-WIRE*	3 = *ALTERNATE*	4 = *MOTOR POT*	5 = *HAND/AUTO*	6 = *PID CONTROL*	7 = *TORQUE CTRL*
1001 EXT1 COMMANDS	2 = *DI1,2*	4 = *DI1P,2P,3*	9 = *DI1F,2R*	2 = *DI1,2*	2 = *DI1,2*	20 = *DI5*	2 = *DI1,2*
1002 EXT2 COMMANDS	0 = *NOT SEL*	0 = *NOT SEL*	0 = *NOT SEL*	0 = *NOT SEL*	21 = *DI5,4*	1 = *DI1*	2 = *DI1,2*
1003 DIRECTION	3 = *REQUEST*	3 = *REQUEST*	3 = *REQUEST*	3 = *REQUEST*	3 = *REQUEST*	1 = *FORWARD*	3 = *REQUEST*
1102 EXT1/EXT2 SEL	0 = *EXT1*	0 = *EXT1*	0 = *EXT1*	0 = *EXT1*	3 = *DI3*	-2 = *DI2(INV)*	3 = *DI3*
1103 REF1 SELECT	1 = *AI1*	1 = *AI1*	1 = *AI1*	12 = *DI3U,4D(NC)*	1 = *AI1*	1 = *AI1*	1 = *AI1*
1106 REF2 SELECT	2 = *AI2*	2 = *AI2*	2 = *AI2*	2 = *AI2*	2 = *AI2*	19 = *PID1OUT*	2 = *AI2*
1201 CONST SPEED SEL	9 = *DI3,4*	10 = *DI4,5*	9 = *DI3,4*	5 = *DI5*	0 = *NOT SEL*	3 = *DI3*	4 = *DI4*
1304 MINIMUM AI2	1.0%	1.0%	1.0%	1.0%	20.0%	20.0%	20.0%
1501 AO1 CONTENT SEL	103	102	102	102	102	102	102
1601 RUN ENABLE	0 = *NOT SEL*	0 = *NOT SEL*	0 = *NOT SEL*	0 = *NOT SEL*	0 = *NOT SEL*	4 = *DI4*	0 = *NOT SEL*
2201 ACC/DEC 1/2 SEL	5 = *DI5*	0 = *NOT SEL*	5 = *DI5*	0 = *NOT SEL*	0 = *NOT SEL*	0 = *NOT SEL*	5 = *DI5*
3201 SUPERV 1 PARAM	103	102	102	102	102	102	102
3401 SIGNAL1 PARAM	103	102	102	102	102	102	102
9904 MOTOR CTRL MODE	3 = *SCALAR: FREQ*	1 = *VECTOR: SPEED*	1 = *VECTOR: SPEED*	1 = *VECTOR: SPEED*	1 = *VECTOR: SPEED*	3 = *SCALAR: FREQ*	2 = *VECTOR: TORQ*

Note: It is possible to control several functions with one input (DI or AI), and there is a chance of mismatch between these functions. In some cases it is desired to control several functions with one input.

For example in the ABB standard macro, DI3 and DI4 are set to control constant speeds. On the other hand, it is possible to select value 6 (*DI3U,4D*) for parameter *1103 REF1 SELECT*. That would mean a mismatched duplicate functionality for DI3 and DI4: either constant speed or acceleration and deceleration. The function that is not required must be disabled. In this case the constant speed selection must be disabled by setting parameter *1201 CONST SPEED SEL* to *NOT SEL* or to values not related to DI3 and DI4.

Remember to also check the default values of the selected macro when configuring the drive inputs.

Differences between the default values in E and U type drives

The type designation label shows the type of the drive, see section *Type designation key* on page *31*.

The following table lists the differences between the parameter default values in the E and U type drives.

No.	Name	**E type** EMC filter screw connected	**U type** EMC filter screw disconnected
9905	*MOTOR NOM VOLT*	230/400V	230/460V
9907	*MOTOR NOM FREQ*	50	60
9909	*MOTOR NOM POWER*	[kW]	[hp]
1105	*REF1 MAX*	50	60
1202	*CONST SPEED 1*	5	6
1203	*CONST SPEED 2*	10	12
1204	*CONST SPEED 3*	15	18
1205	*CONST SPEED 4*	20	24
1206	*CONST SPEED 5*	25	30
1207	*CONST SPEED 6*	40	48
1208	*CONST SPEED 7*	50	60
2002	*MAXIMUM SPEED*	1500	1800
2008	*MAXIMUM FREQ*	50	60

Actual signals

Actual signals		
No. Name/Value	**Description**	**FbEq**
01 OPERATING DATA	Basic signals for monitoring the drive (read-only)	
0101 SPEED & DIR	Calculated motor speed in rpm. A negative value indicates reverse direction.	1 = 1 rpm
0102 SPEED	Calculated motor speed in rpm	1 = 1 rpm
0103 OUTPUT FREQ	Calculated drive output frequency in Hz. (Shown by default on the panel Output mode display.)	1 = 0.1 Hz
0104 CURRENT	Measured motor current in A. (Shown by default on the panel Output mode display.)	1 = 0.1 A
0105 TORQUE	Calculated motor torque as a percentage of the motor nominal torque	1 = 0.1%
0106 POWER	Measured motor power in kW	1 = 0.1 kW
0107 DC BUS VOLTAGE	Measured intermediate circuit voltage in V DC	1 = 1 V
0109 OUTPUT VOLTAGE	Calculated motor voltage in V AC	1 = 1 V
0110 DRIVE TEMP	Measured IGBT temperature in °C	1 = 0.1 °C
0111 EXTERNAL REF 1	External reference REF1 in rpm or Hz. Unit depends on parameter *9904 MOTOR CTRL MODE* setting.	1 = 0.1 Hz / 1 rpm
0112 EXTERNAL REF 2	External reference REF2 as a percentage. Depending on the use, 100% equals the maximum motor speed, nominal motor torque, or maximum process reference.	1 = 0.1%
0113 CTRL LOCATION	Active control location. (0) LOCAL; (1) EXT1; (2) EXT2. See section *Local control vs. external control* on page *126*.	1 = 1
0114 RUN TIME (R)	Elapsed drive running time counter (hours). Runs when the drive is modulating. The counter can be reset by pressing the UP and DOWN keys simultaneously when the control panel is in the Parameter mode.	1 = 1 h
0115 KWH COUNTER (R)	kWh counter. The counter value is accumulated till it reaches 65535 after which the counter rolls over and starts again from 0. The counter can be reset by pressing UP and DOWN keys simultaneously when the control panel is in the Parameter mode.	1 = 1 kWh
0120 AI 1	Relative value of analog input AI1 as a percentage	1 = 0.1%
0121 AI 2	Relative value of analog input AI2 as a percentage	1 = 0.1%
0124 AO 1	Value of analog output AO in mA	1 = 0.1 mA
0126 PID 1 OUTPUT	Output value of the process PID1 controller as a percentage	1 = 0.1%
0127 PID 2 OUTPUT	Output value of the PID2 controller as a percentage	1 = 0.1%

Actual signals			
No.	**Name/Value**	**Description**	**FbEq**
0128	PID 1 SETPNT	Setpoint signal (reference) for the process PID1 controller. Unit depends on parameter *4006 UNITS*, *4007 UNIT SCALE* and *4027 PID 1 PARAM SET* settings.	-
0129	PID 2 SETPNT	Setpoint signal (reference) for the PID2 controller. Unit depends on parameter *4106 UNITS* and *4107 UNIT SCALE* settings.	-
0130	PID 1 FBK	Feedback signal for the process PID1 controller. Unit depends on parameter *4006 UNITS*, *4007 UNIT SCALE* and *4027 PID 1 PARAM SET* settings.	-
0131	PID 2 FBK	Feedback signal for the PID2 controller. Unit depends on parameter *4106 UNITS* and *4107 UNIT SCALE* settings.	-
0132	PID 1 DEVIATION	Deviation of the process PID1 controller, ie, the difference between the reference value and the actual value. Unit depends on parameter *4006 UNITS*, *4007 UNIT SCALE* and *4027 PID 1 PARAM SET* settings.	-
0133	PID 2 DEVIATION	Deviation of the PID2 controller, ie, the difference between the reference value and the actual value. Unit depends on parameter *4106 UNITS* and *4107 UNIT SCALE* settings.	-
0134	COMM RO WORD	Relay output Control word through fieldbus (decimal). See parameter *1401 RELAY OUTPUT 1*.	1 = 1
0135	COMM VALUE 1	Data received from fieldbus	1 = 1
0136	COMM VALUE 2	Data received from fieldbus	1 = 1
0137	PROCESS VAR 1	Process variable 1 defined by parameter group *34 PANEL DISPLAY*	-
0138	PROCESS VAR 2	Process variable 2 defined by parameter group *34 PANEL DISPLAY*	-
0139	PROCESS VAR 3	Process variable 3 defined by parameter group *34 PANEL DISPLAY*	-
0140	RUN TIME	Elapsed drive running time counter (thousands of hours). Runs when the drive is modulating. Counter cannot be reset.	1 = 0.01 kh
0141	MWH COUNTER	MWH counter. The counter value is accumulated till it reaches 65535 after which the counter rolls over and starts again from 0. Cannot be reset.	1 = 1 MWh
0142	REVOLUTION CNTR	Motor revolution counter (millions of revolutions). The counter can be reset by pressing UP and DOWN keys simultaneously when the control panel is in the Parameter mode.	1 = 1 Mrev
0143	DRIVE ON TIME HI	Drive control board power-on time in days. Counter cannot be reset.	1 = 1 days

Actual signals			
No.	**Name/Value**	**Description**	**FbEq**
0144	DRIVE ON TIME LO	Drive control board power-on time in 2 second ticks (30 ticks = 60 seconds). Counter cannot be reset.	1 = 2 s
0145	MOTOR TEMP	Measured motor temperature. Unit depends on the sensor type selected by group *35 MOTOR TEMP MEAS* parameters.	1 = 1
0146	MECH ANGLE	Calculated mechanical angle. 1 = 5001 PULSE NR. The signal indicates the angle as a percentage of the number of pulses per revolution.	1 = 1
0147	MECH REVS	Mechanical revolutions, ie, the motor shaft revolutions calculated by the encoder. Overflow is not prevented.	1 = 1
0148	Z PLS DETECTED	Encoder zero pulse detector. 0 = NOT DETECTED, 1 = DETECTED.	1 = 1
0150	CB TEMP	Temperature of the drive control board in degrees Celsius (0.0…150.0 °C).	1 = 0.1 °C
0158	PID COMM VALUE 1	Data received from fieldbus for PID control (PID1 and PID2)	1 = 1
0159	PID COMM VALUE 2	Data received from fieldbus for PID control (PID1 and PID2)	1 = 1
0160	DI 1-5 STATUS	Status of digital inputs. **Example (panel):** • 10000 = DI1 is on, DI2…DI5 are off. • 10010 = DI1 and DI4 are on, DI2, DI3 and DI5 are off. **Example (DWL2):** • 16 (decimal) = DI1 is on, DI2…DI5 are off. • 18 (decimal) = DI1 and DI4 are on, DI2, DI3 and DI5 are off.	
0161	PULSE INPUT FREQ	Value of frequency input in Hz	1 = 1 Hz
0162	RO STATUS	Status of relay output 1. 1 = RO is energized, 0 = RO is de-energized.	1 = 1
0163	TO STATUS	Status of transistor output, when transistor output is used as a digital output.	1 = 1
0164	TO FREQUENCY	Transistor output frequency, when transistor output is used as a frequency output.	1 = 1 Hz
0165	TIMER VALUE	Timer value of timed start/stop. See parameter group *19 TIMER & COUNTER*.	1 = 0.01 s
0166	COUNTER VALUE	Pulse counter value of counter start/stop. See parameter group *19 TIMER & COUNTER*.	1 = 1

Actual signals			
No.	**Name/Value**	**Description**	**FbEq**
0167	SEQ PROG STS	Status word of the Sequence programming:	1 = 1
		Bit 0 = ENABLED (1 = enabled)	
		Bit 1 = STARTED	
		Bit 2 = PAUSED	
		Bit 3 = LOGIC VALUE (logic operation defined by parameters *8406*…*8410*).	
0168	SEQ PROG STATE	Active state of the Sequence programming. 1…8 = state 1…8.	1 = 1
0169	SEQ PROG TIMER	Current state time counter of the Sequence programming	1 = 2 s
0170	SEQ PROG AO VAL	Analog output control values defined by the Sequence programming. See parameter *8423 ST1 OUT CONTROL*.	1 = 0.1%
0171	SEQ CYCLE CNTR	Executed sequence counter of the Sequence programming. See parameters *8415 CYCLE CNT LOC* and *8416 CYCLE CNT RST*.	1 = 1
0172	ABS TORQUE	Calculated absolute value of the motor torque as a percentage of the motor nominal torque	1 = 0.1%
0173	RO 2-4 STATUS	Status of the relays in the MREL-01 output relay module. See *MREL-01 output relay module user's manual* (3AUA0000035974 [English]). **Example:** 100 = RO 2 is on, RO 3 and RO 4 are off.	
0179	BRAKE TORQ MEM	Vector control: Torque value (0…180% of the motor nominal torque) saved before the mechanical brake is taken in use. Scalar control: Current value (0…180% of the motor nominal current) saved before the mechanical brake is taken in use. This torque or current is applied when the drive is started. See parameter *4307 BRK OPEN LVL SEL*.	1 = 0.1%
0180	ENC SYNCHRONIZED	Monitors the synchronization of the measured position with the estimated position for permanent magnet synchronous motors. 0 = NOT SYNC, 1 = SYNC.	1 = 1
0181	EXTENSION	Shows which optional extension module is connected to the drive. 0 = NONE, 1 = EXTENSION MREL-01, 2 = EXTENSION MTAC-01, 3 = EXTENSION MPOW-01	1 = 1
03 FB ACTUAL SIGNALS		Data words for monitoring the fieldbus communication (read-only). Each signal is a 16-bit data word. Data words are displayed on the panel in hexadecimal format.	
0301	FB CMD WORD 1	A 16-bit data word. See section *DCU communication profile* on page *333*.	
0302	FB CMD WORD 2	A 16-bit data word. See section *DCU communication profile* on page *333*	

Actual signals			
No.	**Name/Value**	**Description**	**FbEq**
0303	FB STS WORD 1	A 16-bit data word. See section *DCU communication profile* on page *333*.	
0304	FB STS WORD 2	A 16-bit data word. See section *DCU communication profile* on page *333*	
0305	FAULT WORD 1	A 16-bit data word. For the possible causes and remedies and fieldbus equivalents, see chapter *Fault tracing* on page *349*.	
		Bit 0 = *OVERCURRENT*	
		Bit 1 = *DC OVERVOLT*	
		Bit 2 = *DEV OVERTEMP*	
		Bit 3 = *SHORT CIRC*	
		Bit 4 = Reserved	
		Bit 5 = *DC UNDERVOLT*	
		Bit 6 = *AI1 LOSS*	
		Bit 7 = *AI2 LOSS*	
		Bit 8 = *MOT OVERTEMP*	
		Bit 9 = *PANEL LOSS*	
		Bit 10 = *ID RUN FAIL*	
		Bit 11 = *MOTOR STALL*	
		Bit 12 = *CB OVERTEMP*	
		Bit 13 = *EXT FAULT 1*	
		Bit 14 = *EXT FAULT 2*	
		Bit 15 = *EARTH FAULT*	
0306	FAULT WORD 2	A 16-bit data word. For the possible causes and remedies and fieldbus equivalents, see chapter *Fault tracing* on page *349*.	
		Bit 0 = *UNDERLOAD*	
		Bit 1 = *THERM FAIL*	
		Bit 2…3 = Reserved	
		Bit 4 = *CURR MEAS*	
		Bit 5 = *SUPPLY PHASE*	
		Bit 6 = *ENCODER ERR*	
		Bit 7 = *OVERSPEED*	
		Bit 8…9 = Reserved	
		Bit 10 = *CONFIG FILE*	
		Bit 11 = *SERIAL 1 ERR*	
		Bit 12 = *EFB CON FILE*. Configuration file reading error.	
		Bit 13 = *FORCE TRIP*	

Actual signals			
No.	**Name/Value**	**Description**	**FbEq**
		Bit 14 = *MOTOR PHASE*	
		Bit 15 = *OUTP WIRING*	
0307	FAULT WORD 3	A 16-bit data word. For the possible causes and remedies and fieldbus equivalents, see chapter *Fault tracing* on page *349*.	
		Bit 0…2 Reserved	
		Bit 3 = *INCOMPATIBLE SW*	
		Bit 4 = *SAFE TORQUE OFF*	
		Bit 5 = *STO1 LOST*	
		Bit 6 = *STO2 LOST*	
		Bit 7…10 Reserved	
		Bit 11 = *CB ID ERROR*	
		Bit 12 = *DSP STACK ERROR*	
		Bit 13 = *DSP T1 OVERLOAD…DSP T3 OVERLOAD*	
		Bit 14 = *SERF CORRUPT* / *SERF MACRO*	
		Bit 15 = *PAR PCU 1* / *PAR PCU 2* / *PAR HZRPM* / *PAR AI SCALE* / *PAR AO SCALE* / *PAR FBUSMISS* / *PAR USER U/F* / *PAR SETUP 1*	
0308	ALARM WORD 1	A 16-bit data word. For the possible causes and remedies and fieldbus equivalents, see chapter *Fault tracing* on page *349*. An alarm can be reset by resetting the whole alarm word: Write zero to the word.	
		Bit 0 = *OVERCURRENT*	
		Bit 1 = *OVERVOLTAGE*	
		Bit 2 = *UNDERVOLTAGE*	
		Bit 3 = *DIR LOCK*	
		Bit 4 = *IO COMM*	
		Bit 5 = *AI1 LOSS*	
		Bit 6 = *AI2 LOSS*	
		Bit 7 = *PANEL LOSS*	
		Bit 8 = *DEVICE OVERTEMP*	
		Bit 9 = *MOTOR TEMP*	
		Bit 10 = *UNDERLOAD*	
		Bit 11 = *MOTOR STALL*	
		Bit 12 = *AUTORESET*	
		Bit 13…15 = Reserved	

Actual signals			
No.	**Name/Value**	**Description**	**FbEq**
0309	ALARM WORD 2	A 16-bit data word. For the possible causes and remedies and fieldbus equivalents, see chapter *Fault tracing* on page *349*. An alarm can be reset by resetting the whole alarm word: Write zero to the word.	
		Bit 0 = Reserved	
		Bit 1 = *PID SLEEP*	
		Bit 2 = *ID RUN*	
		Bit 3 = Reserved	
		Bit 4 = *START ENABLE 1 MISSING*	
		Bit 5 = *START ENABLE 2 MISSING*	
		Bit 6 = *EMERGENCY STOP*	
		Bit 7 = *ENCODER ERROR*	
		Bit 8 = *FIRST START*	
		Bit 9 = *INPUT PHASE LOSS*	
		Bit 10…11 = Reserved	
		Bit 12 = *MOTOR BACK EMF*	
		Bit 13 = *SAFE TORQUE OFF*	
		Bit 14…15 = Reserved	
04 FAULT HISTORY		Fault history (read-only)	
0401	LAST FAULT	Code of the latest fault. See chapter *Fault tracing* on page *349* for the codes. 0 = Fault history is clear (on panel display = NO RECORD).	1 = 1
0402	FAULT TIME 1	Day on which the latest fault occurred. Format: Date if the real time clock is operating. / The number of days elapsed after the power-on if the real time clock is not used, or was not set.	1 = 1 days
0403	FAULT TIME 2	Time at which the latest fault occurred. Format on the assistant control panel: Real time (hh:mm:ss) if the real time clock is operating. / Time elapsed after the power-on (hh:mm:ss minus the whole days stated by signal *0402 FAULT TIME 1*) if real time clock is not used, or was not set. Format on the basic control panel: Time elapsed after power-on in 2 second ticks (minus the whole days stated by signal *0402 FAULT TIME 1*). 30 ticks = 60 seconds. For example, value 514 equals 17 minutes and 8 seconds (= 514/30).	1 = 2 s
0404	SPEED AT FLT	Motor speed in rpm at the time the latest fault occurred	1 = 1 rpm
0405	FREQ AT FLT	Frequency in Hz at the time the latest fault occurred	1 = 0.1 Hz

Actual signals			
No.	**Name/Value**	**Description**	**FbEq**
0406	VOLTAGE AT FLT	Intermediate circuit voltage in V DC at the time the latest fault occurred	1 = 0.1 V
0407	CURRENT AT FLT	Motor current in A at the time the latest fault occurred	1 = 0.1 A
0408	TORQUE AT FLT	Motor torque as a percentage of the motor nominal torque at the time the latest fault occurred	1 = 0.1%
0409	STATUS AT FLT	Drive status in hexadecimal format at the time the latest fault occurred	
0412	PREVIOUS FAULT 1	Fault code of the 2nd latest fault. See chapter *Fault tracing* on page *349* for the codes.	1 = 1
0413	PREVIOUS FAULT 2	Fault code of the 3rd latest fault. See chapter *Fault tracing* on page *349* for the codes.	1 = 1
0414	DI 1-5 AT FLT	Status of digital inputs DI1…5 at the time the latest fault occurred. **Example (panel):** • 10000 = DI1 is on, DI2…DI5 are off. • 10010 = DI1 and DI4 are on, DI2, DI3 and DI5 are off. **Example (DWL2):** • 16 (decimal) = DI1 is on, DI2…DI5 are off. • 18 (decimal) = DI1 and DI4 are on, DI2, DI3 and DI5 are off.	

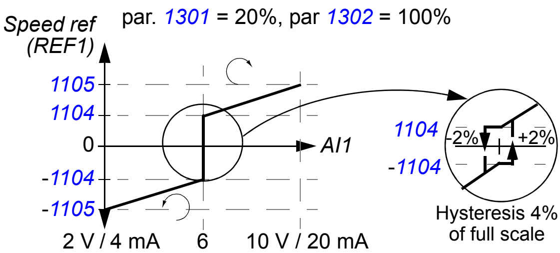
Parameters

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
10 START/STOP/DIR		The sources for external start, stop and direction control	
1001	EXT1 COMMANDS	Defines the connections and the source for the start, stop and direction commands for external control location 1 (EXT1). **Note:** Start signal must be reset if the drive has been stopped through STO (Safe torque off) input (see parameter *3025 STO OPERATION*) or emergency stop selection (see parameter *2109 EMERG STOP SEL*).	*DI1,2*
	NOT SEL	No start, stop and direction command source	0
	DI1	Start and stop through digital input DI1. 0 = stop, 1 = start. Direction is fixed according to parameter *1003 DIRECTION* (setting *REQUEST* = *FORWARD*).	1
	DI1,2	Start and stop through digital input DI1. 0 = stop, 1 = start. Direction through digital input DI2. 0 = forward, 1 = reverse. To control direction, parameter *1003 DIRECTION* setting must be *REQUEST*.	2
	DI1P,2P	Pulse start through digital input DI1. 0 -> 1: Start. (In order to start the drive, digital input DI2 must be activated prior to the pulse fed to DI1.) Pulse stop through digital input DI2. 1 -> 0: Stop. Direction of rotation is fixed according to parameter *1003 DIRECTION* (setting *REQUEST* = *FORWARD*). **Note:** When the stop input (DI2) is deactivated (no input), the control panel start and stop keys are disabled.	3
	DI1P,2P,3	Pulse start through digital input DI1. 0 -> 1: Start. (In order to start the drive, digital input DI2 must be activated prior to the pulse fed to DI1.) Pulse stop through digital input DI2. 1 -> 0: Stop. Direction through digital input DI3. 0 = forward, 1 = reverse. To control direction, parameter *1003 DIRECTION* setting must be *REQUEST*. **Note:** When the stop input (DI2) is deactivated (no input), the control panel start and stop keys are disabled.	4
	DI1P,2P,3P	Pulse start forward through digital input DI1. 0 -> 1: Start forward. Pulse start reverse through digital input DI2. 0 -> 1: Start reverse. (In order to start the drive, digital input DI3 must be activated prior to the pulse fed to DI1/DI2). Pulse stop through digital input DI3. 1 -> 0: Stop. To control the direction, parameter *1003 DIRECTION* setting must be *REQUEST*. **Note:** When the stop input (DI3) is deactivated (no input), the control panel start and stop keys are disabled.	5

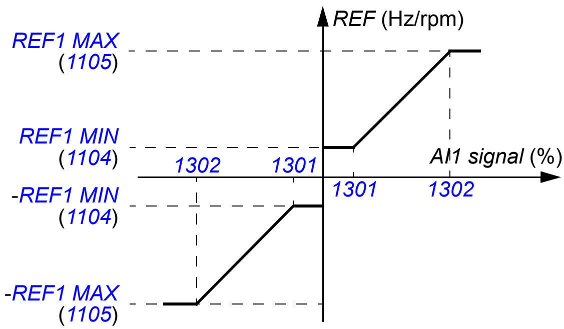
All parameters			
No.	Name/Value	Description	Def/FbEq
	KEYPAD	Start, stop and direction commands through control panel when EXT1 is active. To control the direction, parameter *1003 DIRECTION* setting must be *REQUEST*.	8
	DI1F,2R	Start, stop and direction commands through digital inputs DI1 and DI2. **DI1** / **DI2** / **Operation** 0 / 0 / Stop 1 / 0 / Start forward 0 / 1 / Start reverse 1 / 1 / Stop Parameter *1003 DIRECTION* setting must be *REQUEST*.	9
	COMM	Fieldbus interface as the source for the start and stop commands, ie, Control word *0301 FB CMD WORD 1* bits 0…1. The Control word is sent by the fieldbus controller through the fieldbus adapter or embedded fieldbus (Modbus) to the drive. For the Control word bits, see section *DCU communication profile* on page *333*.	10
	TIMED FUNC 1	Timed start/stop control. Timed function 1 active = start, timed function 1 inactive = stop. See parameter group *36 TIMED FUNCTIONS*.	11
	TIMED FUNC 2	See selection *TIMED FUNC 1*.	12
	TIMED FUNC 3	See selection *TIMED FUNC 1*.	13
	TIMED FUNC 4	See selection *TIMED FUNC 1*.	14
	DI5	Start and stop through digital input DI5. 0 = stop, 1 = start. Direction is fixed according to parameter *1003 DIRECTION* (setting *REQUEST* = *FORWARD*).	20
	DI5,4	Start and stop through digital input DI5. 0 = stop, 1 = start. Direction through digital input DI4. 0 = forward, 1 = reverse. To control direction, parameter *1003 DIRECTION* must be *REQUEST*.	21
	TIMER STOP	Stop when timer delay defined by parameter *1901 TIMER DELAY* has passed. Start with timer start signal. Source for the signal is selected by parameter *1902 TIMER START*.	22
	TIMER START	Start when timer delay defined by parameter *1901 TIMER DELAY* has passed. Stop when timer is reset by parameter *1903 TIMER RESET*.	23
	COUNTER STOP	Stop when counter limit defined by parameter *1905 COUNTER LIMIT* has been exceeded. Start with counter start signal. Source for the signal is selected by parameter *1911 CNTR S/S COMMAND*.	24

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	COUNTR START	Start when counter limit defined by parameter *1905 COUNTER LIMIT* has been exceeded. Stop with counter stop signal. Source for the signal is selected by parameter *1911 CNTR S/S COMMAND*.	25
	SEQ PROG	Start, stop and direction commands through Sequence programming. See parameter group *84 SEQUENCE PROG*.	26
1002	EXT2 COMMANDS	Defines the connections and the source for the start, stop and direction commands for external control location 2 (EXT2).	*NOT SEL*
		See parameter *1001 EXT1 COMMANDS*.	
1003	DIRECTION	Enables the control of rotation direction of the motor, or fixes the direction.	*REQUEST*
	FORWARD	Fixed to forward	1
	REVERSE	Fixed to reverse	2
	REQUEST	Control of rotation direction allowed	3
1010	JOGGING SEL	Defines the signal that activates the jogging function. See section *Control of a mechanical brake* on page *159*.	*NOT SEL*
	DI1	Digital input DI1. 0 = jogging inactive, 1 = jogging active.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	COMM	Fieldbus interface as the source for jogging 1 or 2 activation, ie, Control word *0302 FB CMD WORD 2* bits 20 and 21. The Control word is sent by the fieldbus controller through the fieldbus adapter or embedded fieldbus (Modbus) to the drive. For the Control word bits, see section *DCU communication profile* on page *333*.	6
	NOT SEL	Not selected	0
	DI1(INV)	Inverted digital input DI1. 1 = jogging inactive, 0 = jogging active.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
11 REFERENCE SELECT		Panel reference type, external control location selection and external reference sources and limits	
1101	KEYPAD REF SEL	Selects the type of the reference in local control mode.	*REF1(Hz/ rpm)*
	REF1(Hz/rpm)	Speed reference in rpm. Frequency reference (Hz) if parameter *9904 MOTOR CTRL MODE* setting is *SCALAR: FREQ*.	1
	REF2(%)	%-reference	2
1102	EXT1/EXT2 SEL	Defines the source from which the drive reads the signal that selects between the two external control locations, EXT1 or EXT2.	*EXT1*
	EXT1	EXT1 active. The control signal sources are defined by parameters *1001 EXT1 COMMANDS* and *1103 REF1 SELECT*.	0
	DI1	Digital input DI1. 0 = EXT1, 1 = EXT2.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	EXT2	EXT2 active. The control signal sources are defined by parameters *1002 EXT2 COMMANDS* and *1106 REF2 SELECT*.	7
	COMM	Fieldbus interface as the source for EXT1/EXT2 selection, ie, Control word *0301 FB CMD WORD 1* bit 5 (with ABB drives profile *5319 EFB PAR 19* bit 11). The Control word is sent by the fieldbus controller through the fieldbus adapter or embedded fieldbus (Modbus) to the drive. For the Control word bits, see sections *DCU communication profile* on page *333* and *ABB drives communication profile* on page *328*.	8
	TIMED FUNC 1	Timed EXT1/EXT2 control selection. Timed function 1 active = EXT2, timed function 1 inactive = EXT1. See parameter group *36 TIMED FUNCTIONS*.	9
	TIMED FUNC 2	See selection *TIMED FUNC 1*.	10
	TIMED FUNC 3	See selection *TIMED FUNC 1*.	11
	TIMED FUNC 4	See selection *TIMED FUNC 1*.	12
	DI1(INV)	Inverted digital input DI1. 1 = EXT1, 0 = EXT2.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
1103	REF1 SELECT	Selects the signal source for external reference REF1. See section *Block diagram: Reference source for EXT1* on page *128*.	*AI1*
	KEYPAD	Control panel	0
	AI1	Analog input AI1	1
	AI2	Analog input AI2	2
	AI1/JOYST	Analog input AI1 as joystick. The minimum input signal runs the motor at the maximum reference in the reverse direction, the maximum input at the maximum reference in the forward direction. Minimum and maximum references are defined by parameters *1104 REF1 MIN* and *1105 REF1 MAX*. **Note:** Parameter *1003 DIRECTION* must be set to *REQUEST*.  **WARNING!** If parameter *1301 MINIMUM AI1* is set to 0 V and analog input signal is lost (ie, 0 V), the rotation of the motor is reversed to the maximum reference. Set the following parameters to activate a fault when analog input signal is lost: Set parameter *1301 MINIMUM AI1* to 20% (2 V or 4 mA). Set parameter *3021 AI1 FAULT LIMIT* to 5% or higher. Set parameter *3001 AI<MIN FUNCTION* to *FAULT*.	3
	AI2/JOYST	See selection *AI1/JOYST*.	4
	DI3U,4D(R)	Digital input DI3: Reference increase. Digital input DI4: Reference decrease. Stop command resets the reference to zero. Parameter *2205 ACCELER TIME 2* defines the rate of the reference change.	5
	DI3U,4D	Digital input DI3: Reference increase. Digital input DI4: Reference decrease. The program stores the active speed reference (not reset by a stop command). When the drive is restarted, the motor ramps up at the selected acceleration rate to the stored reference. Parameter *2205 ACCELER TIME 2* defines the rate of the reference change.	6
	COMM	Fieldbus reference REF1	8

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	COMM+AI1	Summation of fieldbus reference REF1 and analog input AI. See section *Reference selection and correction* on page *320*.	9
	COMM*AI1	Multiplication of fieldbus reference REF1 and analog input AI1. See section *Reference selection and correction* on page *320*.	10
	DI3U,4D(RNC)	Digital input DI3: Reference increase. Digital input DI4: Reference decrease. Stop command resets the reference to zero. The reference is not saved if the control source is changed (from EXT1 to EXT2, from EXT2 to EXT1 or from LOC to REM). Parameter *2205 ACCELER TIME 2* defines the rate of the reference change.	11
	DI3U,4D(NC)	Digital input DI3: Reference increase. Digital input DI4: Reference decrease. The program stores the active speed reference (not reset by a stop command). The reference is not saved if the control source is changed (from EXT1 to EXT2, from EXT2 to EXT1 or from LOC to REM). When the drive is restarted, the motor ramps up at the selected acceleration rate to the stored reference. Parameter *2205 ACCELER TIME 2* defines the rate of the reference change.	12
	AI1+AI2	Reference is calculated with the following equation: REF = AI1(%) + AI2(%) - 50%	14
	AI1*AI2	Reference is calculated with the following equation: REF = AI1(%) · (AI2(%) / 50%)	15
	AI1-AI2	Reference is calculated with the following equation: REF = AI1(%) + 50% - AI2(%)	16
	AI1/AI2	Reference is calculated with the following equation: REF = AI1(%) · (50% / AI2 (%))	17
	KEYPAD(RNC)	Defines the control panel as the reference source. Stop command resets the reference to zero (the R stands for reset). The reference is not copied if the control source is changed (from EXT1 to EXT2, from EXT2 to EXT1).	20
	KEYPAD(NC)	Defines the control panel as the reference source. Stop command does not reset the reference to zero. The reference is stored. The reference is not copied if the control source is changed (from EXT1 to EXT2, from EXT2 to EXT1).	21
	DI4U,5D	See selection *DI3U,4D*.	30
	DI4U,5D(NC)	See selection *DI3U,4D(NC)*.	31
	FREQ INPUT	Frequency input	32

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	SEQ PROG	Sequence programming output. See parameter *8420 ST1 REF SEL*.	33
	AI1+SEQ PROG	Addition of analog input AI1 and Sequence programming output	34
	AI2+SEQ PROG	Addition of analog input AI2 and Sequence programming output	35
	ODVA HZ REF	ODVA AC/DC profile speed reference and actual values in Hz	36
1104	REF1 MIN	Defines the minimum value for external reference REF1. Corresponds to the minimum setting of the used source signal.	0.0 Hz / 1 rpm
	0.0…599.0 Hz / 0…30000 rpm	Minimum value in rpm. Hz if parameter *9904 MOTOR CTRL MODE* setting is *SCALAR: FREQ*. **Example:** Analog input AI1 is selected as the reference source (value of parameter *1103* is *AI1*). The reference minimum and maximum correspond to the *1301 MINIMUM AI1* and *1302 MAXIMUM AI1* settings as follows: 	1 = 0.1 Hz / 1 rpm
1105	REF1 MAX	Defines the maximum value for external reference REF1. Corresponds to the maximum setting of the used source signal.	E: 50.0 Hz U: 60.0 Hz
	0.0…599.0 Hz / 0…30000 rpm	Maximum value in rpm. Hz if parameter *9904 MOTOR CTRL MODE* setting is *SCALAR: FREQ*. See the example for parameter *1104 REF1 MIN*.	1 = 0.1 Hz / 1 rpm
1106	REF2 SELECT	Selects the signal source for external reference REF2.	*AI2*
	KEYPAD	See parameter *1103 REF1 SELECT*.	0
	AI1	See parameter *1103 REF1 SELECT*.	1
	AI2	See parameter *1103 REF1 SELECT*.	2
	AI1/JOYST	See parameter *1103 REF1 SELECT*.	3
	AI2/JOYST	See parameter *1103 REF1 SELECT*.	4
	DI3U,4D(R)	See parameter *1103 REF1 SELECT*.	5

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	DI3U,4D	See parameter *1103 REF1 SELECT*.	6
	COMM	See parameter *1103 REF1 SELECT*.	8
	COMM+AI1	See parameter *1103 REF1 SELECT*.	9
	COMM*AI1	See parameter *1103 REF1 SELECT*.	10
	DI3U,4D(RNC)	See parameter *1103 REF1 SELECT*.	11
	DI3U,4D(NC)	See parameter *1103 REF1 SELECT*.	12
	AI1+AI2	See parameter *1103 REF1 SELECT*.	14
	AI1*AI2	See parameter *1103 REF1 SELECT*.	15
	AI1-AI2	See parameter *1103 REF1 SELECT*.	16
	AI1/AI2	See parameter *1103 REF1 SELECT*.	17
	PID1OUT	PID controller 1 output. See parameter groups *40 PROCESS PID SET 1* and *41 PROCESS PID SET 2*.	19
	KEYPAD(RNC)	See parameter *1103 REF1 SELECT*.	20
	KEYPAD(NC)	See parameter *1103 REF1 SELECT*.	21
	DI4U,5D	See parameter *1103 REF1 SELECT*.	30
	DI4U,5D(NC)	See parameter *1103 REF1 SELECT*.	31
	FREQ INPUT	See parameter *1103 REF1 SELECT*.	32
	SEQ PROG	See parameter *1103 REF1 SELECT*.	33
	AI1+SEQ PROG	See parameter *1103 REF1 SELECT*.	34
	AI2+SEQ PROG	See parameter *1103 REF1 SELECT*.	35
1107	REF2 MIN	Defines the minimum value for external reference REF2. Corresponds to the minimum setting of the used source signal.	0.0%
	0.0…100.0%	Value as a percentage of the maximum frequency / maximum speed / nominal torque. See the example for parameter *1104 REF1 MIN* for correspondence to the source signal limits.	1 = 0.1%
1108	REF2 MA	Defines the maximum value for external reference REF2. Corresponds to the maximum setting of the used source signal.	100.0%
	0.0…100.0%	Value as a percentage of the maximum frequency / maximum speed / nominal torque. See the example for parameter *1104 REF1 MIN* for correspondence to the source signal limits.	1 = 0.1%
1109	ODVA HZ REF SEL	Decimal point location for ODVA frequency reference values if parameter *1103 REF1 SELECT* = *ODVA HZ REF*	1
	SCALE 1	ODVA profile Hz reference 500 equals 50.0 Hz in EXT1.	1
	SCALE 2	ODVA profile Hz reference 5000 equals 50.00 Hz in EXT1.	2

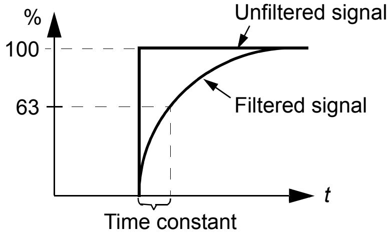
<table>
<tr><th colspan="4">All parameters</th></tr>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq</th></tr>
<tr><td colspan="2">12 CONSTANT SPEEDS</td><td>Constant speed selection and values. See section Constant speeds on page 142.</td><td></td></tr>
<tr><td>1201</td><td>CONST SPEED SEL</td><td>Activates the constant speeds or selects the activation signal.</td><td>DI3,4</td></tr>
<tr><td></td><td>NOT SEL</td><td>No constant speed in use</td><td>0</td></tr>
<tr><td></td><td>DI1</td><td>Speed defined by parameter 1202 CONST SPEED 1 is activated through digital input DI1. 1 = active, 0 = inactive.</td><td>1</td></tr>
<tr><td></td><td>DI2</td><td>Speed defined by parameter 1202 CONST SPEED 1 is activated through digital input DI2. 1 = active, 0 = inactive.</td><td>2</td></tr>
<tr><td></td><td>DI3</td><td>Speed defined by parameter 1202 CONST SPEED 1 is activated through digital input DI3. 1 = active, 0 = inactive.</td><td>3</td></tr>
<tr><td></td><td>DI4</td><td>Speed defined by parameter 1202 CONST SPEED 1 is activated through digital input DI4. 1 = active, 0 = inactive.</td><td>4</td></tr>
<tr><td></td><td>DI5</td><td>Speed defined by parameter 1202 CONST SPEED 1 is activated through digital input DI5. 1 = active, 0 = inactive.</td><td>5</td></tr>
<tr><td></td><td>DI1,2</td><td>Constant speed selection through digital inputs DI1 and DI2.1 = DI active, 0 = DI inactive.
<table>
<tr><th>DI1</th><th>DI2</th><th>Operation</th></tr>
<tr><td>0</td><td>0</td><td>No constant speed</td></tr>
<tr><td>1</td><td>0</td><td>Speed defined by par. 1202 CONST SPEED 1</td></tr>
<tr><td>0</td><td>1</td><td>Speed defined by par. 1203 CONST SPEED 2</td></tr>
<tr><td>1</td><td>1</td><td>Speed defined by par. 1204 CONST SPEED 3</td></tr>
</table></td><td>7</td></tr>
<tr><td></td><td>DI2,3</td><td>See selection DI1,2.</td><td>8</td></tr>
<tr><td></td><td>DI3,4</td><td>See selection DI1,2.</td><td>9</td></tr>
<tr><td></td><td>DI4,5</td><td>See selection DI1,2.</td><td>10</td></tr>
<tr><td></td><td>DI1,2,3</td><td>Constant speed selection through digital inputs DI1, DI2 and DI3. 1 = DI active, 0 = DI inactive.
<table>
<tr><th>DI</th><th>DI2</th><th>DI3</th><th>Operation</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>No constant speed</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Speed defined by par. 1202 CONST SPEED 1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Speed defined by par. 1203 CONST SPEED 2</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Speed defined by par. 1204 CONST SPEED 3</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Speed defined by par. 1205 CONST SPEED 4</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Speed defined by par. 1206 CONST SPEED 5</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Speed defined by par. 1207 CONST SPEED 6</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Speed defined by par. 1208 CONST SPEED 7</td></tr>
</table></td><td>12</td></tr>
<tr><td></td><td>DI3,4,5</td><td>See selection DI1,2,3.</td><td>13</td></tr>
</table>

<table>
<tr><th colspan="4">All parameters</th></tr>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq</th></tr>
<tr><td></td><td>TIMED FUNC 1</td><td>External speed reference, speed defined by parameter 1202 CONST SPEED 1 or speed defined by parameter 1203 CONST SPEED 2 is used, depending on the selection of parameter 1209 TIMED MODE SEL and the state of timed function 1. See parameter group 36 TIMED FUNCTIONS.</td><td>15</td></tr>
<tr><td></td><td>TIMED FUNC 2</td><td>See selection TIMED FUNC 1.</td><td>16</td></tr>
<tr><td></td><td>TIMED FUNC 3</td><td>See selection TIMED FUNC 1.</td><td>17</td></tr>
<tr><td></td><td>TIMED FUNC 4</td><td>See selection TIMED FUNC 1.</td><td>18</td></tr>
<tr><td></td><td>TIMED FUN1&2</td><td>External speed reference or speed defined by parameter 1202 CONST SPEED 1 … 1205 CONST SPEED 4 is used, depending on the selection of parameter 1209 TIMED MODE SEL and the state of timed functions 1 and 2. See parameter group 36 TIMED FUNCTIONS.</td><td>19</td></tr>
<tr><td></td><td>DI1(INV)</td><td>Speed defined by parameter 1202 CONST SPEED 1 is activated through inverted digital input DI1. 0 = active, 1 = inactive.</td><td>-1</td></tr>
<tr><td></td><td>DI2(INV)</td><td>Speed defined by parameter 1202 CONST SPEED 1 is activated through inverted digital input DI2. 0 = active, 1 = inactive.</td><td>-2</td></tr>
<tr><td></td><td>DI3(INV)</td><td>Speed defined by parameter 1202 CONST SPEED 1 is activated through inverted digital input DI3. 0 = active, 1 = inactive.</td><td>-3</td></tr>
<tr><td></td><td>DI4(INV)</td><td>Speed defined by parameter 1202 CONST SPEED 1 is activated through inverted digital input DI4. 0 = active, 1 = inactive.</td><td>-4</td></tr>
<tr><td></td><td>DI5(INV)</td><td>Speed defined by parameter 1202 CONST SPEED 1 is activated through inverted digital input DI5. 0 = active, 1 = inactive.</td><td>-5</td></tr>
<tr><td></td><td>DI1,2(INV)</td><td>Constant speed selection through inverted digital inputs DI1 and DI2. 1 = DI active, 0 = DI inactive.
<table>
<tr><th>DI1</th><th>DI2</th><th>Operation</th></tr>
<tr><td>1</td><td>1</td><td>No constant speed</td></tr>
<tr><td>0</td><td>1</td><td>Speed defined by par. 1202 CONST SPEED 1</td></tr>
<tr><td>1</td><td>0</td><td>Speed defined by par. 1203 CONST SPEED 2</td></tr>
<tr><td>0</td><td>0</td><td>Speed defined by par. 1204 CONST SPEED 3</td></tr>
</table></td><td>-7</td></tr>
<tr><td></td><td>DI2,3(INV)</td><td>See selection DI1,2(INV).</td><td>-8</td></tr>
<tr><td></td><td>DI3,4(INV)</td><td>See selection DI1,2(INV).</td><td>-9</td></tr>
<tr><td></td><td>DI4,5(INV)</td><td>See selection DI1,2(INV).</td><td>-10</td></tr>
</table>

<table>
<tr><th colspan="4">All parameters</th></tr>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq</th></tr>
<tr><td></td><td>DI1,2,3(INV)</td><td>Constant speed selection through inverted digital inputs DI1, DI2 and DI3. 1 = DI active, 0 = DI inactive.
<table>
<tr><th>DI</th><th>DI2</th><th>DI3</th><th>Operation</th></tr>
<tr><td>1</td><td>1</td><td>1</td><td>No constant speed</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Speed defined by par. 1202 CONST SPEED 1</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Speed defined by par. 1203 CONST SPEED 2</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Speed defined by par. 1204 CONST SPEED 3</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Speed defined by par. 1205 CONST SPEED 4</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Speed defined by par. 1206 CONST SPEED 5</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Speed defined by par. 1207 CONST SPEED 6</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Speed defined by par. 1208 CONST SPEED 7</td></tr>
</table></td><td>-12</td></tr>
<tr><td></td><td>DI3,4,5(INV)</td><td>See selection DI1,2,3(INV).</td><td>-13</td></tr>
<tr><td>1202</td><td>CONST SPEED 1</td><td>Defines constant speed (or drive output frequency) 1.</td><td>E: 5.0 Hz
U: 6.0 Hz</td></tr>
<tr><td></td><td>0.0…599.0 Hz / 0…30000 rpm</td><td>Speed in rpm. Output frequency in Hz if parameter 9904 MOTOR CTRL MODE setting is SCALAR: FREQ.</td><td>1 = 0.1 Hz / 1 rpm</td></tr>
<tr><td>1203</td><td>CONST SPEED 2</td><td>Defines constant speed (or drive output frequency) 2.</td><td>E: 10.0 Hz
U: 12.0 Hz</td></tr>
<tr><td></td><td>0.0…599.0 Hz / 0…30000 rpm</td><td>Speed in rpm. Output frequency in Hz if parameter 9904 MOTOR CTRL MODE setting is SCALAR: FREQ.</td><td>1 = 0.1 Hz / 1 rpm</td></tr>
<tr><td>1204</td><td>CONST SPEED 3</td><td>Defines constant speed (or drive output frequency) 3.</td><td>E: 15.0 Hz
U: 18.0 Hz</td></tr>
<tr><td></td><td>0.0…599.0 Hz / 0…30000 rpm</td><td>Speed in rpm. Output frequency in Hz if parameter 9904 MOTOR CTRL MODE setting is SCALAR: FREQ.</td><td>1 = 0.1 Hz / 1 rpm</td></tr>
<tr><td>1205</td><td>CONST SPEED 4</td><td>Defines constant speed (or drive output frequency) 4.</td><td>E: 20.0 Hz
U: 24.0 Hz</td></tr>
<tr><td></td><td>0.0…599.0 Hz / 0…30000 rpm</td><td>Speed in rpm. Output frequency in Hz if parameter 9904 MOTOR CTRL MODE setting is SCALAR: FREQ.</td><td>1 = 0.1 Hz / 1 rpm</td></tr>
<tr><td>1206</td><td>CONST SPEED 5</td><td>Defines constant speed (or drive output frequency) 5.</td><td>E: 25.0 Hz
U: 30.0 Hz</td></tr>
<tr><td></td><td>0.0…599.0 Hz / 0…30000 rpm</td><td>Speed in rpm. Output frequency in Hz if parameter 9904 MOTOR CTRL MODE setting is SCALAR: FREQ.</td><td>1 = 0.1 Hz / 1 rpm</td></tr>
<tr><td>1207</td><td>CONST SPEED 6</td><td>Defines constant speed (or drive output frequency) 6.</td><td>E: 40.0 Hz
U: 48.0 Hz</td></tr>
<tr><td></td><td>0.0…599.0 Hz / 0…30000 rpm</td><td>Speed in rpm. Output frequency in Hz if parameter 9904 MOTOR CTRL MODE setting is SCALAR: FREQ. Constant speed 6 is used also as jogging speed. See section Control of a mechanical brake on page 159.</td><td>1 = 0.1 Hz / 1 rpm</td></tr>
</table>

<table>
<tr><th colspan="4">All parameters</th></tr>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq</th></tr>
<tr><td>1208</td><td>CONST SPEED 7</td><td>Defines constant speed (or drive output frequency) 7. Constant speed 7 is used also as jogging speed (see section Control of a mechanical brake on page 159) or with fault functions (3001 AI<MIN FUNCTION and 3002 PANEL COMM ERR).</td><td>E: 50.0 Hz
U: 60.0 Hz</td></tr>
<tr><td></td><td>0.0…599.0 Hz / 0…30000 rpm</td><td>Speed in rpm. Output frequency in Hz if parameter 9904 MOTOR CTRL MODE setting is SCALAR: FREQ. Constant speed 7 is used also as jogging speed. See section Control of a mechanical brake on page 159.</td><td>1 = 0.1 Hz / 1 rpm</td></tr>
<tr><td>1209</td><td>TIMED MODE SEL</td><td>Selects timed function activated speed. Timed function can be used to change between the external reference and constant speeds when parameter 1201 CONST SPEED SEL selection is TIMED FUNC 1 … TIMED FUNC 4 or TIMED FUN1&2.</td><td>CS1/2/3/4</td></tr>
<tr><td></td><td>EXT/CS1/2/3</td><td>When parameter 1201 CONST SPEED SEL = TIMED FUNC 1 … TIMED FUNC 4, this timed function selects an external speed reference or constant speed. 1 = timed function active, 0 = timed function inactive.
<table>
<tr><th>Timed function 1…4</th><th>Operation</th></tr>
<tr><td>0</td><td>External reference</td></tr>
<tr><td>1</td><td>Speed defined by par. 1202 CONST SPEED 1</td></tr>
</table>
When parameter 1201 CONST SPEED SEL = TIMED FUN1&2, timed functions 1 and 2 select an external speed reference or constant speed. 1 = timed function active, 0 = timed function inactive.
<table>
<tr><th>Timed function 1</th><th>Timed function 2</th><th>Operation</th></tr>
<tr><td>0</td><td>0</td><td>External reference</td></tr>
<tr><td>1</td><td>0</td><td>Speed defined by par. 1202 CONST SPEED 1</td></tr>
<tr><td>0</td><td>1</td><td>Speed defined by par. 1203 CONST SPEED 2</td></tr>
<tr><td>1</td><td>1</td><td>Speed defined by par. 1204 CONST SPEED 3</td></tr>
</table></td><td>1</td></tr>
</table>

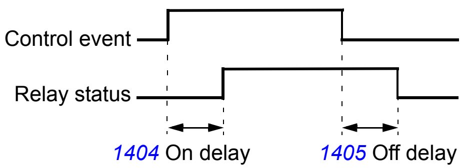
<table>
<tr><th colspan="3">All parameters</th></tr>
<tr><th>No. Name/Value</th><th>Description</th><th>Def/FbEq</th></tr>
<tr><td>CS1/2/3/4</td><td>When parameter 1201 CONST SPEED SEL = TIMED FUNC 1 … TIMED FUNC 4, this timed function selects a constant speed. 1 = timed function active, 0 = timed function inactive.
<table>
<tr><th>Timed function 1…4</th><th>Operation</th></tr>
<tr><td>0</td><td>Speed defined by parameter 1202 CONST SPEED 1</td></tr>
<tr><td>1</td><td>Speed defined by parameter 1203 CONST SPEED 2</td></tr>
</table>
When parameter 1201 CONST SPEED SEL = TIMED FUN1&2, timed functions 1 and 2 select a constant speed. 1 = timed function active, 0 = timed function inactive.
<table>
<tr><th>Timed function 1</th><th>Timed function 2</th><th>Operation</th></tr>
<tr><td>0</td><td>0</td><td>Speed defined by parameter 1202 CONST SPEED 1</td></tr>
<tr><td>1</td><td>0</td><td>Speed defined by parameter 1203 CONST SPEED 2</td></tr>
<tr><td>0</td><td>1</td><td>Speed defined by parameter 1204 CONST SPEED 3</td></tr>
<tr><td>1</td><td>1</td><td>Speed defined by parameter 1205 CONST SPEED 4</td></tr>
</table></td><td>2</td></tr>
<tr><td>13 ANALOG INPUTS</td><td>Analog input signal processing</td><td></td></tr>
<tr><td>1301 MINIMUM AI1</td><td>Defines the minimum %-value that corresponds to minimum mA/(V) signal for analog input AI1. When used as a reference, the value corresponds to the reference minimum setting.
0…20 mA ≙ 0…100%
4…20 mA ≙ 20…100%
-10…10 mA ≙ -50…50%
Example: If AI1 is selected as the source for external reference REF1, this value corresponds to the value of parameter 1104 REF1 MIN.
Note: MINIMUM AI1 value must not exceed MAXIMUM AI1 value.</td><td>1.0%</td></tr>
<tr><td>-100.0…100.0%</td><td>Value as a percentage of the full signal range.
Example: If the minimum value for analog input is 4 mA, the percentage value for 0…20 mA range is:
(4 mA / 20 mA) · 100% = 20%</td><td>1 = 0.1%</td></tr>
</table>

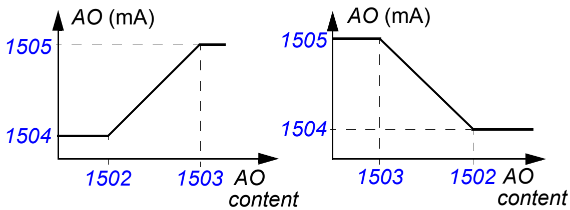
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
1302	MAXIMUM AI1	Defines the maximum %-value that corresponds to maximum mA/(V) signal for analog input AI1. When used as a reference, the value corresponds to the reference maximum setting. 0…20 mA ≙ 0…100% 4…20 mA ≙ 20…100% -10…10 mA ≙ -50…50% **Example:** If AI1 is selected as the source for external reference REF1, this value corresponds to the value of parameter *1105 REF1 MAX*.	100.0%
	-100.0…100.0%	Value as a percentage of the full signal range. **Example:** If the maximum value for analog input is 10 mA, the percentage value for 0…20 mA range is: (10 mA / 20 mA) · 100% = 50%	1 = 0.1%
1303	FILTER AI1	Defines the filter time constant for analog input AI1, ie, the time within which 63% of a step change is reached. 	0.1 s
	0.0…10.0 s	Filter time constant	1 = 0.1 s
1304	MINIMUM AI2	Defines the minimum %-value that corresponds to minimum mA/(V) signal for analog input AI2. See parameter *1301 MINIMUM AI1*.	20%
	-100.0…100.0%	See parameter *1301 MINIMUM AI1*.	1 = 0.1%
1305	MAXIMUM AI2	Defines the maximum %-value that corresponds to maximum mA/(V) signal for analog input AI2. See parameter *1302 MAXIMUM AI1*.	100.0%
	-100.0…100.0%	See parameter *1302 MAXIMUM AI1*.	1 = 0.1%
1306	FILTER AI2	Defines the filter time constant for analog input AI2. See parameter *1303 FILTER AI1*.	0.1 s
	0.0…10.0 s	Filter time constant	1 = 0.1 s

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
14 RELAY OUTPUTS		Status information indicated through relay output, and relay operating delays. **Note:** Relay outputs 2…4 are available only if the MREL-01 output relay module is connected to the drive. See *MREL-01 output relay module user's manual* (3AUA0000035974 [English]).	
1401	RELAY OUTPUT 1	Selects a drive status indicated through relay output RO 1. The relay energizes when the status meets the setting.	*FAULT(-1)*
	NOT SEL	Not used	0
	READY	Ready to function: Run enable signal on, no fault, supply voltage within acceptable range and emergency stop signal off.	1
	RUN	Running: Start signal on, Run enable signal on, no active fault.	2
	FAULT(-1)	Inverted fault. Relay is de-energized on a fault trip.	3
	FAULT	Fault	4
	ALARM	Alarm	5
	REVERSED	Motor rotates in reverse direction.	6
	STARTED	The drive has received start command. Relay is energized even if Run enable signal is off. Relay is de-energized when drive receives a stop command or a fault occurs.	7
	SUPRV1 OVER	Status according to supervision parameters *3201*…*3203*. See parameter group *32 SUPERVISION*.	8
	SUPRV1 UNDER	See selection *SUPRV1 OVER*.	9
	SUPRV2 OVER	Status according to supervision parameters *3204*…*3206*. See parameter group *32 SUPERVISION*.	10
	SUPRV2 UNDER	See selection *SUPRV2 OVER*.	11
	SUPRV3 OVER	Status according to supervision parameters *3207*…*3209*. See parameter group *32 SUPERVISION*.	12
	SUPRV3 UNDER	See selection *SUPRV3 OVER*.	13
	AT SET POINT	Output frequency is equal to the reference frequency.	14
	FAULT(RST)	Fault. Automatic reset after the autoreset delay. See parameter group *31 AUTOMATIC RESET*.	15
	FLT/ALARM	Fault or alarm	16
	EXT CTRL	Drive is under external control.	17
	REF 2 SEL	External reference REF 2 is in use.	18
	CONST FREQ	A constant speed is in use. See parameter group *12 CONSTANT SPEEDS*.	19

<table>
<tr><th colspan="4">All parameters</th></tr>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq</th></tr>
<tr><td></td><td>REF LOSS</td><td>Reference or active control location is lost.</td><td>20</td></tr>
<tr><td></td><td>OVERCURRENT</td><td>Alarm/Fault by overcurrent protection function</td><td>21</td></tr>
<tr><td></td><td>OVERVOLTAGE</td><td>Alarm/Fault by overvoltage protection function</td><td>22</td></tr>
<tr><td></td><td>DRIVE TEMP</td><td>Alarm/Fault by drive overtemperature protection function</td><td>23</td></tr>
<tr><td></td><td>UNDERVOLTAGE</td><td>Alarm/Fault by undervoltage protection function</td><td>24</td></tr>
<tr><td></td><td>AI1 LOSS</td><td>Analog input AI1 signal is lost.</td><td>25</td></tr>
<tr><td></td><td>AI2 LOSS</td><td>Analog input AI2 signal is lost.</td><td>26</td></tr>
<tr><td></td><td>MOTOR TEMP</td><td>Alarm/Fault by motor overtemperature protection function. See parameter 3005 MOT THERM PROT.</td><td>27</td></tr>
<tr><td></td><td>STALL</td><td>Alarm/Fault by stall protection function. See parameter 3010 STALL FUNCTION.</td><td>28</td></tr>
<tr><td></td><td>UNDERLOAD</td><td>Alarm/Fault by underload protection function. See parameter 3013 UNDERLOAD FUNC.</td><td>29</td></tr>
<tr><td></td><td>PID SLEEP</td><td>PID sleep function. See parameter group 40 PROCESS PID SET 1 / 41 PROCESS PID SET 2.</td><td>30</td></tr>
<tr><td></td><td>FLUX READY</td><td>Motor is magnetized and able to supply nominal torque.</td><td>33</td></tr>
<tr><td></td><td>USER MACRO 2</td><td>User macro 2 is active.</td><td>34</td></tr>
<tr><td></td><td>COMM</td><td>Fieldbus control signal 0134 COMM RO WORD. 0 = de-energize output, 1 = energize output.
<table>
<tr><th>0134 value</th><th>Binary</th><th>RO4 (MREL)</th><th>RO3 (MREL)</th><th>RO2 (MREL)</th><th>DO</th><th>RO1</th></tr>
<tr><td>0</td><td>00000</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>00001</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>2</td><td>00010</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>3</td><td>00011</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>4</td><td>00100</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>5…30</td><td>…</td><td>…</td><td>…</td><td>…</td><td>…</td><td>…</td></tr>
<tr><td>31</td><td>11111</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table></td><td>35</td></tr>
<tr><td></td><td>COMM(-1)</td><td>Fieldbus control signal 0134 COMM RO WORD. 0 = de-energize output, 1 = energize output.
<table>
<tr><th>0134 value</th><th>Binary</th><th>RO4 (MREL)</th><th>RO3 (MREL)</th><th>RO2 (MREL)</th><th>DO</th><th>RO1</th></tr>
<tr><td>0</td><td>00000</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>00001</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>2</td><td>00010</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>3</td><td>00011</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>4</td><td>00100</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>5…30</td><td>…</td><td>…</td><td>…</td><td>…</td><td>…</td><td>…</td></tr>
<tr><td>31</td><td>11111</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table></td><td>36</td></tr>
</table>

All parameters

No.	Name/Value	Description	Def/FbEq
	TIMED FUNC 1	Timed function 1 is active. See parameter group *36 TIMED FUNCTIONS*.	37
	TIMED FUNC 2	Timed function 2 is active. See parameter group *36 TIMED FUNCTIONS*.	38
	TIMED FUNC 3	Timed function 3 is active. See parameter group *36 TIMED FUNCTIONS*.	39
	TIMED FUNC 4	Timed function 4 is active. See parameter group *36 TIMED FUNCTIONS*.	40
	MNT TRIG FAN	Cooling fan running time counter is triggered. See parameter group *29 MAINTENANCE TRIG*.	41
	MNT TRIG REV	Revolutions counter is triggered. See parameter group *29 MAINTENANCE TRIG*.	42
	MNT TRIG RUN	Run time counter is triggered. See parameter group *29 MAINTENANCE TRIG*.	43
	MNT TRIG MWH	MWh counter is triggered. See parameter group *29 MAINTENANCE TRIG*.	44
	SEQ PROG	Relay output control with Sequence programming. See parameter *8423 ST1 OUT CONTROL*.	50
	MBRK	On/Off control of a mechanical brake. See parameter group *43 MECH BRK CONTROL*.	51
	JOG ACTIVE	Jogging function active. See parameter *1010 JOGGING SEL*.	52
	STO	STO (Safe torque off) has been triggered.	57
	STO(-1)	STO (Safe torque off) is inactive and the drive operates normally.	58
1402	RELAY OUTPUT 2	See parameter *1401 RELAY OUTPUT 1*. Available only if the MREL-01 output relay module is connected to the drive. See parameter *0181 EXTENSION*.	*NOT SEL*
1403	RELAY OUTPUT 3	See parameter *1401 RELAY OUTPUT 1*. Available only if the MREL-01 output relay module is connected to the drive. See parameter *0181 EXTENSION*.	*NOT SEL*
1404	RO 1 ON DELAY	Defines the operation delay for relay output RO 1.	0.0 s
	0.0…3600.0 s	Delay time. The figure below illustrates the operation (on) and release (off) delays for relay output RO.  	1 = 0.1 s

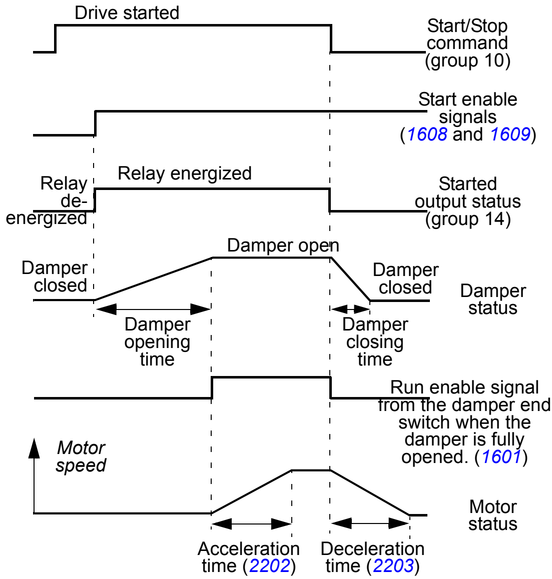
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
1405	RO 1 OFF DELAY	Defines the release delay for relay output RO 1.	0.0 s
	0.0…3600.0 s	Delay time. See the figure for parameter *1404 RO 1 ON DELAY*.	1 = 0.1 s
1406	RO 2 ON DELAY	See parameter *1404 RO 1 ON DELAY*.	0.0 s
1407	RO 2 OFF DELAY	See parameter *1405 RO 1 OFF DELAY*.	0.0 s
1408	RO 3 ON DELAY	See parameter *1404 RO 1 ON DELAY*.	0.0 s
1409	RO 3 OFF DELAY	See parameter *1405 RO 1 OFF DELAY*.	0.0 s
1410	RELAY OUTPUT 4	See parameter *1401 RELAY OUTPUT 1*. Available only if the MREL-01 output relay extension module is connected to the drive. See parameter *0181 EXTENSION*.	*NOT SEL*
1413	RO 4 ON DELAY	See parameter *1404 RO 1 ON DELAY*.	0.0 s
1414	RO 4 OFF DELAY	See parameter *1405 RO 1 OFF DELAY*.	0.0 s
15 ANALOG OUTPUTS		Selection of the actual signals to be indicated through analog output and output signal processing.	
1501	AO1 CONTENT SEL	Connects a drive signal to analog output AO.	103
	x…x	Parameter index in group *01 OPERATING DATA*. For example, 102 = *0102 SPEED*.	
1502	AO1 CONTENT MIN	Defines the minimum value for the signal selected with parameter *1501 AO1 CONTENT SEL*. AO minimum and maximum correspond to the *1504 MINIMUM AO1* and *1505 MAXIMUM AO1* settings as follows: 	-
	x…x	Setting range depends on the parameter *1501 AO1 CONTENT SEL* setting.	-

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
1503	AO1 CONTENT MAX	Defines the maximum value for the signal selected with parameter *1501 AO1 CONTENT SEL*. See the figure for parameter *1502 AO1 CONTENT MIN*.	-
	x…x	Setting range depends on the parameter *1501 AO1 CONTENT SEL* setting.	-
1504	MINIMUM AO1	Defines the minimum value for the analog output signal AO. See the figure for parameter *1502 AO1 CONTENT MIN*.	0.0 mA
	0.0…20.0 mA	Minimum value	1 = 0.1 mA
1505	MAXIMUM AO1	Defines the maximum value for the analog output signal AO. See the figure for parameter *1502 AO1 CONTENT MIN*.	20.0 mA
	0.0…20.0 mA	Maximum value	1 = 0.1 mA
1506	FILTER AO1	Defines the filter time constant for analog output AO, ie, the time within which 63% of a step change is reached. See the figure for parameter *1303 FILTER AI1*.	0.1 s
	0.0…10.0 s	Filter time constant	1 = 0.1 s
16 SYSTEM CONTROLS		Parameter view, Run enable, parameter lock etc.	
1601	RUN ENABLE	Selects a source for the external Run enable signal.	*NOT SEL*
	NOT SEL	Allows the drive to start without an external Run enable signal.	0
	DI1	External signal required through digital input DI1. 1 = Run enable. If Run enable signal is switched off, the drive will not start or coasts to stop if it is running.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	COMM	Fieldbus interface as the source for inverted Run enable signal (Run disable), ie, Control word *0301 FB CMD WORD 1* bit 6 (with ABB drives profile *5319 EFB PAR 19* bit 3). The Control word is sent by the fieldbus controller through the fieldbus adapter or embedded fieldbus (Modbus) to the drive. For the Control word bits, see sections *DCU communication profile* on page *333* and *ABB drives communication profile* on page *328*.	7
	DI1(INV)	External signal required through inverted digital input DI1. 0 = Run enable. If Run enable signal is switched on, the drive will not start or coasts to stop if it is running.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
1602	PARAMETER LOCK	Selects the state of the parameter lock. The lock prevents parameter changing from the control panel.	*OPEN*
	LOCKED	Parameter values cannot be changed from the control panel. The lock can be opened by entering the valid code to parameter *1603 PASS CODE*. The lock does not prevent parameter changes made by macros or fieldbus.	0
	OPEN	The lock is open. Parameter values can be changed.	1
	NOT SAVED	Parameter changes from the control panel are not stored into the permanent memory. To store changed parameter values, set parameter *1607 PARAM SAVE* value to *SAVE…*.	2
1603	PASS CODE	Selects the pass code for the parameter lock (see parameter *1602 PARAMETER LOCK*).	0
	0…65535	Pass code. Setting 358 opens the lock. The value reverts back to 0 automatically.	1 = 1
1604	FAULT RESET SEL	Selects the source for the fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists.	*KEYPAD*
	KEYPAD	Fault reset only from the control panel	0
	DI1	Reset through digital input DI1 (reset on the rising edge of DI1) or from the control panel	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	START/STOP	Reset along with the stop signal received through a digital input, or from the control panel. **Note:** Do not use this option when start, stop and direction commands are received through fieldbus communication.	7
	COMM	Fieldbus interface as the source for the fault reset signal, ie, Control word *0301 FB CMD WORD 1* bit 4 (with ABB drives profile *5319 EFB PAR 19* bit 7). The Control word is sent by the fieldbus controller through the fieldbus adapter or embedded fieldbus (Modbus) to the drive. For the Control word bits, see sections *DCU communication profile* on page *333* and *ABB drives communication profile* on page *328*.	8
	DI1(INV)	Reset through inverted digital input DI1 (reset on the falling edge of DI1) or from the control panel	-1
	DI2(INV)	See selection *DI1(INV)*.	-2

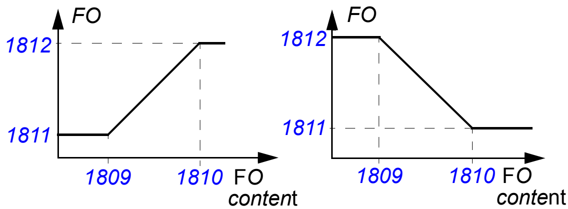
<table>
<tr><th colspan="4">All parameters</th></tr>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq</th></tr>
<tr><td></td><td>DI3(INV)</td><td>See selection DI1(INV).</td><td>-3</td></tr>
<tr><td></td><td>DI4(INV)</td><td>See selection DI1(INV).</td><td>-4</td></tr>
<tr><td></td><td>DI5(INV)</td><td>See selection DI1(INV).</td><td>-5</td></tr>
<tr><td>1605</td><td>USER PAR SET CHG</td><td>Enables the change of the User parameter set through a digital input. See parameter 9902 APPLIC MACRO. The change is only allowed when the drive is stopped. During the change, the drive will not start.
Note: Always save the User parameter set with parameter 9902 after changing any parameter setting, or reperforming the motor identification. The last settings saved by the user are loaded into use whenever the power is switched off and on again or the parameter 9902 setting is changed. Any unsaved changes will be lost.
Note: The value of this parameter is not included in the User parameter sets. A setting once made remains despite User parameter set change.
Note: Selection of User parameter set 2 can be supervised through relay outputs RO 1…4 and digital output DO. See parameters 1401 RELAY OUTPUT 1 … 1403 RELAY OUTPUT 3, 1410 RELAY OUTPUT 4 and 1805 DO SIGNAL.</td><td>NOT SEL</td></tr>
<tr><td></td><td>NOT SEL</td><td>User parameter set change is not possible through a digital input. Parameter sets can be changed only from the control panel.</td><td>0</td></tr>
<tr><td></td><td>DI1</td><td>User parameter set control through digital input DI1. Falling edge of digital input DI1: User parameter set 1 is loaded into use. Rising edge of digital input DI1: User parameter set 2 is loaded into use.</td><td>1</td></tr>
<tr><td></td><td>DI2</td><td>See selection DI1.</td><td>2</td></tr>
<tr><td></td><td>DI3</td><td>See selection DI1.</td><td>3</td></tr>
<tr><td></td><td>DI4</td><td>See selection DI1.</td><td>4</td></tr>
<tr><td></td><td>DI5</td><td>See selection DI1.</td><td>5</td></tr>
<tr><td></td><td>DI1,2</td><td>User parameter set selection through digital inputs DI1 and DI2. 1 = DI active, 0 = DI inactive.
<table><tr><th>DI1</th><th>DI2</th><th>User parameter set</th></tr><tr><td>0</td><td>0</td><td>User parameter set 1</td></tr><tr><td>1</td><td>0</td><td>User parameter set 2</td></tr><tr><td>0</td><td>1</td><td>User parameter set 3</td></tr></table></td><td>7</td></tr>
<tr><td></td><td>DI2,3</td><td>See selection DI1,2.</td><td>8</td></tr>
<tr><td></td><td>DI3,4</td><td>See selection DI1,2.</td><td>9</td></tr>
<tr><td></td><td>DI4,5</td><td>See selection DI1,2.</td><td>10</td></tr>
</table>

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	DI1(INV)	User parameter set control through inverted digital input DI1. Falling edge of inverted digital input DI1: User parameter set 2 is loaded into use. Rising edge of inverted digital input DI1: User parameter set 1 is loaded into use.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI1,2(INV)	User parameter set selection through inverted digital inputs DI1 and DI2. 1 = DI inactive, 0 =DI active. <table><tr><th>DI1</th><th>DI2</th><th>User parameter set</th></tr><tr><td>1</td><td>1</td><td>User parameter set 1</td></tr><tr><td>0</td><td>1</td><td>User parameter set 2</td></tr><tr><td>1</td><td>0</td><td>User parameter set 3</td></tr></table>	-7
	DI2,3(INV)	See selection *DI1,2*.	-8
	DI3,4(INV)	See selection *DI1,2*.	-9
	DI4,5(INV)	See selection *DI1,2*.	-10
1606	LOCAL LOCK	Disables entering local control mode or selects the source for the local control mode lock signal. When local lock is active, entering the local control mode is disabled (LOC/REM key of the panel).	*NOT SEL*
	NOT SEL	Local control is allowed.	0
	DI1	Local control mode lock signal through digital input DI1. Rising edge of digital input DI1: Local control disabled. Falling edge of digital input DI1: Local control allowed.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	ON	Local control is disabled.	7
	COMM	Fieldbus interface as the source for the local lock, ie, Control word *0301 FB CMD WORD 1* bit 14. The Control word is sent by the fieldbus controller through the fieldbus adapter or embedded fieldbus (Modbus) to the drive. For the Control word bits, see section *DCU communication profile* on page *333*. **Note:** This setting applies only for the DCU profile.	8
	DI1(INV)	Local lock through inverted digital input DI1. Rising edge of inverted digital input DI1: Local control allowed. Falling edge of inverted digital input DI1: Local control disabled.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3

<table>
<tr><th colspan="4">All parameters</th></tr>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq</th></tr>
<tr><td></td><td>DI4(INV)</td><td>See selection DI1(INV).</td><td>-4</td></tr>
<tr><td></td><td>DI5(INV)</td><td>See selection DI1(INV).</td><td>-5</td></tr>
<tr><td>1607</td><td>PARAM SAVE</td><td>Saves the valid parameter values to the permanent memory.
Note: A new parameter value of a standard macro is saved automatically when changed from the panel but not when altered through a fieldbus connection.</td><td>DONE</td></tr>
<tr><td></td><td>DONE</td><td>Saving completed</td><td>0</td></tr>
<tr><td></td><td>SAVE…</td><td>Saving in progress</td><td>1</td></tr>
<tr><td>1608</td><td>START ENABLE 1</td><td>Selects the source for the Start enable 1 signal.
Note: Functionality of the Start enable signal is different from the Run enable signal.
Example: External damper control application using Start enable and Run enable. Motor can start only after the damper is fully open.

</td><td>NOT SEL</td></tr>
<tr><td></td><td>NOT SEL</td><td>Start enable signal is on.</td><td>0</td></tr>
<tr><td></td><td>DI1</td><td>External signal required through digital input DI1. 1 = Start enable. If the Start enable signal is switched off, the drive will not start or it coasts to stop if it is running and alarm START ENABLE 1 MISSING (2021) is activated.
The drive can also ramp to stop depending on parameter 2102 STOP FUNCTION.</td><td>1</td></tr>
</table>

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	COMM	Fieldbus interface as the source for the inverted Start enable (Start disable) signal, ie, Control word *0302 FB CMD WORD 2* bit 18 (bit 19 for Start enable 2). The Control word is sent by the fieldbus controller through the fieldbus adapter or embedded fieldbus (Modbus) to the drive. For the Control word bits, see section *DCU communication profile* on page *333*. **Note:** This setting applies only for the DCU profile.	7
	DI1(INV)	External signal required through inverted digital input DI1. 0 = Start enable. If Start enable signal is switched off, the drive will not start or it coasts to stop if it is running and alarm *START ENABLE 1 MISSING* (*2021*) is activated.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
1609	START ENABLE 2	Selects the source for the Start enable 2 signal. See parameter *1608 START ENABLE 1*.	*NOT SEL*
		See parameter *1608 START ENABLE 1*.	
1610	DISPLAY ALARMS	Activates/deactivates alarms *OVERCURRENT* (*2001*), *OVERVOLTAGE* (*2002*), *PID SLEEP* (*2018*) and *DEVICE OVERTEMP* (*2009*). For more information, see chapter *Fault tracing* on page *349*.	NO
	NO	Alarms are inactive.	0
	YES	Alarms are active.	1

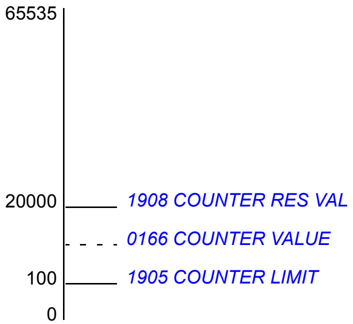
All parameters				
No.	**Name/Value**	**Description**	**Def/FbEq**
1611	PARAMETER VIEW	Selects the parameter view, ie, which parameters are shown. **Note:** This parameter is visible only when it is activated by the optional FlashDrop device. FlashDrop is designed for fast copying of parameters to unpowered drives. It allows for easy customization of the parameter list, eg, selected parameters can be hidden. For more information, see *MFDT-01 FlashDrop user's manual* (3AFE68591074 [English]). FlashDrop parameter values are activated by setting parameter *9902 APPLIC MACRO* to 31 (*LOAD FD SET*).	*DEFAULT*
	DEFAULT	Complete long and short parameter lists	0
	FLASHDROP	FlashDrop parameter list. Does not include short parameter list. Parameters which are hidden by the FlashDrop device are not visible.	1
1612	FAN CONTROL	Selects the fan to be switched on and off automatically or keeps the fan on all the time. When the drive is used in ambient temperatures of 35 °C (95 °F) and above, it is recommended to have the cooling fan always on (selection *ON*).	*AUTO*
	AUTO	Automatic fan control. The fan is switched on when the drive is modulating. After the drive has stopped, the fan stays on until the temperature of the drive has dropped below 55 °C (131 °F). The fan then remains switched off until either the drive is started or the temperature increases above 65 °C (149 °F). If the control board is powered from an external 24 V power supply, the fan is switched off.	0
	ON	Fan always on	1
1613	FAULT RESET	Resets the current fault.	*DEFAULT*
	DEFAULT	No reset done. Current status continues.	0
	RESET NOW	Resets the current fault. After reset, the parameter value returns to DEFAULT.	1
18 FREQ IN & TRAN OUT		Frequency input and transistor output signal processing.	
1801	FREQ INPUT MIN	Defines the minimum input value when DI5 is used as a frequency input. See section *Frequency input* on page *135*.	0 Hz
	0…16000 Hz	Minimum frequency	1 = 1 Hz
1802	FREQ INPUT MAX	Defines the maximum input value when DI5 is used as a frequency input. See section *Frequency input* on page *135*.	1000 Hz
	0…16000 Hz	Maximum frequency	1 = 1 Hz

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
1803	FILTER FREQ IN	Defines the filter time constant for frequency input, ie, the time within which 63% of a step change is reached. See section *Frequency input* on page *135*.	0.1 s
	0.0…10.0 s	Filter time constant	1 = 0.1 s
1804	TO MODE	Selects the operation mode for the transistor output TO. See section *Transistor output* on page *136*.	*DIGITAL*
	DIGITAL	Transistor output is used as a digital output DO.	0
	FREQUENCY	Transistor output is used as a frequency output FO.	1
1805	DO SIGNAL	Selects a drive status indicated through digital output DO.	*FAULT(-1)*
		See parameter *1401 RELAY OUTPUT 1*.	
1806	DO ON DELAY	Defines the operation delay for digital output DO.	0.0 s
	0.0…3600.0 s	Delay time	1 = 0.1 s
1807	DO OFF DELAY	Defines the release delay for digital output DO.	0.0 s
	0.0…3600.0 s	Delay time	1 = 0.1 s
1808	FO CONTENT SEL	Selects a drive signal to be connected to frequency output FO.	104
	x…x	Parameter index in group *01 OPERATING DATA*. For example, 102 = *0102 SPEED*.	1 = 1
1809	FO CONTENT MIN	Defines the minimum frequency output FO signal value. Signal is selected with parameter *1808 FO CONTENT SEL*. FO minimum and maximum correspond to *1811 MINIMUM FO* and *1812 MAXIMUM FO* settings as follows:  	-
	x…x	Setting range depends on parameter *1808 FO CONTENT SEL* setting.	-
1810	FO CONTENT MAX	Defines the maximum frequency output FO signal value. Signal is selected with parameter *1808 FO CONTENT SEL*. See parameter *1809 FO CONTENT MIN*.	-
	x…x	Setting range depends on parameter *1808 FO CONTENT SEL* setting.	-
1811	MINIMUM FO	Defines the minimum value for frequency output FO.	10 Hz
	10…16000 Hz	Minimum frequency. See parameter *1809 FO CONTENT MIN*.	1 = 1 Hz

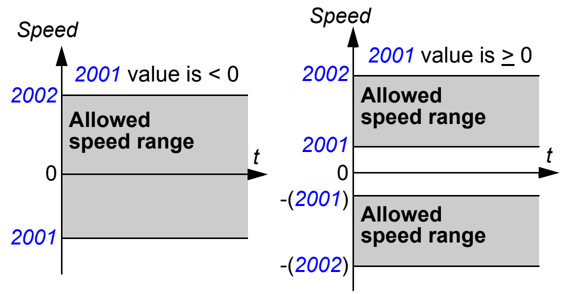
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
1812	MAXIMUM FO	Defines the maximum value for frequency output FO.	1000 Hz
	10…16000 Hz	Maximum frequency. See parameter *1809 FO CONTENT MIN*.	1 = 1 Hz
1813	FILTER FO	Defines the filter time constant for frequency output FO, ie, the time within which 63% of a step change is reached.	0.1 s
	0.0…10.0 s	Filter time constant	1 = 0.1 s
19 TIMER & COUNTER		Timer and counter for start and stop control	
1901	TIMER DELAY	Defines the time delay for the timer.	10.00 s
	0.01…120.00 s	Delay time	1 = 0.01 s
1902	TIMER START	Selects the source for the timer start signal.	*NOT SEL*
	DI1(INV)	Timer start through inverted digital input DI1. Timer start on the falling edge of digital input DI1. **Note:** Timer start is not possible when reset is active (parameter *1903 TIMER RESET*).	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
	NOT SEL	No start signal	0
	DI1	Timer start through digital input DI1. Timer start on the rising edge of digital input DI1. **Note:** Timer start is not possible when reset is active (parameter *1903 TIMER RESET*).	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	START	External start signal, eg, start signal through fieldbus	6
1903	TIMER RESET	Selects the source for the timer reset signal.	*NOT SEL*
	DI1(INV)	Timer reset through inverted digital input DI1. 0 = active, 1 = inactive.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
	NOT SEL	No reset signal	0
	DI1	Timer reset through digital input DI1. 1 = active, 0 = inactive.	1
	DI2	See selection *DI1*.	2

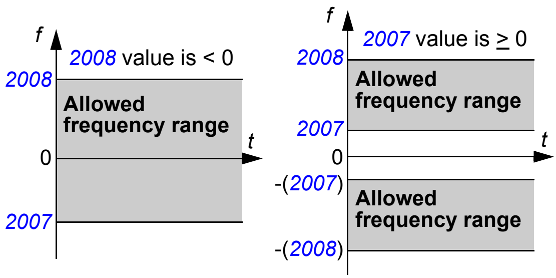
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	START	Timer reset at start. Start signal source is selected by parameter *1902 TIMER START*.	6
	START (INV)	Time reset at start (inverted), ie, timer is reset when start signal is deactivated. Start signal source is selected by parameter *1902 TIMER START*.	7
	RESET	External reset, eg, reset through fieldbus	8
1904	COUNTER ENABLE	Selects the source for the counter enable signal.	*DISABLED*
	DI1(INV)	Counter enable signal through inverted digital input DI1. 0 = active, 1 = inactive.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
	DISABLED	No counter enable	0
	DI1	Counter enable signal through digital input DI1. 1 = active, 0 = inactive.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	ENABLED	Counter enabled	6
1905	COUNTER LIMIT	Defines the counter limit.	1000
	0…65535	Limit value	1 = 1
1906	COUNTER INPUT	Selects the input signal source for the counter.	*PLS IN(DI 5)*
	PLS IN(DI 5)	Digital input DI5 pulses. When a pulse is detected, the counter value increases by 1.	1
	ENC W/O DIR	Encoder pulse edges. When a rising or a falling edge is detected, the counter value increases by 1.	2
	ENC WITH DIR	Encoder pulse edges. The direction of rotation is taken into account. When a rising or a falling edge is detected and the direction of rotation is forward, the counter value increases by 1. When the direction of rotation is reverse, the counter value decreases by 1.	3

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	FILTERED DI5	Filtered digital input DI5 pulses. When a pulse is detected, the counter value increases by 1. **Note:** Due to filtering, the maximum input signal frequency is 50 Hz.	4
1907	COUNTER RESET	Selects the source for the counter reset signal.	*NOT SEL*
	DI1(INV)	Counter reset through inverted digital input DI1. 0 = active, 1 = inactive.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
	NOT SEL	No reset signal	0
	DI1	Counter reset through digital input DI1. 1 = active, 0 = inactive.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	AT LIMIT	Reset at the limit defined by parameter *1905 COUNTER LIMIT*	6
	STRT/STP CMD	Counter reset at start/stop command. Source for the start/stop is selected by parameter *1911 CNTR S/S COMMAND*.	7
	S/S CMD(INV)	Counter reset at start/stop command (inverted), ie, counter is reset when start/stop command is deactivated. Start signal source is selected by parameter *1902 TIMER START*.	8
	RESET	Reset enabled	9

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	OVERFLOW	Counter moves between the minimum and maximum limits and rolls over to the opposite limit, when either the minimum or maximum limit is reached. Minimum and maximum limits are set by parameters *1905 COUNTER LIMIT* and *1908 COUNTER RES VAL*. Greater value from the two will be set as the maximum and the other as the minimum. When parameter *1909 COUNT DIVIDER* or either of the limits is changed so that the change causes the value of parameter *0166 COUNTER VALUE* to be outside of the min/max limits, the counter is assigned to the closest limit value. **Example:** If the limits are set as shown in the figure below, the value of parameter *0166 COUNTER VALUE* changes as follows: • Counting up: … –> 19998 –> 19999 –> 20000 –> 100 –> 101 –> 102 … • Counting down: … –> 102 –> 101 –> 100 –> 20000 –> 19999 –> 19998 …  When *0166 COUNTER VALUE* is equal to *1905 COUNTER LIMIT*, the counter limit values trigger state changes.	10
1908	COUNTER RES VAL	Defines the value for the counter after reset.	0
	0…65535	Counter value	1 = 1
1909	COUNT DIVIDER	Defines the divider for the pulse counter.	0
	0…12	Pulse counter divider N. Every 2^N bit is counted.	1 = 1
1910	COUNT DIRECTION	Defines the source for the counter direction selection.	*UP*
	DI1(INV)	Counter direction selection through inverted digital input DI1. 1 = counts up, 0 = counts down.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
	UP	Counts up	0
	DI1	Counter direction selection through digital input DI1. 0 = counts up, 1 = counts down.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	DOWN	Counts down	6
1911	CNTR S/S COMMAND	Selects the source for the drive start/stop command when parameter *1001 EXT1 COMMANDS* value is set to *COUNTR START* / *COUNTER STOP*.	*NOT SEL*
	DI1(INV)	Start/stop command through inverted digital input DI1. When parameter *1001 EXT1 COMMANDS* value is *COUNTER STOP*: 0 = start. Stop when counter limit defined by parameter *1905 COUNTER LIMIT* has been exceeded. When parameter *1001* value is *COUNTR START*: 0 = stop. Start when counter limit defined by parameter *1905* has been exceeded.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
	NOT SEL	Not start/stop command source	0
	DI1	Start/stop command through digital input DI1. When parameter *1001 EXT1 COMMANDS* value is *COUNTER STOP*: 1 = start. Stop when counter limit defined by parameter *1905 COUNTER LIMIT* has been exceeded. When parameter *1001* value is *COUNTR START*: 1 = stop. Start when counter limit defined by parameter *1905* has been exceeded.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	ACTIVATE	External start/stop command, eg, through fieldbus	6

All parameters		
No. Name/Value	**Description**	**Def/FbEq**
20 LIMITS	Drive operation limits. Speed values are used in vector control and frequency values are used in scalar control. The control mode is selected by parameter *9904 MOTOR CTRL MODE*.	
2001 MINIMUM SPEED	Defines the allowed minimum speed. A positive (or zero) minimum speed value defines two ranges, one positive and one negative. A negative minimum speed value defines one speed range.  	0 rpm
-30000… 30000 rpm	Minimum speed	1 = 1 rpm
2002 MAXIMUM SPEED	Defines the allowed maximum speed. See parameter *2001 MINIMUM SPEED*.	E: 1500 rpm / U: 1800 rpm
0…30000 rpm	Maximum speed	1 = 1 rpm
2003 MAX CURRENT	Defines the allowed maximum motor current.	1.8 · I_{2N} A
0.0…1.8 · I_{2N} A	Current	1 = 0.1 A
2005 OVERVOLT CTRL	Activates or deactivates the overvoltage control of the intermediate DC link. Fast braking of a high inertia load causes the voltage to rise to the overvoltage control limit. To prevent the DC voltage from exceeding the limit, the overvoltage controller automatically decreases the braking torque. **Note:** If a brake chopper and resistor are connected to the drive, the controller must be off (selection *DISABLE*) to allow chopper operation.	*ENABLE*
DISABLE	Overvoltage control deactivated	0
ENABLE	Overvoltage control activated	1
EN WITH BRCH	Both braking chopper and overvoltage controller are enabled so that the braking chopper capability is used to its maximum and the overvoltage controller is activated above that.	2

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2006	UNDERVOLT CTRL	Activates or deactivates the undervoltage control of the intermediate DC link. If the DC voltage drops due to input power cut off, the undervoltage controller will automatically decrease the motor speed in order to keep the voltage above the lower limit. By decreasing the motor speed, the inertia of the load will cause regeneration back into the drive, keeping the DC link charged and preventing an undervoltage trip until the motor coasts to stop. This will act as a power-loss ride-through functionality in systems with a high inertia, such as a centrifuge or a fan. See section *Motor identification* on page *137*.	*ENABLE(TIME)*
	DISABLE	Undervoltage control deactivated	0
	ENABLE(TIME)	Undervoltage control activated. After being in undervoltage control for 500 ms the drive faults and stops using an emergency ramp.	1
	ENABLE	Undervoltage control activated. No operation time limit.	2
2007	MINIMUM FREQ	Defines the minimum limit for the drive output frequency. A positive (or zero) minimum frequency value defines two ranges, one positive and one negative. A negative minimum frequency value defines one speed range. **Note:** *MINIMUM FREQ* ≤ *MAXIMUM FREQ*. 	0.0 Hz
	-599.0…599.0 Hz	Minimum frequency	1 = 0.1 Hz
2008	MAXIMUM FREQ	Defines the maximum limit for the drive output frequency.	E: 50.0 Hz U: 60.0 Hz
	0.0…599.0 Hz	Maximum frequency	1 = 0.1 Hz
2013	MIN TORQUE SEL	Selects the minimum torque limit for the drive.	*MIN TORQUE 1*
	MIN TORQUE 1	Value defined by parameter *2015 MIN TORQUE 1*	0
	DI1	Digital input DI1. 0 = parameter *2015 MIN TORQUE 1* value. 1 = parameter *2016 MIN TORQUE 2* value.	1

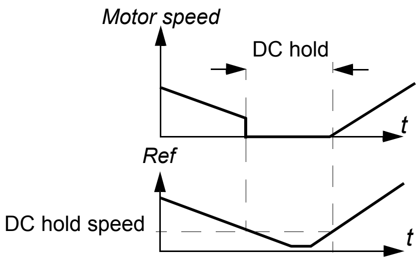
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	COMM	Fieldbus interface as the source for the torque limit 1/2 selection, ie, Control word *0301 FB CMD WORD 1* bit 15. The Control word is sent by the fieldbus controller through the fieldbus adapter or embedded fieldbus (Modbus) to the drive. For the Control word bits, see section *DCU communication profile* on page *333*. Minimum torque limit 1 is defined by parameter *2015 MIN TORQUE 1* and minimum torque limit 2 is defined by parameter *2016 MIN TORQUE 2*. **Note:** This setting applies only for the DCU profile.	7
	EXT2	Value of signal *0112 EXTERNAL REF 2*	11
	DI1(INV)	Inverted digital input DI1. 1 = value of parameter *2015 MIN TORQUE 1* 1. 0 = value of parameter *2016 MIN TORQUE 2*.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
2014	MAX TORQUE SEL	Selects the maximum torque limit for the drive.	*MAX TORQUE 1*
	MAX TORQUE 1	Value of parameter *2017 MAX TORQUE 1*	
	DI1	Digital input DI1. 0 = parameter *2017 MAX TORQUE 1* value. 1 = parameter *2018 MAX TORQUE 2* value.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5

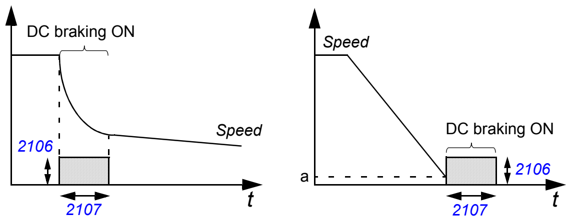
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	COMM	Fieldbus interface as the source for the torque limit 1/2 selection, ie, Control word *0301 FB CMD WORD 1* bit 15. The Control word is sent by the fieldbus controller through the fieldbus adapter or embedded fieldbus (Modbus) to the drive. For the Control word bits, see section *DCU communication profile* on page *333*. Maximum torque limit 1 is defined by parameter *2017 MAX TORQUE 1* and maximum torque limit 2 is defined by parameter *2018 MAX TORQUE 2*. **Note:** This setting applies only for the DCU profile.	7
	EXT2	Value of signal *0112 EXTERNAL REF 2*	11
	DI1(INV)	Inverted digital input DI1. 1 = parameter *2017 MAX TORQUE 1* value. 0 = parameter *2018 MAX TORQUE 2* value.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
2015	MIN TORQUE 1	Defines minimum torque limit 1 for the drive. See parameter *2013 MIN TORQUE SEL*.	-300%
	-600.0…0.0%	Value as a percentage of the motor nominal torque	1 = 0.1%
2016	MIN TORQUE 2	Defines minimum torque limit 2 for the drive. See parameter *2013 MIN TORQUE SEL*.	-300%
	-600.0…0.0%	Value as a percentage of the motor nominal torque	1 = 0.1%
2017	MAX TORQUE 1	Defines maximum torque limit 1 for the drive. See parameter *2014 MAX TORQUE SEL*.	300%
	0.0…600.0%	Value as a percentage of the motor nominal torque	1 = 0.1%
2018	MAX TORQUE 2	Defines maximum torque limit 2 for the drive. See parameter *2014 MAX TORQUE SEL*.	300%
	0.0…600.0%	Value as a percentage of the motor nominal torque	1 = 0.1%

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2020	BRAKE CHOPPER	Selects the brake chopper control. When using the drive in a Common DC bus system, the parameter must be set to *EXTERNAL*. When in Common DC, the drive cannot feed or receive more power than P_N.	*INBUILT*
	INBUILT	Internal brake chopper control. **Note:** Ensure the brake resistor(s) is installed and the overvoltage control is switched off by setting parameter *2005 OVERVOLT CTRL* to selection *DISABLE*. See also *2005 OVERVOLT CTRL* selection *EN WITH BRCH*.	0
	EXTERNAL	External brake chopper control. **Note:** The drive is compatible only with ABB **ACS-BRK-X** brake units. **Note:** Ensure the brake unit is installed and the overvoltage control is switched off by setting parameter *2005 OVERVOLT CTRL* to selection *DISABLE*.	1
2021	MAX SPEED SEL	Maximum speed source for torque control	*PAR 2002*
	PAR 2002	Value of parameter *2002 MAXIMUM SPEED*	0
	EXT REF 1	Value of signal *0111 EXTERNAL REF 1*	1
21 START/STOP		Start and stop modes of the motor	
2101	START FUNCTION	Selects the motor starting method.	*AUTO*
	AUTO	The drive starts the motor instantly from zero frequency if parameter *9904 MOTOR CTRL MODE* setting is *SCALAR: FREQ*. If flying start is required use selection *SCAN START*. If parameter *9904 MOTOR CTRL MODE* value is *VECTOR: SPEED* or *VECTOR: TORQ*, the drive pre-magnetizes the motor with DC current before the start. The pre-magnetizing time is defined by parameter *2103 DC MAGN TIME*. See selection *DC MAGN*. For permanent magnet synchronous motors, flying start is used if the motor is rotating.	1

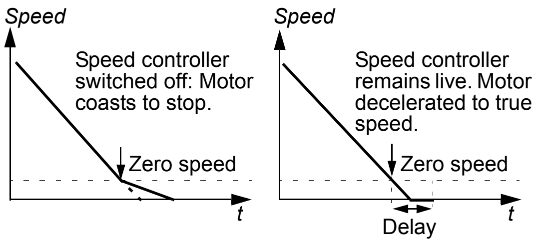
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	DC MAGN	The drive pre-magnetizes the motor with DC current before the start. The pre-magnetizing time is defined by parameter *2103 DC MAGN TIME*. If parameter *9904 MOTOR CTRL MODE* value is *VECTOR: SPEED* or *VECTOR: TORQ*, DC magnetizing guarantees the highest possible break-away torque when the pre-magnetizing is set long enough. **Note:** Starting the drive connected to a rotating motor is not possible when *DC MAGN* is selected. When a permanent magnet synchronous motor is used, alarm *MOTOR BACK EMF* (*2029*) is generated. **WARNING!** The drive will start after the set pre-magnetizing time has passed even if the motor magnetization is not completed. In applications where a full break-away torque is essential, always ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.	2
	TORQ BOOST	Torque boost should be selected if a high break-away torque is required. Used only when parameter *9904 MOTOR CTRL MODE* setting is *SCALAR: FREQ*. The drive pre-magnetizes the motor with DC current before the start. The pre-magnetizing time is defined by parameter *2103 DC MAGN TIME*. Torque boost is applied at start. Torque boost is stopped when output frequency exceeds 20 Hz or when it is equal to the reference value. See parameter *2110 TORQ BOOST CURR*. **Note:** Starting the drive connected to a rotating motor is not possible when *TORQ BOOST* is selected. **WARNING!** The drive will start after the set pre-magnetizing time has passed although the motor magnetization is not completed. In applications where a full break-away torque is essential, always ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.	4
	SCAN START	Frequency scanning flying start (starting the drive connected to a rotating motor). Based on frequency scanning (interval *2008 MAXIMUM FREQ*…*2007 MINIMUM FREQ*) to identify the frequency. If frequency identification fails, DC magnetization is used (see selection *DC MAGN*). Not for multimotor drives.	6

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	SCAN + BOOST	Combines scanning start (starting the drive connected to a rotating motor) and torque boost. See selections *SCAN START* and *TORQ BOOST*. If frequency identification fails, torque boost is used. Used only when parameter *9904 MOTOR CTRL MODE* setting is *SCALAR: FREQ*.	7
	AUTO2	Effective with asynchronous motors and vector:speed and vector:torque modes. Reduces the motor bumping effect during the start. Bumping effect can be further reduced with the ramp stop and DC brake functions (operation also affected). Starting can further be smoothened by adjusting the DC magnetization time up to 1 s (longer times do not apply). Shorter time increases the breakaway torque but may amplify the bumping effect. Motor is started from the last known rotor position. This reduces the backstroke effect caused by the rotor reluctance flux. Used only when parameter *9904 MOTOR CTRL MODE* setting is *VECTOR: SPEED* or *VECTOR: TORQ*.	9
2102	STOP FUNCTION	Selects the motor stop function. See section *Speed compensated stop* on page *139*.	*COAST*
	COAST	Stop by cutting off the motor power supply. The motor coasts to stop.	1
	RAMP	Stop along a ramp. See parameter group *22 ACCEL/DECEL*.	2
	SPEED COMP	Speed compensation is used for constant distance braking. Speed difference (between used speed and maximum speed) is compensated by running the drive with current speed before the motor is stopped along a ramp. See section *Acceleration and deceleration ramps* on page *141*.	3
	SPD COMP FWD	Speed compensation is used for constant distance braking if the direction of rotation is forward. Speed difference (between used speed and maximum speed) is compensated by running the drive with current speed before the motor is stopped along a ramp. See section *Acceleration and deceleration ramps* on page *141*. If the direction of rotation is reverse, the drive is stopped along a ramp.	4

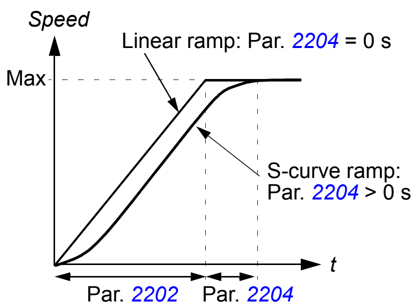
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	SPD COMP REV	Speed compensation is used for constant distance braking if the direction of rotation is reverse. Speed difference (between used speed and maximum speed) is compensated by running the drive with current speed before the motor is stopped along a ramp. See section *Acceleration and deceleration ramps* on page *141*. If the direction of rotation is forward, the drive is stopped along a ramp.	5
2103	DC MAGN TIME	Defines the pre-magnetizing time. See parameter *2101 START FUNCTION*. After the start command, the drive automatically pre-magnetizes the motor for the defined time.	0.30 s
	0.00…10.00 s	Magnetizing time. Set this value long enough to allow full motor magnetization. Too long a time heats the motor excessively.	1 = 0.01 s
2104	DC HOLD CTL	Activates the DC hold or DC braking function.	*NOT SEL*
	NOT SEL	Inactive	0
	DC HOLD	DC hold function active. DC hold is not possible if parameter *9904 MOTOR CTRL MODE* setting is *SCALAR: FREQ*. When both the reference and the motor speed drop below the value of parameter *2105 DC HOLD SPEED*, the drive will stop generating sinusoidal current and start to inject DC into the motor. The current is set by parameter *2106 DC CURR REF*. When the reference speed exceeds parameter *2105* value, normal drive operation continues.  **Note:** DC hold has no effect if the start signal is switched off. **Note:** Injecting DC current into the motor causes the motor to heat up. In applications where long DC hold times are required, externally ventilated motors should be used. If the DC hold period is long, the DC hold cannot prevent the motor shaft from rotating if a constant load is applied to the motor.	1

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	DC BRAKING	DC current braking function active. If parameter *2102 STOP FUNCTION* is set to *COAST*, DC braking is applied after the start command is removed. If parameter *2102 STOP FUNCTION* is set to *RAMP*, DC braking is applied after the ramp. **Coast mode** **Ramp mode**  a: Ramp release at zero speed (1% of the nominal speed)	2
2105	DC HOLD SPEED	Defines the DC hold speed. See parameter *2104 DC HOLD CTL*.	5 rpm
	0…360 rpm	Speed	1 = 1 rpm
2106	DC CURR REF	Defines the DC hold current. See parameter *2104 DC HOLD CTL*.	30%
	0…100%	Value as a percentage of the nominal motor current (parameter *9906 MOTOR NOM CURR*)	1 = 1%
2107	DC BRAKE TIME	Defines the DC brake time.	0.0 s
	0.0…250.0 s	Time	1 = 0.1 s
2108	START INHIBIT	Sets the Start inhibit function on or off. If the drive is not actively started and running, the Start inhibit function ignores a pending start command in any of the following situations and a new start command is required: • a fault is reset. • Run enable signal activates while the start command is active. See parameter *1601 RUN ENABLE*. • control mode changes from local to remote. • external control mode switches from EXT1 to EXT2 or from EXT2 to EXT1. • the drive that is set to external pulse start (parameter *1001 EXT1 COMMANDS* is set to *DI1P,2P*; *DI1P,2P,3* or *DI1P,2P,3P*) is powered up and the corresponding digital inputs (DI1 and DI2 or DI3) are at high level during power-up.	*OFF*
	OFF	Disabled	0
	ON	Enabled	1

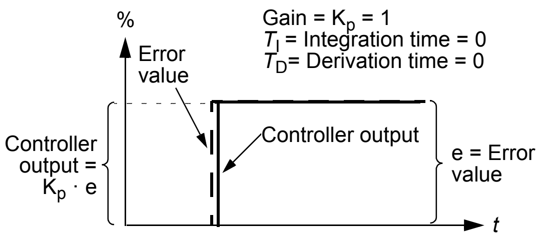
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2109	EMERG STOP SEL	Selects the source for the external emergency stop command. The drive cannot be restarted before the emergency stop command is reset. **Note:** The installation must include emergency stop devices and any other safety equipment that may be needed. Pressing the stop key on the drive's control panel does NOT: • generate an emergency stop of the motor • separate the drive from dangerous potential.	*NOT SEL*
	NOT SEL	Emergency stop function is not selected	0
	DI1	Digital input DI1. 1 = stop along the emergency stop ramp. See parameter *2208 EMERG DEC TIME*. 0 = emergency stop command reset.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	DI1(INV)	Inverted digital input DI. 0 = stop along the emergency stop ramp. See parameter *2208 EMERG DEC TIME*. 1 = emergency stop command reset	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
2110	TORQ BOOST CURR	Defines the maximum supplied current during torque boost. See parameter *2101 START FUNCTION*.	100%
	15…300%	Value as a percentage	1 = 1%
2111	STOP SIGNAL DLY	Defines the stop signal delay time when parameter *2102 STOP FUNCTION* is set to *SPEED COMP*.	0 ms
	0…10000 ms	Delay time	1 = 1 ms

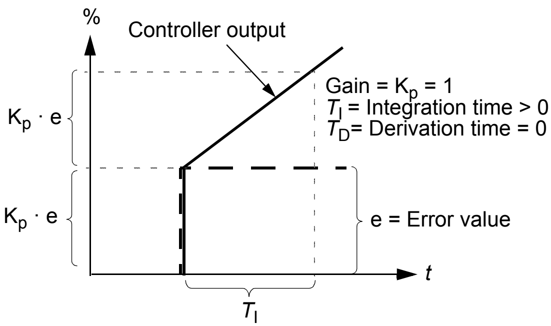
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2112	ZERO SPEED DELAY	Defines the delay for the Zero speed delay function. The function is useful in applications where a smooth and quick restarting is essential. During the delay the drive knows accurately the rotor position. **No Zero speed delay** **With Zero speed delay**  **No Zero speed delay** The drive receives a stop command and decelerates along a ramp. When the motor actual speed falls below an internal limit (called Zero speed), the speed controller is switched off. The inverter modulation is stopped and the motor coasts to standstill. **With Zero speed delay** The drive receives a stop command and decelerates along a ramp. When the actual motor speed falls below an internal limit (called Zero speed), the zero speed delay function activates. During the delay the functions keeps the speed controller live: The inverter modulates, motor is magnetized and the drive is ready for a quick restart.	*0.0 = NOT SEL*
	0.0 = NOT SEL 0.0…60.0 s	Delay time. If parameter value is set to zero, Zero speed delay function is disabled.	1 = 0.1 s
22 ACCEL/DECEL		Acceleration and deceleration times	
2201	ACC/DEC 1/2 SEL	Defines the source from which the drive reads the signal that selects between the two ramp pairs, acceleration/deceleration pair 1 and 2. Ramp pair 1 is defined by parameters *2202*…*2204*. Ramp pair 2 is defined by parameters *2205*…*2207*.	*DI5*
	NOT SEL	Ramp pair 1 is used.	0
	DI1	Digital input DI1. 1 = ramp pair 2, 0 = ramp pair 1.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5

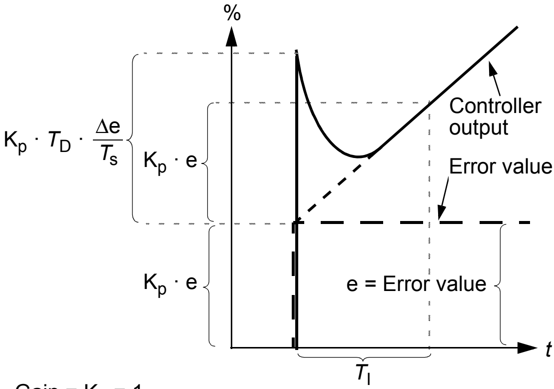
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	COMM	Fieldbus interface as the source for ramp pair 1/2 selection, ie, Control word *0301 FB CMD WORD 1* bit 10. The Control word is sent by the fieldbus controller through the fieldbus adapter or embedded fieldbus (Modbus) to the drive. For the Control word bits, see section *DCU communication profile* on page 333. **Note:** This setting applies only for the DCU profile.	7
	SEQ PROG	Sequence programming ramp defined by parameter *8422 ST1 RAMP* (or *8423*/…/*8492*)	10
	DI1(INV)	Inverted digital input DI1. 0 = ramp pair 2, 1 = ramp pair 1.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
2202	ACCELER TIME 1	Defines the acceleration time 1, ie, the time required for the speed to change from zero to the speed defined by parameter *2008 MAXIMUM FREQ* (in scalar control) / *2002 MAXIMUM SPEED* (in vector control). The control mode is selected by parameter *9904 MOTOR CTRL MODE*. • If the speed reference increases faster than the set acceleration rate, the motor speed will follow the acceleration rate. • If the speed reference increases slower than the set acceleration rate, the motor speed will follow the reference signal. • If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive operating limits. Actual acceleration time depends on parameter *2204 RAMP SHAPE 1* setting.	5.0 s
	0.0…1800.0 s	Time	1 = 0.1 s

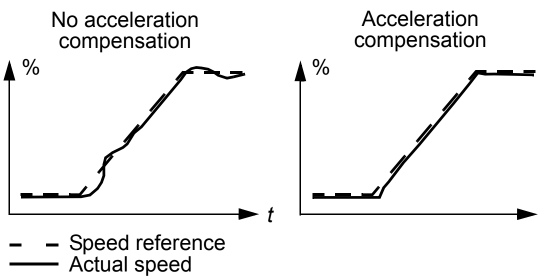
All parameters				
No.	**Name/Value**	**Description**	**Def/FbEq**
2203	DECELER TIME 1	Defines the deceleration time 1, ie, the time required for the speed to change from the value defined by parameter *2008 MAXIMUM FREQ* (in scalar control) / *2002 MAXIMUM SPEED* (in vector control) to zero. The control mode is selected by parameter *9904 MOTOR CTRL MODE*. • If the speed reference decreases slower than the set deceleration rate, the motor speed will follow the reference signal. • If the reference changes faster than the set deceleration rate, the motor speed will follow the deceleration rate. • If the deceleration time is set too short, the drive will automatically prolong the deceleration in order not to exceed drive operating limits. If a short deceleration time is needed for a high inertia application, the drive should be equipped with a brake resistor. Actual deceleration time depends on parameter *2204 RAMP SHAPE 1* setting.	5.0 s
	0.0…1800.0 s	Time	1 = 0.1 s
2204	RAMP SHAPE 1	Selects the shape of the acceleration/deceleration ramp 1. The function is deactivated during emergency stop and jogging.	*0.0 = LINEAR*
	0.0 = LINEAR 0.1…1000.0 s	0.0: Linear ramp. Suitable for steady acceleration or deceleration and for slow ramps. 0.1…1000.0 s: S-curve ramp. S-curve ramps are ideal for conveyors carrying fragile loads, or other applications where a smooth transition is required when changing from one speed to another. The S-curve consists of symmetrical curves at both ends of the ramp and a linear part in between. A rule of thumb: A suitable relation between the ramp shape time and the acceleration ramp time is 1/5. 	1 = 0.1 s

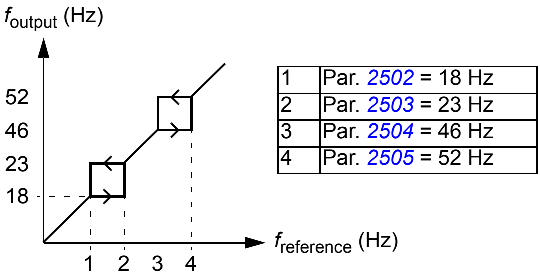
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2205	ACCELER TIME 2	Defines the acceleration time 2, ie, the time required for the speed to change from zero to the speed defined by parameter *2008 MAXIMUM FREQ* (in scalar control) / *2002 MAXIMUM SPEED* (in vector control). The control mode is selected by parameter *9904 MOTOR CTRL MODE*. See parameter *2202 ACCELER TIME 1*. Acceleration time 2 is used also as jogging acceleration time. See parameter *1010 JOGGING SEL*.	60.0 s
	0.0…1800.0 s	Time	1 = 0.1 s
2206	DECELER TIME 2	Defines the deceleration time 2, ie, the time required for the speed to change from the value defined by parameter *2008 MAXIMUM FREQ* (in scalar control) / *2002 MAXIMUM SPEED* (in vector control) to zero. The control mode is selected by parameter *9904 MOTOR CTRL MODE*. See parameter *2203 DECELER TIME 1*. Deceleration time 2 is used also as jogging deceleration time. See parameter *1010 JOGGING SEL*.	60.0 s
	0.0…1800.0 s	Time	1 = 0.1 s
2207	RAMP SHAPE 2	Selects the shape of the acceleration/deceleration ramp 2. The function is deactivated during emergency stop. During jogging, parameter value is set to zero (ie, linear ramp). See *1010 JOGGING SEL*.	*0.0 = LINEAR*
	0.0 = LINEAR 0.1…1000.0 s	See parameter *2204 RAMP SHAPE 1*.	1 = 0.1 s
2208	EMERG DEC TIME	Defines the time within which the drive is stopped if an emergency stop is activated. See parameter *2109 EMERG STOP SEL*.	1.0 s
	0.0…1800.0 s	Time	1 = 0.1 s
2209	RAMP INPUT 0	Defines the control for forcing the speed to 0 with the currently used deceleration ramp (see parameters *2203 DECELER TIME 1* and *2206 DECELER TIME 2*).	*NOT SEL*
	NOT SEL	Not selected	0
	DI1	Digital input DI1. Defines digital input DI1 as the control for forcing the speed to zero. • Activating the digital input forces the speed to zero, after which the speed will stay at zero. • De-activating the digital input: speed control resumes normal operation.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	COMM	Defines bit 13 of Command word 1 as the control for forcing the speed to zero. The Command word 1 is supplied through fieldbus communication (parameter *0301*).	7
	DI1(INV)	Inverted digital input DI1. Defines inverted digital input DI1 as the control for forcing the speed to zero. • De-activating the digital input forces the speed to zero. • Activating the digital input: speed control resumes normal operation.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
23 SPEED CONTROL		Speed controller variables. See section *Speed controller tuning* on page *144*. **Note:** These parameters do not affect drive operation in scalar control, ie, when parameter *9904 MOTOR CTRL MODE* setting is *SCALAR: FREQ*.	
2301	PROP GAIN	Defines a relative gain for the speed controller. High gain may cause speed oscillation. The figure below shows the speed controller output after an error step when the error remains constant.  **Note:** For automatic setting of the gain, use autotune run (parameter *2305 AUTOTUNE RUN*).	5.00
	0.00…200.00	Gain	1 = 0.01

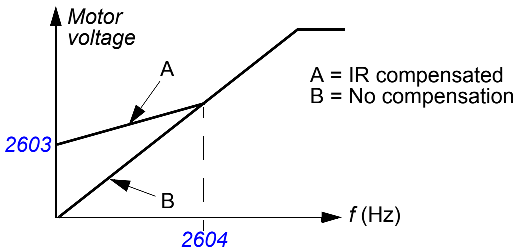
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2302	INTEGRATION TIME	Defines an integration time for the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant. The shorter the integration time, the faster the continuous error value is corrected. Too short an integration time makes the control unstable. The figure below shows the speed controller output after an error step when the error remains constant.  **Note:** For automatic setting of the integration time, use autotune run (parameter *2305 AUTOTUNE RUN*).	0.50 s
	0.00…600.00 s	Time	1 = 0.01 s

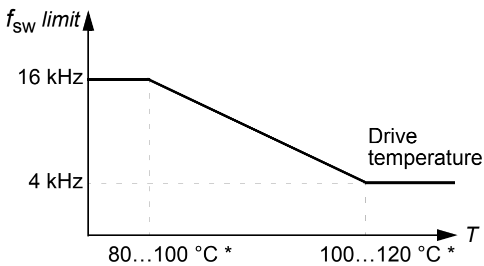
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2303	DERIVATION TIME	Defines the derivation time for the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted during the change. If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The derivation makes the control more responsive for disturbances. The figure below shows the speed controller output after an error step when the error remains constant.  Gain = K_p = 1 T_I = Integration time > 0 T_D= Derivation time > 0 T_s= Sample time period = 2 ms Δe = Error value change between two samples	0 ms
	0….10000 ms	Time	1 = 1 ms

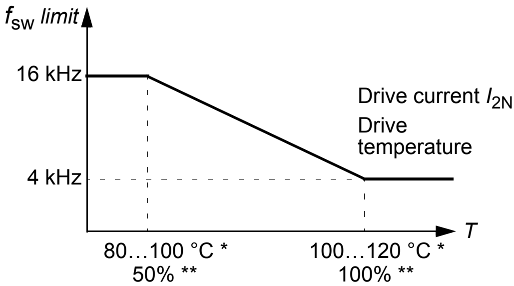
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2304	ACC COMPENSATION	Defines the derivation time for acceleration/(deceleration) compensation. In order to compensate inertia during acceleration, a derivative of the reference is added to the output of the speed controller. The principle of a derivative action is described for parameter *2303 DERIVATION TIME*. **Note:** As a general rule, set this parameter to the value between 50 and 100% of the sum of the mechanical time constants of the motor and the driven machine. (The speed controller Autotune run does this automatically, see parameter *2305 AUTOTUNE RUN*.) The figure below shows the speed responses when a high inertia load is accelerated along a ramp.  	0.00 s
	0.00…600.00 s	Time	1 = 0.01 s
2305	AUTOTUNE RUN	Start automatic tuning of the speed controller. Instructions: • Run the motor at a constant speed of 20 to 40% of the rated speed. • Change the autotuning parameter 2305 to *ON*. **Note:** The motor load must be connected to the motor.	*OFF*
	OFF	No autotuning	0
	ON	Activates the speed controller autotuning. The drive • accelerates the motor • calculates values for proportional gain, integration time and acceleration compensation (parameter *2301 PROP GAIN*, *2302 INTEGRATION TIME* and *2304 ACC COMPENSATION* values). Setting is automatically reverted to *OFF*.	1
24 TORQUE CONTROL		Torque control variables	
2401	TORQ RAMP UP	Defines the torque reference ramp up time, ie, the minimum time for the reference to increase from zero to the nominal motor torque.	0.00 s
	0.00…120.00 s	Time	1 = 0.01 s

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2402	TORQ RAMP DOWN	Defines the torque reference ramp down time, ie, the minimum time for the reference to decrease from the nominal motor torque to zero.	0.00 s
	0.00…120.00 s	Time	1 = 0.01 s
25 CRITICAL SPEEDS		Speed bands within which the drive is not allowed to operate.	
2501	CRIT SPEED SEL	Activates/deactivates the critical speeds function. The critical speed function avoids specific speed ranges. **Example:** A fan has vibrations in the range of 18 to 23 Hz and 46 to 52 Hz. To make the drive to jump over the vibration speed ranges: • Activate the critical speeds function. • Set the critical speed ranges as in the figure below. 	*OFF*
	OFF	Inactive	0
	ON	Active	1
2502	CRIT SPEED 1 LO	Defines the minimum limit for critical speed/frequency range 1.	0.0 Hz / 1 rpm
	0.0…599.0 Hz / 0…30000 rpm	Limit in rpm. Limit in Hz if parameter *9904 MOTOR CTRL MODE* setting is *SCALAR: FREQ*. The value cannot be above the maximum (parameter *2503 CRIT SPEED 1 HI*).	1 = 0.1 Hz / 1 rpm
2503	CRIT SPEED 1 HI	Defines the maximum limit for critical speed/frequency range 1.	0.0 Hz / 1 rpm
	0.0…599.0 Hz / 0…30000 rpm	Limit in rpm. Limit in Hz if parameter *9904 MOTOR CTRL MODE* setting is *SCALAR: FREQ*. The value cannot be below the minimum (parameter *2502 CRIT SPEED 1 LO*).	1 = 0.1 Hz / 1 rpm
2504	CRIT SPEED 2 LO	See parameter *2502 CRIT SPEED 1 LO*.	0.0 Hz / 1 rpm
	0.0…599.0 Hz / 0…30000 rpm	See parameter *2502*.	1 = 0.1 Hz / 1 rpm

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2505	CRIT SPEED 2 HI	See parameter *2503 CRIT SPEED 1 HI*.	0.0 Hz / 1 rpm
	0.0…599.0 Hz / 0…30000 rpm	See parameter *2503*.	1 = 0.1 Hz / 1 rpm
2506	CRIT SPEED 3 LO	See parameter *2502 CRIT SPEED 1 LO*.	0.0 Hz / 1 rpm
	0.0…599.0 Hz / 0…30000 rpm	See parameter *2502*.	1 = 0.1 Hz / 1 rpm
2507	CRIT SPEED 3 HI	See parameter *2503 CRIT SPEED 1 HI*.	0.0 Hz / 1 rpm
	0.0…599.0 Hz / 0…30000 rpm	See parameter *2503*.	1 = 0.1 Hz / 1 rpm
26 MOTOR CONTROL		Motor control variables	
2601	FLUX OPT ENABLE	Activates/deactivates the flux optimization function. Flux optimization reduces the total energy consumption and motor noise level when the drive operates below the nominal load. The total efficiency (motor and the drive) can be improved by 1% to 10%, depending on the load torque and speed. The disadvantage of this function is that the dynamic performance of the drive is weakened.	*OFF*
	OFF	Inactive	0
	ON	Active	1
2602	FLUX BRAKING	Activates/deactivates the Flux braking function. See section *Flux braking* on page *140*.	*OFF*
	OFF	Inactive	0
	MODERATE	Flux level is limited during the braking. Deceleration time is longer compared to full braking. The moderate mode is always used with permanent magnet motor selection and vector control.	1
	FULL	Maximum braking power. Almost all available current is used to convert the mechanical braking energy to thermal energy in the motor.	2

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2603	IR COMP VOLT	Defines the output voltage boost at zero speed (IR compensation). The function is useful in applications with a high break-away torque when vector control cannot be applied. To prevent overheating, set IR compensation voltage as low as possible. **Note:** The function can be used only when parameter *9904 MOTOR CTRL MODE* setting is *SCALAR: FREQ*. The figure below illustrates the IR compensation. Typical IR compensation values: <table><tr><td>P_N (kW)</td><td>0.37</td><td>0.75</td><td>2.2</td><td>4.0</td><td>7.5</td></tr><tr><td colspan="6">**200…240** V units</td></tr><tr><td>IR comp (V)</td><td>8.4</td><td>7.7</td><td>5.6</td><td>8.4</td><td>N/A</td></tr><tr><td colspan="6">**380…480** V units</td></tr><tr><td>IR comp (V)</td><td>14</td><td>14</td><td>5.6</td><td>8.4</td><td>7</td></tr></table>  	Type dependent
	0.0…100.0 V	Voltage boost	1 = 0.1 V
2604	IR COMP FREQ	Defines the frequency at which the IR compensation is 0 V. See the figure for parameter *2603 IR COMP VOLT* **Note:** If parameter *2605 U/F RATIO* is set to *USER DEFINED*, this parameter is not active. The IR compensation frequency is set by parameter *2610 USER DEFINED U1*.	80%
	0…100%	Value as a percentage of the motor frequency	1 = 1%
2605	U/F RATIO	Selects the voltage to frequency (U/f) ratio below the field weakening point. For scalar control only.	*LINEAR*
	LINEAR	Linear ratio for constant torque applications.	1
	SQUARED	Squared ratio for centrifugal pump and fan applications. With squared U/f ratio the noise level is lower for most operating frequencies. Not recommended for permanent magnet synchronous motors.	2
	USER DEFINED	Custom ratio defined by parameters *2610…2618*. See section *Custom U/f ratio* on page *143*.	3

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2606	SWITCHING FREQ	Defines the switching frequency of the drive. Higher switching frequency results in lower acoustic noise. In multimotor systems, do not change the switching frequency from the default value. See also parameter *2607 SWITCH FREQ CTRL* and section *Switching frequency derating, I2N* on page *376*.	4 kHz
	4 kHz	Sets the switching frequency to 4 kHz.	1 = 1 kHz
	8 kHz	Sets the switching frequency to 8 kHz.	
	12 kHz	Sets the switching frequency to 12 kHz.	
	16 kHz	Sets the switching frequency to 16 kHz.	
2607	SWITCH FREQ CTRL	Selects the control method for the switching frequency. Selection has no effect if parameter *2606 SWITCHING FREQ* is 4 kHz.	*ON (LOAD)*
	ON	Drive maximum current is automatically derated according to the selected switching frequency (see parameter *2607 SWITCH FREQ CTRL* and section *Switching frequency derating, I2N* on page *376*) and adapted according to the drive temperature. It is recommended to use this selection when a specific switching frequency is required with maximum performance.  * Temperature depends on the drive output frequency.	1

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	ON (LOAD)	The drive is started with 4 kHz switching frequency to gain maximum output during the start. After start-up, the switching frequency is controlled towards the selected value (parameter *2607 SWITCH FREQ CTRL*) if the output current or the temperature allows. This selection provides adaptive switching frequency control. Adaptation decreases the output performance in some cases.  * Temperature depends on the drive output frequency. ** Short term overloading is allowed with each switching frequency depending on actual loading.	2
	LONG CABLE	Fixes switching frequency to 4 kHz and prolongs the minimum pulse time enabling the use of longer cables.	3
2608	SLIP COMP RATIO	Defines the slip gain for the motor slip compensation control. 100% means full slip compensation, 0% means no slip compensation. Other values can be used if a static speed error is detected despite the full slip compensation. Can be used only in scalar control (ie, when parameter *9904 MOTOR CTRL MODE* setting is *SCALAR: FREQ*). **Example:** 35 Hz constant speed reference is given to the drive. Despite the full slip compensation (*SLIP COMP RATIO* = 100%), a manual tachometer measurement from the motor axis gives a speed value of 34 Hz. The static speed error is 35 Hz - 34 Hz = 1 Hz. To compensate the error, the slip gain should be increased.	0%
	0…200%	Slip gain	1 = 1%

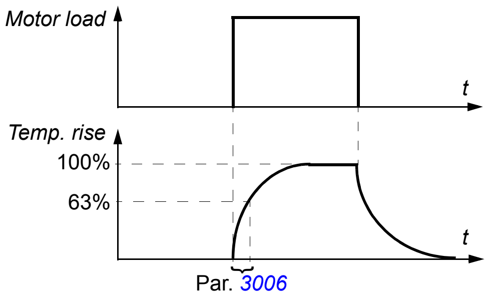
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2609	NOISE SMOOTHING	Enables the noise smoothing function. Noise smoothing distributes the acoustic motor noise over a range of frequencies instead of a single tonal frequency resulting in lower peak noise intensity. A random component with an average of 0 Hz is added to the switching frequency set by parameter *2606 SWITCHING FREQ*. **Note:** Parameter has no effect if parameter *2606 SWITCHING FREQ* is set to 16 kHz.	*DISABLE*
	DISABLE	Disabled	0
	ENABLE	Enabled	1
2610	USER DEFINED U1	Defines the first voltage point of the custom U/f curve at the frequency defined by parameter *2611 USER DEFINED F1*. See section *Custom U/f ratio* on page *143*.	19% of U_N
	0…120% of U_N V	Voltage	1 = 1 V
2611	USER DEFINED F1	Defines the first frequency point of the custom U/f curve.	10.0 Hz
	0.0…599.0 Hz	Frequency	1 = 0.1 Hz
2612	USER DEFINED U2	Defines the second voltage point of the custom U/f curve at the frequency defined by parameter *2613 USER DEFINED F2*. See section *Custom U/f ratio* on page *143*.	38% of U_N
	0…120% of U_N V	Voltage	1 = 1 V
2613	USER DEFINED F2	Defines the second frequency point of the custom U/f curve.	20.0 Hz
	0.0…599.0 Hz	Frequency	1 = 0.1 Hz
2614	USER DEFINED U3	Defines the third voltage point of the custom U/f curve at the frequency defined by parameter *2615 USER DEFINED F3*. See section *Custom U/f ratio* on page *143*.	47.5% of U_N
	0…120% of U_N V	Voltage	1 = 1 V
2615	USER DEFINED F3	Defines the third frequency point of the custom U/f curve.	25.0 Hz
	0.0…599.0 Hz	Frequency	1 = 0.1 Hz
2616	USER DEFINED U4	Defines the fourth voltage point of the custom U/f curve at the frequency defined by parameter *2617 USER DEFINED F4*. See section *Custom U/f ratio* on page *143*.	76% of U_N
	0…120% of U_N V	Voltage	1 = 1 V
2617	USER DEFINED F4	Defines the fourth frequency point of the custom U/f curve.	40.0 Hz
	0.0…599.0 Hz	Frequency	1 = 0.1 Hz
2618	FW VOLTAGE	Defines the voltage of the U/f curve when frequency is equal to or exceeds the motor nominal frequency (*9907 MOTOR NOM FREQ*). See section *Custom U/f ratio* on page *143*.	95% of U_N
	0…120% of U_N V	Voltage	1 = 1 V

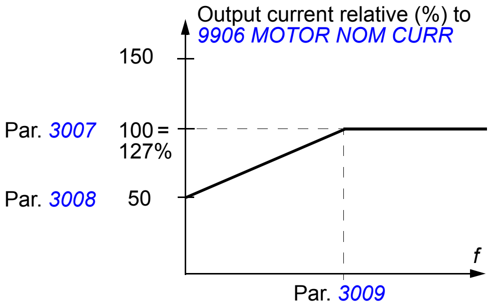
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2619	DC STABILIZER	Enables or disables the DC voltage stabilizer. The DC stabilizer is used to prevent possible voltage oscillations in the drive DC bus caused by motor load or weak supply network. In case of voltage variation, the drive tunes the frequency reference to stabilize the DC bus voltage and therefore the load torque oscillation.	*DISABLE*
	DISABLE	Disabled	0
	ENABLE	Enabled	1
2621	SMOOTH START	Selects the forced current vector rotation mode at low speeds. When the smooth start mode is selected, the rate of acceleration is limited by the acceleration and deceleration ramp times (parameters *2202* and *2203*). If the process driven by the permanent magnet synchronous motor has high inertia, slow ramp times are recommended. Can be used for permanent magnet synchronous motors only (see chapter *Appendix: Permanent magnet synchronous motors (PMSMs)*).	*NO*
	NO	Disabled	0
	YES	Enabled always when the frequency is below the smooth start frequency (parameter *2623 SMOOTH START FRQ*).	1
	START ONLY	Enabled below the smooth start frequency (parameter *2623 SMOOTH START FRQ*) only when starting the motor.	2
2622	SMOOTH START CUR	Current used in the current vector rotation at low speeds. Increase the smooth start current if the application requires high pull-up torque. Decrease the smooth start current if motor shaft swinging needs to be minimized. Note that accurate torque control is not possible in the current vector rotation mode. Can be used for permanent magnet synchronous motors only (see chapter *Appendix: Permanent magnet synchronous motors (PMSMs)*).	50%
	10…100%	Value as a percentage of the nominal motor current	1 = 1%
2623	SMOOTH START FRQ	Output frequency up to which the current vector rotation is used. Can be used for permanent magnet synchronous motors only (see chapter *Appendix: Permanent magnet synchronous motors (PMSMs)*).	10%
	2…100%	Value as a percentage of the motor nominal frequency	1 = 1%
2624	SMOOTH STRT TIME	The maximum time the smooth start feature is active. When value is set to 0 (default), the smooth start time limitation is not activated.	0 s
	0.0…100.0 s	Maximum time in seconds	1 = 1 s

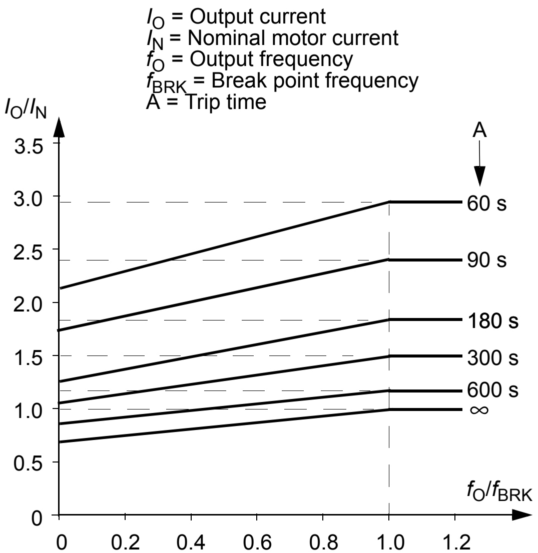
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2626	SPD EST BW TRIM	Speed estimation bandwidth trimming. Effective only in vector:speed and vector:torque modes. Speed estimation is trimmed to be very dynamic. When the drive is used with non-dynamic loads such as compressors, pumps and fans, this variable can be trimmed to a higher value.	0%
	0…20%	Speed estimation bandwidth	1 = 1%
29 MAINTENANCE TRIG		Maintenance triggers	
2901	COOLING FAN TRIG	Defines the trigger point for the drive cooling fan run time counter. Value is compared to parameter *2902 COOLING FAN ACT* value.	0.0 kh
	0.0…6553.5 kh	Time. If parameter value is set to zero, the trigger is disabled.	1 = 0.1 kh
2902	COOLING FAN ACT	Defines the actual value for the cooling fan run time counter. When parameter *2901 COOLING FAN TRIG* has been set to a non zero value, the counter starts. When the actual value of the counter exceeds the value defined by parameter *2901*, a maintenance notice is displayed on the panel.	0.0 kh
	0.0…6553.5 kh	Time. Parameter is reset by setting it to zero.	1 = 0.1 kh
2903	REVOLUTION TRIG	Defines the trigger point for the motor revolution counter. Value is compared to parameter *2904 REVOLUTION ACT* value.	0 Mrev
	0…65535 Mrev	Millions of revolutions. If parameter value is set to zero, the trigger is disabled.	1 = 1 Mrev
2904	REVOLUTION ACT	Defines the actual value for the motor revolution counter. When parameter *2903 REVOLUTION TRIG* has been set to a non zero value, the counter starts. When the actual value of the counter exceeds the value defined by parameter *2903*, a maintenance notice is displayed on the panel.	0 Mrev
	0…65535 Mrev	Millions of revolutions. Parameter is reset by setting it to zero.	1 = 1 Mrev
2905	RUN TIME TRIG	Defines the trigger point for the drive run time counter. Value is compared to parameter *2906 RUN TIME ACT* value.	0.0 kh
	0.0…6553.5 kh	Time. If parameter value is set to zero, the trigger is disabled.	1 = 0.1 kh
2906	RUN TIME ACT	Defines the actual value for the drive run time counter. When parameter *2905 RUN TIME TRIG* has been set to a non zero value, the counter starts. When the actual value of the counter exceeds the value defined by parameter *2905*, a maintenance notice is displayed on the panel.	0.0 kh
	0.0…6553.5 kh	Time. Parameter is reset by setting it to zero.	1 = 0.1 kh

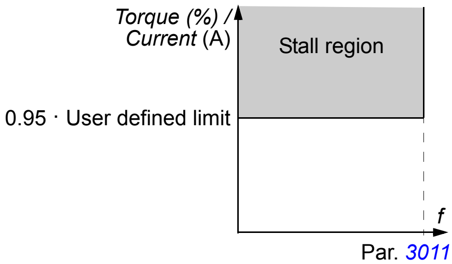
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
2907	USER MWh TRIG	Defines the trigger point for the drive power consumption counter. Value is compared to parameter *2908 USER MWh ACT* value.	0.0 MWh
	0.0… 6553.5 MWh	Megawatt hours. If parameter value is set to zero, the trigger is disabled.	1 = 0.1 MWh
2908	USER MWh ACT	Defines the actual value of the drive power consumption counter. When parameter *2907 USER MWh TRIG* has been set to a non zero value, the counter starts. When the actual value of the counter exceeds the value defined by parameter *2907*, a maintenance notice is displayed on the panel.	0.0 MWh
	00.0… 6553.5 MWh	Megawatt hours. Parameter is reset by setting it to zero.	1 = 0.1 MWh
30 FAULT FUNCTIONS		Programmable protection functions	
3001	AI<MIN FUNCTION	Defines the drive response if the analog input (AI) signal drops below the fault limits and AI is used • as the active reference source (group *11 REFERENCE SELECT*) • as the process or external PID controllers' feedback or setpoint source (group *40 PROCESS PID SET 1*, *41 PROCESS PID SET 2* or *42 EXT / TRIM PID*) and the corresponding PID controller is active. *3021 AI1 FAULT LIMIT* and *3022 AI2 FAULT LIMIT* set the fault limits.	*NOT SEL*
	NOT SEL	Protection is inactive.	0
	FAULT	The drive trips on fault *AI1 LOSS* (*0007*) / *AI2 LOSS* (*0008*) and the motor coasts to stop. Fault limit is defined by parameter *3021 AI1 FAULT LIMIT* / *3022 AI2 FAULT LIMIT*.	1
	CONST SP 7	The drive generates alarm *AI1 LOSS* (*2006*) / *AI2 LOSS* (*2007*) and sets the speed to the value defined by parameter *1208 CONST SPEED 7*. Alarm limit is defined by parameter *3021 AI1 FAULT LIMIT* / *3022 AI2 FAULT LIMIT*. **WARNING!** Make sure that it is safe to continue operation in case the analog input signal is lost.	2
	LAST SPEED	The drive generates alarm *AI1 LOSS* (*2006*) / *AI2 LOSS* (*2007*) and freezes the speed to the level the drive was operating at. The speed is determined by the average speed over the previous 10 seconds. Alarm limit is defined by parameter *3021 AI1 FAULT LIMIT* / *3022 AI2 FAULT LIMIT*. **WARNING!** Make sure that it is safe to continue operation in case the analog input signal is lost.	3

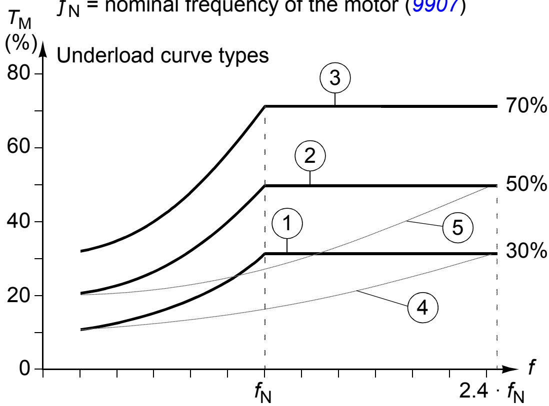
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
3002	PANEL COMM ERR	Selects how the drive reacts to a control panel communication break. **Note:** When either of the two external control locations are active, and start, stop and/or direction are through the control panel – *1001 EXT1 COMMANDS* / *1002 EXT2 COMMANDS* = 8 (*KEYPAD*) – the drive follows the speed reference according to the configuration of the external control locations, instead of the value of the last speed or parameter *1208 CONST SPEED 7*.	*FAULT*
	FAULT	Drive trips on fault *PANEL LOSS* (*0010*) and the motor coasts to stop.	1
	CONST SP 7	The drive generates alarm *PANEL LOSS* (*2008*) and sets the speed to the speed defined by parameter *1208 CONST SPEED 7*. ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a panel communication break.	2
	LAST SPEED	The drive generates alarm *PANEL LOSS* (*2008*) and freezes the speed to the level the drive was operating at. The speed is determined by the average speed over the previous 10 seconds. ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a panel communication break.	3
3003	EXTERNAL FAULT 1	Selects an interface for an external fault 1 signal.	*NOT SEL*
	NOT SEL	Not selected	0
	DI1	External fault indication through digital input DI1. 1 = Fault trip on *EXT FAULT 1* (*0014*). Motor coasts to stop. 0 = No external fault.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	DI1(INV)	External fault indication through inverted digital input DI1. 0 = Fault trip on *EXT FAULT 1* (*0014*). Motor coasts to stop. 1 = No external fault.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
3004	EXTERNAL FAULT 2	Selects an interface for an external fault 2 signal.	*NOT SEL*
		See parameter *3003 EXTERNAL FAULT 1*.	

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
3005	MOT THERM PROT	Selects how the drive reacts when the motor overtemperature is detected.	*FAULT*
	NOT SEL	Protection is inactive.	0
	FAULT	The drive trips on fault *MOT OVERTEMP* (*0009*) when the temperature exceeds 110 °C, and the motor coasts to stop.	1
	ALARM	The drive generates alarm *MOTOR TEMP* (*2010*) when the motor temperature exceeds 90 °C.	2
3006	MOT THERM TIME	Defines the thermal time constant for the motor thermal model, ie, the time within which the motor temperature has reached 63% of the nominal temperature with steady load. For thermal protection according to UL requirements for NEMA class motors, use the rule of thumb: Motor thermal time = 35 · t6. t6 (in seconds) is specified by the motor manufacturer as the time the motor can safely operate at six times its rated current. Thermal time for a Class 10 trip curve is 350 s, for a Class 20 trip curve 700 s, and for a Class 30 trip curve 1050 s.  	500 s
	256…9999 s	Time constant	1 = 1 s

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
3007	MOT LOAD CURVE	Defines the load curve together with parameters *3008 ZERO SPEED LOAD* and *3009 BREAK POINT FREQ*. With the default value 100%, motor overload protection is functioning when the constant current exceeds 127% of the parameter *9906 MOTOR NOM CURR* value. The default overloadability is at the same level as what motor manufacturers typically allow below 30 °C (86 °F) ambient temperature and below 1000 m (3300 ft) altitude. When the ambient temperature exceeds 30 °C (86 °F) or the installation altitude is over 1000 m (3300 ft), decrease the parameter *3007* value according to the motor manufacturer's recommendation. **Example:** If the constant protection level needs to be 115% of the nominal motor current, set parameter *3007* value to 91% (= 115/127·100%). 	100%
	50….150%	Allowed continuous motor load relative to the nominal motor current	1 = 1%
3008	ZERO SPEED LOAD	Defines the load curve together with parameters *3007 MOT LOAD CURVE* and *3009 BREAK POINT FREQ*.	70%
	25….150%	Allowed continuous motor load at zero speed as a percentage of the nominal motor current	1 = 1%

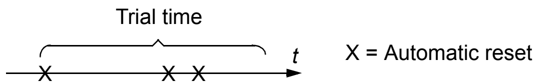
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
3009	BREAK POINT FREQ	Defines the load curve together with parameters *3007 MOT LOAD CURVE* and *3008 ZERO SPEED LOAD*. **Example:** Thermal protection trip times when parameters *3006*…*3008* have default values. 	35 Hz
	1…250 Hz	Drive output frequency at 100% load	1 = 1 Hz

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
3010	STALL FUNCTION	Selects how the drive reacts to a motor stall condition. The protection wakes up if the drive has operated in a stall region (see the figure below) longer than the time set by parameter *3012 STALL TIME*. In vector control the user defined limit = *2017 MAX TORQUE 1* / *2018 MAX TORQUE 2* (applies for positive and negative torques). In scalar control the user defined limit = *2003 MAX CURRENT*. The control mode is selected by parameter *9904 MOTOR CTRL MODE*.  	*NOT SEL*
	NOT SEL	Protection is inactive.	0
	FAULT	The drive trips on fault *MOTOR STALL* (*0012*) and the motor coasts to stop.	1
	ALARM	The drive generates alarm *MOTOR STALL* (*2012*).	2
3011	STALL FREQUENCY	Defines the frequency limit for the stall function. See parameter *3010 STALL FUNCTION*.	20.0 Hz
	0.5…50.0 Hz	Frequency	1 = 0.1 Hz
3012	STALL TIME	Defines the time for the stall function. See parameter *3010 STALL FUNCTION*.	20 s
	1…400 s	Time	1 = 1 s
3013	UNDERLOAD FUNC	Selects how the drive reacts to underload. The protection wakes up if: • the motor torque falls below the curve selected by parameter *3015 UNDERLOAD CURVE*, • output frequency is higher than 10% of the nominal motor frequency and • the above conditions have been valid longer than the time set by parameter *3014 UNDERLOAD TIME*.	*NOT SEL*
	NOT SEL	Protection is inactive.	0

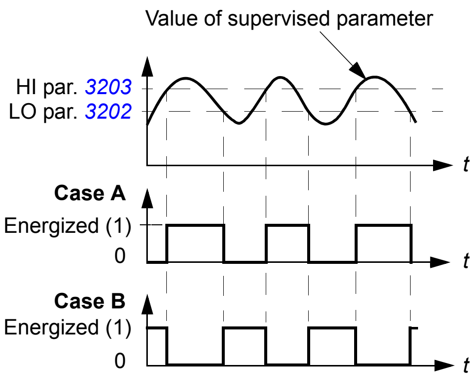
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	FAULT	The drive trips on fault *UNDERLOAD* (*0017*) and the motor coasts to stop. **Note:** Set parameter value to *FAULT* only after the drive ID run is performed! If *FAULT* is selected, the drive may generate an *UNDERLOAD* fault during ID run.	1
	ALARM	The drive generates alarm *UNDERLOAD* (*2011*).	2
3014	UNDERLOAD TIME	Defines the time limit for the underload function. See parameter *3013 UNDERLOAD FUNC*.	20 s
	10…400 s	Time limit	1 = 1 s
3015	UNDERLOAD CURVE	Selects the load curve for the underload function. See parameter *3013 UNDERLOAD FUNC*. T_M = nominal torque of the motor f_N = nominal frequency of the motor (*9907*) 	1
	1…5	Number of the load curve type in the figure	1 = 1
3016	SUPPLY PHASE	Selects how the drive reacts to supply phase loss, ie, when DC voltage ripple is excessive.	*FAULT*
	FAULT	The drive trips on fault *SUPPLY PHASE* (*0022*) and the motor coasts to stop when the DC voltage ripple exceeds 14% of the nominal DC voltage.	0
	LIMIT/ALARM	Drive output current is limited and alarm *INPUT PHASE LOSS* (*2026*) is generated when the DC voltage ripple exceeds 14% of the nominal DC voltage. There is a 10 s delay between the activation of the alarm and the output current limitation. The current is limited until the ripple drops under the minimum limit, 0.3 · I_{hd}.	1
	ALARM	The drive generates alarm *INPUT PHASE LOSS* (*2026*) when the DC ripple exceeds 14% of the nominal DC voltage.	2

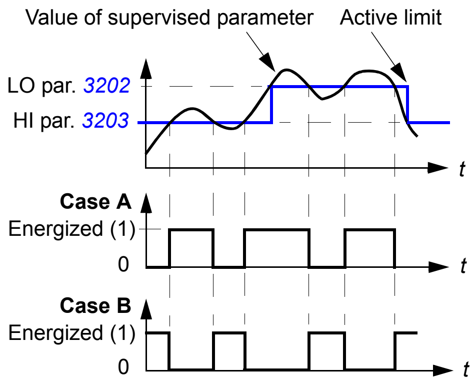
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
3017	EARTH FAULT	Selects how the drive reacts when an earth (ground) fault is detected in the motor or the motor cable. **Note:** Disabling earth (ground) fault may void the warranty.	*ENABLE*
	DISABLE	No action	0
	ENABLE	The drive trips on fault *EARTH FAULT* (*0016*) when the earth fault is detected during run.	1
	START ONLY	The drive trips on fault *EARTH FAULT* (*0016*) when the earth fault is detected before run.	2
3018	COMM FAULT FUNC	Selects how the drive reacts in a fieldbus communication break. The time delay is defined by parameter *3019 COMM FAULT TIME*. After a start-up, the protection is inactive for 60 seconds.	*NOT SEL*
	NOT SEL	Protection is inactive.	0
	FAULT	Protection is active. The drive trips on fault *SERIAL 1 ERR* (*0028*) and coasts to stop.	1
	CONST SP 7	Protection is active. The drive generates alarm *IO COMM* (*2005*) and sets the speed to the value defined by parameter *1208 CONST SPEED 7*. **WARNING**! Make sure that it is safe to continue operation in case of a communication break.	2
	LAST SPEED	Protection is active. The drive generates alarm *IO COMM* (*2005*) and freezes the speed to the level the drive was operating at. The speed is determined by the average speed over the previous 10 seconds. **WARNING**! Make sure that it is safe to continue operation in case of a communication break.	3
3019	COMM FAULT TIME	Defines the time delay for the fieldbus communication break supervision. See parameter *3018 COMM FAULT FUNC*.	3.0 s
	0.0…600.0 s	Delay time	1 = 0.1 s
3021	AI1 FAULT LIMIT	Defines a fault level for analog input AI1. If parameter *3001 AI<MIN FUNCTION* is set to *FAULT*, the drive trips on fault *AI1 LOSS* (*0007*) when the analog input signal falls below the set level. Do not set this limit below the level defined by parameter *1301 MINIMUM AI1*.	0.0%
	0.0…100.0%	Value as a percentage of the full signal range	1 = 0.1%

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
3022	AI2 FAULT LIMIT	Defines a fault level for analog input AI2. If parameter *3001 AI<MIN FUNCTION* is set to *FAULT*, the drive trips on fault *AI2 LOSS* (*0008*) when the analog input signal falls below the set level. Do not set this limit below the level defined by parameter *1304 MINIMUM AI2*.	0.0%
	0.0…100.0%	Value as a percentage of the full signal range	1 = 0.1%
3023	WIRING FAULT	Selects how the drive reacts when incorrect input power and motor cable connection is detected (ie, the input power cable is connected to the motor connection of the drive). **Note:** Disabling wiring fault (ground fault) may void the warranty.	*ENABLE*
	DISABLE	No action	0
	ENABLE	The drive trips on fault *OUTP WIRING* (*0035*).	1
3025	STO OPERATION	Selects how the drive reacts when the drive detects that the STO (Safe torque off) function is active.	*ONLY ALARM*
	ONLY FAULT	The drive trips on fault *SAFE TORQUE OFF* (*0044*).	1
	ALARM&FAULT	The drive generates alarm *SAFE TORQUE OFF* (*2035*) when stopped and trips on fault *SAFE TORQUE OFF* (*0044*) when running.	2
	NO & FAULT	The drive gives no indication to the user when stopped and trips on fault *SAFE TORQUE OFF* (*0044*) when running.	3
	ONLY ALARM	The drive generates alarm *SAFE TORQUE OFF* (*2035*). **Note:** The start signal must be reset (toggled to 0) if STO (Safe torque off) has been used while the drive has been running.	4
3026	POWER FAIL START	Selects how the drive reacts when the control board is externally powered by the MPOW-01 auxiliary power extension module (see *Appendix: Extension modules* on page *411*) and start is requested by the user.	*ALARM*
	ALARM	The drive generates alarm *UNDERVOLTAGE* (*2003*).	1
	FAULT	The drive trips on fault *DC UNDERVOLT* (*0006*).	2
	NO	The drive gives no indication to the user.	3
3027	OPTION COM LOSS	Selects how the drive reacts when the MREL-01 output relay module is removed from the drive, and parameters *1402 RELAY OUTPUT 2*, *1403 RELAY OUTPUT 3* or *1410 RELAY OUTPUT 4* have non-zero values.	1
	DISABLE	No action.	0
	ENABLE	The drive trips on fault *1006 PAR EXT RO*.	1

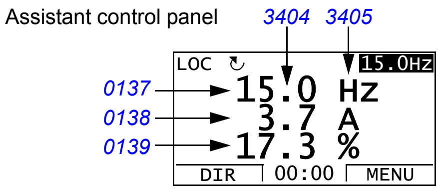
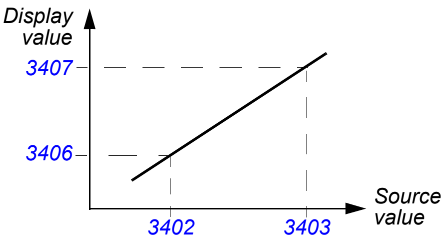
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
3029	FAULT RAMP STOP	Enables the emergency ramp stop when the drive faults.	0
	DISABLE	Coast stop used.	0
	ENABLE	Fault ramp stop enabled. The drive stops using an emergency ramp when a non-critical fault occurs. The following critical faults will always cause the coast stop regardless of the value of this parameter: • 0001 OVERCURRENT • 0002 DC OVERVOLT • 0004 SHORT CIRC • 0044 SAFE TORQUE OFF • 0045 STO1 LOST • 0046 STO2 LOST.	1
31 AUTOMATIC RESET		Automatic fault reset. Automatic resets are possible only for certain fault types and when the automatic reset function is activated for that fault type.	
3101	NUMBER OF TRIALS	Defines the number of automatic fault resets the drive performs within the time defined by parameter *3102 TRIAL TIME*. If the number of automatic resets exceeds the set number (within the trial time), the drive prevents additional automatic resets and remains stopped. The drive must be reset from the control panel or from a source selected by parameter *1604 FAULT RESET SEL*. **Example:** Three faults have occurred during the trial time defined by parameter *3102*. Last fault is reset only if the number defined by parameter *3101* is 3 or more. 	0
	0…5	Number of the automatic resets	1 = 1
3102	TRIAL TIME	Defines the time for the automatic fault reset function. See parameter *3101 NUMBER OF TRIALS*.	30.0 s
	1.0…600.0 s	Time	1 = 0.1 s
3103	DELAY TIME	Defines the time that the drive will wait after a fault before attempting an automatic reset. See parameter *3101 NUMBER OF TRIALS*. If delay time is set to zero, the drive resets immediately.	0.0 s
	0.0…120.0 s	Time	1 = 0.1 s

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
3104	AR OVERCURRENT	Activates/deactivates the automatic reset for the overcurrent fault. Automatically resets fault *OVERCURRENT* (*0001*) after the delay set by parameter *3103 DELAY TIME*.	*DISABLE*
	DISABLE	Inactive	0
	ENABLE	Active	1
3105	AR OVERVOLTAGE	Activates/deactivates the automatic reset for the intermediate link overvoltage fault. Automatically resets fault *DC OVERVOLT* (*0002*) after the delay set by parameter *3103 DELAY TIME*.	*DISABLE*
	DISABLE	Inactive	0
	ENABLE	Active	1
3106	AR UNDERVOLTAGE	Activates/deactivates the automatic reset for the intermediate link undervoltage fault. Automatically resets fault *DC UNDERVOLT* (*0006*) after the delay set by parameter *3103 DELAY TIME*.	*DISABLE*
	DISABLE	Inactive	0
	ENABLE	Active	1
3107	AR AI<MIN	Activates/deactivates the automatic reset for AI<MIN (analog input signal under the allowed minimum level) faults *AI1 LOSS* (*0007*) and *AI2 LOSS* (*0008*). Automatically resets the fault after the delay set by parameter *3103 DELAY TIME*.	*DISABLE*
	DISABLE	Inactive	0
	ENABLE	Active **WARNING!** The drive may restart even after a long stop if the analog input signal is restored. Ensure that the use of this feature will not cause danger.	1
3108	AR EXTERNAL FLT	Activates/deactivates the automatic reset for faults *EXT FAULT 1* (*0014*) and *EXT FAULT 2* (*0015*). Automatically resets the fault after the delay set by parameter *3103 DELAY TIME*.	*DISABLE*
	DISABLE	Inactive	0
	ENABLE	Active	1

All parameters		
No. Name/Value	**Description**	**Def/FbEq**
32 SUPERVISION	Signal supervision. Supervision status can be monitored with relay or transistor output. See parameter groups *14 RELAY OUTPUTS* and *18 FREQ IN & TRAN OUT*.	
3201 SUPERV 1 PARAM	Selects the first supervised signal. Supervision limits are defined by parameters *3202 SUPERV 1 LIM LO* and *3203 SUPERV 1 LIM HI*. **Example 1**: If *3202 SUPERV 1 LIM LO* ≤ *3203 SUPERV 1 LIM HI* **Case A** = *1401 RELAY OUTPUT 1* value is set to *SUPRV1 OVER*. Relay energizes when value of the signal selected with *3201 SUPERV 1 PARAM* exceeds the supervision limit defined by *3203 SUPERV 1 LIM HI*. The relay remains active until the supervised value drops below the low limit defined by *3202 SUPERV 1 LIM LO*. **Case B** = *1401 RELAY OUTPUT 1* value is set to *SUPRV1 UNDER*. Relay energizes when value of the signal selected with *3201 SUPERV 1 PARAM* drops below the supervision limit defined by *3202 SUPERV 1 LIM LO*. The relay remains active until the supervised value rises above the high limit defined by *3203 SUPERV 1 LIM HI*.  	103

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
		Example 2: If *3202 SUPERV 1 LIM LO* > *3203 SUPERV 1 LIM HI* The lower limit *3203 SUPERV 1 LIM HI* remains active until the supervised signal exceeds the higher limit *3202 SUPERV 1 LIM LO*, making it the active limit. The new limit remains active until the supervised signal drops below the lower limit *3203 SUPERV 1 LIM HI*, making it the active limit. **Case A** = *1401 RELAY OUTPUT 1* value is set to *SUPRV1 OVER*. Relay is energized whenever the supervised signal exceeds the active limit. **Case B** = *1401 RELAY OUTPUT 1* value is set to *SUPRV1 UNDER*. Relay is de-energized whenever the supervised signal drops below the active limit.  	
	0, x…x	Parameter index in group *01 OPERATING DATA*. For example, 102 = *0102 SPEED*. 0 = not selected.	1 = 1
3202	SUPERV 1 LIM LO	Defines the low limit for the first supervised signal selected by parameter *3201 SUPERV 1 PARAM*. Supervision wakes up if the value is below the limit.	-
	x…x	Setting range depends on parameter *3201* setting.	-
3203	SUPERV 1 LIM HI	Defines the high limit for the first supervised signal selected by parameter *3201 SUPERV 1 PARAM*. Supervision wakes up if the value is above the limit.	-
	x…x	Setting range depends on parameter *3201* setting.	-
3204	SUPERV 2 PARAM	Selects the second supervised signal. Supervision limits are defined by parameters *3205 SUPERV 2 LIM LO* and *3206 SUPERV 2 LIM HI*. See parameter *3201 SUPERV 1 PARAM*.	104
	x…x	Parameter index in group *01 OPERATING DATA*. For example, 102 = *0102 SPEED*.	1 = 1

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
3205	SUPERV 2 LIM LO	Defines the low limit for the second supervised signal selected by parameter *3204 SUPERV 2 PARAM*. Supervision wakes up if the value is below the limit.	-
	x…x	Setting range depends on parameter *3204* setting.	-
3206	SUPERV 2 LIM HI	Defines the high limit for the second supervised signal selected by parameter *3204 SUPERV 2 PARAM*. Supervision wakes up if the value is above the limit.	-
	x…x	Setting range depends on parameter *3204* setting.	-
3207	SUPERV 3 PARAM	Selects the third supervised signal. Supervision limits are defined by parameters *3208 SUPERV 3 LIM LO* and *3209 SUPERV 3 LIM HI*. See parameter *3201 SUPERV 1 PARAM*.	105
	x…x	Parameter index in group *01 OPERATING DATA*. For example, 102 = *0102 SPEED*.	1 = 1
3208	SUPERV 3 LIM LO	Defines the low limit for the third supervised signal selected by parameter *3207 SUPERV 3 PARAM*. Supervision wakes up if the value is below the limit.	-
	x…x	Setting range depends on parameter *3207* setting.	-
3209	SUPERV 3 LIM HI	Defines the high limit for the third supervised signal selected by parameter *3207 SUPERV 3 PARAM*. Supervision wakes up if the value is above the limit.	-
	x…x	Setting range depends on parameter *3207* setting.	-
33 INFORMATION		Firmware package version, test date etc.	
3301	FIRMWARE	Displays the version of the firmware package.	
	0000…FFFF hex	For example, 241A hex	
3302	LOADING PACKAGE	Displays the version of the loading package.	type dependent
	2201…22FF hex	2201 hex = ACS355-0nE- 2202 hex = ACS355-0nU-	
3303	TEST DATE	Displays the test date.	00.00
		Date value in format YY.WW (year, week)	
3304	DRIVE RATING	Displays the drive current and voltage ratings.	0000 hex
	0000…FFFF hex	Value in format XXXY hex: XXX = Nominal current of the drive in amperes. An “A” indicates decimal point. For example if XXX is 9A8, nominal current is 9.8 A. Y = Nominal voltage of the drive: 1 = 1-phase 200…240 V 2 = 3-phase 200…240 V 4 = 3-phase 380…480 V	

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
3305	PARAMETER TABLE	Displays the version of the parameter table used in the drive.	
	0000…FFFF hex	For example, 400E hex	
34 PANEL DISPLAY		Selection of actual signals to be displayed on the panel	
3401	SIGNAL1 PARAM	Selects the first signal to be displayed on the control panel in the Output mode.  	103
	0 = NOT SELECTED 101…181	Parameter index in group *01 OPERATING DATA*. For example, 102 = *0102 SPEED*. If value is set to 0, no signal is selected.	1 = 1
3402	SIGNAL1 MIN	Defines the minimum value for the signal selected by parameter *3401 SIGNAL1 PARAM*.  **Note:** Parameter is not effective if parameter *3404 OUTPUT1 DSP FORM* setting is *DIRECT*.	-
	x…x	Setting range depends on parameter *3401* setting.	-
3403	SIGNAL1 MAX	Defines the maximum value for the signal selected by parameter *3401 SIGNAL1 PARAM*. See the figure for parameter *3402 SIGNAL1 MIN*. **Note:** Parameter is not effective if parameter *3404 OUTPUT1 DSP FORM* setting is *DIRECT*.	-
	x…x	Setting range depends on parameter *3401* setting.	-

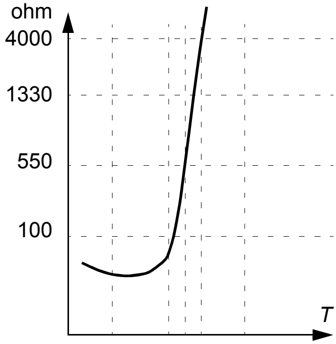
<table>
<tr><th colspan="4">All parameters</th></tr>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq</th></tr>
<tr><td>3404</td><td>OUTPUT1 DSP FORM</td><td>Defines the format for the displayed signal (selected by parameter 3401 SIGNAL1 PARAM).</td><td>DIRECT</td></tr>
<tr><td></td><td>+/-0</td><td rowspan="8">Signed/Unsigned value. Unit is selected by parameter 3405 OUTPUT1 UNIT.
Example: PI (3.14159)
<table>
<tr><th>3404 value</th><th>Display</th><th>Range</th></tr>
<tr><td>+/-0</td><td>± 3</td><td rowspan="4">-32768…+32767</td></tr>
<tr><td>+/-0.0</td><td>± 3.1</td></tr>
<tr><td>+/-0.00</td><td>± 3.14</td></tr>
<tr><td>+/-0.000</td><td>± 3.142</td></tr>
<tr><td>+0</td><td>3</td><td rowspan="4">0…65535</td></tr>
<tr><td>+0.0</td><td>3.1</td></tr>
<tr><td>+0.00</td><td>3.14</td></tr>
<tr><td>+0.000</td><td>3.142</td></tr>
</table></td><td>0</td></tr>
<tr><td></td><td>+/-0.0</td><td>1</td></tr>
<tr><td></td><td>+/-0.00</td><td>2</td></tr>
<tr><td></td><td>+/-0.000</td><td>3</td></tr>
<tr><td></td><td>+0</td><td>4</td></tr>
<tr><td></td><td>+0.0</td><td>5</td></tr>
<tr><td></td><td>+0.00</td><td>6</td></tr>
<tr><td></td><td>+0.000</td><td>7</td></tr>
<tr><td></td><td>BAR METER</td><td>Bar graph</td><td>8</td></tr>
<tr><td></td><td>DIRECT</td><td>Direct value. Decimal point location and units of measure are the same as for the source signal.
Note: Parameters 3402, 3403 and 3405…3407 are not effective.</td><td>9</td></tr>
<tr><td>3405</td><td>OUTPUT1 UNIT</td><td>Selects the unit for the displayed signal selected by parameter 3401 SIGNAL1 PARAM.
Note: Parameter is not effective if parameter 3404 OUTPUT1 DSP FORM setting is DIRECT.
Note: Unit selection does not convert values.</td><td>Hz</td></tr>
<tr><td></td><td>NO UNIT</td><td>No unit selected</td><td>0</td></tr>
<tr><td></td><td>A</td><td>ampere</td><td>1</td></tr>
<tr><td></td><td>V</td><td>volt</td><td>2</td></tr>
<tr><td></td><td>Hz</td><td>hertz</td><td>3</td></tr>
<tr><td></td><td>%</td><td>percentage</td><td>4</td></tr>
<tr><td></td><td>s</td><td>second</td><td>5</td></tr>
<tr><td></td><td>h</td><td>hour</td><td>6</td></tr>
<tr><td></td><td>rpm</td><td>revolutions per minute</td><td>7</td></tr>
<tr><td></td><td>kh</td><td>kilohour</td><td>8</td></tr>
<tr><td></td><td>°C</td><td>celsius</td><td>9</td></tr>
<tr><td></td><td>lb ft</td><td>pounds per foot</td><td>10</td></tr>
<tr><td></td><td>mA</td><td>milliampere</td><td>11</td></tr>
<tr><td></td><td>mV</td><td>millivolt</td><td>12</td></tr>
<tr><td></td><td>kW</td><td>kilowatt</td><td>13</td></tr>
<tr><td></td><td>W</td><td>watt</td><td>14</td></tr>
<tr><td></td><td>kWh</td><td>kilowatt hour</td><td>15</td></tr>
</table>

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	°F	fahrenheit	16
	hp	horsepower	17
	MWh	megawatt hour	18
	m/s	meters per second	19
	m3/h	cubic meters per hour	20
	dm3/s	cubic decimeters per second	21
	bar	bar	22
	kPa	kilopascal	23
	GPM	gallons per minute	24
	PSI	pounds per square inch	25
	CFM	cubic feet per minute	26
	ft	foot	27
	MGD	millions of gallons per day	28
	inHg	inches of mercury	29
	FPM	feet per minute	30
	kb/s	kilobytes per second	31
	kHz	kilohertz	32
	ohm	ohm	33
	ppm	pulses per minute	34
	pps	pulses per second	35
	l/s	liters per second	36
	l/min	liters per minute	37
	l/h	liters per hour	38
	m3/s	cubic meters per second	39
	m3/m	cubic meters per minute	40
	kg/s	kilograms per second	41
	kg/m	kilograms per minute	42
	kg/h	kilograms per hour	43
	mbar	millibar	44
	Pa	pascal	45
	GPS	gallons per second	46
	gal/s	gallons per second	47
	gal/m	gallons per minute	48
	gal/h	gallons per hour	49
	ft3/s	cubic feet per second	50
	ft3/m	cubic feet per minute	51
	ft3/h	cubic feet per hour	52

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	lb/s	pounds per second	53
	lb/m	pounds per minute	54
	lb/h	pounds per hour	55
	FPS	feet per second	56
	ft/s	feet per second	57
	inH2O	inches of water	58
	in wg	inches of water gauge	59
	ft wg	feet on water gauge	60
	lbsi	pounds per squared inch	61
	ms	millisecond	62
	Mrev	millions of revolutions	63
	d	days	64
	inWC	inches of water column	65
	m/min	meters per minute	66
	Nm	Newton meter	67
	Km3/h	thousand cubic meters per hour	68
	min	Reserved for solar pumps	69
	m3		70
	m6		71
	Reserved		72…116
	%ref	reference as a percentage	117
	%act	actual value as a percentage	118
	%dev	deviation as a percentage	119
	% LD	load as a percentage	120
	% SP	set point as a percentage	121
	%FBK	feedback as a percentage	122
	Iout	output current (as a percentage)	123
	Vout	output voltage	124
	Fout	output frequency	125
	Tout	output torque	126
	Vdc	DC voltage	127
3406	OUTPUT1 MIN	Sets the minimum display value for the signal selected by parameter *3401 SIGNAL1 PARAM*. See parameter *3402 SIGNAL1 MIN*. **Note:** Parameter is not effective if parameter *3404 OUTPUT1 DSP FORM* setting is *DIRECT*.	-
	x…x	Setting range depends on parameter *3401* setting.	-

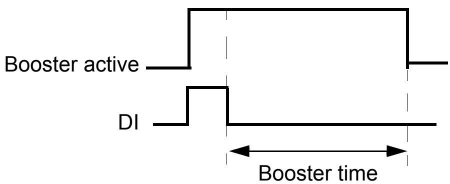
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
3407	OUTPUT1 MAX	Sets the maximum display value for the signal selected by parameter *3401 SIGNAL1 PARAM*. See parameter *3402 SIGNAL1 MIN*. **Note:** Parameter is not effective if parameter *3404 OUTPUT1 DSP FORM* setting is *DIRECT*.	-
	x…x	Setting range depends on parameter *3401* setting.	-
3408	SIGNAL2 PARAM	Selects the second signal to be displayed on the control panel in the Output mode. See parameter *3401 SIGNAL1 PARAM*.	104
	0 = NOT SELECTED 101…181	Parameter index in group *01 OPERATING DATA*. For example, 102 = *0102 SPEED*. If value is set to 0, no signal is selected.	1 = 1
3409	SIGNAL2 MIN	Defines the minimum value for the signal selected by parameter *3408 SIGNAL2 PARAM*. See parameter *3402 SIGNAL1 MIN*.	-
	x…x	Setting range depends on parameter *3408* setting.	-
3410	SIGNAL2 MAX	Defines the maximum value for the signal selected by parameter *3408 SIGNAL2 PARAM*. See parameter *3402 SIGNAL1 MIN*.	-
	x…x	Setting range depends on parameter *3408* setting.	-
3411	OUTPUT2 DSP FORM	Defines the format for the displayed signal selected by parameter *3408 SIGNAL2 PARAM*.	*DIRECT*
		See parameter *3404 OUTPUT1 DSP FORM*.	-
3412	OUTPUT2 UNIT	Selects the unit for the displayed signal selected by parameter *3408 SIGNAL2 PARAM*.	-
		See parameter *3405 OUTPUT1 UNIT*.	-
3413	OUTPUT2 MIN	Sets the minimum display value for the signal selected by parameter *3408 SIGNAL2 PARAM*. See parameter *3402 SIGNAL1 MIN*.	-
	x…x	Setting range depends on parameter *3408* setting.	-
3414	OUTPUT2 MAX	Sets the maximum display value for the signal selected by parameter *3408 SIGNAL2 PARAM*. See parameter *3402 SIGNAL1 MIN*.	-
	x…x	Setting range depends on parameter *3408* setting.	-
3415	SIGNAL3 PARAM	Selects the third signal to be displayed on the control panel in the Output mode. See parameter *3401 SIGNAL1 PARAM*.	105
	0 = NOT SELECTED 101…181	Parameter index in group *01 OPERATING DATA*. For example, 102 = *0102 SPEED*. If value is set to 0, no signal is selected.	1 = 1

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
3416	SIGNAL3 MIN	Defines the minimum value for the signal selected by parameter *3415*. See parameter *3402 SIGNAL1 MIN*.	-
	x…x	Setting range depends on parameter *3415 SIGNAL3 PARAM* setting.	-
3417	SIGNAL3 MAX	Defines the maximum value for the signal selected by parameter *3415 SIGNAL3 PARAM*. See parameter *3402 SIGNAL1 MIN*.	-
	x…x	Setting range depends on parameter *3415 SIGNAL3 PARAM* setting.	-
3418	OUTPUT3 DSP FORM	Defines the format for the displayed signal selected by parameter *3415 SIGNAL3 PARAM*.	*DIRECT*
		See parameter *3404 OUTPUT1 DSP FORM*.	-
3419	OUTPUT3 UNIT	Selects the unit for the displayed signal selected by parameter *3415 SIGNAL3 PARAM*.	-
		See parameter *3405 OUTPUT1 UNIT*.	-
3420	OUTPUT3 MIN	Sets the minimum display value for the signal selected by parameter *3415 SIGNAL3 PARAM*. See parameter *3402 SIGNAL1 MIN*.	-
	x…x	Setting range depends on parameter *3415 SIGNAL3 PARAM* setting.	-
3421	OUTPUT3 MAX	Sets the maximum display value for the signal selected by parameter *3415 SIGNAL3 PARAM*. See parameter *3402 SIGNAL1 MIN*.	-
	x…x	Setting range depends on parameter *3415* setting.	-
35 MOTOR TEMP MEAS		Motor temperature measurement. See section *Motor temperature measurement through the standard I/O* on page *157*.	
3501	SENSOR TYPE	Activates the motor temperature measurement function and selects the sensor type. See also parameter group *15 ANALOG OUTPUTS*.	*NONE*
	NONE	The function is inactive.	0
	1 x PT100	The function is active. The temperature is measured with one Pt100 sensor. Analog output AO feeds constant current through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function reads the voltage through analog input AI1/2 and converts it to degrees centigrade.	1
	2 x PT100	The function is active. Temperature is measured using two Pt100 sensors. See selection *1 x PT100*.	2
	3 x PT100	The function is active. Temperature is measured using three Pt100 sensors. See selection *1 x PT100*.	3

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	PTC	The function is active. The temperature is supervised using one PTC sensor. Analog output AO feeds constant current through the sensor. The resistance of the sensor increases sharply as the motor temperature rises over the PTC reference temperature (Tref), as does the voltage over the resistor. The temperature measurement function reads the voltage through analog input AI1/2 and converts it into ohms. The figure below shows typical PTC sensor resistance values as a function of the motor operating temperature. **Temperature** / **Resistance** Normal / 0…1.5 kohm Excessive / ≥ 4 kohm  	4
	THERM(0)	The function is active. Motor temperature is monitored using a PTC sensor (see selection *PTC*) connected to drive through a normally closed thermistor relay connected to a digital input. 0 = motor overtemperature.	5
	THERM(1)	The function is active. Motor temperature is monitored using a PTC sensor (see selection *PTC*) connected to drive through a normally open thermistor relay connected to a digital input. 1 = motor overtemperature.	6
3502	INPUT SELECTION	Selects the source for the motor temperature measurement signal.	*AI1*
	AI1	Analog input AI1. Used when Pt100 or PTC sensor is selected for the temperature measurement.	1
	AI2	Analog input AI2. Used when Pt100 or PTC sensor is selected for the temperature measurement	2
	DI1	Digital input DI1. Used when parameter *3501 SENSOR TYPE* value is set to *THERM(0)*/*THERM(1)*.	3
	DI2	Digital input DI2. Used when parameter *3501 SENSOR TYPE* value is set to *THERM(0)*/*THERM(1)*.	4

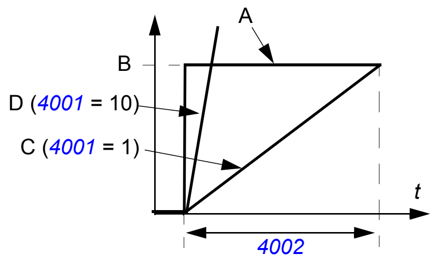
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	DI3	Digital input DI3. Used when parameter *3501 SENSOR TYPE* value is set to *THERM(0)*/*THERM(1)*.	5
	DI4	Digital input DI4. Used when parameter *3501 SENSOR TYPE* value is set to *THERM(0)*/*THERM(1)*.	6
	DI5	Digital input DI5. Used when parameter *3501 SENSOR TYPE* value is set to *THERM(0)*/*THERM(1)*.	7
3503	ALARM LIMIT	Defines the alarm limit for motor temperature measurement. Alarm *MOTOR TEMP* (*2010*) indication is given when the limit is exceeded. When parameter *3501 SENSOR TYPE* value is set to *THERM(0)*/*THERM(1)*: 1 = alarm.	0
	x…x	Alarm limit	-
3504	FAULT LIMIT	Defines the fault trip limit for motor temperature measurement. The drive trips on fault *MOT OVERTEMP* (*0009*) when the limit is exceeded. When parameter *3501 SENSOR TYPE* value is set to *THERM(0)*/*THERM(1)*: 1 = fault.	0
	x…x	Fault limit	-
3505	AO EXCITATION	Enables current feed from analog output AO. Parameter setting overrides parameter group *15 ANALOG OUTPUTS* settings. With PTC the output current is 1.6 mA. With Pt 100 the output current is 9.1 mA.	*DISABLE*
	DISABLE	Disabled	0
	ENABLE	Enabled	1
36 TIMED FUNCTIONS		Time periods 1 to 4 and booster signal. See section *Real-time clock and timed functions* on page *165*.	
3601	TIMERS ENABLE	Selects the source for the timed function enable signal.	*NOT SEL*
	NOT SEL	Timed function is not selected.	0
	DI1	Digital input DI. Timed function enable on the rising edge of DI1.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	ACTIVE	Timed function is always enabled.	7
	DI1(INV)	Inverted digital input DI1. Timed function enable on the falling edge of DI1.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3

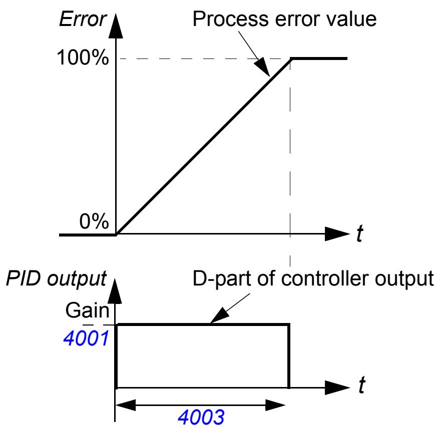
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
3602	START TIME 1	Defines the daily start time 1. The time can be changed in 2-second steps.	00:00:00
	00:00:00… 23:59:58	hours:minutes:seconds. **Example:** If parameter value is set to 07:00:00, timed function 1 is activated at 7:00 (7 a.m).	
3603	STOP TIME 1	Defines the daily stop time 1. The time can be changed in 2-second steps.	00:00:00
	00:00:00… 23:59:58	hours:minutes:seconds. **Example:** If parameter value is set to 18:00:00, timed function 1 is deactivated at 18:00 (6 p.m).	
3604	START DAY 1	Defines the start day 1.	*MONDAY*
	MONDAY	**Example:** If parameter value is set to *MONDAY*, timed function 1 is active from Monday midnight (00:00:00).	1
	TUESDAY		2
	WEDNESDAY		3
	THURSDAY		4
	FRIDAY		5
	SATURDAY		6
	SUNDAY		7
3605	STOP DAY 1	Defines the stop day 1.	*MONDAY*
		See parameter *3604 START DAY 1*. **Example:** If parameter is set to *FRIDAY*, timed function 1 is deactivated on Friday midnight (23:59:58).	
3606	START TIME 2	See parameter *3602 START TIME 1*.	
		See parameter *3602 START TIME 1*.	
3607	STOP TIME 2	See parameter *3603 STOP TIME 1*.	
		See parameter *3603 STOP TIME 1*.	
3608	START DAY 2	See parameter *3604 START DAY 1*.	
		See parameter *3604 START DAY 1*.	
3609	STOP DAY 2	See parameter *3605 STOP DAY 1*.	
		See parameter *3605 STOP DAY 1*.	
3610	START TIME 3	See parameter *3602 START TIME 1*.	
		See parameter *3602 START TIME 1*.	
3611	STOP TIME 3	See parameter *3603 STOP TIME 1*.	
		See parameter *3603 STOP TIME 1*.	
3612	START DAY 3	See parameter *3604 START DAY 1*.	
		See parameter *3604 START DAY 1*.	

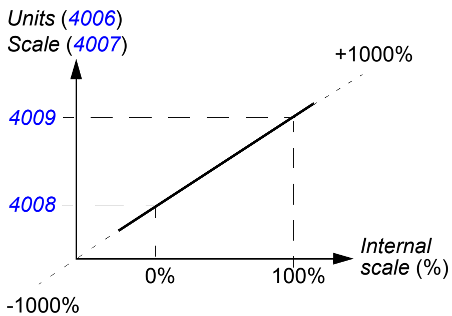
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
3613	STOP DAY 3	See parameter *3605 STOP DAY 1*.	
		See parameter *3605 STOP DAY 1*.	
3614	START TIME 4	See parameter *3602 START TIME 1*.	
		See parameter *3602 START TIME 1*.	
3615	STOP TIME 4	See parameter *3603 STOP TIME 1*.	
		See parameter *3603 STOP TIME 1*.	
3616	START DAY 4	See parameter *3604 START DAY 1*.	
		See parameter *3604 START DAY 1*.	
3617	STOP DAY 4	See parameter *3605 STOP DAY 1*.	
		See parameter *3605 STOP DAY 1*.	
3622	BOOSTER SEL	Selects the source for the booster activation signal.	*NOT SEL*
	NOT SEL	No booster activation signal	0
	DI1	Digital input DI1. 1 = active, 0 = inactive.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	DI1(INV)	Inverted digital input DI1. 0 = active, 1 = inactive.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
3623	BOOSTER TIME	Defines the time inside which the booster is deactivated after the booster activation signal is switched off.	00:00:00
	00:00:00… 23:59:58	hours:minutes:seconds **Example:** If parameter *3622 BOOSTER SEL* is set to *DI1* and *3623 BOOSTER TIME* is set to 01:30:00, the booster is active for 1 hour and 30 minutes after digital input DI is deactivated. 	

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
3626	TIMED FUNC 1 SRC	Selects the time periods for *TIMED FUNC 1 SRC*. Timed function can consist of 0…4 time periods and a booster.	*NOT SEL*
	NOT SEL	No time periods selected	0
	T1	Time period 1	1
	T2	Time period 2	2
	T1+T2	Time periods 1 and 2	3
	T3	Time period 3	4
	T1+T3	Time periods 1 and 3	5
	T2+T3	Time periods 2 and 3	6
	T1+T2+T3	Time periods 1, 2 and 3	7
	T4	Time period 4	8
	T1+T4	Time periods 1 and 4	9
	T2+T4	Time periods 2 and 4	10
	T1+T2+T4	Time periods 1, 2 and 4	11
	T3+T4	Time periods 4 and 3	12
	T1+T3+T4	Time periods 1, 3 and 4	13
	T2+T3+T4	Time periods 2, 3 and 4	14
	T1+T2+T3+T4	Time periods 1, 2, 3 and 4	15
	BOOSTER	Booster	16
	T1+B	Booster and time period 1	17
	T2+B	Booster and time period 2	18
	T1+T2+B	Booster and time periods 1 and 2	19
	T3+B	Booster and time period 3	20
	T1+T3+B	Booster and time periods 1 and 3	21
	T2+T3+B	Booster and time periods 2 and 3	22
	T1+T2+T3+B	Booster and time periods 1, 2 and 3	23
	T4+B	Booster and time period 4	24
	T1+T4+B	Booster and time periods 1 and 4	25
	T2+T4+B	Booster and time periods 2 and 4	26
	T1+T2+T4+B	Booster and time periods 1, 2 and 4	27
	T3+T4+B	Booster and time periods 3 and 4	28
	T1+T3+T4+B	Booster and time periods 1, 3 and 4	29
	T2+T3+T4+B	Booster and time periods 2, 3 and 4	30
	T1+2+3+4+B	Booster and time periods 1, 2, 3 and 4	31
3627	TIMED FUNC 2 SRC	See parameter *3626 TIMED FUNC 1 SRC*.	
		See parameter *3626 TIMED FUNC 1 SRC*.	

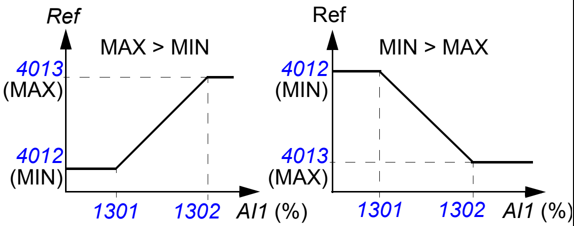
All parameters

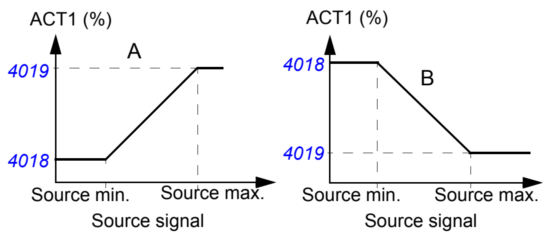
No.	**Name/Value**	**Description**	**Def/FbEq**
3628	TIMED FUNC 3 SRC	See parameter *3626 TIMED FUNC 1 SRC*.	
		See parameter *3626 TIMED FUNC 1 SRC*.	
3629	TIMED FUNC 4 SRC	See parameter *3626 TIMED FUNC 1 SRC*.	
		See parameter *3626 TIMED FUNC 1 SRC*.	
40 PROCESS PID SET 1		Process PID (PID1) control parameter set 1. See section *PID control* on page *151*.	
4001	GAIN	Defines the gain for the process PID controller. High gain may cause speed oscillation.	1.0
	0.1…100.0	Gain. When value is set to 0.1, the PID controller output changes one-tenth as much as the error value. When value is set to 100, the PID controller output changes one hundred times as much as the error value.	1 = 0.1
4002	INTEGRATION TIME	Defines the integration time for the process PID1 controller. The integration time defines the rate at which the controller output changes when the error value is constant. The shorter the integration time, the faster the continuous error value is corrected. Too short an integration time makes the control unstable. A = Error B = Error value step C = Controller output with gain = 1 D = Controller output with gain = 10 	10.0 s
	0.0 = NOT SEL 0.1…3600.0 s	Integration time. If parameter value is set to zero, integration (I-part of the PID controller) is disabled.	1 = 0.1 s

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
4003	DERIVATION TIME	Defines the derivation time for the process PID controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted during the change. If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The derivation makes the control more responsive for disturbances. The derivative is filtered with a 1-pole filter. Filter time constant is defined by parameter *4004 PID DERIV FILTER*. 	0.0 s
	0.0…10.0 s	Derivation time. If parameter value is set to zero, the derivative part of the PID controller is disabled.	1 = 0.1 s
4004	PID DERIV FILTER	Defines the filter time constant for the derivative part of the process PID controller. Increasing the filter time smooths the derivative and reduces noise.	1.0 s
	0.0…10.0 s	Filter time constant. If parameter value is set to zero, the derivative filter is disabled.	1 = 0.1 s
4005	ERROR VALUE INV	Selects the relationship between the feedback signal and drive speed.	*NO*
	NO	Normal: A decrease in feedback signal increases drive speed. Error = Reference - Feedback	0
	YES	Inverted: A decrease in feedback signal decreases drive speed. Error = Feedback - Reference	1
4006	UNITS	Selects the unit for PID controller actual values.	%
	0…127	See parameter *3405 OUTPUT1 UNIT* selections in the given range.	

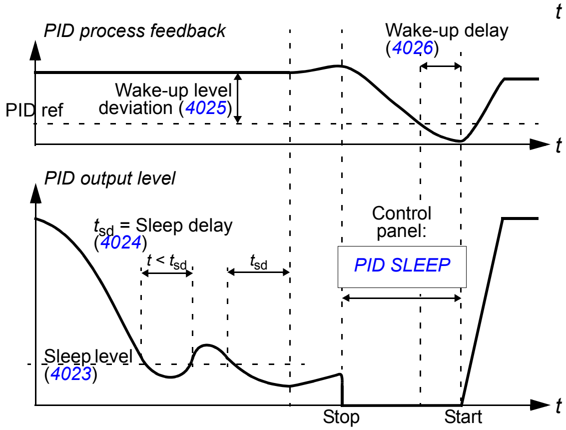
<table>
<tr><th colspan="4">All parameters</th></tr>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq</th></tr>
<tr><td>4007</td><td>UNIT SCALE</td><td>Defines the decimal point location for PID controller actual values.</td><td>1</td></tr>
<tr><td></td><td>0…4</td><td>Example: PI (3.141593)
<table>
<tr><th>4007 value</th><th>Entry</th><th>Display</th></tr>
<tr><td>0</td><td>00003</td><td>3</td></tr>
<tr><td>1</td><td>00031</td><td>3.1</td></tr>
<tr><td>2</td><td>00314</td><td>3.14</td></tr>
<tr><td>3</td><td>03142</td><td>3.142</td></tr>
<tr><td>4</td><td>31416</td><td>3.1416</td></tr>
</table></td><td>1 = 1</td></tr>
<tr><td>4008</td><td>0% VALUE</td><td>Defines together with parameter 4009 100% VALUE the scaling applied to the PID controller’s actual values.

</td><td>0.0</td></tr>
<tr><td></td><td>x…x</td><td>Unit and range depend on the unit and scale defined by parameters 4006 UNITS and 4007 UNIT SCALE.</td><td></td></tr>
<tr><td>4009</td><td>100% VALUE</td><td>Defines together with parameter 4008 0% VALUE the scaling applied to the PID controller’s actual values.</td><td>100.0</td></tr>
<tr><td></td><td>x…x</td><td>Unit and range depend on the unit and scale defined by parameters 4006 UNITS and 4007 UNIT SCALE.</td><td></td></tr>
<tr><td>4010</td><td>SET POINT SEL</td><td>Selects the source for the process PID controller reference signal.</td><td>INTERNAL</td></tr>
<tr><td></td><td>KEYPAD</td><td>Control panel</td><td>0</td></tr>
<tr><td></td><td>AI1</td><td>Analog input AI1</td><td>1</td></tr>
<tr><td></td><td>AI2</td><td>Analog input AI2</td><td>2</td></tr>
<tr><td></td><td>COMM</td><td>Fieldbus reference REF2</td><td>8</td></tr>
<tr><td></td><td>COMM+AI1</td><td>Summation of fieldbus reference REF2 and analog input AI1. See section Reference selection and correction on page 320.</td><td>9</td></tr>
<tr><td></td><td>COMM*AI1</td><td>Multiplication of fieldbus reference REF2 and analog input AI1. See section Reference selection and correction on page 320.</td><td>10</td></tr>
</table>

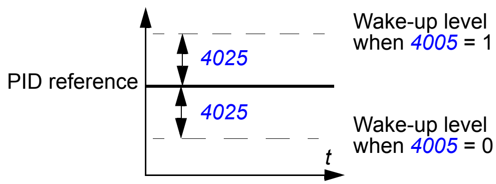
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	DI3U,4D(RNC)	Digital input DI3: Reference increase. Digital input DI4: Reference decrease. Stop command resets the reference to zero. The reference is not saved if the control source is changed from EXT1 to EXT2, from EXT2 to EXT1 or from LOC to REM.	11
	DI3U,4D(NC)	Digital input DI3: Reference increase. Digital input DI4: Reference decrease. The program stores the active reference (not reset by a stop command). The reference is not saved if the control source is changed from EXT1 to EXT2, from EXT2 to EXT1 or from LOC to REM.	12
	AI1+AI2	Reference is calculated with the following equation: REF = AI1(%) + AI2(%) - 50%	14
	AI1*AI2	Reference is calculated with the following equation: REF = AI1(%) · (AI2(%) / 50%)	15
	AI1-AI2	Reference is calculated with the following equation: REF = AI1(%) + 50% - AI2(%)	16
	AI1/AI2	Reference is calculated with the following equation: REF = AI1(%) · (50% / AI2 (%))	17
	INTERNAL	A constant value defined by parameter *4011 INTERNAL SETPNT*.	19
	DI4U,5D(NC)	See selection *DI3U,4D(NC)*.	31
	FREQ INPUT	Frequency input	32
	SEQ PROG OUT	Sequence programming output. See parameter group *84 SEQUENCE PROG*.	33
4011	INTERNAL SETPNT	Selects a constant value as process PID controller reference, when parameter *4010 SET POINT SEL* value is set to *INTERNAL*.	40
	x…x	Unit and range depend on the unit and scale defined by parameters *4006 UNITS* and *4007 UNIT SCALE*.	

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
4012	SETPOINT MIN	Defines the minimum value for the selected PID reference signal source. See parameter *4010 SET POINT SEL*.	0.0%
	-500.0…500.0%	Value as a percentage. **Example:** Analog input AI1 is selected as the PID reference source (value of parameter *4010* is *AI1*). The reference minimum and maximum correspond to the *1301 MINIMUM AI1* and *1302 MAXIMUM AI1* settings as follows: 	1 = 0.1%
4013	SETPOINT MAX	Defines the maximum value for the selected PID reference signal source. See parameters *4010 SET POINT SEL* and *4012 SETPOINT MIN*.	100.0%
	-500.0…500.0%	Value as a percentage	1 = 0.1%
4014	FBK SEL	Selects the process actual value (feedback signal) for the process PID controller: The sources for the variables ACT1 and ACT2 are further defined by parameters *4016 ACT1 INPUT* and *4017 ACT2 INPUT*.	*ACT1*
	ACT1	ACT1	1
	ACT1-ACT2	Subtraction of ACT1 and ACT2	2
	ACT1+ACT2	Addition of ACT1 and ACT2	3
	ACT1*ACT2	Multiplication of ACT1 and ACT2	4
	ACT1/ACT2	Division of ACT1 and ACT2	5
	MIN(ACT1,2)	Selects the smaller of ACT1 and ACT2	6
	MAX(ACT1,2)	Selects the higher of ACT1 and ACT2	7
	sqrt(ACT1-2)	Square root of the subtraction of ACT1 and ACT2	8
	sqA1+sqA2	Addition of the square root of ACT1 and the square root of ACT2	9
	sqrt(ACT1)	Square root of ACT1	10
	COMM FBK 1	Signal *0158 PID COMM VALUE 1* value	11
	COMM FBK 2	Signal *0159 PID COMM VALUE 2* value	12

<table>
<tr><th colspan="4">All parameters</th></tr>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq</th></tr>
<tr><td>4015</td><td>FBK MULTIPLIER</td><td>Defines an extra multiplier for the value defined by parameter 4014 FBK SEL. Parameter is used mainly in applications where feedback value is calculated from another variable (eg, flow from pressure difference).</td><td>0.000</td></tr>
<tr><td></td><td>-32.768…
32.767</td><td>Multiplier. If parameter value is set to zero, no multiplier is used.</td><td>1 = 0.001</td></tr>
<tr><td>4016</td><td>ACT1 INPUT</td><td>Defines the source for actual value 1 (ACT1). See also parameter 4018 ACT1 MINIMUM.</td><td>AI2</td></tr>
<tr><td></td><td>AI1</td><td>Uses analog input 1 for ACT1</td><td>1</td></tr>
<tr><td></td><td>AI2</td><td>Uses analog input 2 for ACT1</td><td>2</td></tr>
<tr><td></td><td>CURRENT</td><td>Uses current for ACT1</td><td>3</td></tr>
<tr><td></td><td>TORQUE</td><td>Uses torque for ACT1</td><td>4</td></tr>
<tr><td></td><td>POWER</td><td>Uses power for ACT1</td><td>5</td></tr>
<tr><td></td><td>COMM ACT 1</td><td>Uses value of signal 0158 PID COMM VALUE 1 for ACT1</td><td>6</td></tr>
<tr><td></td><td>COMM ACT 2</td><td>Uses value of signal 0159 PID COMM VALUE 2 for ACT1</td><td>7</td></tr>
<tr><td></td><td>FREQ INPUT</td><td>Frequency input</td><td>8</td></tr>
<tr><td>4017</td><td>ACT2 INPUT</td><td>Defines the source for actual value ACT2. See also parameter 4020 ACT2 MINIMUM.</td><td>AI2</td></tr>
<tr><td></td><td></td><td>See parameter 4016 ACT1 INPUT.</td><td></td></tr>
<tr><td>4018</td><td>ACT1 MINIMUM</td><td>Sets the minimum value for ACT1.
Scales the source signal used as the actual value ACT1 (defined by parameter 4016 ACT1 INPUT). For parameter 4016 values 6 (COMM ACT 1) and 7 (COMM ACT 2) scaling is not done.
<table>
<tr><th>Par 4016</th><th>Source</th><th>Source min.</th><th>Source max.</th></tr>
<tr><td>1</td><td>Analog input 1</td><td>1301 MINIMUM AI1</td><td>1302 MAXIMUM AI1</td></tr>
<tr><td>2</td><td>Analog input 2</td><td>1304 MINIMUM AI2</td><td>1305 MAXIMUM AI2</td></tr>
<tr><td>3</td><td>Current</td><td>0</td><td>2 · nominal current</td></tr>
<tr><td>4</td><td>Torque</td><td>-2 · nominal torque</td><td>2 · nominal torque</td></tr>
<tr><td>5</td><td>Power</td><td>-2 · nominal power</td><td>2 · nominal power</td></tr>
</table>
A = Normal; B = Inversion (ACT1 minimum > ACT1 maximum)

</td><td>0%</td></tr>
<tr><td></td><td>-1000…1000%</td><td>Value as a percentage</td><td>1 = 1%</td></tr>
</table>

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
4019	ACT1 MAXIMUM	Defines the maximum value for variable ACT1 if an analog input is selected as a source for ACT1. See parameter *4016 ACT1 INPUT*. The minimum (*4018 ACT1 MINIMUM*) and maximum settings of ACT1 define how the voltage/current signal received from the measuring device is converted to a percentage value used by the process PID controller. See parameter *4018 ACT1 MINIMUM*.	100%
	-1000…1000%	Value as a percentage	1 = 1%
4020	ACT2 MINIMUM	See parameter *4018 ACT1 MINIMUM*.	0%
	-1000…1000%	See parameter *4018*.	1 = 1%
4021	ACT2 MAXIMUM	See parameter *4019 ACT1 MAXIMUM*.	100%
	-1000…1000%	See parameter *4019*.	1 = 1%
4022	SLEEP SELECTION	Activates the sleep function and selects the source for the activation input. See section *Sleep function for the process PID (PID1) control* on page *155*.	*NOT SEL*
	NOT SEL	No sleep function selected	0
	DI1	The function is activated/deactivated through digital input DI1.1 = activation, 0 = deactivation. The internal sleep criteria set by parameters *4023 PID SLEEP LEVEL* and *4025 WAKE-UP DEV* are not effective. The sleep start and stop delay parameters *4024 PID SLEEP DELAY* and *4026 WAKE-UP DELAY* are effective.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	INTERNAL	Activated and deactivated automatically as defined by parameters *4023 PID SLEEP LEVEL* and *4025 WAKE-UP DEV*.	7
	DI1(INV)	The function is activated/deactivated through inverted digital input DI1. 1 = deactivation, 0 = activation. The internal sleep criteria set by parameters *4023 PID SLEEP LEVEL* and *4025 WAKE-UP DEV* are not effective. The sleep start and stop delay parameters *4024 PID SLEEP DELAY* and *4026 WAKE-UP DELAY* are effective.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
4023	PID SLEEP LEVEL	Defines the start limit for the sleep function. If the motor speed is below a set level (*4023*) longer than the sleep delay (*4024*), the drive shifts to the sleeping mode: The motor is stopped and the control panel shows alarm message *PID SLEEP* (*2018*). Parameter *4022 SLEEP SELECTION* must be set to *INTERNAL*. 	0.0 Hz / 0 rpm
	0.0…599.0 Hz / 0…30000 rpm	Sleep start level	1 = 0.1 Hz 1 rpm
4024	PID SLEEP DELAY	Defines the delay for the sleep start function. See parameter *4023 PID SLEEP LEVEL*. When the motor speed falls below the sleep level, the counter starts. When the motor speed exceeds the sleep level, the counter is reset.	60.0 s
	0.0…3600.0 s	Sleep start delay	1 = 0.1 s

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
4025	WAKE-UP DEV	Defines the wake-up deviation for the sleep function. The drive wakes up if the process actual value deviation from the PID reference value exceeds the set wake-up deviation (*4025*) longer than the wake-up delay (*4026*). Wake-up level depends on parameter *4005 ERROR VALUE INV* settings. If parameter *4005* is set to 0: Wake-up level = PID reference (*4010*) - Wake-up deviation (*4025*). If parameter *4005* is set to 1: Wake-up level = PID reference (*4010*) + Wake-up deviation (*4025*)  See also figures for parameter *4023 PID SLEEP LEVEL*.	0
	x…x	Unit and range depend on the unit and scale defined by parameters *4026 WAKE-UP DELAY* and *4007 UNIT SCALE*.	
4026	WAKE-UP DELAY	Defines the wake-up delay for the sleep function. See parameter *4023 PID SLEEP LEVEL*.	0.50 s
	0.00…60.00 s	Wake-up delay	1 = 0.01 s
4027	PID 1 PARAM SET	Defines the source from which the drive reads the signal that selects between PID parameter set 1 and 2. PID parameter set 1 is defined by parameters *4001*…*4026*. PID parameter set 2 is defined by parameters *4101*…*4126*.	*SET 1*
	SET 1	PID SET 1 is active.	0
	DI1	Digital input DI1. 1 = PID SET 2, 0 = PID SET 1.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	SET 2	PID SET 2 is active.	7
	TIMED FUNC 1	Timed PID SET 1/2 control. Timed function 1 inactive = PID SET 1, timed function 1 active = PID SET 2. See parameter group *36 TIMED FUNCTIONS*.	8
	TIMED FUNC 2	See selection *TIMED FUNC 1*.	9
	TIMED FUNC 3	See selection *TIMED FUNC 1*.	10
	TIMED FUNC 4	See selection *TIMED FUNC 1*.	11

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	DI1(INV)	Inverted digital input DI1. 0 = PID SET 2, 1 = PID SET 1.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
41	**PROCESS PID SET 2**	Process PID (PID1) control parameter set 2. See section *PID control* on page *151*.	
4101	GAIN	See parameter *4001 GAIN*.	
4102	INTEGRATION TIME	See parameter *4002 INTEGRATION TIME*.	
4103	DERIVATION TIME	See parameter *4003 DERIVATION TIME*.	
4104	PID DERIV FILTER	See parameter *4004 PID DERIV FILTER*.	
4105	ERROR VALUE INV	See parameter *4005 ERROR VALUE INV*.	
4106	UNITS	See parameter *4006 UNITS*.	
4107	UNIT SCALE	See parameter *4007 UNIT SCALE*.	
4108	0% VALUE	See parameter *4008 0% VALUE*.	
4109	100% VALUE	See parameter *4009 100% VALUE*.	
4110	SET POINT SEL	See parameter *4010 SET POINT SEL*.	
4111	INTERNAL SETPNT	See parameter *4011 INTERNAL SETPNT*.	
4112	SETPOINT MIN	See parameter *4012 SETPOINT MIN*.	
4113	SETPOINT MAX	See parameter *4013 SETPOINT MAX*.	
4114	FBK SEL	See parameter *4014 FBK SEL*.	
4115	FBK MULTIPLIER	See parameter *4015 FBK MULTIPLIER*.	
4116	ACT1 INPUT	See parameter *4016 ACT1 INPUT*.	
4117	ACT2 INPUT	See parameter *4017 ACT2 INPUT*.	
4118	ACT1 MINIMUM	See parameter *4018 ACT1 MINIMUM*.	
4119	ACT1 MAXIMUM	See parameter *4019 ACT1 MAXIMUM*.	
4120	ACT2 MINIMUM	See parameter *4020 ACT2 MINIMUM*.	
4121	ACT2 MAXIMUM	See parameter *4021 ACT2 MAXIMUM*.	

All parameters		
No. Name/Value	**Description**	**Def/FbEq**
4122 SLEEP SELECTION	See parameter *4022 SLEEP SELECTION*.	
4123 PID SLEEP LEVEL	See parameter *4023 PID SLEEP LEVEL*.	
4124 PID SLEEP DELAY	See parameter *4024 PID SLEEP DELAY*.	
4125 WAKE-UP DEV	See parameter *4025 WAKE-UP DEV*.	
4126 WAKE-UP DELAY	See parameter *4026 WAKE-UP DELAY*.	
42 EXT / TRIM PID	External/Trim PID (PID2) control. See section *PID control* on page *151*.	
4201 GAIN	See parameter *4001 GAIN*.	
4202 INTEGRATION TIME	See parameter *4002 INTEGRATION TIME*.	
4203 DERIVATION TIME	See parameter *4003 DERIVATION TIME*.	
4204 PID DERIV FILTER	See parameter *4004 PID DERIV FILTER*.	
4205 ERROR VALUE INV	See parameter *4005 ERROR VALUE INV*.	
4206 UNITS	See parameter *4006 UNITS*.	
4207 UNIT SCALE	See parameter *4007 UNIT SCALE*.	
4208 0% VALUE	See parameter *4008 0% VALUE*.	
4209 100% VALUE	See parameter *4009 100% VALUE*.	
4210 SET POINT SEL	See parameter *4010 SET POINT SEL*.	
4211 INTERNAL SETPNT	See parameter *4011 INTERNAL SETPNT*.	
4212 SETPOINT MIN	See parameter *4012 SETPOINT MIN*.	
4213 SETPOINT MAX	See parameter *4013 SETPOINT MAX*.	
4214 FBK SEL	See parameter *4014 FBK SEL*.	
4215 FBK MULTIPLIER	See parameter *4015 FBK MULTIPLIER*.	
4216 ACT1 INPUT	See parameter *4016 ACT1 INPUT*.	
4217 ACT2 INPUT	See parameter *4017 ACT2 INPUT*.	
4218 ACT1 MINIMUM	See parameter *4018 ACT1 MINIMUM*.	
4219 ACT1 MAXIMUM	See parameter *4019 ACT1 MAXIMUM*.	
4220 ACT2 MINIMUM	See parameter *4020 ACT2 MINIMUM*.	

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
4221	ACT2 MAXIMUM	See parameter *4021 ACT2 MAXIMUM*.	
4228	ACTIVATE	Selects the source for the external PID function activation signal. Parameter *4230 TRIM MODE* must be set to *NOT SEL*.	*NOT SEL*
	NOT SEL	No external PID control activation selected	0
	DI1	Digital input DI1. 1 = active, 0 = inactive.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	DRIVE RUN	Activation at drive start. Start (drive running) = active.	7
	ON	Activation at drive power-up. Power-up (drive powered) = active.	8
	TIMED FUNC 1	Activation by a timed function. Timed function 1 active = PID control active. See parameter group *36 TIMED FUNCTIONS*.	9
	TIMED FUNC 2	See selection *TIMED FUNC 1*.	10
	TIMED FUNC 3	See selection *TIMED FUNC 1*.	11
	TIMED FUNC 4	See selection *TIMED FUNC 1*.	12
	DI1(INV)	Inverted digital input DI1. 0 = active, 1 = inactive.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
4229	OFFSET	Defines the offset for the external PID controller output. When PID controller is activated, controller output starts from the offset value. When PID controller is deactivated, controller output is reset to the offset value. Parameter *4230 TRIM MODE* must be set to *NOT SEL*.	0.0%
	0.0…100.0%	Value as a percentage	1 = 0.1%
4230	TRIM MODE	Activates the trim function and selects between the direct and proportional trimming. With trimming it is possible to combine a corrective factor to the drive reference. See section *Reference trimming* on page *130*.	*NOT SEL*
	NOT SEL	No trim function selected	0
	PROPORTIONAL	Active. The trimming factor is proportional to the rpm/Hz reference before trimming (REF1).	1
	DIRECT	Active. The trimming factor is relative to a fixed maximum limit used in the reference control loop (maximum speed, frequency or torque).	2

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
4231	TRIM SCALE	Defines the multiplier for the trimming function. See section *Reference trimming* on page *130*.	0.0%
	-100.0…100.0%	Multiplier	1 = 0.1%
4232	CORRECTION SRC	Selects the trim reference. See section *Reference trimming* on page *130*.	*PID2REF*
	PID2REF	PID2 reference selected by parameter *4210* (ie, signal *0129 PID 2 SETPNT* value)	1
	PID2OUTPUT	PID2 output, ie, signal *0127 PID 2 OUTPUT* value	2
4233	TRIM SELECTION	Selects whether the trimming is used for correcting the speed or torque reference. See section *Reference trimming* on page *130*.	*SPEED/FREQ*
	SPEED/FREQ	Speed reference trimming	0
	TORQUE	Torque reference trimming (only for REF2 (%))	1
43 MECH BRK CONTROL		Control of a mechanical brake. See section *Control of a mechanical brake* on page *159*.	
4301	BRAKE OPEN DLY	Defines the brake open delay (= the delay between the internal open brake command and the release of the motor speed control). The delay counter starts when the motor current/torque/speed has risen to the level required at brake release (parameter *4302 BRAKE OPEN LVL* or *4304 FORCED OPEN LVL*) and the motor has been magnetized. Simultaneously with the start of the counter, the brake function energizes the relay output controlling the brake and the brake starts opening.	0.20 s
	0.00…2.50 s	Delay time	1 = 0.01 s
4302	BRAKE OPEN LVL	Defines the motor starting torque/current at brake release. After start the drive current/torque is frozen to the set value, until the motor is magnetized.	100%
	0.0…180.0%	Value as a percentage of the nominal torque T_N (in vector control) or the nominal current I_{2N} (in scalar control). The control mode is selected by parameter *9904 MOTOR CTRL MODE*.	1 = 0.1%
4303	BRAKE CLOSE LVL	Defines the brake close speed. After stop the brake is closed when drive speed falls below the set value.	4.0%
	0.0…100.0%	Value as a percentage of the nominal speed (in vector control) or the nominal frequency (in scalar control). The control mode is selected by parameter *9904 MOTOR CTRL MODE*.	1 = 0.1%

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
4304	FORCED OPEN LVL	Defines the speed at brake release. Parameter setting overrides parameter *4302 BRAKE OPEN LVL* setting. After start, the drive speed is frozen to the set value, until the motor is magnetized. The purpose of this parameter is to generate enough start torque to prevent the motor rotating into the wrong direction because of the motor load.	*0.0 = NOT SEL*
	0.0 = NOT SEL 0.0…100.0%	Value as a percentage of the maximum frequency (in scalar control) or the maximum speed (in vector control). If parameter value is set to zero, the function is disabled. The control mode is selected by parameter *9904 MOTOR CTRL MODE*.	1 = 0.1%
4305	BRAKE MAGN DELAY	Defines motor magnetizing time. After start drive current/torque/speed is frozen to the value defined by parameter *4302 BRAKE OPEN LVL* or *4304 FORCED OPEN LVL* for the set time.	*0 = NOT SEL*
	0 = NOT SEL 0…10000 ms	magnetizing time. If parameter value is set to zero, the function is disabled.	1 = 1 ms
4306	RUNTIME FREQ LVL	Defines the brake close speed. When frequency falls below the set level during run, the brake is closed. The brake is re-opened when the requirements set by parameters *4301*…*4305* are met.	*0.0 = NOT SEL*
	0.0 = NOT SEL 0.0…100.0%	Value as a percentage of the maximum frequency (in scalar control) or the maximum speed (in vector control). If parameter value is set to zero, the function is disabled. The control mode is selected by parameter *9904 MOTOR CTRL MODE*.	1 = 0.1%
4307	BRK OPEN LVL SEL	Selects the torque (in vector control) or current (in scalar control) applied at brake release.	*PAR 4302*
	PAR 4302	Value of parameter *4302 BRAKE OPEN LVL* used.	1
	MEMORY	Torque value (in vector control) or current value (in scalar control) saved in parameter *0179 BRAKE TORQ MEM* used. Useful in applications where initial torque is needed to prevent unintended movement when the mechanical brake is released.	2
50 ENCODER		Encoder connection. For more information, see *MTAC-01 pulse encoder interface module user's manual* (3AFE68591091 [English]).	
5001	PULSE NR	States the number of encoder pulses per one revolution.	1024 ppr
	32…16384 ppr	Pulse number in pulses per round (ppr)	1 = 1 ppr

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
5002	ENCODER ENABLE	Enables the encoder.	*DISABLE*
	DISABLE	Disabled	0
	ENABLE	Enabled	1
5003	ENCODER FAULT	Defines the operation of the drive if a failure is detected in communication between the pulse encoder and the pulse encoder interface module, or between the module and the drive.	*FAULT*
	FAULT	The drive trips on fault *ENCODER ERR* (*0023*).	1
	ALARM	The drive generates alarm *ENCODER ERROR* (*2024*).	2
5010	Z PLS ENABLE	Enables the encoder zero (Z) pulse. Zero pulse is used for position reset.	*DISABLE*
	DISABLE	Disabled	0
	ENABLE	Enabled	1
5011	POSITION RESET	Enables the position reset.	*DISABLE*
	DISABLE	Disabled	0
	ENABLE	Enabled	1
51 EXT COMM MODULE		The parameters need to be adjusted only when a fieldbus adapter module (optional) is installed and activated by parameter *9802 COMM PROT SEL*. For more details on the parameters, refer to the manual of the fieldbus module and chapter *Fieldbus control with fieldbus adapter* on page *339*. These parameter settings will remain the same even though the macro is changed. **Note:** In adapter module the parameter group number is 1.	
5101	FBA TYPE	Displays the type of the connected fieldbus adapter module.	
	NOT_DEFINED	Fieldbus module is not found, or it is not properly connected, or parameter *9802 COMM PROT SEL* setting is not *EXT FBA*.	0
	PROFIBUS_DP	FPBA-01 PROFIBUS DP adapter module, FPBA-01-M PROFIBUS DP adapter module	1
	LONWORKS	FLON-01 LONWORKS® adapter module	21
	CANOPEN	FCAN-01 CANopen adapter module, FCAN-01-M CANopen adapter module	32
	DEVICENET	FDNA-01 DeviceNet adapter module	37
	CONTROLNET	FCNA-01 ControlNet adapter module	101
	ETHERNET	FENA-01/-11/-21 Ethernet adapter module	128
	ETHERCAT	FECA-01 EtherCAT adapter module	135
	ETHERN_POWERLINK	FEPL-02 Ethernet POWERLINK adapter module	136

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	RS-485	FSCA-01 RS-485 adapter module	485
5102	FB PAR 2	These parameters are adapter module-specific. For more information, see the module manual. Note that not all of these parameters are necessarily visible.	
…	…		
5126	FB PAR 26		
5127	FBA PAR REFRESH	Validates any changed adapter module configuration parameter settings. After refreshing, the value reverts automatically to *DONE*.	
	DONE	Refreshing done	0
	REFRESH	Refreshing	1
5128	FILE CPI FW REV	Displays the parameter table revision of the fieldbus adapter module mapping file stored in the memory of the drive. Format is xyz where: • x = major revision number • y = minor revision number • x = correction letter.	
	0000…FFFF hex	Parameter table revision	1 = 1
5129	FILE CONFIG ID	Displays the drive type code of the fieldbus adapter module mapping file stored in the memory of the drive.	
	0000…FFFF hex	Drive type code of fieldbus adapter module mapping file	1 = 1
5130	FILE CONFIG REV	Displays the fieldbus adapter module mapping file revision stored in the memory of the drive in decimal format. **Example:** 1 = revision 1.	
	0000…FFFF hex	Mapping file revision	1 = 1
5131	FBA STATUS	Displays the status of the fieldbus adapter module communication.	
	IDLE	Adapter is not configured.	0
	EXECUT INIT	Adapter is initializing.	1
	TIME OUT	A time-out has occurred in the communication between the adapter and the drive.	2
	CONFIG ERROR	Adapter configuration error: The major or minor revision code of the common program revision in the fieldbus adapter module is not the revision required by the module (see parameter *5132 FBA CPI FW REV*) or mapping file upload has failed more than three times.	3
	OFF-LINE	Adapter is off-line.	4
	ON-LINE	Adapter is on-line.	5
	RESET	Adapter is performing a hardware reset.	6

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
5132	FBA CPI FW REV	Displays the common program revision of the adapter module in format axyz, where: • a = major revision number • xy = minor revision numbers • z = correction letter. **Example:** 190A = revision 1.90A	
		Common program revision of the adapter module	1 = 1
5133	FBA APPL FW REV	Displays the application program revision of the adapter module in format axyz, where: • a = major revision number • xy = minor revision numbers • z = correction letter. **Example:** 190A = revision 1.90A	
		Application program revision of the adapter module	1 = 1
52 PANEL COMM		Communication settings for the control panel port on the drive	
5201	STATION ID	Defines the address of the drive. Two units with the same address are not allowed on-line.	1
	1…247	Address	1 = 1
5202	BAUD RATE	Defines the transfer rate of the link.	*9.6 kb/s*
	1.2 kb/s	1.2 kbit/s	1 = 0.1 kbit/s
	2.4 kb/s	2.4 kbit/s	
	4.8 kb/s	4.8 kbit/s	
	9.6 kb/s	9.6 kbit/s	
	19.2 kb/s	19.2 kbit/s	
	38.4 kb/s	38.4 kbit/s	
	57.6 kb/s	57.6 kbit/s	
	115.2 kb/s	115.2 kbit/s	
5203	PARITY	Defines the use of parity and stop bit(s). The same setting must be used in all on-line stations.	*8 NONE 1*
	8 NONE 1	8 data bits, no parity bit, one stop bit	0
	8 NONE 2	8 data bits, no parity bit, two stop bits	1
	8 EVEN 1	8 data bits, even parity indication bit, one stop bit	2
	8 ODD 1	8 data bits, odd parity indication bit, one stop bit	3
5204	OK MESSAGES	Number of valid messages received by the drive. During normal operation, this number increases constantly.	0
	0…65535	Number of messages	1 = 1

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
5205	PARITY ERRORS	Number of characters with a parity error received from the Modbus link. If the number is high, check that the parity settings of the devices connected on the bus are the same. **Note:** High electromagnetic noise levels generate errors.	0
	0…65535	Number of characters	1 = 1
5206	FRAME ERRORS	Number of characters with a framing error received by the Modbus link. If the number is high, check that the communication speed settings of the devices connected on the bus are the same. **Note:** High electromagnetic noise levels generate errors.	0
	0…65535	Number of characters	1 = 1
5207	BUFFER OVERRUNS	Number of characters which overflow the buffer, ie, number of characters which exceed the maximum message length, 128 bytes.	0
	0…65535	Number of characters	1 = 1
5208	CRC ERRORS	Number of messages with an CRC (cyclic redundancy check) error received by the drive. If the number is high, check CRC calculation for possible errors. **Note:** High electromagnetic noise levels generate errors.	0
	0…65535	Number of messages	1 = 1
53 EFB PROTOCOL		Embedded fieldbus link settings. See chapter *Fieldbus control with embedded fieldbus* on page *313*.	
5302	EFB STATION ID	Defines the address of the device. Two units with the same address are not allowed on-line.	1
	0…247	Address	1 = 1
5303	EFB BAUD RATE	Defines the transfer rate of the link.	*9.6 kb/s*
	1.2 kb/s	1.2 kbit/s	1 = 0.1 kbit/s
	2.4 kb/s	2.4 kbit/s	
	4.8 kb/s	4.8 kbit/s	
	9.6 kb/s	9.6 kbit/s	
	19.2 kb/s	19.2 kbit/s	
	38.4 kb/s	38.4 kbit/s	
	57.6 kb/s	57.6 kbit/s	
	115.2 kb/s	115.2 kbit/s	
5304	EFB PARITY	Defines the use of parity and stop bit(s) and the data length. The same setting must be used in all on-line stations.	*8 NONE 1*
	8 NONE 1	No parity bit, one stop bit, 8 data bits	0
	8 NONE 2	No parity bit, two stop bits, 8 data bits	1

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	8 EVEN 1	Even parity indication bit, one stop bit, 8 data bits	2
	8 ODD 1	Odd parity indication bit, one stop bit, 8 data bits	3
5305	EFB CTRL PROFILE	Selects the communication profile. See section *Communication profiles* on page *328*.	*ABB DRV LIM*
	ABB DRV LIM	ABB drives limited profile	0
	DCU PROFILE	DCU profile	1
	ABB DRV FULL	ABB drives profile	2
5306	EFB OK MESSAGES	Number of valid messages received by the drive. During normal operation, this number increases constantly.	0
	0…65535	Number of messages	1 = 1
5307	EFB CRC ERRORS	Number of messages with an CRC (cyclic redundancy check) error received by the drive. If the number is high, check CRC calculation for possible errors. **Note:** High electromagnetic noise levels generate errors.	0
	0…65535	Number of messages	1 = 1
5310	EFB PAR 10	Selects an actual value to be mapped to Modbus register 40005.	103
	0…65535	Parameter index	1 = 1
5311	EFB PAR 11	Selects an actual value to be mapped to Modbus register 40006.	104
	0…65535	Parameter index	1 = 1
5312	EFB PAR 12	Selects an actual value to be mapped to Modbus register 40007.	0
	0…65535	Parameter index	1 = 1
5313	EFB PAR 13	Selects an actual value to be mapped to Modbus register 40008.	0
	0…65535	Parameter index	1 = 1
5314	EFB PAR 14	Selects an actual value to be mapped to Modbus register 40009.	0
	0…65535	Parameter index	1 = 1
5315	EFB PAR 15	Selects an actual value to be mapped to Modbus register 40010.	0
	0…65535	Parameter index	1 = 1
5316	EFB PAR 16	Selects an actual value to be mapped to Modbus register 40011.	0
	0…65535	Parameter index	1 = 1
5317	EFB PAR 17	Selects an actual value to be mapped to Modbus register 40012.	0
	0…65535	Parameter index	1 = 1

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
5318	EFB PAR 18	For Modbus: Sets an additional delay before the drive begins transmitting response to the master request.	0
	0…65535	Delay in milliseconds	1 = 1
5319	EFB PAR 19	ABB drives profile (*ABB DRV LIM* or *ABB DRV FULL*) Control word.	0000 hex
	0000…FFFF hex	Control word	
5320	EFB PAR 20	ABB drives profile (*ABB DRV LIM* or *ABB DRV FULL*) Status word.	0000 hex
	0000…FFFF hex	Status word	
54 FBA DATA IN		Data from the drive to the fieldbus controller through a fieldbus adapter. See chapter *Fieldbus control with fieldbus adapter* on page *339*. **Note:** In adapter module the parameter group number is 3.	
5401	FBA DATA IN 1	Selects data to be transferred from the drive to the fieldbus controller.	
	0	Not in use	
	1…6	Control and status data words	
	101…9999	Parameter index	
5402	FBA DATA IN 2	See *5401 FBA DATA IN 1*.	
…	…	…	
5410	FBA DATA IN 10	See *5401 FBA DATA IN 1*.	

5401 setting	Data word
1	Control word
2	REF1
3	REF2
4	Status word
5	Actual value 1
6	Actual value 2

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
55 FBA DATA OUT		Data from the fieldbus controller to the drive through a fieldbus adapter. See chapter *Fieldbus control with fieldbus adapter* on page *339*. **Note:** In adapter module the parameter group number is 2.	
5501	FBA DATA OUT 1	Selects data to be transferred from the fieldbus controller to the drive.	
	0	Not in use	
	1…6	Control and status data words <table><tr><th>5501 setting</th><th>Data word</th></tr><tr><td>1</td><td>Control word</td></tr><tr><td>2</td><td>REF1</td></tr><tr><td>3</td><td>REF2</td></tr><tr><td>4</td><td>Status word</td></tr><tr><td>5</td><td>Actual value 1</td></tr><tr><td>6</td><td>Actual value 2</td></tr></table>	
	101…9999	Drive parameter	
5502	FBA DATA OUT 2	See *5501 FBA DATA OUT 1*.	
…	…	…	
5510	FBA DATA OUT 10	See *5501 FBA DATA OUT 1*.	
84 SEQUENCE PROG		Sequence programming. See section *Sequence programming* on page *169*.	
8401	SEQ PROG ENABLE	Enables Sequence programming. If Sequence programming enable signal is lost, the Sequence programming is stopped, Sequence programming state (*0168 SEQ PROG STATE*) is set to 1 and all timers and outputs (RO/TO/AO) are set to zero.	*DISABLED*
	DISABLED	Disabled	0
	EXT2	Enabled in external control location 2 (EXT2)	1
	EXT1	Enabled in external control location 1 (EXT1)	2
	EXT1&EXT2	Enabled in external control locations 1 and 2 (EXT1 and EXT2)	3
	ALWAYS	Enabled in external control locations 1 and 2 (EXT1 and EXT2) and in local control (LOCAL)	4

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
8402	SEQ PROG START	Selects the source for the Sequence programming activation signal. When Sequence programming is activated, the programming starts from the previously used state. If Sequence programming activation signal is lost, the Sequence programming is stopped and all timers and outputs (RO/TO/AO) are set to zero. Sequence programming state (*0168 SEQ PROG STATE*) remains unchanged. If start from the first Sequence programming state is required, the Sequence programming must be reset by parameter *8404 SEQ PROG RESET*. If start from the first Sequence programming state is always required, reset and start signal sources (*8404* and *8402 SEQ PROG START*) must be through the same digital input. **Note**: The drive will not start if no Run enable signal is received (*1601 RUN ENABLE*).	*NOT SEL*
	DI1(INV)	Sequence programming activation through inverted digital input DI1. 0 = active, 1 = inactive.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
	NOT SEL	No Sequence programming activation signal	0
	DI1	Sequence programming activation through digital input DI1. 1 = active, 0 = inactive.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	DRIVE START	Sequence programming activation at drive start	6
	TIMED FUNC 1	Sequence programming is activated by timed function 1. See parameter group *36 TIMED FUNCTIONS*.	7
	TIMED FUNC 2	See selection *TIMED FUNC 1*.	8
	TIMED FUNC 3	See selection *TIMED FUNC 1*.	9
	TIMED FUNC 4	See selection *TIMED FUNC 1*.	10
	RUNNING	Sequence programming is always active.	11

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
8403	SEQ PROG PAUSE	Selects the source for the Sequence programming pause signal. When Sequence programming pause is activated, all timers and outputs (RO/TO/AO) are frozen. Sequence programming state transition is possible only by parameter *8405 SEQ ST FORCE*.	*NOT SEL*
	DI1(INV)	Pause signal through inverted digital input DI1. 0 = active, 1 = inactive.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
	NOT SEL	No pause signal	0
	DI1	Pause signal through digital input DI1. 1 = active, 0 = inactive.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	PAUSED	Sequence programming pause enabled	6
8404	SEQ PROG RESET	Selects the source for the Sequence programming reset signal. Sequence programming state (*0168 SEQ PROG STATE*) is set to the first state and all timers and outputs (RO/TO/AO) are set to zero. Reset is possible only when Sequence programming is stopped.	*NOT SEL*
	DI1(INV)	Reset through inverted digital input DI1. 0 = active, 1 = inactive.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
	NOT SEL	No reset signal	0
	DI1	Reset through digital input DI1. 1 = active, 0 = inactive.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	RESET	Reset. After reset parameter value is automatically set to *NOT SEL*.	6

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
8405	SEQ ST FORCE	Forces the Sequence programming to a selected state. **Note:** State is changed only when Sequence programming is paused by parameter *8403 SEQ PROG PAUSE* and this parameter is set to the selected state.	*STATE 1*
	STATE 1	State is forced to state 1.	1
	STATE 2	State is forced to state 2.	2
	STATE 3	State is forced to state 3.	3
	STATE 4	State is forced to state 4.	4
	STATE 5	State is forced to state 5.	5
	STATE 6	State is forced to state 6.	6
	STATE 7	State is forced to state 7.	7
	STATE 8	State is forced to state 8.	8
8406	SEQ LOGIC VAL 1	Defines the source for the logic value 1. Logic value 1 is compared to logic value 2 as defined by parameter *8407 SEQ LOGIC OPER 1*. Logic operation values are used in state transitions. See parameter *8425 ST1 TRIG TO ST 2* / *8426 ST1 TRIG TO ST N* selection *LOGIC VAL*.	*NOT SEL*
	DI1(INV)	Logic value 1 through inverted digital input DI1	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
	NOT SEL	No logic value	0
	DI1	Logic value 1 through digital input DI1	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	SUPRV1 OVER	Logic value according to supervision parameters *3201…3203*. See parameter group *32 SUPERVISION*.	6
	SUPRV2 OVER	Logic value according to supervision parameters *3204…3206*. See parameter group *32 SUPERVISION*.	7
	SUPRV3 OVER	Logic value according to supervision parameters *3207…3209*. See parameter group *32 SUPERVISION*.	8
	SUPRV1 UNDER	See selection *SUPRV1 OVER*.	9
	SUPRV2 UNDER	See selection *SUPRV2 OVER*.	10

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	SUPRV3 UNDER	See selection *SUPRV3 OVER*.	11
	TIMED FUNC 1	Logic value 1 is activated by timed function 1. See parameter group *36 TIMED FUNCTIONS*. 1 = timed function active.	12
	TIMED FUNC 2	See selection *TIMED FUNC 1*.	13
	TIMED FUNC 3	See selection *TIMED FUNC 1*.	14
	TIMED FUNC 4	See selection *TIMED FUNC 1*.	15
8407	SEQ LOGIC OPER 1	Selects the operation between logic value 1 and 2. Logic operation values are used in state transitions. See parameter *8425 ST1 TRIG TO ST 2* / *8426 ST1 TRIG TO ST N* selection *LOGIC VAL*.	*NOT SEL*
	NOT SEL	Logic value 1 (no logic comparison)	0
	AND	Logic function: AND	1
	OR	Logic function: OR	2
	XOR	Logic function: XOR	3
8408	SEQ LOGIC VAL 2	See parameter *8406 SEQ LOGIC VAL 1*.	*NOT SEL*
		See parameter *8406*.	
8409	SEQ LOGIC OPER 2	Selects the operation between logic value 3 and the result of the first logic operation defined by parameter *8407 SEQ LOGIC OPER 1*.	*NOT SEL*
	NOT SEL	Logic value 2 (no logic comparison)	0
	AND	Logic function: AND	1
	OR	Logic function: OR	2
	XOR	Logic function: XOR	3
8410	SEQ LOGIC VAL 3	See parameter *8406 SEQ LOGIC VAL 1*.	*NOT SEL*
		See parameter *8406*.	
8411	SEQ VAL 1 HIGH	Defines the high limit for the state change when parameter *8425 ST1 TRIG TO ST 2* is set to, eg, *AI 1 HIGH 1*.	0.0%
	0.0…100.0%	Value as a percentage	1 = 0.1%
8412	SEQ VAL 1 LOW	Defines the low limit for the state change when parameter *8425 ST1 TRIG TO ST 2* is set to, eg, *AI 1 LOW 1*.	0.0%
	0.0…100.0%	Value as a percentage	1 = 0.1%
8413	SEQ VAL 2 HIGH	Defines the high limit for the state change when parameter *8425 ST1 TRIG TO ST 2* is set to, eg, *AI 2 HIGH 1*.	0.0%
	0.0…100.0%	Value as a percentage	1 = 0.1%

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
8414	SEQ VAL 2 LOW	Defines the low limit for the state change when parameter *8425 ST1 TRIG TO ST 2* is set to, eg, *AI 2 LOW 1*.	0.0%
	0.0…100.0%	Value as a percentage	1 = 0.1%
8415	CYCLE CNT LOC	Activates the cycle counter for Sequence programming. **Example:** When parameter is set to *ST6 TO NEXT*, the cycle count (*0171 SEQ CYCLE CNTR*) increases every time the state changes from state 6 to state 7.	*NOT SEL*
	NOT SEL	Disabled	0
	ST1 TO NEXT	From state 1 to state 2	1
	ST2 TO NEXT	From state 2 to state 3	2
	ST3 TO NEXT	From state 3 to state 4	3
	ST4 TO NEXT	From state 4 to state 5	4
	ST5 TO NEXT	From state 5 to state 6	5
	ST6 TO NEXT	From state 6 to state 7	6
	ST7 TO NEXT	From state 7 to state 8	7
	ST8 TO NEXT	From state 8 to state 1	8
	ST1 TO N	From state 1 to state n. State n is defined by parameter *8427 ST1 STATE N*.	9
	ST2 TO N	From state 2 to state n. State n is defined by parameter *8427 ST1 STATE N*.	10
	ST3 TO N	From state 3 to state n. State n is defined by parameter *8427 ST1 STATE N*.	11
	ST4 TO N	From state 4 to state n. State n is defined by parameter *8427 ST1 STATE N*.	12
	ST5 TO N	From state 5 to state n. State n is defined by parameter *8427 ST1 STATE N*.	13
	ST6 TO N	From state 6 to state n. State n is defined by parameter *8427 ST1 STATE N*.	14
	ST7 TO N	From state 7 to state n. State n is defined by parameter *8427 ST1 STATE N*.	15
	ST8 TO N	From state 8 to state n. State n is defined by parameter *8427 ST1 STATE N*.	16
8416	CYCLE CNT RST	Selects the source for the cycle counter reset signal (*0171 SEQ CYCLE CNTR*).	*NOT SEL*
	DI1(INV)	Reset through inverted digital input DI1. 0 = active, 1 = inactive.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	NOT SEL	No reset signal	0
	DI1	Reset through digital input DI1. 1 = active, 0 = inactive.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	STATE 1	Reset during state transition to state 1. Counter is reset, when the state has been reached.	6
	STATE 2	Reset during state transition to state 2. Counter is reset, when the state has been reached.	7
	STATE 3	Reset during state transition to state 3. Counter is reset, when the state has been reached.	8
	STATE 4	Reset during state transition to state 4. Counter is reset, when the state has been reached.	9
	STATE 5	Reset during state transition to state 5. Counter is reset, when the state has been reached.	10
	STATE 6	Reset during state transition to state 6. Counter is reset, when the state has been reached.	11
	STATE 7	Reset during state transition to state 7. Counter is reset, when the state has been reached.	12
	STATE 8	Reset during state transition to state 8. Counter is reset, when the state has been reached.	13
	SEQ PROG RST	Reset signal source defined by parameter *8404 SEQ PROG RESET*	14
8420	ST1 REF SEL	Selects the source for the Sequence programming state 1 reference. Parameter is used when parameter *1103 REF1 SELECT* or *1106 REF2 SELECT* is set to *SEQ PROG* / *AI1+SEQ PROG* / *AI2+SEQ PROG*. **Note:** Constant speeds in group *12 CONSTANT SPEEDS* overwrite the selected Sequence programming reference.	0.0%
	COMM	*0136 COMM VALUE 2*. For scaling, see *Fieldbus reference scaling* on page *322*.	-1.3
	AI1/AI2	Reference is calculated with the following equation: REF = AI1(%) · (50% / AI2 (%))	-1.2
	AI1-AI2	Reference is calculated with the following equation: REF = AI1(%) + 50% - AI2(%)	-1.1
	AI1*AI2	Reference is calculated with the following equation: REF = AI1(%) · (AI2(%) / 50%)	-1.0
	AI1+AI2	Reference is calculated with the following equation: REF = AI1(%) + AI2(%) - 50%	-0.9

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	DI4U,5D	Digital input DI4: Reference increase. Digital input DI5: Reference decrease.	-0.8
	DI3U,4D	Digital input DI3: Reference increase. Digital input DI4: Reference decrease.	-0.7
	DI3U,4D(R)	Digital input DI3: Reference increase. Digital input DI4: Reference decrease.	-0.6
	AI2 JOY	Analog input AI2 as joystick. The minimum input signal runs the motor at the maximum reference in the reverse direction, the maximum input at the maximum reference in the forward direction. Minimum and maximum references are defined by parameters *1104 REF1 MIN* and *1105 REF1 MAX*. See parameter *1103 REF1 SELECT* selection *AI1/JOYST* for more information.	-0.5
	AI1 JOY	See selection *AI2 JOY*.	-0.4
	AI2	Analog input AI2	-0.3
	AI1	Analog input AI1	-0.2
	KEYPAD	Control panel	-0.1
	0.0 …100.0%	Constant speed	1 = 0.1%
8421	ST1 COMMANDS	Selects the start, stop and direction for state 1. Parameter *1002 EXT2 COMMANDS* must be set to *SEQ PROG*. **Note:** If change of direction of rotation is required, parameter *1003 DIRECTION* must be set to *REQUEST*.	*DRIVE STOP*
	DRIVE STOP	Drive coast or ramps to stop depending on parameter *2102 STOP FUNCTION* setting.	0
	START FRW	Direction or rotation is fixed to forward. If the drive is not already running, it is started according to parameter *2101 START FUNCTION* settings.	1
	START REV	Direction or rotation is fixed to reverse. If the drive is not already running, it is started according to parameter *2101 START FUNCTION* settings.	2
8422	ST1 RAMP	Selects the acceleration/deceleration ramp time for Sequence programming state 1, ie, defines the rate of the reference change.	0.0 s
	-0.2/-0.1/ 0.0…1800.0 s	Time When value is set to -0.2, ramp pair 2 is used. Ramp pair 2 is defined by parameters *2205*…*2207*. When value is set to -0.1, ramp pair 1 is used. Ramp pair 1 is defined by parameters *2202*…*2204*. With ramp pair 1/2, parameter *2201 ACC/DEC 1/2 SEL* must be set to *SEQ PROG*. See also parameters *2202*…*2207*.	1 = 0.1 s

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
8423	ST1 OUT CONTROL	Selects the relay, transistor and analog output control for Sequence programming state 1. The relay/transistor output control must be activated by setting parameter *1401 RELAY OUTPUT 1* / *1805 DO SIGNAL* to *SEQ PROG*. Analog output control must be activated by parameter group *15 ANALOG OUTPUTS*. Analog output control values can be monitored with signal *0170 SEQ PROG AO VAL*.	*AO=0*
	RO2=RO3 =RO4=1	Relay outputs are energized (closed). Effective only with the MREL-01 option.	-1.5
	RO2=1, RO3=1	Relay outputs are energized (closed). Effective only with the MREL-01 option.	-1.4
	RO4 = 1	Relay output is energized (closed). Effective only with the MREL-01 option.	-1.3
	RO3 = 1	Relay output is energized (closed). Effective only with the MREL-01 option.	-1.2
	RO2 = 1	Relay output is energized (closed). Effective only with the MREL-01 option.	-1.1
	RST CNT NEXT	Reserved for Enhanced Sequence Program (ESP).	-1.0
	RST CNT ENT	Reserved for ESP.	-0.8
	RST CNT STNX	Reserved for ESP.	-0.9
	R=0,D=1,AO=0	Relay output is de-energized (opened), transistor output is energized and analog output is cleared.	-0.7
	R=1,D=0,AO=0	Relay output is energized (closed), transistor output is de-energized and analog output is cleared.	-0.6
	R=0,D=0,AO=0	Relay and transistor outputs are de-energized (opened) and analog output value is set to zero.	-0.5
	RO=0,DO=0	Relay and transistor outputs are de-energized (opened) and analog output control is frozen to the previously set value.	-0.4
	RO=1,DO=1	Relay and transistor outputs are energized (closed) and analog output control is frozen to the previously set value.	-0.3
	DO=1	Transistor output is energized (closed) and relay output is de-energized. Analog output control is frozen to the previously set value.	-0.2
	RO=1	Transistor output is de-energized (opened) and relay output is energized. Analog output control is frozen to the previously set value.	-0.1

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	AO=0	Analog output value is set to zero. Relay and transistor outputs are frozen to the previously set value.	0.0
	0.1…100.0%	Value written to signal *0170 SEQ PROG AO VAL*. Value can be connected to control analog output AO by setting parameter *1501 AO1 CONTENT SEL* value to 170 (ie, signal *0170 SEQ PROG AO VAL*). AO value is frozen to this value until it is zeroed.	
8424	ST1 CHANGE DLY	Defines the delay time for state 1. When delay has elapsed, state transition is allowed. See parameters *8425 ST1 TRIG TO ST 2* and *8426 ST1 TRIG TO ST N*.	0.0 s
	0.0…6553.5 s	Delay time	1 = 0.1 s
8425	ST1 TRIG TO ST 2	Selects the source for the trigger signal which changes the state from state 1 to state 2. **Note:** State change to state N (*8426 ST1 TRIG TO ST N*) has a higher priority than state change to the next state (*8425 ST1 TRIG TO ST 2*).	*NOT SEL*
	DI1(INV)	Trigger through inverted digital input DI1. 0 = active, 1 = inactive.	-1
	DI2(INV)	See selection *DI1(INV)*.	-2
	DI3(INV)	See selection *DI1(INV)*.	-3
	DI4(INV)	See selection *DI1(INV)*.	-4
	DI5(INV)	See selection *DI1(INV)*.	-5
	NOT SEL	No trigger signal. If parameter *8426 ST1 TRIG TO ST N* setting is also *NOT SEL*, the state is frozen and can be reset only with parameter *8402 SEQ PROG START*.	0
	DI1	Trigger through digital input DI1. 1 = active, 0 = inactive.	1
	DI2	See selection *DI1*.	2
	DI3	See selection *DI1*.	3
	DI4	See selection *DI1*.	4
	DI5	See selection *DI1*.	5
	AI 1 LOW 1	State change when AI1 value < par. *8412 SEQ VAL 1 LOW* value.	6
	AI 1 HIGH 1	State change when AI1 value > par. *8411 SEQ VAL 1 HIGH* value.	7
	AI 2 LOW 1	State change when AI2 value < par. *8412 SEQ VAL 1 LOW* value.	8
	AI 2 HIGH 1	State change when AI2 value > par. *8411 SEQ VAL 1 HIGH* value.	9
	AI1 OR 2 LO1	State change when AI1 or AI2 value < par. *8412 SEQ VAL 1 LOW* value.	10

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	AI1LO1AI2HI1	State change when AI1 value < par. *8412 SEQ VAL 1 LOW* value and AI2 value > par. *8411 SEQ VAL 1 HIGH* value.	11
	AI1LO1 ORDI5	State change when AI1 value < par. *8412 SEQ VAL 1 LOW* value or when DI5 is active.	12
	AI2HI1 ORDI5	State change when AI2 value > par. *8411 SEQ VAL 1 HIGH* value or when DI5 is active.	13
	AI 1 LOW 2	State change when AI1 value < par. *8414 SEQ VAL 2 LOW* value.	14
	AI 1 HIGH 2	State change when AI1 value > par. *8413 SEQ VAL 2 HIGH* value.	15
	AI 2 LOW 2	State change when AI2 value < par. *8414 SEQ VAL 2 LOW* value.	16
	AI 2 HIGH 2	State change when AI2 value > par. *8413 SEQ VAL 2 HIGH* value.	17
	AI1 OR 2 LO2	State change when AI1 or AI2 value < par. *8414 SEQ VAL 2 LOW* value.	18
	AI1LO2AI2HI2	State change when AI1 value < par. *8414 SEQ VAL 2 LOW* value and AI2 value > par. *8413 SEQ VAL 2 HIGH* value.	19
	AI1LO2 ORDI5	State change when AI1 value < par. *8414 SEQ VAL 2 LOW* value or when DI5 is active.	20
	AI2HI2 ORDI5	State change when AI2 value > par. *8413 SEQ VAL 2 HIGH* value or when DI5 is active.	21
	TIMED FUNC 1	Trigger with timed function 1. See parameter group *36 TIMED FUNCTIONS*.	22
	TIMED FUNC 2	See selection *TIMED FUNC 1*.	23
	TIMED FUNC 3	See selection *TIMED FUNC 1*.	24
	TIMED FUNC 4	See selection *TIMED FUNC 1*.	25
	CHANGE DLY	State change after delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed.	26
	DI1 OR DELAY	State change after DI1 activation or after delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed.	27
	DI2 OR DELAY	See selection *DI1 OR DELAY*.	28
	DI3 OR DELAY	See selection *DI1 OR DELAY*.	29
	DI4 OR DELAY	See selection *DI1 OR DELAY*.	30
	DI5 OR DELAY	See selection *DI1 OR DELAY*.	31
	AI1HI1 ORDLY	State change when AI1 value > par. *8411 SEQ VAL 1 HIGH* value or after delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed.	32
	AI2LO1 ORDLY	State change when AI1 value < par. *8412 SEQ VAL 1 LOW* value or after delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed.	33

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	AI1HI2 ORDLY	State change when AI1 value > par. *8413 SEQ VAL 2 HIGH* value or after delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed.	34
	AI2LO2 ORDLY	State change when AI2 value < par. *8414 SEQ VAL 2 LOW* value or after delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed.	35
	SUPRV1 OVER	Logic value according to supervision parameters *3201*…*3203*. See parameter group *32 SUPERVISION*.	36
	SUPRV2 OVER	Logic value according to supervision parameters *3204*…*3206*. See parameter group *32 SUPERVISION*.	37
	SUPRV3 OVER	Logic value according to supervision parameters *3207*…*3209*. See parameter group *32 SUPERVISION*.	38
	SUPRV1 UNDER	See selection *SUPRV1 OVER*.	39
	SUPRV2 UNDER	See selection *SUPRV2 OVER*.	40
	SUPRV3 UNDER	See selection *SUPRV3 OVER*.	41
	SPV1OVRORDLY	State change according to supervision parameters *3201*…*3203* or when delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed. See parameter group *32 SUPERVISION*.	42
	SPV2OVRORDLY	State change according to supervision parameters *3204*…*3206* or when delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed. See parameter group *32 SUPERVISION*.	43
	SPV3OVRORDLY	State change according to supervision parameters *3207*…*3209* or when delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed. See parameter group *32 SUPERVISION*.	44
	SPV1UNDORDLY	See selection *SPV1OVRORDLY*.	45
	SPV2UNDORDLY	See selection *SPV2OVRORDLY*.	46
	SPV3UNDORDLY	See selection *SPV3OVRORDLY*.	47
	CNTR OVER	State change when counter value exceeds the limit defined by par. *1905 COUNTER LIMIT*. See parameters *1904*…*1911*.	48
	CNTR UNDER	State change when counter value is below the limit defined by par. *1905 COUNTER LIMIT*. See parameters *1904*…*1911*.	49
	LOGIC VAL	State change according to logic operation defined by parameters *8406*…*8410*	50

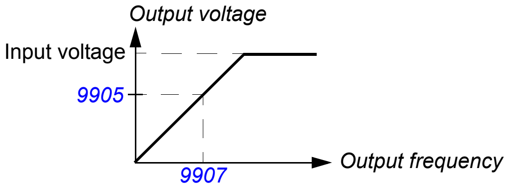
All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	ENTER SETPNT	State change when drive output frequency/speed enters the reference area (ie, the difference is less than or equal to 4% of the maximum reference).	51
	AT SETPOINT	State change when drive output frequency/speed equals the reference value (= is within tolerance limits, ie, the error is less than or equal to 1% of the maximum reference).	52
	AI1 L1 & DI5	State change when AI1 value < par. *8412 SEQ VAL 1 LOW* and when DI5 is active.	53
	AI2 L2 & DI5	State change when AI2 value < par. *8414 SEQ VAL 2 LOW* value and when DI5 is active.	54
	AI1 H1 & DI5	State change when AI1 value > par. *8411 SEQ VAL 1 HIGH* value and when DI5 is active.	55
	AI2 H2 & DI5	State change when AI2 value > par. *8413 SEQ VAL 2 HIGH* value and when DI5 is active.	56
	AI1 L1 & DI4	State change when AI1 value < par. *8412 SEQ VAL 1 LOW* value and when DI4 is active.	57
	AI2 L2 & DI4	State change when AI2 value < par. *8414 SEQ VAL 2 LOW* value and when DI4 is active.	58
	AI1 H1 & DI4	State change when AI1 value > par. *8411 SEQ VAL 1 HIGH* value and when DI4 is active.	59
	AI2 H2 & DI4	State change when AI2 value > par. *8413 SEQ VAL 2 HIGH* value and when DI4 is active.	60
	DLY AND DI1	State change when delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed and DI1 is active.	61
	DLY AND DI2	State change when delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed and DI2 is active.	62
	DLY AND DI3	State change when delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed and DI3 is active.	63
	DLY AND DI4	State change when delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed and DI4 is active.	64
	DLY AND DI5	State change when delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed and DI5 is active.	65
	DLY & AI2 H2	State change when delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed and AI2 value > par. *8413 SEQ VAL 2 HIGH* value.	66
	DLY & AI2 L2	State change when delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed and AI2 value < par. *8414 SEQ VAL 2 LOW* value.	67
	DLY & AI1 H1	State change when delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed and AI1 value > par. *8411 SEQ VAL 1 HIGH* value.	68

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	DLY & AI1 L1	State change when delay time defined by parameter *8424 ST1 CHANGE DLY* has elapsed and AI1 value < par. *8412 SEQ VAL 1 LOW* value.	69
	COMM VAL1 #0	*0135 COMM VALUE 1* bit 0. 1 = state change.	70
	COMM VAL1 #1	*0135 COMM VALUE 1* bit 1. 1 = state change.	71
	COMM VAL1 #2	*0135 COMM VALUE 1* bit 2. 1 = state change.	72
	COMM VAL1 #3	*0135 COMM VALUE 1* bit 3. 1 = state change.	73
	COMM VAL1 #4	*0135 COMM VALUE 1* bit 4. 1 = state change.	74
	COMM VAL1 #5	*0135 COMM VALUE 1* bit 5. 1 = state change.	75
	COMM VAL1 #6	*0135 COMM VALUE 1* bit 6. 1 = state change.	76
	COMM VAL1 #7	*0135 COMM VALUE 1* bit 7. 1 = state change.	77
	AI2H2DI4SV1O	State change according to supervision parameters *3201*…*3203* when AI2 value > par. *8413 SEQ VAL 2 HIGH* value and DI4 is active.	78
	AI2H2DI5SV1O	State change according to supervision parameters *3201*…*3203* when AI2 value > par. *8413 SEQ VAL 2 HIGH* value and DI5 is active.	79
	STO	State change when STO (Safe torque off) has been triggered.	80
	STO(-1)	State change when STO (Safe torque off) becomes inactive and the drive operates normally.	81
8426	ST1 TRIG TO ST N	Selects the source for the trigger signal which changes the state from state 1 to state N. State N is defined with parameter *8427 ST1 STATE N*. **Note:** State change to state N (*8426 ST1 TRIG TO ST N*) has a higher priority than state change to the next state (*8425 ST1 TRIG TO ST 2*).	*NOT SEL*
		See parameter *8425 ST1 TRIG TO ST 2*.	
8427	ST1 STATE N	Defines the state N. See parameter *8426 ST1 TRIG TO ST N*.	*STATE 1*
	STATE 1	State 1	1
	STATE 2	State 2	2
	STATE 3	State 3	3
	STATE 4	State 4	4
	STATE 5	State 5	5

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	STATE 6	State 6	6
	STATE 7	State 7	7
	STATE 8	State 8	8
8430	ST2 REF SEL	See parameters *8420*…*8427*.	
…			
8497	ST8 STATE N		
98 OPTIONS		External serial communication activation	
9802	COMM PROT SEL	Activates the external serial communication and selects the interface.	*NOT SEL*
	NOT SEL	No communication	0
	STD MODBUS	Embedded fieldbus. Interface: EIA-485 provided by optional FMBA-01 Modbus adapter connected to drive terminal X3. See chapter *Fieldbus control with embedded fieldbus* on page *313*.	1
	EXT FBA	The drive communicates through a fieldbus adapter module connected to drive terminal X3. See also parameter group *51 EXT COMM MODULE*. See chapter *Fieldbus control with fieldbus adapter* on page *339*.	4
	MODBUS RS232	Embedded fieldbus. Interface: RS-232 (ie, control panel connector). See chapter *Fieldbus control with fieldbus adapter* on page *339*.	10
99 START-UP DATA		Language selection. Definition of motor set-up data.	
9901	LANGUAGE	Selects the display language used on the assistant control panel. **Note:** With the ACS-CP-D assistant control panel, the following languages are available: English (0), Chinese (1), Korean (2) and Japanese (3).	*ENGLISH*
	ENGLISH	British English	0
	ENGLISH (AM)	American English	1
	DEUTSCH	German	2
	ITALIANO	Italian	3
	ESPAÑOL	Spanish	4
	PORTUGUES	Portuguese	5
	NEDERLANDS	Dutch	6
	FRANÇAIS	French	7
	DANSK	Danish	8
	SUOMI	Finnish	9
	SVENSKA	Swedish	10
	RUSSKI	Russian	11

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	POLSKI	Polish	12
	TÜRKÇE	Turkish	13
	CZECH	Czech	14
	MAGYAR	Hungarian	15
	ELLINIKA	Greek	16
	CHINESE	Chinese	17
	KOREAN	Korean	18
	JAPANESE	Japanese	19
9902	APPLIC MACRO	Selects the application macro. See chapter *Application macros* on page *107*.	*ABB STANDARD*
	ABB STANDARD	Standard macro for constant speed applications	1
	3-WIRE	3-wire macro for constant speed applications	2
	ALTERNATE	Alternate macro for start forward and start reverse applications	3
	MOTOR POT	Motor potentiometer macro for digital signal speed control applications	4
	HAND/AUTO	Hand/Auto macro to be used when two control devices are connected to the drive: • Device 1 communicates through the interface defined by external control location EXT1. • Device 2 communicates through the interface defined by external control location EXT2. EXT1 or EXT2 is active at a time. Switching between EXT1/2 through digital input.	5
	PID CONTROL	PID control. For applications in which the drive controls a process value, eg, pressure control by the drive running the pressure boost pump. Measured pressure and the pressure reference are connected to the drive.	6
	TORQUE CTRL	Torque control macro	8
	AC500 MODBUS	AC500 PLC macro. See section *AC500 Modbus macro* on page *117*.	10
	LOAD FD SET	FlashDrop parameter values as defined by the FlashDrop file. Parameter view is selected by parameter *1611 PARAMETER VIEW*. FlashDrop is an optional device for fast copying of parameters to unpowered drives. FlashDrop allows easy customization of the parameter list, eg, selected parameters can be hidden. For more information, see *MFDT-01 FlashDrop user's manual* (3AFE68591074 [English]).	31

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
	USER S1 LOAD	User 1 macro loaded into use. Before loading, check that the saved parameter settings and the motor model are suitable for the application.	0
	USER S1 SAVE	Save User 1 macro. Stores the current parameter settings and the motor model.	-1
	USER S2 LOAD	User 2 macro loaded into use. Before loading, check that the saved parameter settings and the motor model are suitable for the application.	-2
	USER S2 SAVE	Save User 2 macro. Stores the current parameter settings and the motor model.	-3
	USER S3 LOAD	User 3 macro loaded into use. Before loading, check that the saved parameter settings and the motor model are suitable for the application.	-4
	USER S3 SAVE	Save User 3 macro. Stores the current parameter settings and the motor model.	-5
9903	MOTOR TYPE	Selects the motor type. Cannot be changed while the drive is running.	*AM*
	AM	Asynchronous motor. Three-phase AC voltage-supplied induction motor with squirrel cage rotor.	1
	PMSM	Permanent magnet synchronous motor. Three-phase AC voltage-supplied synchronous motor with permanent magnet rotor and sinusoidal back emf voltage.	2
9904	MOTOR CTRL MODE	Selects the motor control mode.	*SCALAR: FREQ*
	VECTOR: SPEED	Sensorless vector control mode. Reference 1 = speed reference in rpm. Reference 2 = speed reference as a percentage. 100% is the absolute maximum speed, equal to the value of parameter *2002 MAXIMUM SPEED* (or *2001 MINIMUM SPEED* if the absolute value of the minimum speed is greater than the maximum speed value).	1
	VECTOR: TORQ	Vector control mode. Reference 1 = speed reference in rpm. Reference 2 = torque reference as a percentage. 100% equals nominal torque.	2
	SCALAR: FREQ	Scalar control mode. Reference 1 = frequency reference in Hz. Reference 2 = frequency reference as a percentage. 100% is the absolute maximum frequency, equal to the value of parameter *2008 MAXIMUM FREQ* (or *2007 MINIMUM FREQ* if the absolute value of the minimum speed is greater than the maximum speed value).	3

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
9905	MOTOR NOM VOLT	Defines the nominal motor voltage. For asynchronous motors, must be equal to the value on the motor rating plate. For permanent magnet synchronous motors, the nominal voltage is the back emf voltage at nominal speed. If the voltage is given as voltage per rpm, eg, 60 V per 1000 rpm, the voltage for 3000 rpm nominal speed is 3 · 60 V = 180 V. The drive cannot supply the motor with a voltage greater than the input power voltage. Note that the output voltage is not limited by the nominal motor voltage but increased linearly up to the value of the input voltage.  **WARNING!** The stress on the motor insulations depends on the drive supply voltage. This applies also when the motor voltage rating is lower than the rating of the drive and the supply voltage of the drive. The rms voltage can be limited to motor nominal voltage by setting the maximum frequency of the drive (parameter *2008*) to the motor nominal frequency.	200 V units: 230 V 400 V E units: 400 V 400 V U units: 460 V
	200 V units: 46…345 V 400 V E units: 80…600 V 400 V U units: 92…690 V	Voltage.	1 = 1 V
9906	MOTOR NOM CURR	Defines the nominal motor current. Must be equal to the value on the motor rating plate.	I_{2N}
	0.2…2.0 · I_{2N}	Current	1 = 0.1 A
9907	MOTOR NOM FREQ	Defines the nominal motor frequency, ie, the frequency at which the output voltage equals the motor nominal voltage: Field weakening point = Nom. frequency · Supply voltage / Motor nom. voltage	E: 50.0 Hz U: 60.0 Hz
	0.0…599.0 Hz	Frequency	1 = 0.1 Hz
9908	MOTOR NOM SPEED	Defines the nominal motor speed. Must be equal to the value on the motor rating plate.	Type dependent
	50…30000 rpm	Speed	1 = 1 rpm

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
9909	MOTOR NOM POWER	Defines the nominal motor power. Must equal the value on the motor rating plate.	P_N
	0.2…3.0 · P_N kW	Power	1 = 0.1 kW / 0.1 hp
9910	ID RUN	This parameter controls a self-calibration process called the Motor ID run. During this process, the drive operates the motor and makes measurements to identify motor characteristics and create a model used for internal calculations.	*OFF/IDMAGN*
	OFF/IDMAGN	The Motor ID run process is not run. Identification magnetization is performed, depending on parameter *9904 MOTOR CTRL MODE*. In identification magnetization, the motor model is calculated at first start by magnetizing the motor for 10 to 15 s at zero speed (motor not rotating, except that a permanent magnet synchronous motor can rotate a fraction of a revolution). The model is recalculated always at start after motor parameter changes. • Parameter *9904* = 1 (*VECTOR: SPEED*) or 2 (*VECTOR: TORQ*): Identification magnetization is performed. • Parameter *9904* = 3 (*SCALAR: FREQ*): Identification magnetization is not performed.	0
	ON	ID run. Guarantees the best possible control accuracy. The ID run takes about one minute. An ID run is especially effective when: • vector control mode is used (parameter *9904* = 1 [*VECTOR: SPEED*] or 2 [*VECTOR: TORQ*]), and • operation point is near zero speed and/or • operation requires a torque range above the motor nominal torque, over a wide speed range, and without any measured speed feedback (ie, without a pulse encoder). **Note:** The motor must be de-coupled from the driven equipment. **Note:** Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction. **Note:** If motor parameters are changed after ID run, repeat the ID run. ⚠ **WARNING!** The motor will run at up to approximately 50…80% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	1

All parameters			
No.	**Name/Value**	**Description**	**Def/FbEq**
9912	MOTOR NOM TORQUE	Calculated motor nominal torque in N·m (calculation is based on parameter *9909 MOTOR NOM POWER* and *9908 MOTOR NOM SPEED* values).	0
	0…3000.0 N·m	Read-only	1 = 0.1 N·m
9913	MOTOR POLE PAIRS	Calculated motor pole pair number (calculation is based on parameter *9907 MOTOR NOM FREQ* and *9908 MOTOR NOM SPEED* values).	0
	-	Read-only	1 = 1
9914	PHASE INVERSION	Inverts two phases in the motor cable. This changes the direction of the motor rotation without having to exchange the positions of two motor cable phase conductors at the drive output terminals or at the motor connection box.	*NO*
	NO	Phases not inverted	0
	YES	Phases inverted	1
9915	MOTOR COS PHI	When set to 0, an estimated cos phi value is used.	0
	0 … 0.97	Active range of the parameter is 0.5 … 0.97 and should be used when high efficiency motors (IE3 or IE4) are used.	1 = 0.01

13

Fieldbus control with embedded fieldbus

What this chapter contains

The chapter describes how the drive can be controlled by external devices over a communication network using embedded fieldbus.

System overview

The drive can be connected to an external control system through a fieldbus adapter or embedded fieldbus. For the fieldbus adapter control, see chapter *Fieldbus control with fieldbus adapter* on page *339*.

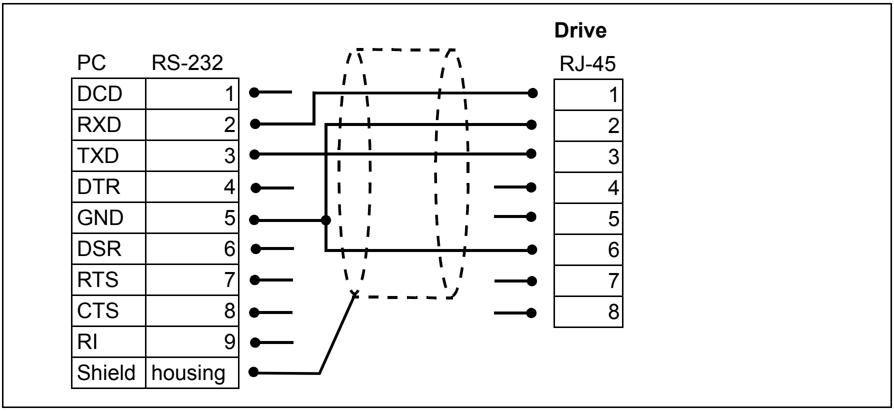
The embedded fieldbus supports Modbus RTU protocol. Modbus is a serial, asynchronous protocol. Transaction is half-duplex.

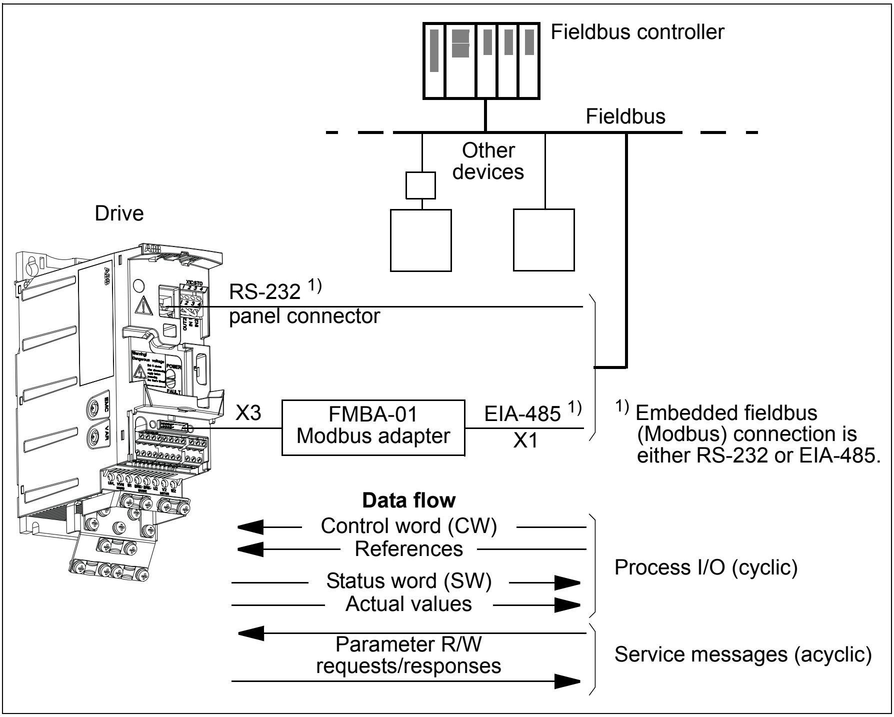
The embedded fieldbus can be connected with either EIA-485 (terminal X1 of the optional FMBA-01 Modbus adapter connected to drive terminal X3) or RS-232 (control panel connector X2).

EIA-485 is designed for a multipoint application (a single master controlling one or more slaves). RS-232 is designed for a point-to-point application (a single master controlling one slave).

For more information on the FMBA-01 Modbus adapter module, see *FMBA-01 Modbus adapter module user's manual* (3AFE68586704 [English]).

The pin configuration of the RS-232 connector is shown below.The maximum length of the communication cable with RS-232 is restricted to 3 meters (9.8 ft).





The drive can be set to receive all of its control information through the fieldbus interface, or the control can be distributed between the fieldbus interface and other available sources, for example, digital and analog inputs.

Setting up communication through the embedded Modbus

Before configuring the drive for fieldbus control, the FMBA-01 Modbus adapter (if used) must be mechanically and electrically installed according to the instructions given in section *Attach the optional fieldbus module* on page *38*, and the module manual.

The communication through the fieldbus link is initialized by setting parameter *9802 COMM PROT SEL* to *STD MODBUS* or *MODBUS RS232*. The communication parameters in group *53 EFB PROTOCOL* must also be adjusted. See the table below.

Parameter	Alternative settings	Setting for fieldbus control	Function/Information
COMMUNICATION INITIALIZATION			
9802 COMM PROT SEL	*NOT SEL* *STD MODBUS* *EXT FBA* *MODBUS RS232*	*STD MODBUS* (with EIA-485) *MODBUS RS232* (with RS-232)	Initializes embedded fieldbus communication.
ADAPTER MODULE CONFIGURATION			
5302 EFB STATION ID	0…247	Any	Defines the station ID address of the RS-232/EIA-485 link. No two stations on line may have the same address.
5303 EFB BAUD RATE	1.2 kbit/s 2.4 kbit/s 4.8 kbit/s 9.6 kbit/s 19.2 kbit/s 38.4 kbit/s 57.6 kbit/s 115.2 kbit/s		Defines the communication speed of the RS-232/EIA-485 link.
5304 EFB PARITY	*8 NONE 1* *8 NONE 2* *8 EVEN 1* *8 ODD 1*		Selects the parity setting. The same settings must be used in all on-line stations.
5305 EFB CTRL PROFILE	*ABB DRV LIM* *DCU PROFILE* *ABB DRV FULL*	Any	Selects the communication profile used by the drive. See section *Communication profiles* on page *328*.
5310 EFB PAR 10 … … *5317 EFB PAR 17*	0…65535	Any	Selects an actual value to be mapped to Modbus register 400xx.

After the configuration parameters in group *53 EFB PROTOCOL* have been set, the drive control parameters (shown in section *Drive control parameters* on page *316*) must be checked and adjusted when necessary.

The new settings will take effect when the drive is next powered up, or when parameter *5302 EFB STATION ID* setting is cleared and reset.

Drive control parameters

After the Modbus communication has been set up, the drive control parameters listed in the table below should be checked and adjusted when necessary.

The **Setting for fieldbus control** column gives the value to use when the Modbus interface is the desired source or destination for that particular signal. The **Function/Information** column gives a description of the parameter.

Parameter	Setting for fieldbus control	Function/Information	Modbus register address	
CONTROL COMMAND SOURCE SELECTION			ABB DRV	DCU
1001 EXT1 COMMANDS	*COMM*	Enables *0301 FB CMD WORD 1* bits 0…1 (*STOP*/*START*) when EXT1 is selected as the active control location.		40031 bits 0…1
1002 EXT2 COMMANDS	*COMM*	Enables *0301 FB CMD WORD 1* bits 0…1 (*STOP*/*START*) when EXT2 is selected as the active control location.		40031 bits 0…1
1003 DIRECTION	*FORWARD* *REVERSE* *REQUEST*	Enables the rotation direction control as defined by parameters *1001* and *1002*. The direction control is explained in section *Reference handling* on page *323*.		40031 bit 2
1010 JOGGING SEL	*COMM*	Enables jogging 1 or 2 activation through *0302 FB CMD WORD 2* bits 20…21 (*JOGGING 1* / *JOGGING 2*).		40032 bits 20…21
1102 EXT1/EXT2 SEL	*COMM*	Enables EXT1/EXT2 selection through *0301 FB CMD WORD 1* bit 5 (*EXT2*); with the ABB drives profile *5319 EFB PAR 19* bit 11 (*EXT CTRL LOC*).	40001 bit 11	40031 bit 5
1103 REF1 SELECT	*COMM* *COMM+AI1* *COMM*AI1*	Fieldbus reference REF1 is used when EXT1 is selected as the active control location. See section *Fieldbus references* on page *320* for information on the alternative settings.	40002 for REF1	

Parameter	Setting for fieldbus control	Function/Information	Modbus register address	
1106 REF2 SELECT	*COMM* *COMM+AI 1* *COMM*AI1*	Fieldbus reference REF2 is used when EXT2 is selected as the active control location. See section *Fieldbus references* on page *320* for information on the alternative settings.	40003 for REF2	
OUTPUT SIGNAL SOURCE SELECTION			ABB DRV	DCU
1401 RELAY OUTPUT 1	*COMM* *COMM(-1)*	Enables relay output RO control by signal *0134 COMM RO WORD*.	40134 for signal *0134*	
1501 AO1 CONTENT SEL	135	Directs the contents of the fieldbus reference *0135 COMM VALUE 1* to analog output AO.	40135 for signal *0135*	
SYSTEM CONTROL INPUTS			ABB DRV	DCU
1601 RUN ENABLE	*COMM*	Enables the control of the inverted Run enable signal (Run disable) through *0301 FB CMD WORD 1* bit 6 (*RUN_DISABLE*); with the ABB drives profile *5319 EFB PAR 19* bit 3 (*INHIBIT OPERATION*).	40001 bit 3	40031 bit 6
1604 FAULT RESET SEL	*COMM*	Enables fault reset through the fieldbus *0301 FB CMD WORD 1* bit 4 (*RESET*); with the ABB drives profile *5319 EFB PAR 19* bit 7 (*RESET*).	40001 bit 7	40031 bit 4
1606 LOCAL LOCK	*COMM*	Local control mode lock signal through *0301 FB CMD WORD 1* bit 14 (*REQ_LOCALLOC*)	-	40031 bit 14
1607 PARAM SAVE	*DONE* *SAVE…*	Saves parameter value changes (including those made through fieldbus control) to permanent memory.	41607	
1608 START ENABLE 1	*COMM*	Inverted Start enable 1 (Start disable) through *0302 FB CMD WORD 2* bit 18 (*START_DISABLE1*)	-	40032 bit 18
1609 START ENABLE 2	*COMM*	Inverted Start enable 2 (Start disable) through *0302 FB CMD WORD 2* bit 19 (*START_DISABLE2*)	-	40032 bit 19

Parameter	Setting for fieldbus control	Function/Information	Modbus register address	
LIMITS			ABB DRV	DCU
2013 MIN TORQUE SEL	*COMM*	Minimum torque limit 1/2 selection through *0301 FB CMD WORD 1* bit 15 (*TORQLIM2*)	-	40031 bit 15
2014 MAX TORQUE SEL	*COMM*	Maximum torque limit 1/2 selection through *0301 FB CMD WORD 1* bit 15 (*TORQLIM2*)	-	40031 bit 15
2201 ACC/DEC 1/2 SEL	*COMM*	Acceleration/deceleration ramp pair selection through *0301 FB CMD WORD 1* bit 10 (*RAMP_2*)	-	40031 bit 10
2209 RAMP INPUT 0	*COMM*	Ramp input to zero through *0301 FB CMD WORD 1* bit 13 (*RAMP_IN_0*); with the ABB drives profile *5319 EFB PAR 19* bit 6 (*RAMP_IN_ ZERO*)	40001 bit 6	40031 bit 13

COMMUNICATION FAULT FUNCTIONS			ABB DRV	DCU
3018 COMM FAULT FUNC	*NOT SEL* *FAULT* *CONST SP 7* *LAST SPEED*	Determines the drive action in case the fieldbus communication is lost.	43018	
3019 COMM FAULT TIME	0.1… 600.0 s	Defines the time between the communication loss detection and the action selected with parameter *3018 COMM FAULT FUNC*.	43019	

PID CONTROLLER REFERENCE SIGNAL SOURCE SELECTION			ABB DRV	DCU
4010/ 4110/ 4210 SET POINT SEL	*COMM* *COMM+AI 1* *COMM*AI1*	PID control reference (REF2)	40003 for REF2	

Fieldbus control interface

The communication between a fieldbus system and the drive consists of 16-bit input and output data words (with the ABB drives profile) and 32-bit input and output words (with the DCU profile).

Control word and Status word

The Control word (CW) is the principal means of controlling the drive from a fieldbus system. The Control word is sent by the fieldbus controller to the drive. The drive switches between its states according to the bit-coded instructions of the Control word.

The Status word (SW) is a word containing status information, sent by the drive to the fieldbus controller.

References

References (REF) are 16-bit signed integers. A negative reference (eg, reverse direction of rotation) is formed by calculating the two's complement from the corresponding positive reference value. The contents of each reference word can be used as the speed, frequency, torque or process reference.

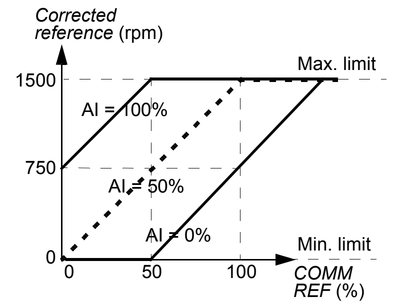
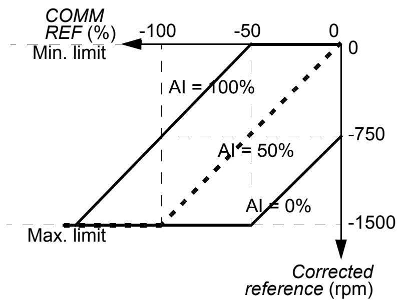
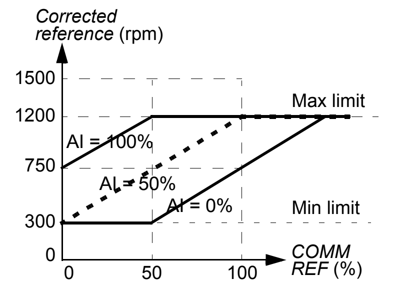
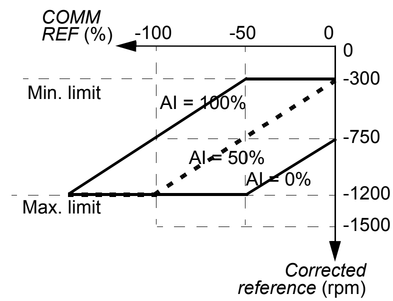
Actual values

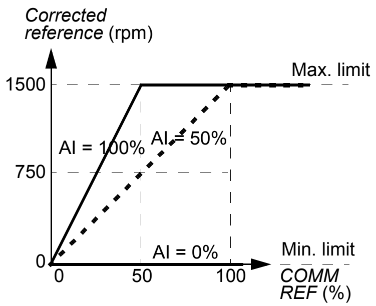
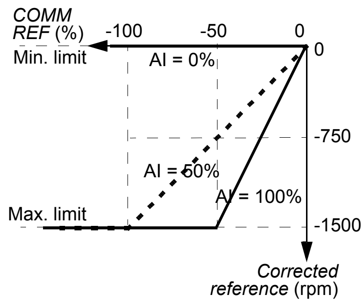
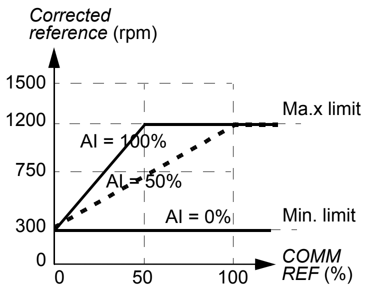
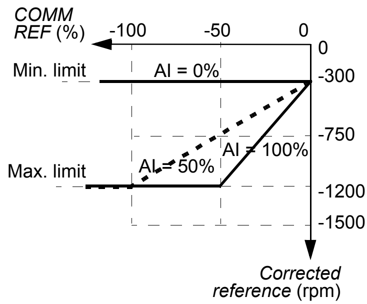
Actual values (ACT) are 16-bit words containing selected values of the drive.

Fieldbus references

Reference selection and correction

Fieldbus reference (called COMM in signal selection contexts) is selected by setting a reference selection parameter – *1103 REF1 SELECT* or *1106 REF2 SELECT* – to *COMM*, *COMM+AI1* or *COMM*AI1*. When parameter *1103* or *1106* is set to *COMM*, the fieldbus reference is forwarded as such without correction. When parameter *1103* or *1106* is set to *COMM+AI1* or *COMM*AI1*, the fieldbus reference is corrected using analog input AI1 as shown in the following examples for the ABB drives profile.

<table>
<tr><th>Setting</th><th>When COMM ≥ 0</th><th>When COMM ≤ 0</th></tr>
<tr><td rowspan="4">COMM+AI1</td><td>COMM(%) · (MAX-MIN) + MIN
+ (AI(%) - 50%) · (MAX-MIN)</td><td>COMM(%) · (MAX-MIN) - MIN
+ (AI(%) - 50%) · (MAX-MIN)</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td colspan="2">Maximum limit is defined by parameter 1105 REF1 MAX / 1108 REF2 MA.
Minimum limit is defined by parameter 1104 REF1 MIN / 1107 REF2 MIN.</td></tr>
</table>

<table>
<tr><th>Setting</th><th>When COMM ≥ 0</th><th>When COMM ≤ 0</th></tr>
<tr><td rowspan="4">COM M*AI1</td><td>COMM(%) · (AI(%) / 50%) · (MAX-MIN) + MIN</td><td>COMM(%) · (AI(%) / 50%) · (MAX-MIN) - MIN</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td colspan="2">Maximum limit is defined by parameter 1105 REF1 MAX / 1108 REF2 MA.
Minimum limit is defined by parameter 1104 REF1 MIN / 1107 REF2 MIN.</td></tr>
</table>

Fieldbus reference scaling

Fieldbus references REF1 and REF2 are scaled for the ABB drives profile as shown in the following table.

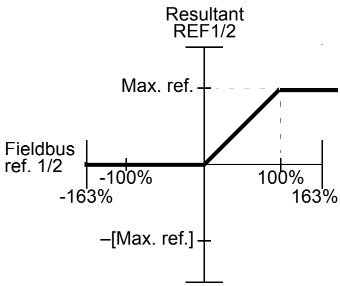
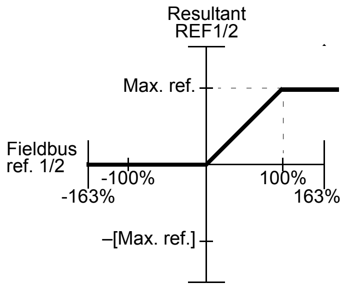
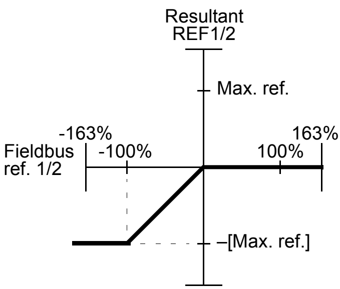
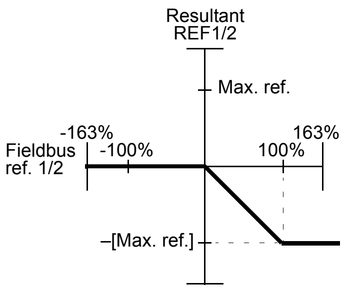
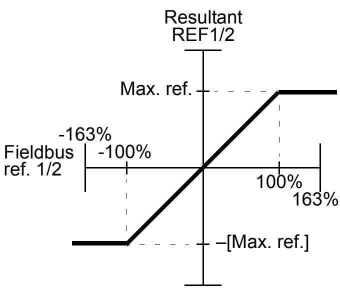
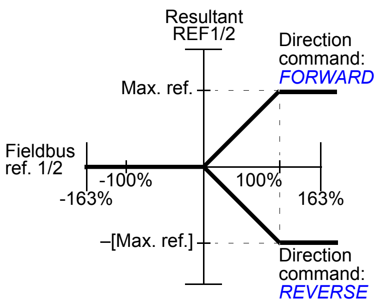
Note: Any correction of the reference (see section *Reference selection and correction* on page *322*) is applied before scaling.

Reference	Range	Reference type	Scaling	Remarks
REF1	-32767 … +32767	Speed or frequency	-20000 = -(**par.** ***1105***) 0 = 0 +20000 = (**par.** ***1105***) (20000 corresponds to 100%)	Final reference limited by *1104*/*1105*. Actual motor speed limited by *2001*/*2002* (speed) or *2007*/*2008* (frequency).
REF2	-32767 … +32767	Speed or frequency	-10000 = -(**par.** ***1108***) 0 = 0 +10000 = (**par.** ***1108***) (10000 corresponds to 100%)	Final reference limited by *1107*/*1108*. Actual motor speed limited by *2001*/*2002* (speed) or *2007*/*2008* (frequency).
		Torque	-10000 = -(**par.** ***1108***) 0 = 0 +10000 = (**par.** ***1108***) (10000 corresponds to 100%)	Final reference limited by *2015*/*2017* (torque 1) or *2016*/*2018* (torque 2).
		PID reference	-10000 = -(**par.** ***1108***) 0 = 0 +10000 = (**par.** ***1108***) (10000 corresponds to 100%)	Final reference limited by *4012*/*4013* (PID set 1) or *4112*/*4113* (PID set 2).

Note: The settings of parameters *1104 REF1 MIN* and *1107 REF2 MIN* have no effect on the reference scaling.

Reference handling

The control of rotation direction is configured for each control location (EXT1 and EXT2) using the parameters in group *10 START/STOP/DIR*. Fieldbus references are bipolar, ie, they can be negative or positive. The following diagrams illustrate how group 10 parameters and the sign of the fieldbus reference interact to produce the reference REF1/REF2.

<table>
<tr><th></th><th>Direction determined by the sign of COMM</th><th>Direction determined by digital command, eg, digital input, control panel</th></tr>
<tr><td>Par. 1003 DIRECTION = FORWARD</td><td>
</td><td>
</td></tr>
<tr><td>Par. 1003 DIRECTION = REVERSE</td><td>
</td><td>
</td></tr>
<tr><td>Par. 1003 DIRECTION = REQUEST</td><td>
</td><td>
</td></tr>
</table>

Actual value scaling

The scaling of the integers sent to the master as Actual values depends on the selected function. See chapter *Actual signals and parameters* on page *179*.

Modbus mapping

The following Modbus function codes are supported by the drive.

Function	Code hex (dec)	Additional information
Read Multiple Holding Registers	03 (03)	Reads the contents of registers in a slave device. Parameter sets, control, status and reference values are mapped as holding registers.
Write Single Holding Register	06 (06)	Writes to a single register in a slave device. Parameter sets, control, status and reference values are mapped as holding registers.
Diagnostics	08 (08)	Provides a series of tests for checking the communication between the master and the slave devices, or for checking various internal error conditions within the slave. The following subcodes are supported: <u>00 Return Query Data:</u> The data passed in the request data field is to be returned in the response. The entire response message should be identical to the request. <u>01 Restart Communications Option:</u> The slave device serial line port must be initialized and restarted, and all of its communication event counters cleared. If the port is currently in Listen Only Mode, no response is returned. If the port is not currently in Listen Only Mode, a normal response is returned before the restart. <u>04 Force Listen Only Mode:</u> Forces the addressed slave device to Listen Only Mode. This isolates it from the other devices on the network, allowing them to continue communicating without interruption from the addressed remote device. No response is returned. The only function that will be processed after this mode is entered is the Restart Communications Option function (subcode 01).
Write Multiple Holding Registers	10 (16)	Writes to the registers (1 to approximately 120 registers) in a slave device. Parameter sets, control, status and reference values are mapped as holding registers.
Read/Write Multiple Holding Registers	17 (23)	Performs a combination of one read operation and one write operation (function codes 03 and 10) in a single Modbus transaction. The write operation is performed before the read operation.

Register mapping

The drive parameters, Control/Status word, references and actual values are mapped to the area 4xxxx so that:

- 40001…40099 are reserved for drive control/status, reference and actual values.
- 40101…49999 are reserved for drive parameters *0101*…9999 (eg, 40102 is parameter *0102*). In this mapping, the thousands and hundreds correspond to the group number, while the tens and ones correspond to the parameter number within a group.

The register addresses that do not correspond with drive parameters are invalid. If there is an attempt to read or write invalid addresses, the Modbus interface returns an exception code to the controller. See *Exception codes* on page *327*.

The following table gives information on the contents of the Modbus addresses 40001…40012 and 40031…40034.

Modbus register		**Access**	**Information**
40001	Control word	R/W	Control word. Supported only by the ABB drives profile, ie, when *5305 EFB CTRL PROFILE* setting is *ABB DRV LIM* or *ABB DRV FULL*. Parameter *5319 EFB PAR 19* shows a copy of the Control word in hexadecimal format.
40002	Reference 1	R/W	External reference REF1. See section *Fieldbus references* on page *320*.
40003	Reference 2	R/W	External reference REF2. See section *Fieldbus references* on page *320*.
40004	Status word	R	Status word. Supported only by the ABB drives profile, ie, when *5305 EFB CTRL PROFILE* setting is *ABB DRV LIM* or *ABB DRV FULL*. Parameter *5320 EFB PAR 20* shows a copy of the Control word in hexadecimal format.
40005 … 40012	Actual 1…8	R	Actual value 1…8. Use parameter *5310*… *5317* to select an actual value to be mapped to Modbus register 40005…40012.
40031	Control word LSW	R/W	*0301 FB CMD WORD 1*, ie, the least significant word of the DCU profile 32-bit Control word. Supported only by the DCU profile, ie, when *5305 EFB CTRL PROFILE* setting is *DCU PROFILE*.
40032	Control word MSW	R/W	*0302 FB CMD WORD 2*, ie, the most significant word of the DCU profile 32-bit Control word. Supported only by the DCU profile, ie, when *5305 EFB CTRL PROFILE* setting is *DCU PROFILE*.
40033	Status word LSW	R	*0303 FB STS WORD 1*, ie, the least significant word of the DCU profile 32-bit Status word. Supported only by the DCU profile, ie, when *5305 EFB CTRL PROFILE* setting is *DCU PROFILE*.

Modbus register		Access	Information
40034	ACS355 Status word MSW	R	*0304 FB STS WORD 2*, ie, the most significant word of the DCU profile 32-bit Status word. Supported only by the DCU profile, ie, when *5305 EFB CTRL PROFILE* setting is *DCU PROFILE*.

Note: Parameter writes through standard Modbus are always volatile, ie, modified values are not automatically stored to the permanent memory. Use parameter *1607 PARAM SAVE* to save all changed values.

Function codes

Supported function codes for the holding 4xxxx register:

Code hex (dec)	Function name	Additional information
03 (03)	Read 4X Register	Reads the binary contents of registers (4X references) in a slave device.
06 (06)	Preset single 4X register	Presets a value into a single register (4X reference). When broadcast, the function presets the same register reference in all attached slaves.
10 (16)	Preset multiple 4X registers	Presets values into a sequence of registers (4X references). When broadcast, the function presets the same register references in all attached slaves.
17 (23)	Read/Write 4X registers	Performs a combination of one read operation and one write operation (function codes 03 and 10) in a single Modbus transaction. Write operation is performed before the read operation.

Note: In the Modbus data message, register 4xxxx is addressed as xxxx -1. For example, register 40002 is addressed as 0001.

Exception codes

Exception codes are serial communication responses from the drive. The drive supports the standard Modbus exception codes listed in the following table.

Code	Name	Description
01	Illegal Function	Unsupported command
02	Illegal Data Address	Address does not exist or is read/write protected.
03	Illegal Data Value	Incorrect value for the drive: • Value is outside minimum or maximum limits. • Parameter is read-only. • Message is too long. • Parameter write is not allowed when start is active. • Parameter write is not allowed when factory macro is selected.

Drive parameter *5318 EFB PAR 18* holds the most recent exception code.

Communication profiles

The embedded fieldbus supports three communication profiles:

- DCU communication profile (*DCU PROFILE*)
- ABB drives limited communication profile (*ABB DRV LIM*)
- ABB drives full communication profile (*ABB DRV FULL*).

The DCU profile extends the control and status interface to 32 bits, and it is the internal interface between the main drive application and the embedded fieldbus environment. The ABB drives limited profile is based on the PROFIBUS interface. The ABB drives full profile (*ABB DRV FULL*) supports two Control word bits not supported by the *ABB DRV LIM* implementation.

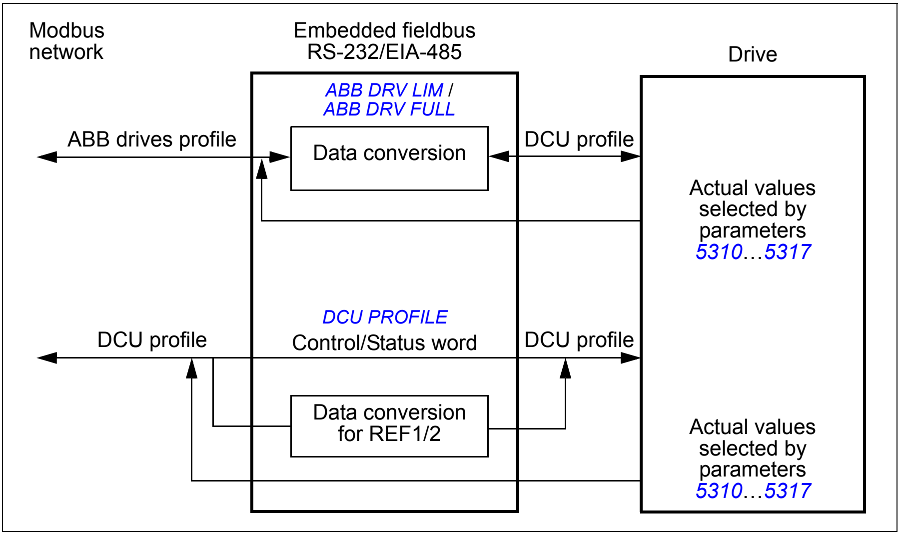


ABB drives communication profile

Two implementations of the ABB drives communication profile are available: ABB drives full and ABB drives limited. The ABB drives communication profile is active when parameter *5305 EFB CTRL PROFILE* is set to *ABB DRV FULL* or *ABB DRV LIM*. The Control word and Status word for the profile are described below.

The ABB drives communication profiles can be used through both EXT1 and EXT2. The Control word commands are in effect when parameter *1001 EXT1 COMMANDS* or *1002 EXT2 COMMANDS* (whichever control location is active) is set to *COMM*.

Control word

The table below and the state diagram on page *332* describe the Control word content for the ABB drives profile. The upper case boldface text refers to the states shown in the diagram.

ABB drives profile Control word, parameter *5319 EFB PAR 19*			
Bit	**Name**	**Value**	**Comments**
0	OFF1 CONTROL	1	Enter **READY TO OPERATE.**
		0	Stop along currently active deceleration ramp (*2203*/*2206*). Enter OFF1 ACTIVE; proceed to READY TO SWITCH ON unless other interlocks (OFF2, OFF3) are active.
1	OFF2 CONTROL	1	Continue operation (OFF2 inactive).
		0	Emergency OFF, drive coast to stop. Enter **OFF2 ACTIVE**; proceed to **SWITCH-ON INHIBITED**.
2	OFF3 CONTROL	1	Continue operation (OFF3 inactive).
		0	Emergency stop, drive stops within time defined by par. *2208*. Enter **OFF3 ACTIVE**; proceed to **SWITCH-ON INHIBITED**. **WARNING!** Ensure motor and driven machine can be stopped using this stop mode.
3	INHIBIT OPERATION	1	Enter **OPERATION ENABLED**. (**Note:** The Run enable signal must be active; see parameter *1601*. If par. *1601* is set to *COMM*, this bit also activates the Run enable signal.)
		0	Inhibit operation. Enter **OPERATION INHIBITED**.
4	**Note:** Bit 4 is supported only by *ABB DRV FULL* profile.		
	RAMP_OUT_ ZERO (*ABB DRV FULL*)	1	Enter **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**.
		0	Force Ramp function generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	Enable ramp function. Enter **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**.
		0	Halt ramping (Ramp function generator output held).
6	RAMP_IN_ ZERO	1	Normal operation. Enter **OPERATING**.
		0	Force Ramp function generator input to zero.
7	RESET	0=>1	Fault reset if an active fault exists. Enter **SWITCH-ON INHIBITED**. Effective if par. *1604* is set to *COMM*.
		0	Continue normal operation.
8…9	Not in use		

ABB drives profile Control word, parameter *5319 EFB PAR 19*			
Bit	**Name**	**Value**	**Comments**
10	**Note:** Bit 10 is supported only by *ABB DRV FULL*.		
	REMOTE_CMD (*ABB DRV FULL*)	1	Fieldbus control enabled.
		0	Control word ≠ 0 or reference ≠ 0: Retain last Control word and reference. Control word = 0 and reference = 0: Fieldbus control enabled. Reference and deceleration/acceleration ramp are locked.
11	EXT CTRL LOC	1	Select external control location EXT2. Effective if par. *1102* is set to *COMM*.
		0	Select external control location EXT1. Effective if par. *1102* is set to *COMM*.
12 … 15	Reserved		

Status word

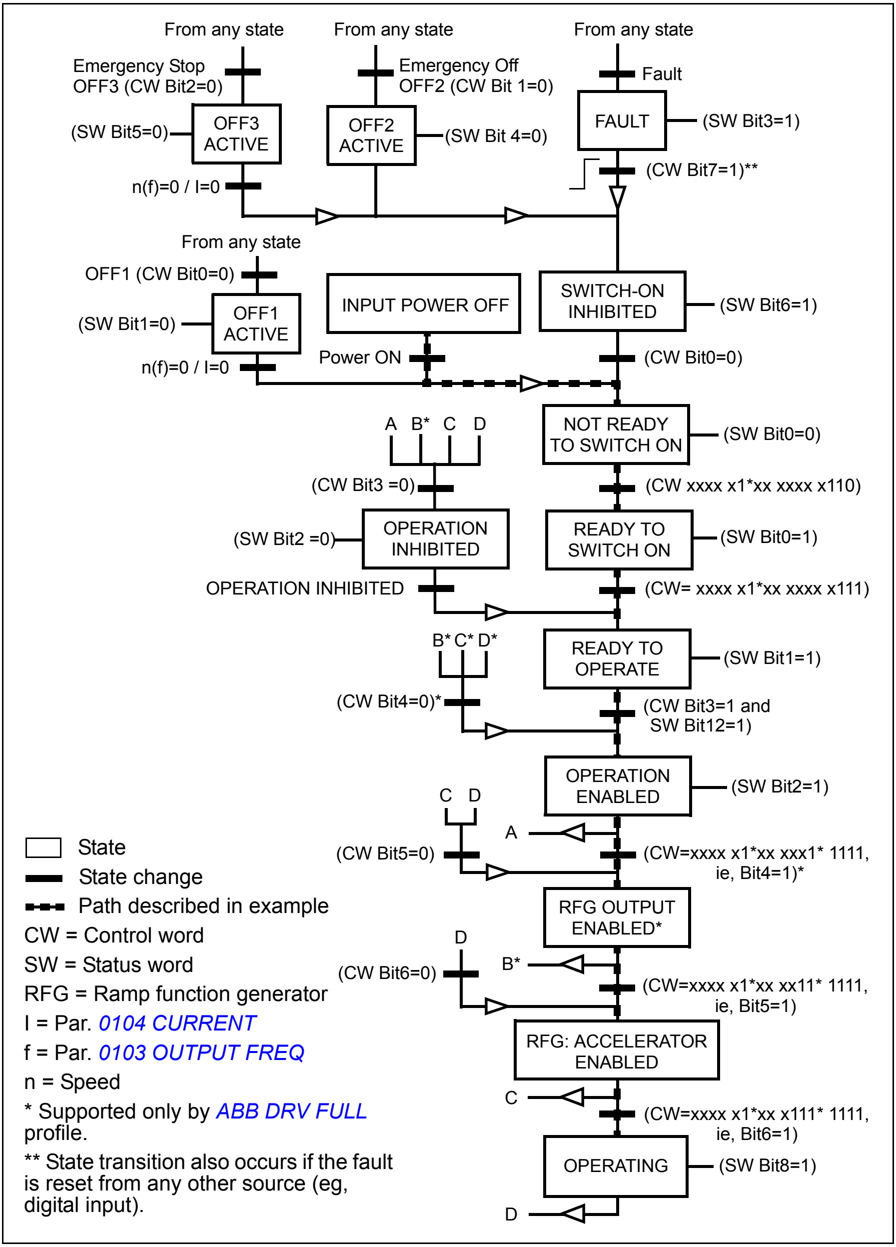
The table below and the state diagram on page *332* describe the Status word content for the ABB drives profile. The upper case boldface text refers to the states shown in the diagram.

ABB drives profile (EFB) Status word, parameter *5320 EFB PAR 20*			
Bit	**Name**	**Value**	**STATE/Description (Correspond to states/boxes in the state diagram)**
0	RDY_ON	1	**READY TO SWITCH ON**
		0	**NOT READY TO SWITCH ON**
1	RDY_RUN	1	**READY TO OPERATE**
		0	**OFF1 ACTIVE**
2	RDY_REF	1	**OPERATION ENABLED**
		0	**OPERATION INHIBITED**
3	TRIPPED	1	**FAULT**. See chapter *Fault tracing* on page *349*.
		0	No fault
4	OFF_2_STA	1	OFF2 inactive
		0	**OFF2 ACTIVE**
5	OFF_3_STA	1	OFF3 inactive
		0	**OFF3 ACTIVE**
6	SWC_ON_INHIB	1	**SWITCH-ON INHIBITED**
		0	Switch-on inhibit not active
7	ALARM	1	Alarm. See chapter *Fault tracing* on page *349*.
		0	No alarm

ABB drives profile (EFB) Status word, parameter *5320 EFB PAR 20*			
Bit	**Name**	**Value**	**STATE/Description (Correspond to states/boxes in the state diagram)**
8	AT_SETPOINT	1	**OPERATING**. Actual value equals reference value (= is within tolerance limits, ie, in speed control the difference between the output speed and the speed reference is less than or equal to 4/1%* of the nominal motor speed). * Asymmetric hysteresis: 4% when speed exits the reference area, 1% when speed enters the reference area.
		0	Actual value differs from reference value (= is outside tolerance limits).
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2)
		0	Drive control location: LOCAL
10	ABOVE_LIMIT	1	Supervised parameter value exceeds the supervision high limit. Bit value is 1 until the supervised parameter value falls below the supervision low limit. See parameter group *32 SUPERVISION*, parameter *3201 SUPERV 1 PARAM*.
		0	Supervised parameter value falls below the supervision low limit. Bit value is 0 until the supervised parameter value exceeds the supervision high limit. See parameter group *32 SUPERVISION*, parameter *3201 SUPERV 1 PARAM*.
11	EXT CTRL LOC	1	External control location EXT2 selected
		0	External control location EXT1 selected
12	EXT RUN ENABLE	1	External Run enable signal received
		0	No external Run enable received
13 … 15	Reserved		

State diagram

The state diagram below describes the start-stop function of Control word (CW) and Status word (SW) bits for the ABB drives profile.



DCU communication profile

Because the DCU profile extends the control and status interface to 32 bits, two different signals are needed for both the Control words (*0301* and *0302*) and Status words (*0303* and *0304*).

Control words

The following tables describe the Control word content for the DCU profile.

DCU profile Control word, parameter *0301 FB CMD WORD 1*			
Bit	**Name**	**Value**	**Information**
0	STOP	1	Stop according to either the stop mode parameter (*2102*) or the stop mode requests (bits 7, 8 and 9). **Note:** Simultaneous STOP and START commands result in a stop command.
		0	No operation
1	START	1	Start **Note:** Simultaneous STOP and START commands result in a stop command.
		0	No operation
2	REVERSE	1	Reverse direction. The direction is defined by using the XOR operation on bit 2 and 31 (= sign of the reference) values.
		0	Forward direction
3	LOCAL	1	Enter local control mode.
		0	Enter external control mode.
4	RESET	-> 1	Reset.
		other	No operation
5	EXT2	1	Switch to external control EXT2.
		0	Switch to external control EXT1.
6	RUN_DISABLE	1	Activate Run disable.
		0	Activate Run enable.
7	STPMODE_R	1	Stop along currently active deceleration ramp (bit 10). Bit 0 value must be 1 (*STOP*).
		0	No operation
8	STPMODE_EM	1	Emergency stop. Bit 0 value must be 1 (*STOP*).
		0	No operation
9	STPMODE_C	1	Coast to stop. Bit 0 value must be 1 (*STOP*).
		0	No operation
10	RAMP_2	1	Use acceleration/deceleration ramp pair 2 (defined by parameters *2205*…*2207*).
		0	Use acceleration/deceleration ramp pair 1 (defined by parameters *2202*…*2204*).

DCU profile Control word, parameter *0301 FB CMD WORD 1*			
Bit	**Name**	**Value**	**Information**
11	RAMP_OUT_0	1	Force ramp output to zero.
		0	No operation
12	RAMP_HOLD	1	Halt ramping (Ramp function generator output held).
		0	No operation
13	RAMP_IN_0	1	Force ramp input to zero.
		0	No operation
14	REQ_LOCALLOC	1	Enable local lock. Entering the local control mode is disabled (LOC/REM key of the panel).
		0	No operation
15	TORQLIM2	1	Use minimum/maximum torque limit 2 (defined by parameters *2016* and *2018*).
		0	Use minimum/maximum torque limit 1 (defined by parameters *2015* and *2017*).

DCU profile Control word, parameter *0302 FB CMD WORD 2*			
Bit	**Name**	**Value**	**Information**
16	FBLOCAL_CTL	1	Fieldbus local mode for Control word requested. **Example:** If the drive is in remote control and the start/stop/direction command source is DI for external control location 1 (EXT1): by setting bit 16 to value 1, the start/stop/direction is controlled by the fieldbus command word.
		0	No fieldbus local mode
17	FBLOCAL_REF	1	Fieldbus local mode Control word for reference requested. See the example for bit 16 (*FBLOCAL_CTL*).
		0	No fieldbus local mode
18	START_DISABLE1	1	No Start enable
		0	Enable start. Effective if parameter *1608* setting is *COMM*.
19	START_DISABLE2	1	No Start enable
		0	Enable start. Effective if parameter *1609* setting is *COMM*.
20	JOGGING 1	1	Activate jogging 1. Effective if parameter *1010* setting is *COMM*. See section *Jogging* on page *162*.
		0	Jogging 1 disabled
21	JOGGING 2	1	Activate jogging 2. Effective if parameter *1010* setting is *COMM*. See section *Jogging* on page *162*.
		0	Jogging 2 disabled
22 … 26	Reserved		

DCU profile Control word, parameter *0302 FB CMD WORD 2*			
Bit	**Name**	**Value**	**Information**
27	REF_CONST	1	Constant speed reference request. This is an internal control bit. Only for supervision.
		0	No operation
28	REF_AVE	1	Average speed reference request. This is an internal control bit. Only for supervision.
		0	No operation
29	LINK_ON	1	Master detected on fieldbus link. This is an internal control bit. Only for supervision.
		0	Fieldbus link is down.
30	REQ_STARTINH	1	Start inhibit
		0	No start inhibit
31	Reserved		

Status words

The following tables describe the Status word content for the DCU profile.

DCU profile Status word, parameter *0303 FB STS WORD 1*			
Bit	**Name**	**Value**	**Status**
0	READY	1	Drive is ready to receive start command.
		0	Drive is not ready.
1	ENABLED	1	External Run enable signal received.
		0	No external Run enable signal received.
2	STARTED	1	Drive has received start command.
		0	Drive has not received start command.
3	RUNNING	1	Drive is modulating and following reference.
		0	Drive is not running.
4	ZERO_SPEED	1	Drive is at zero speed.
		0	Drive has not reached zero speed.
5	ACCELERATE	1	Drive is accelerating.
		0	Drive is not accelerating.
6	DECELERATE	1	Drive is decelerating.
		0	Drive is not decelerating.
7	AT_SETPOINT	1	Drive is at setpoint. Actual value equals reference value (ie, is within tolerance limits).
		0	Drive has not reached setpoint.

DCU profile Status word, parameter *0303 FB STS WORD 1*			
Bit	**Name**	**Value**	**Status**
8	LIMIT	1	Operation is limited by internal protection limits or group *20 LIMITS* settings (excluding speed and frequency limits).
		0	Operation is within internal protection limits and according group *20 LIMITS* settings (excluding speed and frequency limits).
9	SUPERVISION	1	A supervised parameter (group *32 SUPERVISION*) is outside its limits.
		0	All supervised parameters are within limits.
10	REV_REF	1	Drive reference is in reverse direction.
		0	Drive reference is in forward direction.
11	REV_ACT	1	Drive is running in reverse direction.
		0	Drive is running in forward direction.
12	PANEL_LOCAL	1	Control is in control panel (or PC tool) local mode.
		0	Control is not in control panel local mode.
13	FIELDBUS_LOCAL	1	Control is in fieldbus local mode
		0	Control is not in fieldbus local mode.
14	EXT2_ACT	1	Control is in EXT2 mode.
		0	Control is in EXT1 mode.
15	FAULT	1	Drive is in a fault state.
		0	Drive is not in a fault state.

DCU profile Status word, parameter *0304 FB STS WORD 2*			
Bit	**Name**	**Value**	**Status**
16	ALARM	1	An alarm is on.
		0	No alarms are on.
17	NOTICE	1	A maintenance request is pending.
		0	No maintenance request
18	DIRLOCK	1	Direction lock is ON. (Direction change is locked.)
		0	Direction lock is OFF.
19	LOCALLOCK	1	Local mode lock is ON. (Local mode is locked.)
		0	Local mode lock is OFF.
20	CTL_MODE	1	Drive is in vector control mode.
		0	Drive is in scalar control mode.
21	JOGGING ACTIVE	1	Jogging function is active.
		0	Jogging function is not active.

DCU profile Status word, parameter *0304 FB STS WORD 2*			
Bit	**Name**	**Value**	**Status**
22…25	Reserved		
26	REQ_CTL	1	Control word requested from fieldbus
		0	No operation
27	REQ_REF1	1	Reference 1 requested from fieldbus
		0	Reference 1 is not requested from fieldbus.
28	REQ_REF2	1	Reference 2 requested from fieldbus
		0	Reference 2 is not requested from fieldbus.
29	REQ_REF2EXT	1	External PID reference 2 requested from fieldbus
		0	External PID reference 2 is not requested from fieldbus.
30	ACK_STARTINH	1	Start inhibit from fieldbus
		0	No start inhibit from fieldbus
31	Reserved		

14

Fieldbus control with fieldbus adapter

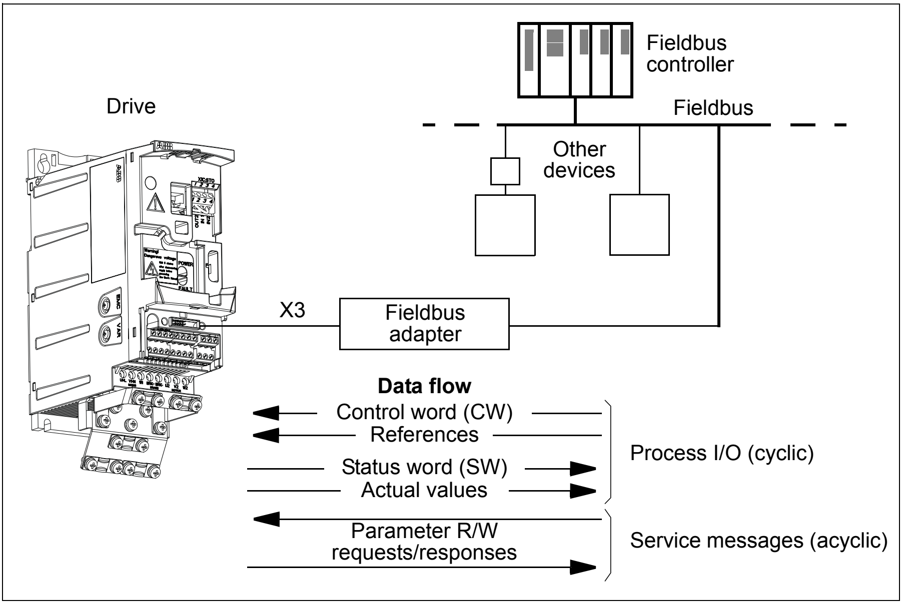
What this chapter contains

The chapter describes how the drive can be controlled by external devices over a communication network through a fieldbus adapter.

System overview

The drive can be connected to an external control system through a fieldbus adapter or embedded fieldbus. For embedded fieldbus control, see chapter *Fieldbus control with embedded fieldbus* on page *313*.

The fieldbus adapter is connected to drive terminal X3.



The drive can be set to receive all of its control information through the fieldbus interface, or the control can be distributed between the fieldbus interface and other available sources, eg, digital and analog inputs.

The drive can communicate to a control system through a fieldbus adapter using, for example, the following serial communication protocols. Other protocols may be available; contact your local ABB representative.

- PROFIBUS-DP (FPBA-01 adapter)
- CANopen (FCAN-01 adapter)
- DeviceNet™ (FDNA-01 adapter)
- Ethernet (FENA-01 adapter)
- Modbus RTU (FMBA-01 adapter. See chapter *Fieldbus control with embedded fieldbus* on page *313*.)

The drive detects automatically which fieldbus adapter is connected to the drive terminal X3 (with the exception of FMBA-01). The DCU profile is always used in communication between the drive and the fieldbus adapter (see section *Fieldbus control interface* on page *344*). The communication profile on the fieldbus network depends on the type and settings of the connected adapter.

The default profile settings are protocol-dependent (for example, vendor-specific profile (ABB drives) for PROFIBUS and industry-standard drive profile (AC/DC Drive) for DeviceNet).

Setting up communication through a fieldbus adapter module

Before configuring the drive for the fieldbus control, the adapter module must be mechanically and electrically installed according to the instructions given in section *Attach the optional fieldbus module* on page *38*, and the module manual.

The communication between the drive and the fieldbus adapter module is activated by setting parameter *9802 COMM PROT SEL* to *EXT FBA*. The adapter-specific parameters in group *51 EXT COMM MODULE* must also be set. See the table below.

Parameter		**Alternative settings**	**Setting for fieldbus control**	**Function/Information**
COMMUNICATION INITIALIZATION				
9802	*COMM PROT SEL*	*NOT SEL* *STD MODBUS* *EXT FBA* *MODBUS RS232*	*EXT FBA*	Initializes the communication between the drive and the fieldbus adapter module.
ADAPTER MODULE CONFIGURATION				
5101	*FBA TYPE*	-	-	Displays the type of the fieldbus adapter module.
5102	*FB PAR 2*	These parameters are adapter module-specific. For more information, see the module manual. Note that not all of these parameters are necessarily used.		
…	…			
5126	*FB PAR 26*			
5127	*FBA PAR REFRESH*	(0) *DONE* (1) *REFRESH*	-	Validates any changed adapter module configuration parameter settings.
Note: In adapter module, the parameter group number is A (group 1) for group *51 EXT COMM MODULE*.				
TRANSMITTED DATA SELECTION				
5401 … *5410*	*FBA DATA IN 1* … *FBA DATA OUT 10*	0 1…6 101…9999		Defines the data transmitted from the drive to the fieldbus controller.
5501 … *5510*	*FBA DATA OUT 1* … *FBA DATA OUT 10*	0 1…6 101…9999		Defines the data transmitted from the fieldbus controller to the drive.
Note: In adapter module, the parameter group number is C (group 3) for group *54 FBA DATA IN* and B (group 2) for group *55 FBA DATA OUT*.				

After the module configuration parameters in groups *51 EXT COMM MODULE*, *54 FBA DATA IN* and *55 FBA DATA OUT* have been set, the drive control parameters (shown in section *Drive control parameters* on page *342*) must be checked and adjusted when necessary.

The new settings will take effect when the drive is next powered up, or when parameter *5127 FBA PAR REFRESH* is activated.

Drive control parameters

After the fieldbus communication has been set up, the drive control parameters listed in the table below should be checked and adjusted where necessary.

The **Setting for fieldbus control** column gives the value to use when the fieldbus interface is the desired source or destination for that particular signal. The **Function/Information** column gives a description of the parameter.

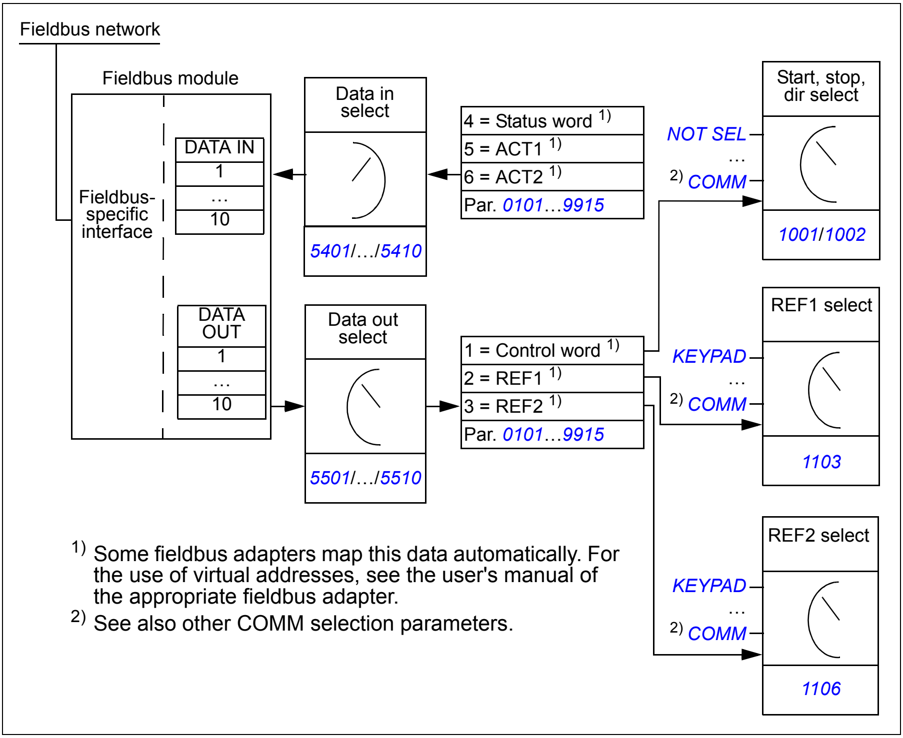
Parameter	Setting for fieldbus control	Function/Information
CONTROL COMMAND SOURCE SELECTION		
1001 EXT1 COMMANDS	*COMM*	Selects the fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.
1002 EXT2 COMMANDS	*COMM*	Selects the fieldbus as the source for the start and stop commands when EXT2 is selected as the active control location.
1003 DIRECTION	*FORWARD* *REVERSE* *REQUEST*	Enables the rotation direction control as defined by parameters *1001* and *1002*. The direction control is explained in section *Reference handling* on page *323*.
1010 JOGGING SEL	*COMM*	Enables jogging 1 or 2 activation through the fieldbus.
1102 EXT1/EXT2 SEL	*COMM*	Enables EXT1/EXT2 selection through the fieldbus.
1103 REF1 SELECT	*COMM* *COMM+AI1* *COMM*AI1*	Fieldbus reference REF1 is used when EXT1 is selected as the active control location. See section *Reference selection and correction* on page *346*.
1106 REF2 SELECT	*COMM* *COMM+AI1* *COMM*AI1*	Fieldbus reference REF2 is used when EXT2 is selected as the active control location. See section *Reference selection and correction* on page *346*.
OUTPUT SIGNAL SOURCE SELECTION		
1401 RELAY OUTPUT 1	*COMM* *COMM(-1)*	Enables relay output RO control by signal *0134 COMM RO WORD*.

Parameter	Setting for fieldbus control	Function/Information
1501 AO1 CONTENT SEL	135 (ie, *0135 COMM VALUE 1*)	Directs the contents of fieldbus reference *0135 COMM VALUE 1* to analog output AO.
SYSTEM CONTROL INPUTS		
1601 RUN ENABLE	*COMM*	Selects the fieldbus interface as the source for the inverted Run enable signal (Run disable).
1604 FAULT RESET SEL	*COMM*	Selects the fieldbus interface as the source for the fault reset signal.
1606 LOCAL LOCK	*COMM*	Selects the fieldbus interface as the source for the local lock signal.
1607 PARAM SAVE	*DONE* *SAVE…*	Saves parameter value changes (including those made through fieldbus control) to the permanent memory.
1608 START ENABLE 1	*COMM*	Selects the fieldbus interface as the source for the inverted Start enable 1 (Start disable) signal.
1609 START ENABLE 2	*COMM*	Selects the fieldbus interface as the source for the inverted Start enable 2 (Start disable) signal.
LIMITS		
2013 MIN TORQUE SEL	*COMM*	Selects the fieldbus interface as the source for the minimum torque limit 1/2 selection.
2014 MAX TORQUE SEL	*COMM*	Selects the fieldbus interface as the source for the maximum torque limit 1/2 selection.
2201 ACC/DEC 1/2 SEL	*COMM*	Selects the fieldbus interface as the source for acceleration/deceleration ramp pair 1/2 selection
2209 RAMP INPUT 0	*COMM*	Selects the fieldbus interface as the source for forcing ramp input to zero.
COMMUNICATION FAULT FUNCTIONS		
3018 COMM FAULT FUNC	*NOT SEL* *FAULT* *CONST SP 7* *LAST SPEED*	Determines the drive action in case the fieldbus communication is lost.
3019 COMM FAULT TIME	0.1 … 60.0 s	Defines the time between the communication loss detection and the action selected with parameter *3018 COMM FAULT FUNC*.
PID CONTROLLER REFERENCE SIGNAL SOURCE SELECTION		
4010/4110/4210 SET POINT SEL	*COMM* *COMM+AI1* *COMM*AI1*	PID control reference (REF2)

Fieldbus control interface

The communication between a fieldbus system and the drive consists of 16-bit input and output data words. The drive supports at the maximum the use of 10 data words in each direction.

Data transformed from the drive to the fieldbus controller is defined by parameter group *54 FBA DATA IN* and data transformed from the fieldbus controller to the drive is defined by parameter group *55 FBA DATA OUT*.



Control word and Status word

The Control word (CW) is the principal means of controlling the drive from a fieldbus system. The Control word is sent by the fieldbus controller to the drive. The drive switches between its states according to the bit-coded instructions of the Control word.

The Status word (SW) is a word containing status information, sent by the drive to the fieldbus controller.

References

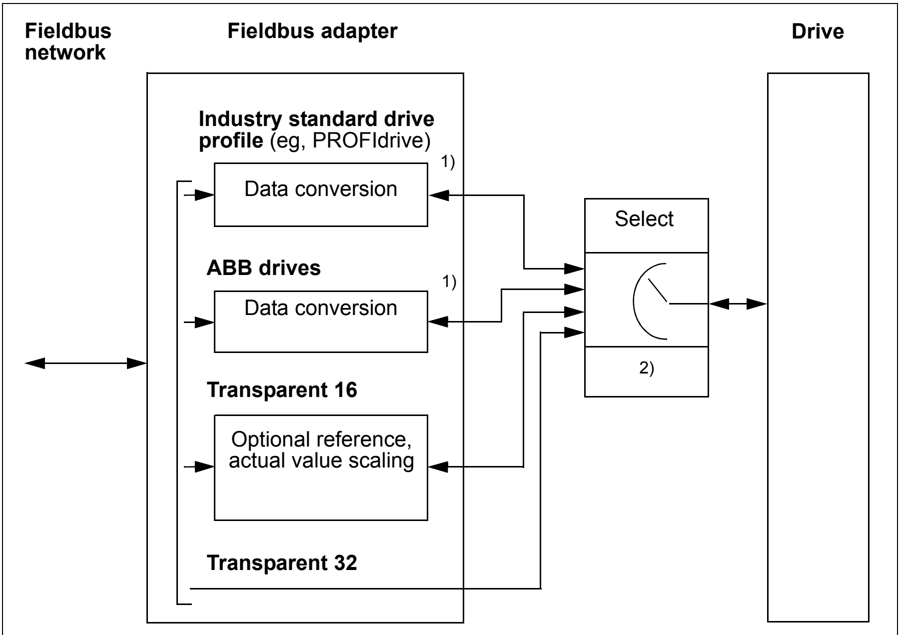
References (REF) are 16-bit signed integers. A negative reference (indicating reversed direction of rotation) is formed by calculating the two’s complement from the corresponding positive reference value. The contents of each reference word can be used as speed or frequency reference.

Actual values

Actual values (ACT) are 16-bit words containing information on selected operations of the drive.

Communication profile

The communication between the drive and the fieldbus adapter supports the DCU communication profile. The DCU profile extends the control and status interface to 32 bits.



1) DCU profile

2) Selection through fieldbus adapter configuration parameters (parameter group *51 EXT COMM MODULE*)

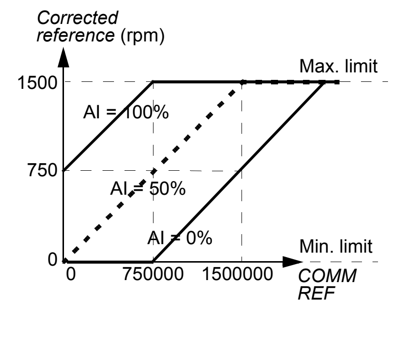
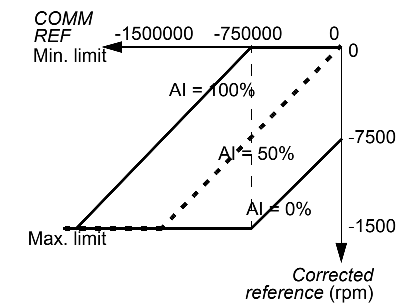
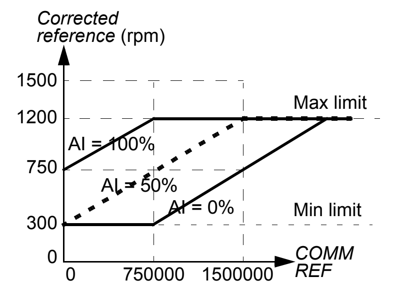
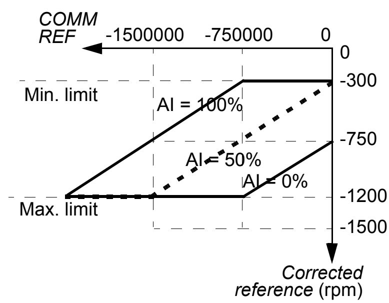
For the DCU profile Control and Status word contents, see section *DCU communication profile* on page *333*.

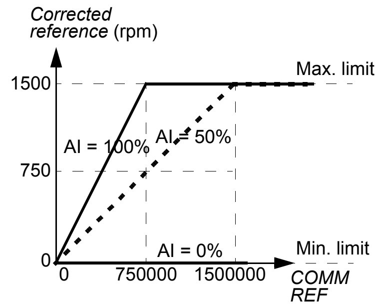
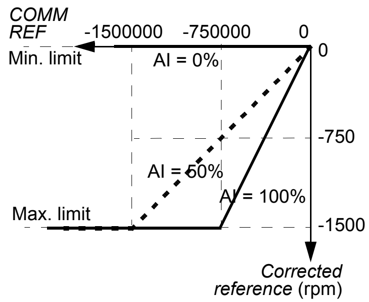
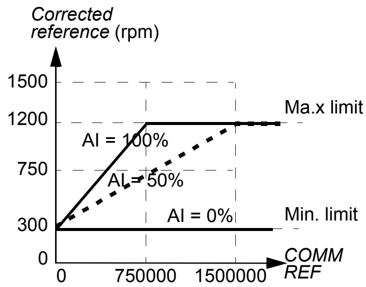
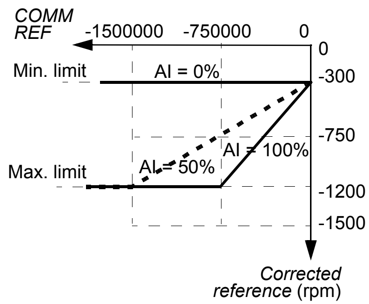
Fieldbus references

Reference selection and correction

Fieldbus reference (called COMM in signal selection contexts) is selected by setting a reference selection parameter – *1103 REF1 SELECT* or *1106 REF2 SELECT* – to *COMM*, *COMM+AI1* or *COMM*AI1*. When parameter *1103* or *1106* is set to *COMM*, the fieldbus reference is forwarded as such without correction. When parameter *1103* or *1106* is set to *COMM+AI1* or *COMM*AI1*, the fieldbus reference is corrected using analog input AI1 as shown in the following examples for the DCU profile.

With the DCU profile the fieldbus reference type can be Hz, rpm or percentage. In the following examples the reference is in rpm.

Setting	**When COMM ≥ 0 rpm**	**When COMM ≤ 0 rpm**
COMM+AI1	COMM/1000 + (AI(%) - 50%) · (MAX-MIN)	COMM/1000 + (AI(%) - 50%) · (MAX-MIN)
		
		
	Maximum limit is defined by parameter *1105 REF1 MAX* / *1108 REF2 MA*. Minimum limit is defined by parameter *1104 REF1 MIN* / *1107 REF2 MIN*.	

Setting	When COMM ≥ 0 rpm	When COMM ≤ 0 rpm
*COM M*AI1*	(COMM/1000) · (AI(%) / 50%)	(COMM/1000) · (AI(%) / 50%)
		
		
	Maximum limit is defined by parameter *1105 REF1 MAX* / *1108 REF2 MA*. Minimum limit is defined by parameter *1104 REF1 MIN* / *1107 REF2 MIN*.	

If the network employs the ODVA AC/DC drive profile and the drive is operating in the scalar mode, the fieldbus speed reference unit is always rpm. The fieldbus adapter module can provide the drive with a frequency reference, if parameter FB PAR 23 ODVA SPEED SCALE or FB PAR 10 ODVA SPEED SCALE is set, but this might not guarantee the accurate speed reference. If there is no accurate speed reference and the EXT1 reference is used, set parameter *1103 REF1 SELECT* to *ODVA HZ REF* (36) to convert the ODVA AC/DC speed reference and actual value type to Hz. In addition, you can set the decimal point location for ODVA frequency reference values by selecting the correct scaling format with parameter *1109 ODVA HZ REF SEL*.

Note: The ODVA AC/DC reference conversion is available only for EXT1 in the scalar mode. The supported networks are Ethernet/IP and DeviceNet.

Fieldbus reference scaling

Fieldbus references REF1 and REF2 are scaled for the DCU profile as shown in the following table.

Note: Any correction of the reference (see section *Reference selection and correction* on page *346*) is applied before scaling.

Reference	Range	Reference type	Scaling	Remarks
REF1	-214783648 … +214783647	Speed or frequency	1000 = 1 rpm / 1 Hz	Final reference limited by *1104*/*1105*. Actual motor speed limited by *2001*/*2002* (speed) or *2007*/*2008* (frequency).
REF2	-214783648 … +214783647	Speed or frequency	1000 = 1%	Final reference limited by *1107*/*1108*. Actual motor speed limited by *2001*/*2002* (speed) or *2007*/*2008* (frequency).
		Torque	1000 = 1%	Final reference limited by *2015*/*2017* (torque 1) or *2016*/*2018* (torque 2).
		PID reference	1000 = 1%	Final reference limited by *4012*/*4013* (PID set 1) or *4112*/*4113* (PID set 2).

Note: The settings of parameters *1104 REF1 MIN* and *1107 REF2 MIN* have no effect on the reference scaling.

Reference handling

Reference handling is the same for the ABB drives profile (embedded fieldbus) and DCU profile. See section *Reference handling* on page *323*.

Actual value scaling

The scaling of the integers sent to the master as Actual values depends on the selected function. See chapter *Actual signals and parameters* on page *179*.

15

Fault tracing

What this chapter contains

The chapter tells how to reset faults and view the fault history. It also lists all alarm and fault messages including the possible cause and corrective actions.

Safety

WARNING! Only qualified electricians are allowed to maintain the drive. Read the safety instructions in chapter *Safety* on page *17* before you work on the drive.

Alarm and fault indications

A fault is indicated with a red LED. See section *LEDs* on page *372*.

An alarm or fault message on the panel display indicates an abnormal drive status. Using the information given in this chapter, most alarm and fault causes can be identified and corrected. If not, contact your local ABB representative.

To display the alarms on the control panel, set parameter *1610 DISPLAY ALARMS* to value 1 (YES).

The four-digit code number in parenthesis after the fault is for the fieldbus communication. See chapters *Fieldbus control with embedded fieldbus* on page *313* and *Fieldbus control with fieldbus adapter* on page *339*.

How to reset

The drive can be reset either by pressing the keypad key RESET EXIT (basic control panel) or RESET (assistant control panel), through digital input or fieldbus, or by switching the supply voltage off for a while. The source for the fault reset signal is selected by parameter *1604 FAULT RESET SEL*. When the fault has been removed, the motor can be restarted.

Fault history

When a fault is detected, it is stored in the fault history. The latest faults are stored together with the time stamp.

Parameters *0401 LAST FAULT*, *0412 PREVIOUS FAULT 1* and *0413 PREVIOUS FAULT 2* store the most recent faults. Parameters *0404*…*0409* show drive operation data at the time the latest fault occurred. The assistant control panel provides additional information about the fault history. See section *Fault logger mode* on page *99* for more information.

Alarm messages generated by the drive

CODE	ALARM	CAUSE	WHAT TO DO
2001	OVERCURRENT *0308* bit 0 (programmable fault function *1610*)	Output current limit controller is active. High ambient temperature.	Check ambient conditions. Load capacity decreases if installation site ambient temperature exceeds 40 °C (104 °F). See section *Derating* on page *376*. For more information, see fault *0001* in *Fault messages generated by the drive* on page *357*.
2002	OVERVOLTAGE *0308* bit 1 (programmable fault function *1610*)	DC overvoltage controller is active.	For more information, see fault *0002* in *Fault messages generated by the drive* on page *357*.
2003	UNDERVOLTAGE *0308* bit 2	DC undervoltage controller is active.	For more information, see fault *0003* in *Fault messages generated by the drive* on page *351*.
2004	DIR LOCK *0308* bit 3	Change of direction is not allowed.	Check parameter *1003 DIRECTION* settings.
2005	IO COMM *0308* bit 4 (programmable fault function *3018*, *3019*)	Fieldbus communication break	Check status of fieldbus communication. See chapter *Fieldbus control with embedded fieldbus* on page *313*, chapter *Fieldbus control with fieldbus adapter* on page *339* or appropriate fieldbus adapter manual. Check fault function parameter settings. Check connections. Check if master can communicate.
2006	AI1 LOSS *0308* bit 5 (programmable fault function *3001*, *3021*)	Analog input AI1 signal has fallen below limit defined by parameter *3021 AI1 FAULT LIMIT*.	For more information, see fault *0007* in *Fault messages generated by the drive* on page *357*.
2007	AI2 LOSS *0308* bit 6 (programmable fault function *3001*, *3022*)	Analog input AI2 signal has fallen below limit defined by parameter *3022 AI2 FAULT LIMIT*.	For more information, see fault in *0008 Fault messages generated by the drive* on page *357*.
2008	PANEL LOSS *0308* bit 7 (programmable fault function *3002*)	Control panel selected as active control location for drive has ceased communicating.	For more information, see fault *0010* in *Fault messages generated by the drive* on page *357*.
2009	DEVICE OVERTEMP *0308* bit 8	Drive IGBT temperature is excessive. Alarm limit depends on the drive type and size.	Check ambient conditions. See also section *Derating* on page *376*. Check air flow and fan operation. Check motor power against drive power.

CODE	ALARM	CAUSE	WHAT TO DO
2010	MOTOR TEMP *0308* bit 9 (programmable fault function *3005*…*3009* / *3503*)	Motor temperature is too high (or appears to be too high) due to excessive load, insufficient motor power, inadequate cooling or incorrect start-up data.	For more information, see fault *0009* in *Fault messages generated by the drive* on page *357*.
		Measured motor temperature has exceeded alarm limit set by parameter *3503 ALARM LIMIT*.	
2011	UNDERLOAD *0308* bit 10 (programmable fault function *3013*…*3015*)	Motor load is too low due to, eg, release mechanism in driven equipment.	Check for problem in driven equipment. Check fault function parameters. Check motor power against drive power.
2012	MOTOR STALL *0308* bit 11 (programmable fault function *3010*…*3012*)	Motor is operating in stall region due to, eg, excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.
2013 1)	AUTORESET *0308* bit 12	Automatic reset alarm	Check parameter group *31 AUTOMATIC RESET* settings.
2018 1)	PID SLEEP *0309* bit 1 (programmable fault function *1610*)	Sleep function has entered sleeping mode.	See parameter groups *40 PROCESS PID SET 1*… *41 PROCESS PID SET 2*.
2019	ID RUN *0309* bit 2	Motor Identification run is on.	This alarm belongs to normal start-up procedure. Wait until drive indicates that motor identification is completed.
2021	START ENABLE 1 MISSING *0309* bit 4	No Start enable 1 signal received	Check parameter *1608 START ENABLE 1* settings. Check digital input connections. Check fieldbus communication settings.
2022	START ENABLE 2 MISSING *0309* bit 5	No Start enable 2 signal received	Check parameter *1609 START ENABLE 2* settings. Check digital input connections. Check fieldbus communication settings.
2023	EMERGENCY STOP *0309* bit 6	Drive has received emergency stop command and ramps to stop according to ramp time defined by parameter *2208 EMERG DEC TIME*.	Check that it is safe to continue operation. Return emergency stop push button to normal position.

CODE	ALARM	CAUSE	WHAT TO DO
2024	ENCODER ERROR *0309* bit 7 (programmable fault function *5003*)	Communication fault between pulse encoder and pulse encoder interface module or between module and drive.	Check pulse encoder and its wiring, pulse encoder interface module and its wiring and parameter group *50 ENCODER* settings.
2025	FIRST START *0309* bit 8	Motor identification magnetization is on. This alarm belongs to normal start-up procedure.	Wait until drive indicates that motor identification is completed.
2026	INPUT PHASE LOSS *0309* bit 9 (programmable fault function *3016*)	Intermediate circuit DC voltage is oscillating due to missing input power line phase or blown fuse. Alarm is generated when DC voltage ripple exceeds 14% of nominal DC voltage.	Check input power line fuses. Check for input power supply imbalance. Check fault function parameters.
2029	MOTOR BACK EMF *0309* bit 12	Permanent magnet synchronous motor is rotating, start mode 2 (*DC MAGN*) is selected with parameter *2101 START FUNCTION*, and run is requested. Drive warns that rotating motor cannot be magnetized with DC current.	If start to rotating motor is required, select start mode 1 (*AUTO*) with parameter *2101 START FUNCTION*. Otherwise drive starts after motor has stopped.
2035	SAFE TORQUE OFF *0309* bit 13	STO (Safe torque off) requested and it functions correctly. Parameter *3025 STO OPERATION* is set to react with alarm.	If this was not expected reaction to safety circuit interruption, check cabling of safety circuit connected to STO terminals X1C. If different reaction is required, change value of parameter *3025 STO OPERATION*. **Note:** Start signal must be reset (toggled to 0) if STO has been used while drive has been running.

[1)] Even when the relay output is configured to indicate alarm conditions (eg, parameter *1401 RELAY OUTPUT 1* = 5 (*ALARM*) or 16 (*FLT/ALARM*)), this alarm is not indicated by a relay output.

Alarms generated by the basic control panel

The basic control panel indicates control panel alarms with a code, A5xxx.

ALARM CODE	CAUSE	WHAT TO DO
5001	Drive is not responding.	Check panel connection.
5002	Incompatible communication profile	Contact your local ABB representative.
5010	Corrupted panel parameter backup file	Retry parameter upload. Retry parameter download.
5011	Drive is controlled from another source.	Change drive control to local control mode.
5012	Direction of rotation is locked.	Enable change of direction. See parameter *1003 DIRECTION*.
5013	Panel control is disabled because start inhibit is active.	Start from panel is not possible. Reset emergency stop command or remove 3-wire stop command before starting from panel. See section *3-wire macro* on page *111* and parameters *1001 EXT1 COMMANDS*, *1002 EXT2 COMMANDS* and *2109 EMERG STOP SEL*.
5014	Panel control is disabled because of drive fault.	Reset drive fault and retry.
5015	Panel control is disabled because local control mode lock is active.	Deactivate local control mode lock and retry. See parameter *1606 LOCAL LOCK*.
5018	Parameter default value is not found.	Contact your local ABB representative.
5019	Writing non-zero parameter value is prohibited.	Only parameter reset is allowed.
5020	Parameter or parameter group does not exist or parameter value is inconsistent.	Contact your local ABB representative.
5021	Parameter or parameter group is hidden.	Contact your local ABB representative.
5022	Parameter is write protected.	Parameter value is read-only and cannot be changed.
5023	Parameter change is not allowed when drive is running.	Stop drive and change parameter value.
5024	Drive is executing a task.	Wait until task is completed.
5025	Software is being uploaded or downloaded.	Wait until upload/download is complete.
5026	Value is at or below minimum limit.	Contact your local ABB representative.
5027	Value is at or above maximum limit.	Contact your local ABB representative.
5028	Invalid value	Contact your local ABB representative.

ALARM CODE	CAUSE	WHAT TO DO
5029	Memory is not ready.	Retry.
5030	Invalid request	Contact your local ABB representative.
5031	Drive is not ready for operation, eg, due to low DC voltage.	Check input power supply.
5032	Parameter error	Contact your local ABB representative.
5040	Parameter download error. Selected parameter set is not in current parameter backup file.	Perform upload function before download.
5041	Parameter backup file does not fit into memory.	Contact your local ABB representative.
5042	Parameter download error. Selected parameter set is not in current parameter backup file.	Perform upload function before download.
5043	No start inhibit	
5044	Parameter backup file restoring error	Check that file is compatible with drive.
5050	Parameter upload aborted	Retry parameter upload.
5051	File error	Contact your local ABB representative.
5052	Parameter upload has failed.	Retry parameter upload.
5060	Parameter download aborted	Retry parameter download.
5062	Parameter download has failed.	Retry parameter download.
5070	Panel backup memory write error	Contact your local ABB representative.
5071	Panel backup memory read error	Contact your local ABB representative.
5080	Operation is not allowed because drive is not in local control mode.	Switch to local control mode.
5081	Operation is not allowed because of active fault.	Check cause of fault and reset fault.
5083	Operation is not allowed because parameter lock is on.	Check parameter *1602 PARAMETER LOCK* setting.
5084	Operation is not allowed because drive is performing a task.	Wait until task is completed and retry.
5085	Parameter download from source to destination drive has failed.	Check that source and destination drive types are same, ie, ACS355. See type designation label of the drive.
5086	Parameter download from source to destination drive has failed.	Check that source and destination drive type designations are the same. See type designation labels of the drives.

ALARM CODE	CAUSE	WHAT TO DO
5087	Parameter download from source to destination drive has failed because parameter sets are incompatible.	Check that source and destination drive information are same. See parameters in group *33 INFORMATION*.
5088	Operation has failed because of drive memory error.	Contact your local ABB representative.
5089	Download has failed because of CRC error.	Contact your local ABB representative.
5090	Download has failed because of data processing error.	Contact your local ABB representative.
5091	Operation has failed because of parameter error.	Contact your local ABB representative.
5092	Parameter download from source to destination drive has failed because parameter sets are incompatible.	Check that source and destination drive information are same. See parameters in group *33 INFORMATION*.

Fault messages generated by the drive

CODE	FAULT	CAUSE	WHAT TO DO
0001	OVERCURRENT (2310) *0305* bit 0	Output current has exceeded trip level.	
		Sudden load change or stall.	Check motor load and mechanics.
		Insufficient acceleration time.	Check acceleration time (*2202* and *2205*). Check the possibility of using vector control.
		Incorrect motor data.	Check that motor data (Group 99) is equal to motor rating plate values. If using vector control, perform ID run (*9910*).
		Motor and/or drive is too small for the application.	Check sizing.
		Damaged motor cables, damaged motor or wrong motor connection (star/delta).	Check motor, motor cable and connections (including phasing).
		Internal fault of the drive. Drive gives an overcurrent fault after start command even when the motor is not connected (use scalar control in this trial).	Replace the drive.
		High frequency noise in STO lines.	Check the STO cabling and remove the noise sources nearby.
0002	DC OVERVOLT (3210) *0305* bit 1	Excessive intermediate circuit DC voltage. DC overvoltage trip limit is 420 V for 200 V drives and 840 V for 400 V drives.	
		Supply voltage is too high or noisy. Static or transient overvoltage in the input power supply.	Check input voltage level and check power line for static or transient overvoltage
		If the drive is used in a floating network, DC overvoltage fault may appear	In a floating network, remove the EMC screw from the drive.

CODE	FAULT	CAUSE	WHAT TO DO
		If the overvoltage fault appears during deceleration, possible causes are: • Overvoltage controller disabled. • Deceleration time is too short. • Faulty or undersized braking chopper.	• Check that overvoltage controller is on (parameter *2005 OVERVOLT CTRL*). • Check deceleration time (*2203*, *2206*). • Check brake chopper and resistor (if used). DC overvoltage control must be deactivated when brake chopper and resistor is used (parameter *2005 OVERVOLT CTRL*). Retrofit drive with brake chopper and brake resistor.
0003	DEV OVERTEMP (4210) *0305* bit 2	Drive IGBT temperature is excessive. The fault trip limit depends on the drive type and size.	
		Ambient temperature is too high.	Check ambient conditions. See also section *Derating* on page *376*.
		Airflow through the inverter is not free.	Check air flow and free space above and below the drive (see section *Free space around the drive* on page *34*).
		Fan is not working properly	Check fan operation.
		Overloading of the drive.	50% overload is allowed for one minute in ten minutes. If higher switching frequency (parameter *2606*) is used, follow the *Derating* rules on page *376*.
0004	SHORT CIRC (2340) *0305* bit 3	Short-circuit in motor cable(s) or motor.	
		Damaged motor or motor cable.	Check motor and cable insulation. Check motor winding
		Internal fault of the drive. Drive gives an overcurrent fault after start command even when the motor is not connected (use scalar control in this trial).	Replace the drive.
		High frequency noise in STO lines.	Check the STO cabling and remove the noise sources nearby.
0006	DC UNDERVOLT (3220) *0305* bit 5	Intermediate circuit DC voltage is not sufficient.	Check input power supply and fuses.
		Undervoltage controller disabled.	Check that undervoltage controller is on (parameter *2006 UNDERVOLT CTRL*).

CODE	FAULT	CAUSE	WHAT TO DO
		Missing input power line phase.	Measure the input and DC voltage during start, stop and running by using a multimeter or check parameter *0107 DC BUS VOLTAGE*.
		Blown fuse	Check the condition of input fuses.
		Rectifier bridge internal fault.	Replace the drive.
0007	AI1 LOSS (8110) *0305* bit 6 (programmable fault function *3001*, *3021*)	Analog input AI1 signal has fallen below limit defined by parameter *3021 AI1 FAULT LIMIT*.	
		Analog input signal is weak or does not exist.	Check the source and wire connections of the analog input.
		Analog input signal is lower than fault limit.	Check parameters *3001 AI<MIN FUNCTION* and *3021 AI1 FAULT LIMIT*.
0008	AI2 LOSS (8110) *0305* bit 7 (programmable fault function *3001*, *3022*)	Analog input AI2 signal has fallen below limit defined by parameter *3022 AI2 FAULT LIMIT*.	.
		Analog input signal is weak or does not exist.	Check the source and wire connections of analog input.
		Analog input signal is lower than fault limit.	Check parameters *3001 AI<MIN FUNCTION* and *3021 AI1 FAULT LIMIT*.

CODE	FAULT	CAUSE	WHAT TO DO
0009	MOT OVERTEMP (4310) *0305* bit 8 (programmable fault function *3005*…*3009* / *3504*)	Motor temperature estimation is too high.	
		Excessive load or insufficient motor power	Check motor ratings, load and cooling.
		Incorrect start-up data.	Check start-up data. Check fault function parameters *3005*...*3009*. Minimize IR compensation to avoid heating (parameter *2603 IR COMP VOLT*). Check frequency of the motor (low running frequency of motor with high input current can cause this fault). Let the motor cool down. The necessary cooling time period depends on the value of parameter *3006 MOT THERM TIME*. Motor temperature estimation is counted down only when the drive is powered on.
		Measured motor temperature has exceeded the fault limit set by parameter *3504 FAULT LIMIT*.	Check value of fault limit. Check that actual number of sensors corresponds to value set by parameter *3501 SENSOR TYPE*. Let the motor cool down. Ensure proper motor cooling: Check the cooling fan, clean cooling surfaces, etc.
0010	PANEL LOSS (5300) *0305* bit 9 (programmable fault function *3002*)	Control panel selected as active control location for drive has ceased communicating.	Check panel connection. Check fault function parameters. Check parameter *3002 PANEL COMM ERR*. Check control panel connector. Refit control panel in mounting platform. If the drive is in external control mode (REM) and is set to accept start/stop, direction commands or references through control panel: Check group *10 START/STOP/DIR* and *11 REFERENCE SELECT* settings.
0011	ID RUN FAIL (FF84) *0305* bit 10	Motor ID run is not completed successfully.	Check motor connection. Check start-up data (group *99 START-UP DATA*). Check maximum speed (parameter *2002*). It should be at least 80% of motor nominal speed (parameter *9908*). Ensure ID run has been performed according to instructions in section *ID run procedure* on page *71*.

CODE	FAULT	CAUSE	WHAT TO DO
0012	MOTOR STALL (7121) *0305* bit 11 (programmable fault function *3010*…*3012*)	Motor is operating in stall region due to, eg, excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters *3010*...*3012*.
0014	EXT FAULT 1 (9000) *0305* bit 13 (programmable fault function *3003*)	External fault 1	Check external devices for faults. Check parameter *3003 EXTERNAL FAULT 1* setting.
0015	EXT FAULT 2 (9001) *0305* bit 14 (programmable fault function *3004*)	External fault 2	Check external devices for faults. Check parameter *3004 EXTERNAL FAULT 2* setting.
0016	EARTH FAULT (2330) *0305* bit 15 (programmable fault function *3017*)	Drive has detected earth (ground) fault in motor or motor cable.	Check motor. Check motor cable. Motor cable length must not exceed maximum specifications. See section *Motor connection data* on page *385*. **Note:** Disabling earth fault (ground fault) may damage drive.
		Drive internal fault.	Internal short-circuit may cause earth fault indication. This has happened if fault *0001* appears after disabling the earth fault. Replace the drive.
0017	UNDERLOAD (FF6A) *0306* bit 0 (programmable fault function *3013*…*3015*)	Motor load is too low due to, eg, release mechanism in driven equipment.	Check for problem in driven equipment. Check fault function parameters *3010*...*3012*. Check motor power against drive power.
0018	THERM FAIL (5210) *0306* bit 1	Temperature of the drive exceeds the operating level of the thermistor.	Check that the ambient temperature is not too low.
		Drive internal fault. Thermistor used for drive internal temperature measurement is open or short-circuited	Replace the drive.
0021	CURR MEAS (2211) *0306* bit 4	Drive internal fault. Current measurement is out of range.	Replace the drive.

CODE	FAULT	CAUSE	WHAT TO DO
0022	SUPPLY PHASE (3130) *0306* bit 5 (programmable fault function *3016*)	Intermediate circuit DC voltage is oscillating due to missing input power line phase or blown fuse.	Check input power line fuses and installation. Check for input power supply imbalance. Check the load.
		Trip occurs when DC voltage ripple exceeds 14% of nominal DC voltage.	Check fault function parameter *2619 DC STABILIZER*.
0023	ENCODER ERR (7301) *0306* bit 6 (programmable fault function *5003*)	Communication fault between pulse encoder and pulse encoder interface module or between module and drive.	Check pulse encoder and its wiring, pulse encoder interface module and its wiring and parameter group *50 ENCODER* settings.
0024	OVERSPEED (7310) *0306* bit 7	Motor is turning faster than 120% of the highest allowed speed due to incorrectly set minimum/maximum speed, insufficient braking torque or changes in load when using torque reference. Operating range limits are set by parameters *2001 MINIMUM SPEED* and *2002 MAXIMUM SPEED* (in vector control) or *2007 MINIMUM FREQ* and *2008 MAXIMUM FREQ* (in scalar control).	Check minimum/maximum frequency settings (parameters *2001 MINIMUM SPEED* and *2002 MAXIMUM SPEED*). Check adequacy of motor braking torque. Check applicability of torque control. Check need for brake chopper and resistor(s).
0027	CONFIG FILE (630F) *0306* bit 10	Internal configuration file error	Replace the drive.
0028	SERIAL 1 ERR (7510) *0306* bit 11 (programmable fault function *3018*, *3019*)	Fieldbus communication break	Check status of fieldbus communication. See chapter *Fieldbus control with embedded fieldbus* on page *313*, chapter *Fieldbus control with fieldbus adapter* on page *339* or appropriate fieldbus adapter manual. Check fault function parameter *3018 COMM FAULT FUNC* and *3019 COMM FAULT TIME* settings. Check connections and/or noise on the line. Check if master can communicate.
0029	EFB CON FILE (6306) *0306* bit 12	Configuration file reading error	Error in reading the configuration files of the embedded fieldbus. See fieldbus user's manual.

CODE	FAULT	CAUSE	WHAT TO DO
0030	FORCE TRIP (FF90) *0306* bit 13	Trip command received from fieldbus	Fault trip was caused by fieldbus. See fieldbus user's manual.
0034	MOTOR PHASE (FF56) *0306* bit 14	Motor circuit fault due to missing motor phase or motor thermistor relay (used in motor temperature measurement) fault.	Check motor and motor cable. Check motor thermistor relay (if used).
0035	OUTP WIRING (FF95) *0306* bit 15 (programmable fault function *3023*)	Incorrect input power and motor cable connection (ie, input power cable is connected to drive motor connection).	Possible power wiring error detected. Check that input power connections are not connected to drive output. Fault can be declared if input power is delta grounded system and motor cable capacitance is large. This fault can be disabled by parameter *3023 WIRING FAULT*.
0036	INCOMPATIBLE SW (630F) *0307* bit 3	Loaded software is not compatible.	Loaded software is not compatible with the drive. Contact your local ABB representative.
0037	CB OVERTEMP (4110) *0305* bit 12	Drive control board overheated. Fault trip limit is 95 °C.	Check for excessive ambient temperature. Check for fan failure. Check for obstructions in air flow. Check the dimensioning and cooling of cabinet.
0044	SAFE TORQUE OFF (FFA0) *0307* bit 4	STO (Safe torque off) requested and it functions correctly. Parameter *3025 STO OPERATION* is set to react with fault.	If this was not expected reaction to safety circuit interruption, check cabling of safety circuit connected to STO terminals X1C. If different reaction is required, change value of parameter *3025 STO OPERATION*. Reset fault before starting.
0045	STO1 LOST (FFA1) *0307* bit 5	STO (Safe torque off) input channel 1 has not de-energized, but channel 2 has. Opening contacts on channel 1 might have been damaged or there is a short-circuit.	Check STO circuit cabling and opening of contacts in STO circuit.
0046	STO2 LOST (FFA2) *0307* bit 6	STO (Safe torque off) input channel 2 has not de-energized, but channel 1 has. Opening contacts on channel 2 might have been damaged or there is a short-circuit.	Check STO circuit cabling and opening of contacts in STO circuit.

CODE	FAULT	CAUSE	WHAT TO DO
0101	SERF CORRUPT (FF55) *0307* bit 14	Drive internal error.	Replace the drive.
0103	SERF MACRO (FF55) *0307* bit 14		
0201	DSP T1 OVERLOAD (6100) *0307* bit 13	Drive internal error.	If fieldbus is in use, check the communication, settings and contacts. Write down fault code and contact your local ABB representative.
0202	DSP T2 OVERLOAD (6100) *0307* bit 13		
0203	DSP T3 OVERLOAD (6100) *0307* bit 13		
0204	DSP STACK ERROR (6100) *0307* bit 12		
0206	CB ID ERROR (5000) *0307* bit 11	Drive internal error.	Replace the drive.
1000	PAR HZRPM (6320) *0307* bit 15	Incorrect speed/frequency limit parameter setting	Check parameter settings. Check that following applies: • *2001 MINIMUM SPEED* < *2002 MAXIMUM SPEED* • *2007 MINIMUM FREQ* < *2008 MAXIMUM FREQ* • *2001 MINIMUM SPEED* / *9908 MOTOR NOM SPEED*, *2002 MAXIMUM SPEED* / *9908 MOTOR NOM SPEED*, *2007 MINIMUM FREQ* / *9907 MOTOR NOM FREQ* and *2008 MAXIMUM FREQ* / *9907 MOTOR NOM FREQ* are within range.
1003	PAR AI SCALE (6320) *0307* bit 15	Incorrect analog input AI signal scaling	Check parameter group *13 ANALOG INPUTS* settings. Check that following applies: • *1301 MINIMUM AI1* < *1302 MAXIMUM AI1* • *1304 MINIMUM AI2* < *1305 MAXIMUM AI2*.

CODE	FAULT	CAUSE	WHAT TO DO
1004	PAR AO SCALE (6320) *0307* bit 15	Incorrect analog output AO signal scaling	Check parameter group *15 ANALOG OUTPUTS* settings. Check that following applies: • *1504 MINIMUM AO1* < *1505 MAXIMUM AO1*.
1005	PAR PCU 2 (6320) *0307* bit 15	Incorrect motor nominal power setting	Check parameter *9909 MOTOR NOM POWER* setting. Following must apply: • 1.1 < (*9906 MOTOR NOM CURR* · *9905 MOTOR NOM VOLT* · 1.73 / P_N) < 3.0 Where P_N = 1000 · *9909 MOTOR NOM POWER* (if units are in kW) or P_N = 746 · *9909 MOTOR NOM POWER* (if units are in hp).
1006	PAR EXT RO (6320) *0307* bit 15 (programmable fault function *3027*)	Incorrect relay output extension parameters	Check parameter settings. Check that following applies: • Output relay module MREL-01 is connected to drive. See parameter *0181 EXTENSION*. • *1402 RELAY OUTPUT 2*, *1403 RELAY OUTPUT 3* and *1410 RELAY OUTPUT 4* have non-zero values. See *MREL-01 output relay module user's manual* (3AUA0000035974 [English]).
1007	PAR FBUSMISS (6320) *0307* bit 15	Fieldbus control has not been activated.	Check fieldbus parameter settings. See chapter *Fieldbus control with fieldbus adapter* on page *339*.
1009	PAR PCU 1 (6320) *0307* bit 15	Incorrect motor nominal speed/frequency setting	Check parameter settings. Following must apply for induction motor: • 1 < (60 · *9907 MOTOR NOM FREQ* / *9908 MOTOR NOM SPEED*) < 16 • 0.8 < *9908 MOTOR NOM SPEED* / (60 · *9907 MOTOR NOM FREQ* / *9913 MOTOR POLE PAIRS*) < 0.992 Following must apply for permanent magnet synchronous motor: • *9908 MOTOR NOM SPEED* / (60 · *9907 MOTOR NOM FREQ* / *9913 MOTOR POLE PAIRS*) = 1.0
1015	PAR USER U/F (6320) *0307* bit 15	Incorrect voltage to frequency (U/f) ratio voltage setting.	Check parameter *2610 USER DEFINED U1* … *2617 USER DEFINED F4* settings.

CODE	FAULT	CAUSE	WHAT TO DO
1017	PAR SETUP 1 (6320) *0307* bit 15	Only two of the following can be used simultaneously: MTAC-01 pulse encoder interface module, frequency input signal or frequency output signal.	Disable frequency output, frequency input or encoder: • change transistor output to digital mode (value of parameter *1804 TO MODE* = 0 [*DIGITAL*]), or • change frequency input selection to other value in parameter groups *11 REFERENCE SELECT*, *40 PROCESS PID SET 1*, *41 PROCESS PID SET 2* and *42 EXT / TRIM PID*, or • disable (parameter *5002 ENCODER ENABLE*) and remove MTAC-01 pulse encoder interface module.

Embedded fieldbus faults

Embedded fieldbus faults can be traced by monitoring group *53 EFB PROTOCOL* parameters. See also fault/alarm *SERIAL 1 ERR* (*0028*).

No master device

If there is no master device on line, parameter *5306 EFB OK MESSAGES* and *5307 EFB CRC ERRORS* values remain unchanged.

What to do:

- Check that the network master is connected and properly configured.
- Check the cable connection.

Same device address

If two or more devices have the same address, parameter *5307 EFB CRC ERRORS* value increases with every read/write command.

What to do:

- Check the device addresses. No two devices on line may have the same address.

Incorrect wiring

If the communication wires are swapped (terminal A on one device is connected to terminal B on another device), parameter *5306 EFB OK MESSAGES*S value remains unchanged and parameter *5307 EFB CRC ERRORS* increases.

What to do:

Check the RS-232/EIA-485 interface connection.

16

Maintenance and hardware diagnostics

What this chapter contains

The chapter contains preventive maintenance instructions and LED indicator descriptions.

Maintenance intervals

If installed in an appropriate environment, the drive requires very little maintenance. The table lists the routine maintenance intervals recommended by ABB.

Maintenance	Interval	Instruction
Reforming of capacitors	Every year when stored	See *Capacitors* on page *371*.
Check of dustiness, corrosion and temperature	Every year	
Replacement of the cooling fan (frame sizes R1…R4)	Every three years	See *Cooling fan* on page *370*.
Check and tightening of the power terminals	Every six years	See *Power connections* on page *371*.
Replacement of the battery in the assistant control panel	Every ten years	See *Changing the battery in the assistant control panel* on page *372*.
Testing of Safe torque off (STO) operation and reaction	Every year	See *Appendix: Safe torque off (STO)* on page *417*.

Consult your local ABB Service representative for more details on the maintenance. On the Internet, go to http://www.abb.com/drives and select *Drive Services – Maintenance and Field Services*.

Cooling fan

The life span of the cooling fan depends on the drive usage and ambient temperature. Automatic fan on/off control increases the life span (see parameter *1612 FAN CONTROL*).

When the assistant control panel is in use, the Notice handler assistant informs when the definable value of the operating hour counter is reached (see parameter *2901 COOLING FAN TRIG*). This information can also be passed to the relay output (see group *14 RELAY OUTPUTS*) regardless of the used panel type.

Fan failure can be predicted by the increasing noise from the fan bearings. If the drive is operated in a critical part of a process, fan replacement is recommended once these symptoms start appearing. Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

Replacing the cooling fan (frame sizes R1…R4)

Only frame sizes R1…R4 include a fan; frame size R0 has natural cooling.

WARNING! Read and follow the instructions in chapter *Safety* on page *17*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

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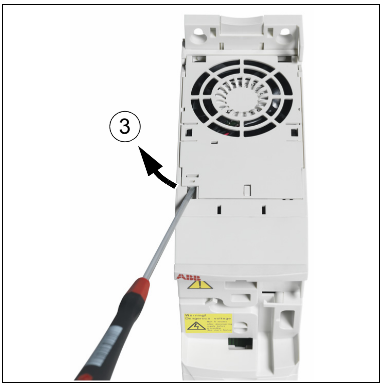
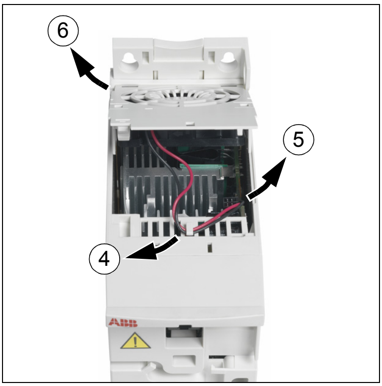
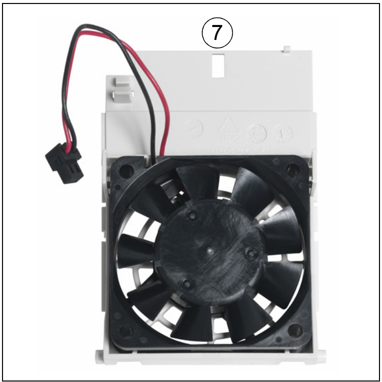
1. Stop the drive and disconnect it from the AC power source.
2. Remove the hood if the drive has the NEMA 1 option.
3. Lever the fan holder off the drive frame with, eg, a screwdriver and lift the hinged fan holder slightly upward from its front edge.
4. Free the fan cable from the clip.
5. Disconnect the fan cable.
6. Remove the fan holder from the hinges.





7. Install the new fan holder including the fan in reverse order.



8. Restore power.

Capacitors

Reforming the capacitors

The capacitors must be reformed if the drive has been stored for a year. See section *Type designation label* on page *30* for how to find out the manufacturing time from the serial number. For information on reforming the capacitors, refer to *Guide for capacitor reforming in ACS50, ACS55, ACS150, ACS310, ACS350, ACS355, ACS550 and ACH550* (3AFE68735190 [English]), available on the Internet (go to http://www.abb.com and enter the code in the Search field).

Power connections

WARNING! Read and follow the instructions in chapter *Safety* on page *17*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Stop the drive and disconnect it from the power line. Wait for five minutes to let the drive DC capacitors discharge. Ensure by measuring with a multimeter (impedance at least 1 Mohm) that there is no voltage present.
2. Check the tightness of the power cable connections. Use the tightening torques given in section *Terminal and lead-through data for the power cables* on page *384*.
3. Restore power.

Control panel

Cleaning the control panel

Use a soft damp cloth to clean the control panel. Avoid harsh cleaners which could scratch the display window.

Changing the battery in the assistant control panel

A battery is only used in assistant control panels that have the clock function available and enabled. The battery keeps the clock operating in memory during power interruptions.

The expected life for the battery is greater than ten years. To remove the battery, use a coin to rotate the battery holder on the back of the control panel. Replace the battery with type CR2032.

Note: The battery is NOT required for any control panel or drive functions, except the clock.

LEDs

There is a green and a red LED on the front of the drive. They are visible through the panel cover but invisible if a control panel is attached to the drive. The assistant control panel has one LED. The table below describes the LED indications.

Where	LED off	LED lit and steady		LED blinking	
On the front of the drive. If a control panel is attached to the drive, switch to remote control (otherwise a fault will be generated), and then remove the panel to be able to see the LEDs.	No power	Green	Power supply on the board OK	Green	Drive in an alarm state
		Red	Drive in a fault state. To reset the fault, press RESET from the control panel or switch off the drive power.	Red	Drive in a fault state. To reset the fault, switch off the drive power.
At the top left corner of the assistant control panel	Panel has no power or no drive connection.	Green	Drive in a normal state	Green	Drive in an alarm state
		Red	Drive in a fault state. To reset the fault, press RESET from the control panel or switch off the drive power.	Red	-

17

Technical data

What this chapter contains

The chapter contains the technical specifications of the drive, eg, ratings, sizes and technical requirements as well as provisions for fulfilling the requirements for CE and other marks.

Ratings

Type ACS355- x = E/U 1)	Input 3) I_{1N} A	I_{1N} (480 V) 4) A	Input with choke 3) I_{1N} A	I_{1N} (480 V) 4) A	Output I_{2N} A	$I_{2,1}$ min/10 min 2) A	I_{2max} A	P_N kW	P_N hp	Frame size
1-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)										
01x-02A4-2	6.1	-	4.5	-	2.4	3.6	4.2	0.37	0.5	R0
01x-04A7-2	11	-	8.1	-	4.7	7.1	8.2	0.75	1	R1
01x-06A7-2	16	-	11	-	6.7	10.1	11.7	1.1	1.5	R1
01x-07A5-2	17	-	12	-	7.5	11.3	13.1	1.5	2	R2
01x-09A8-2	21	-	15	-	9.8	14.7	17.2	2.2	3	R2
3-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)										
03x-02A4-2	4.3	-	2.2	-	2.4	3.6	4.2	0.37	0.5	R0
03x-03A5-2	6.1	-	3.5	-	3.5	5.3	6.1	0.55	0.75	R0
03x-04A7-2	7.6	-	4.2	-	4.7	7.1	8.2	0.75	1	R1
03x-06A7-2	12	-	6.1	-	6.7	10.1	11.7	1.1	1.5	R1
03x-07A5-2	12	-	6.9	-	7.5	11.3	13.1	1.5	2	R1
03x-09A8-2	14	-	9.2	-	9.8	14.7	17.2	2.2	3	R2
03x-13A3-2	22	-	13	-	13.3	20.0	23.3	3	3	R2
03x-17A6-2	25	-	14	-	17.6	26.4	30.8	4	5	R2
03x-24A4-2	41	-	21	-	24.4	36.6	42.7	5.5	7.5	R3
03x-31A0-2	50	-	26	-	31	46.5	54.3	7.5	10	R4
03x-46A2-2	69	-	41	-	46.2	69.3	80.9	11.0	15	R4
3-phase U_N = 380…480 V (380, 400, 415, 440, 460, 480 V)										
03x-01A2-4	2.2	1.8	1.1	0.9	1.2	1.8	2.1	0.37	0.5	R0
03x-01A9-4	3.6	3.0	1.8	1.5	1.9	2.9	3.3	0.55	0.75	R0
03x-02A4-4	4.1	3.4	2.3	1.9	2.4	3.6	4.2	0.75	1	R1
03x-03A3-4	6.0	5.0	3.1	2.6	3.3	5.0	5.8	1.1	1.5	R1
03x-04A1-4	6.9	5.8	3.5	2.9	4.1	6.2	7.2	1.5	2	R1
03x-05A6-4	9.6	8.0	4.8	4.0	5.6	8.4	9.8	2.2	3	R1
03x-07A3-4	12	9.7	6.1	5.1	7.3	11.0	12.8	3	3	R1
03x-08A8-4	14	11	7.7	6.4	8.8	13.2	15.4	4	5	R1
03x-12A5-4	19	16	11	9.5	12.5	18.8	21.9	5.5	7.5	R3
03x-15A6-4	22	18	12	10	15.6	23.4	27.3	7.5	10	R3
03x-23A1-4	31	26	18	15	23.1	34.7	40.4	11	15	R3
03x-31A0-4	52	43	25	20	31	46.5	54.3	15	20	R4
03x-38A0-4	61	51	32	26	38	57	66.5	18.5	25	R4
03x-44A0-4	67	56	38	32	44	66	77.0	22.0	30	R4

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1) E = EMC filter connected (metal EMC filter screw installed),
U = EMC filter disconnected (plastic EMC filter screw installed), US parametrization.

2) Overloading not allowed through Common DC connection.

3) Input current is based on the rated motor nominal power (P_N), supply network, line inductance and load motor.
Input values with choke can be met with ABB CHK-xx or typical 5% chokes.

4) 480 V values are based on the fact that the motor load current is lower with the same output power.

Definitions

Input	
I_{1N}	continuous rms input current (for dimensioning cables and fuses)
I_{1N} **(480 V)**	continuous rms input current (for dimensioning cables and fuses) for drives with 480 V input voltage
Output	
I_{2N}	continuous rms current. 50% overload is allowed for one minute every ten minutes.
$I_{2,1 \min/10 \min}$	maximum (50% overload) current allowed for one minute every ten minutes
I_{2max}	maximum output current. Available for two seconds at start, otherwise as long as allowed by the drive temperature.
P_N	typical motor power. The kilowatt ratings apply to most IEC 4-pole motors. The horsepower ratings apply to most NEMA 4-pole motors. This is also the maximum load through the Common DC connection and must not be exceeded.
R0…R4	ACS355 is manufactured in frame sizes R0…R4. Some instructions and other information that only concern certain frame sizes are marked with the symbol of the frame size (R0…R4).

Sizing

Drive sizing is based on the rated motor current and power. To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current. Also the rated power of the drive must be higher than or equal to compared to the rated motor power. The power ratings are the same regardless of the supply voltage within one voltage range.

Note 1: The maximum allowed motor shaft power is limited to $1.5 \cdot P_N$. If the limit is exceeded, motor torque and current are automatically restricted. The function protects the input bridge of the drive against overload.

Note 2: The ratings apply at ambient temperature of 40 °C (104 °F) for I_{2N}.

Note 3: It is important to check that in Common DC systems the power flowing through the common DC connection does not exceed P_N.

Derating

I_{2N}: The load capacity decreases if the installation site ambient temperature exceeds 40 °C (104 °F), the altitude exceeds 1000 meters (3300 ft) or the switching frequency is changed from 4 kHz to 8, 12 or 16 kHz.

Temperature derating, I_{2N}

In the temperature range +40 °C…+50 °C (+104 °F…+122 °F), the rated output current (I_{2N}) is decreased by 1% for every additional 1 °C (1.8 °F). The output current is calculated by multiplying the current given in the rating table by the derating factor.

Example: If the ambient temperature is 50 °C (+122 °F), the derating factor is $100\% - 1\frac{\%}{°\mathrm{C}} \cdot 10\ °\mathrm{C} = 90\%$ or 0.90. The output current is then $0.90 \cdot I_{2N}$.

Altitude derating, I_{2N}

In altitudes 1000…2000 m (3300…6600 ft) above sea level, the derating is 1% for every 100 m (330 ft).

For 3-phase 200 V drives, the maximum altitude is 3000 m (9800 ft) above sea level. In altitudes 2000…3000 m (6600…9800 ft), the derating is 2% for every 100 m (330 ft).

Switching frequency derating, I_{2N}

The drive derates itself automatically when parameter *2607 SWITCH FREQ CTRL* = 1 (*ON*).

Switching frequency	Drive voltage rating	
	U_N = 200…240 V	U_N = 380…480 V
4 kHz	No derating	No derating
8 kHz	I_{2N} derated to 90%.	I_{2N} derated to 75% for R0 or to 80% for R1…R4.
12 kHz	I_{2N} derated to 80%.	I_{2N} derated to 50% for R0 or to 65% for R1…R4 and maximum ambient temperature derated to 30 °C (86 °F).
16 kHz	I_{2N} derated to 75%.	I_{2N} derated to 50% and maximum ambient temperature derated to 30 °C (86 °F).

When parameter *2607 SWITCH FREQ CTRL* = 2 (*ON (LOAD)*), the drive controls the switching frequency towards the selected switching frequency *2606 SWITCHING FREQ* if the drive's internal temperature allows.

Power cable sizes and fuses

Cable dimensioning for rated currents (I_{1N}) is shown in the table below together with the corresponding fuse types for short-circuit protection of the input power cable. **The rated fuse currents given in the table are the maximums for the mentioned fuse types.** If smaller fuse ratings are used, check that the fuse rms current rating is larger than the rated I_{1N} current given in section *Ratings* on page *374*. If 150% output power is needed, multiply current I_{1N} by 1.5. See also section *Selecting the power cables* on page *41*.

Check that the operating time of the fuse is below 0.5 seconds. The operating time depends on the fuse type, the supply network impedance as well as the cross-sectional area, material and length of the supply cable. In case the 0.5 seconds operating time is exceeded with the gG or T fuses, ultra rapid (aR) fuses will in most cases reduce the operating time to an acceptable level.

Note 1: Larger fuses must not be used when the input power cable is selected according to this table.

Note 2: Choose the correct fuse size according to the actual input current which depends on the input line voltage and the input choke selection.

Note 3: Other fuse types can be used if they meet the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in this table.

Type ACS355-	Fuses		Size of copper conductor in cablings							
	gG	UL Class T or CC (600 V)	Supply (U1, V1, W1)		Motor (U2, V2, W2)		PE		Brake (BRK+, BRK-)	
x = E/U	A	A	mm^2	AWG	mm^2	AWG	mm^2	AWG	mm^2	AWG
1-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)										
01x-02A4-2	10	10	2.5	14	0.75	18	2.5	14	2.5	14
01x-04A7-2	16	20	2.5	14	0.75	18	2.5	14	2.5	14
01x-06A7-2	16/20 1)	25	2.5	10	1.5	14	2.5	10	2.5	12
01x-07A5-2	20/25 1)	30	2.5	10	1.5	14	2.5	10	2.5	12
01x-09A8-2	25/35 1)	35	6	10	2.5	12	6	10	6	12
3-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)										
03x-02A4-2	10	10	2.5	14	0.75	18	2.5	14	2.5	14
03x-03A5-2	10	10	2.5	14	0.75	18	2.5	14	2.5	14
03x-04A7-2	10	15	2.5	14	0.75	18	2.5	14	2.5	14
03x-06A7-2	16	15	2.5	12	1.5	14	2.5	12	2.5	12
03x-07A5-2	16	15	2.5	12	1.5	14	2.5	12	2.5	12
03x-09A8-2	16	20	2.5	12	2.5	12	2.5	12	2.5	12
03x-13A3-2	25	30	6	10	6	10	6	10	2.5	12
03x-17A6-2	25	35	6	10	6	10	6	10	2.5	12
03x-24A4-2	63	60	10	8	10	8	10	8	6	10
03x-31A0-2	80	80	16	6	16	6	16	6	10	8
03x-46A2-2	100	100	25	2	25	2	16	4	10	8

Type ACS355- x = E/U	Fuses		Size of copper conductor in cablings							
	gG	UL Class T or CC (600 V)	Supply (U1, V1, W1)		Motor (U2, V2, W2)		PE		Brake (BRK+, BRK-)	
	A	A	mm^2	AWG	mm^2	AWG	mm^2	AWG	mm^2	AWG
3-phase U_N = 380…480 V (380, 400, 415, 440, 460, 480 V)										
03x-01A2-4	10	10	2.5	14	0.75	18	2.5	14	2.5	14
03x-01A9-4	10	10	2.5	14	0.75	18	2.5	14	2.5	14
03x-02A4-4	10	10	2.5	14	0.75	18	2.5	14	2.5	14
03x-03A3-4	10	10	2.5	12	0.75	18	2.5	12	2.5	12
03x-04A1-4	16	15	2.5	12	0.75	18	2.5	12	2.5	12
03x-05A6-4	16	15	2.5	12	1.5	14	2.5	12	2.5	12
03x-07A3-4	16	20	2.5	12	1.5	14	2.5	12	2.5	12
03x-08A8-4	20	25	2.5	12	2.5	12	2.5	12	2.5	12
03x-12A5-4	25	30	6	10	6	10	6	10	2.5	12
03x-15A6-4	35	35	6	8	6	8	6	8	2.5	12
03x-23A1-4	50	50	10	8	10	8	10	8	6	10
03x-31A0-4	80	80	16	6	16	6	16	6	10	8
03x-38A0-4	100	100	16	4	16	4	16	4	10	8
03x-44A0-4	100	100	25	4	25	4	16	4	10	8

[1)] If 50% overload capacity is needed, use the larger fuse alternative. 00353783.xls L

Alternate short-circuit protection

The ABB Type E manual motor protectors MS132 & S1-M3-25, MS451-xxE, MS495-xxE can be used as an alternate to the recommended fuses as a means of branch circuit protection. This is in accordance with the National Electrical Code (NEC). When the correct ABB Type E manual motor protector is selected from the table and used for branch circuit protection, the drive is suitable for use in a circuit capable of delivering not more than 65 kA RMS symmetrical amperes at the drive maximum rated voltage. See the following table for the appropriate ratings.

IP20 open type and IP21 UL Type 1 ACS355 can use ABB type E manual motor protectors for branch circuit protection. See the MMP rating table for the minimum enlcosure volume of IP20 open type ACS355 mounted in an enclosure.

Type ACS355-	Input Amps	Frame size	MMP type E[1,2]	Min. encl. vol.[5]	
				dm³	cu in
1-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)					
01x-02A4-2	6.1	R0	MS132-6.3 & S1-M3-25[3]	18.9	1152
01x-04A7-2	11.0	R1	MS451-16E	18.9	1152
01x-06A7-2	16.0	R1	MS451-20E	18.9	1152
01x-07A5-2	17.0	R2	MS451-20E	-	-
01x-09A8-2	21.0	R2	MS451-25E	-	-
3-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)[4]					
03x-02A4-2	4.3	R0	MS132-6.3 & S1-M3-25[3]	18.9	1152
03x-03A5-2	6.1	R0	MS132-6.3 & S1-M3-25[3]	18.9	1152
03x-04A7-2	7.6	R1	MS132-10 & S1-M3-25[3]	18.9	1152
03x-06A7-2	11.8	R1	MS451-16E	18.9	1152
03x-07A5-2	12.0	R1	MS451-16E	18.9	1152
03x-09A8-2	14.3	R2	MS451-16E	-	-
03x-13A3-2	22.0	R2	MS451-25E	-	-
03x-17A6-2	25.0	R2	MS451-32E	-	-
03x-24A4-2	41.0	R3	MS451-45E	-	-
03x-31A0-2	50.0	R4	MS495-63E	-	-
03x-46A2-2	69.0	R4	MS495-75E	-	-
3-phase U_N = 380, 400, 415 V[4]					
03x-01A2-4	2.2	R0	MS132-2.5 & S1-M3-25[3]	18.9	1152
03x-01A9-4	3.6	R0	MS132-4.0 & S1-M3-25[3]	18.9	1152
03x-02A4-4	4.1	R1	MS132-6.3 & S1-M3-25[3]	18.9	1152
03x-03A3-4	6.0	R1	MS132-6.3 & S1-M3-25[3]	18.9	1152
03x-04A1-4	6.9	R1	MS132-10 & S1-M3-25[3]	18.9	1152
03x-05A6-4	9.6	R1	MS132-10 & S1-M3-25[3]	18.9	1152
03x-07A3-4	12.0	R1	MS451-16E	18.9	1152
03x-08A8-4	14.0	R1	MS451-16E	18.9	1152
03x-12A5-4	19.0	R3	MS451-20E	-	-
03x-15A6-4	22.0	R3	MS451-25E	-	-
03x-23A1-4	31.0	R3	MS451-32E	-	-
03x-31A0-4	52.0	R4	MS495-63E	-	-
03x-38A0-4	61.0	R4	MS495-63E	-	-
03x-44A0-4	67.0	R4	MS495-75E	-	-
3-phase U_N = 440, 460, 480 V[4]					
03x-01A2-4	1.8	R0	MS132-2.5 & S1-M3-25[3]	18.9	1152
03x-01A9-4	3.0	R0	MS132-4.0 & S1-M3-25[3]	18.9	1152
03x-02A4-4	3.4	R1	MS132-4.0 & S1-M3-25[3]	18.9	1152
03x-03A3-4	5.0	R1	MS132-6.3 & S1-M3-25[3]	18.9	1152
03x-04A1-4	5.8	R1	MS132-6.3 & S1-M3-25[3]	18.9	1152
03x-05A6-4	8.0	R1	MS132-10 & S1-M3-25[3]	18.9	1152

Type ACS355-	Input Amps	Frame size	MMP type E[1,2]	Min. encl. vol.[5)]	
				dm^3	cu in
03x-07A3-4	9.7	R1	MS132-10 & S1-M3-25[3)]	18.9	1152
03x-08A8-4	11.0	R1	MS451-16E	18.9	1152
03x-12A5-4	16.0	R3	MS451-20E	-	-
03x-15A6-4	18.0	R3	MS451-20E	-	-
03x-23A1-4	26.0	R3	MS451-32E	-	-
03x-31A0-4	43.0	R4	MS451-45E	-	-
03x-38A0-4	51.0	R4	MS495-63E	-	-
03x-44A0-4	56.0	R4	MS495-63E	-	-

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1) All manual motor protectors listed are Type E self-protected up to 65 kA. See ABB publication AC1010 for complete technical data on ABB Type E manual motor protectors.

2) Manual motor protectors may require adjusting the trip limit from the factory setting at or above the drive input Amps to avoid nuisance tripping. If the manual motor protector is set to the maximum current trip level and nuisance tripping is occurring, select the next size MMP. (MS132-10 is the highest size in the MS132 frame size to meet Type E at 65kA; the next size up is MS451-16E.)

3) Requires the use of the S1-M3-25 line side feeder terminal with the manual motor protector to meet Type E self-protection class.

4) 480Y/277V only

5) For all drives, the enclosure must be sized to accommodate the specific thermal considerations of the application as well as provide free space for cooling. See section *Free space requirements* on page *381*. For UL only: The minimum enclosure volume is specified in the UL listing for R0 & R1 frame drives when applied with the ABB Type E MMP shown in the table. ACS355 drives are intended to be mounted in an enclosure unless a NEMA 1 kit is added.

Dimensions, weights and free space requirements

Dimensions and weights

Frame size	Dimensions and weights											
	IP20 (cabinet) / UL open											
	H1		H2		H3		W		D		Weight	
	mm	in	mm	in	mm	in	mm	in	mm	in	kg	lb
R0	169	6.65	202	7.95	239	9.41	70	2.76	161	6.34	1.2	2.6
R1	169	6.65	202	7.95	239	9.41	70	2.76	161	6.34	1.4	3.0
R2	169	6.65	202	7.95	239	9.41	105	4.13	165	6.50	1.8	3.9
R3	169	6.65	202	7.95	236	9.29	169	6.65	169	6.65	3.1	6.9
R4	181	7.13	202	7.95	244	9.61	260	10.24	169	6.65	5.2	11.5

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Frame size	Dimensions and weights									
	IP20 / NEMA 1									
	H4		H5		W		D		Weight	
	mm	in	mm	in	mm	in	mm	in	kg	lb
R0	257	10.12	280	11.02	70	2.76	169	6.65	1.6	3.5
R1	257	10.12	280	11.02	70	2.76	169	6.65	1.8	3.9
R2	257	10.12	282	11.10	105	4.13	169	6.65	2.2	4.8
R3	260	10.24	299	11.77	169	6.65	177	6.97	3.7	8.2
R4	270	10.63	320	12.60	260	10.24	177	6.97	5.8	12.9

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Symbols

IP20 (cabinet) / UL open

H1 height without fastenings and clamping plate

H2 height with fastenings, without clamping plate

H3 height with fastenings and clamping plate

IP20 / NEMA 1

H4 height with fastenings and connection box

H5 height with fastenings, connection box and hood

Weight is calculated as the measured drive weight + cable clamps + 50 g (for component tolerances).

Free space requirements

Frame size	Free space required					
	Above		Below		On the sides	
	mm	in	mm	in	mm	in
R0…R4	75	3	75	3	0	0

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Losses, cooling data and noise

Losses and cooling data

Frame size R0 has natural convection cooling. Frame sizes R1…R4 are provided with an internal fan. The air flow direction is from bottom to top.

The table below specifies the heat dissipation in the main circuit at nominal load and in the control circuit with minimum load (I/O and panel not in use) and maximum load (all digital inputs in the on state and the panel, fieldbus and fan in use). The total heat dissipation is the sum of the heat dissipation in the main and control circuits.

Type ACS355- x = E/U	Heat dissipation			Air flow	
	Main circuit	Control circuit			
	Rated I_{1N} and I_{2N}	Min	Max		
	W	W	W	m^3/h	ft^3/min
1-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)					
01x-02A4-2	25	6.1	22.7	-	-
01x-04A7-2	46	9.5	26.4	24	14
01x-06A7-2	71	9.5	26.4	24	14
01x-07A5-2	73	10.5	27.5	21	12
01x-09A8-2	96	10.5	27.5	21	12
3-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)					
03x-02A4-2	19	6.1	22.7	-	-
03x-03A5-2	31	6.1	22.7	-	-
03x-04A7-2	38	9.5	26.4	24	14
03x-06A7-2	60	9.5	26.4	24	14
03x-07A5-2	62	9.5	26.4	21	12
03x-09A8-2	83	10.5	27.5	21	12
03x-13A3-2	112	10.5	27.5	52	31
03x-17A6-2	152	10.5	27.5	52	31
03x-24A4- 2	250	16.6	35.4	71	42
03x-31A0-2	270	33.4	57.8	96	57
03x-46A2-2	430	33.4	57.8	96	57

Type ACS355- x = E/U	Heat dissipation			Air flow	
	Main circuit	Control circuit			
	Rated I_{1N} and I_{2N}	Min	Max		
	W	W	W	m^3/h	ft^3/min
3-phase U_N = 380…480 V (380, 400, 415, 440, 460, 480 V)					
03x-01A2-4	11	6.6	24.4	-	-
03x-01A9-4	16	6.6	24.4	-	-
03x-02A4-4	21	9.8	28.7	13	8
03x-03A3-4	31	9.8	28.7	13	8
03x-04A1-4	40	9.8	28.7	13	8
03x-05A6-4	61	9.8	28.7	19	11
03x-07A3-4	74	14.1	32.7	24	14
03x-08A8-4	94	14.1	32.7	24	14
03x-12A5-4	130	12.0	31.2	52	31
03x-15A6-4	173	12.0	31.2	52	31
03x-23A1-4	266	16.6	35.4	71	42
03x-31A0-4	350	33.4	57.8	96	57
03x-38A0-4	440	33.4	57.8	96	57
03x-44A0-4	530	33.4	57.8	96	57

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Noise

Frame size	Noise level
	dBA
R0	<30
R1	50…62
R2	50…62
R3	50…62
R4	<62

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Terminal and lead-through data for the power cables

Frame size	Max. cable diameter for NEMA 1				U1, V1, W1, U2, V2, W2, BRK+ and BRK-				PE			
	U1, V1, W1, U2, V2, W2		BRK+ and BRK-		Terminal size		Tightening torque		Clamp size		Tightening torque	
	mm	in	mm	in	mm^2	AWG	N·m	lbf·in	mm^2	AWG	N·m	lbf·in
R0	16	0.63	16	0.63	4.0/6.0	10	0.8	7	25	3	1.2	11
R1	16	0.63	16	0.63	4.0/6.0	10	0.8	7	25	3	1.2	11
R2	16	0.63	16	0.63	4.0/6.0	10	0.8	7	25	3	1.2	11
R3	29	1.14	16	0.63	10.0/16.0	6	1.7	15	25	3	1.2	11
R4	35	1.38	29	1.14	25.0/35.0	2	2.5	22	25	3	1.2	11

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Terminal and lead-through data for the control cables

Conductor size		Tightening torque	
Min/Max	Min/Max		
mm^2	AWG	N·m	lbf·in
0.25/1.5	24/16	0.5	4.4

Electric power network specification

Voltage (U_1)	200/208/220/230/240 V AC 1-phase for 200 V AC drives 200/208/220/230/240 V AC 3-phase for 200 V AC drives 380/400/415/440/460/480 V AC 3-phase for 400 V AC drives ±10% variation from converter nominal voltage is allowed as default.
Short-circuit capacity	Maximum allowed prospective short-circuit current at the input power connection as defined in IEC 61439-1:2009 and UL 508C is 100 kA. The drive is suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes at the drive maximum rated voltage.
Frequency	50/60 Hz ± 5%, maximum rate of change 17%/s
Imbalance	Max. ±3% of nominal phase-to-phase input voltage

Motor connection data

Motor type	Asynchronous induction motor or permanent magnet synchronous motor
Voltage (U_2)	0 to U_1, 3-phase symmetrical, U_{max} at the field weakening point
Short-circuit protection (IEC 61800-5-1, UL 508C)	The motor output is short-circuit proof by IEC 61800-5-1 and UL 508C.
Frequency	0…599 Hz
Frequency resolution	0.01 Hz
Current	See section *Ratings* on page *374*.
Power limit	$1.5 \cdot P_N$
Field weakening point	10…599 Hz
Switching frequency	4, 8, 12 or 16 kHz (in scalar control)
Speed control	See section *Speed control performance figures* on page *145*.
Torque control	See section *Torque control performance figures* on page *146*.

Maximum recommended motor cable length

Operational functionality and motor cable length

The drive is designed to operate with optimum performance with the following maximum motor cable lengths. The motor cable lengths may be extended with output chokes as shown in the table.

Frame size	Maximum motor cable length	
	m	ft
Standard drive, without external options		
R0	30	100
R1…R4	50	165
With external output chokes		
R0	60	195
R1…R4	100	330

Note: In multimotor systems, the calculated sum of all motor cable lengths must not exceed the maximum motor cable length given in the table.

EMC compatibility and motor cable length

To comply with the European EMC Directive (standard IEC/EN 61800-3), use the following maximum motor cable lengths for 4 kHz switching frequency.

All frame sizes	Maximum motor cable length, 4 kHz	
	m	ft
With internal EMC filter		
Second environment (category C3 1))	30	100
With optional external EMC filter		
Second environment (category C3 1))	30 (at least) 2)	100 (at least) 2)
First environment (category C2 1))	30 (at least) 2)	100 (at least) 2)
First environment (category C1 1))	10 (at least) 2)	30 (at least) 2)

1) See the terms in section *Definitions* on page *391*.

2) Maximum motor cable length is determined by the drive's operational factors. Contact your local ABB representative for the

Note 1: The internal EMC filter must be disconnected by removing the EMC screw (see the figure on page *50*) while using the low leakage current EMC filter (LRFI-XX).

Note 2: Radiated emissions are according to C2 with and without an external EMC filter.

Note 3: Category C1 with conducted emissions only. Radiated emissions are not compatible when measured with standard emission measurement setup and should be checked or measured on cabinet and machine installations case by case.

Control connection data

Analog inputs X1A: 2 and 5 (AI1 and AI2)	Voltage signal, unipolar bipolar Current signal, unipolar bipolar Potentiometer reference value (X1A: 4) Resolution Accuracy	0 (2)…10 V, R_{in} = 675 kohm -10…10 V, R_{in} = 675 kohm 0 (4)…20 mA, R_{in} = 100 ohm -20…20 mA, R_{in} = 100 ohm 10 V ± 1%, max. 10 mA, R < 10 kohm 0.1% ±2%
Analog output X1A: 7 (AO)		0 (4)…20 mA, load < 500 ohm
Auxiliary voltage X1A: 9		24 V DC ± 10%, max. 200 mA
Digital inputs X1A: 12…16 (DI1…DI5)	Voltage Type Input impedance, X1A: 12…15 X1A: 16	12…24 V DC with internal or external supply. Max. voltage for digital inputs 30 V DC. PNP and NPN R_{in} = 2 kohm R_{in} = 4 kohm
Frequency input X1A: 16 (DI5)	X1A: 16 can be used either as a digital or as a frequency input. Frequency	Pulse train 0…10 kHz with 50% duty cycle. 0…16 kHz between two ACS355 drives.
Relay output X1B: 17…19 (RO 1)	Type Max. switching voltage Max. switching current Max. continuous current	NO + NC 250 V AC / 30 V DC 0.5 A / 30 V DC; 5 A / 230 V AC 2 A rms
Digital output X1B: 20…21 (DO)	Type Max. switching voltage Max. switching current Frequency Resolution Accuracy	Transistor output PNP 30 V DC 100 mA / 30 V DC, short-circuit protected 10 Hz …16 kHz 1 Hz 0.2%
Frequency output X1B: 20…21 (FO)	X1A: 20…21 can be used either as a digital or as a frequency output.	
STO interface X1C: 23…26	See *Appendix: Safe torque off (STO)* on page *417*.	

Clearance and creepage distance

Clearance and creepage distance between I/O connections and the main circuit is 5.5 mm (0.20 in). This meets the requirement for the reinforced insulation of overvoltage category 3 when the installation altitude is below 2000 m (6562 ft). (EC 61800-5-1).

Brake resistor connection

Short-circuit protection (IEC 61800-5-1, IEC 60439-1, UL 508C)	The brake resistor output is conditionally short-circuit proof by IEC/EN 61800-5-1 and UL 508C. For correct fuse selection, contact your local ABB representative. Rated conditional short-circuit current as defined in IEC 60439-1 and the Short-circuit test current by UL 508C is 100 kA.

Common DC connection

Maximum power through common DC connection is equal to the drive nominal power. See *ACS355 Common DC application guide* (3AUA0000070130 [English]).

Efficiency

Approximately 95 to 98% at nominal power level, depending on the drive size and options.

Degrees of protection

IP20 (cabinet installation) / UL open: Standard enclosure. The drive must be installed in a cabinet to fulfil the requirements for shielding from contact.

IP20 / NEMA 1: Achieved with an option kit (MUL1-R1, MUL1-R3 or MUL1-R4) including a hood and a connection box.

Ambient conditions

Environmental limits for the drive are given below. The drive is to be used in a heated indoor controlled environment.

	Operation installed for stationary use	**Storage** in the protective package	**Transportation** in the protective package
Installation site altitude	0…2000 m (6600 ft) above sea level (above 1000 m [3300 ft], see section *Derating* on page *376*)	-	-
Air temperature	-10 … +50 °C (14 … 122 °F). No frost allowed. See section *Derating* on page *376*.	-40 … +70 °C ±2% (-40 … +158 °F ±2%)	-40 … +70 °C ±2% (-40 … +158 °F ±2%)
Relative humidity	0 … 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination levels (IEC 60721-3-3, IEC 60721-3-2, IEC 60721-3-1)	No conductive dust allowed.		
	According to IEC 60721-3-3, chemical gases: Class 3C2 solid particles: Class 3S2. **Note:** The drive must be installed in clean air according to enclosure classification. **Note:** Cooling air must be clean, free from corrosive materials and electrically conductive dust.	According to IEC 60721-3-1, chemical gases: Class 1C2 solid particles: Class 1S2	According to IEC 60721-3-2, chemical gases: Class 2C2 solid particles: Class 2S2
Sinusoidal vibration (IEC 60721-3-3)	Tested according to IEC 60721-3-3, mechanical conditions: Class 3M4 2…9 Hz, 3.0 mm (0.12 in) 9…200 Hz, 10 m/s^2 (33 ft/s^2)	-	-

Shock (IEC 60068-2-27, ISTA 1A)	Not allowed	According to ISTA 1A. Max. 100 m/s^2 (330 ft/s^2), 11 ms.	According to ISTA 1A. Max. 100 m/s^2 (330 ft/s^2), 11 ms.
Free fall	Not allowed	76 cm (30 in)	76 cm (30 in)

Materials

Drive enclosure	• PC/ABS 2 mm, PC+10%GF 2.5…3 mm and PA66+25%GF 1.5 mm, all in color NCS 1502-Y (RAL 9002 / PMS 420 C) • hot-dip zinc coated steel sheet 1.5 mm, thickness of coating 20 micrometers • extruded aluminum AlSi.
Package	Corrugated cardboard.
Disposal	The drive contains raw materials that should be recycled to preserve energy and natural resources. The package materials are environmentally compatible and recyclable. All metal parts can be recycled. The plastic parts can either be recycled or burned under controlled circumstances, according to local regulations. Most recyclable parts are marked with recycling marks. If recycling is not feasible, all parts excluding electrolytic capacitors and printed circuit boards can be landfilled. The DC capacitors contain electrolyte, which is classified as hazardous waste within the EU. They must be removed and handled according to local regulations. For further information on environmental aspects and more detailed recycling instructions, please contact your local ABB distributor.

Applicable standards

The drive complies with the following standards:

• **EN ISO 13849-1: 2008**	Safety of machinery - Safety related parts of control systems - Part 1: general principles for design
• **IEC/EN 60204-1: 2006**	Safety of machinery. Electrical equipment of machines. Part 1: General requirements. *Provisions for compliance:* The final assembler of the machine is responsible for installing - an emergency-stop device - a supply disconnecting device.
• **IEC/EN 62061: 2005**	Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems
• **IEC/EN 61800-3: 2004**	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods
• **IEC/EN 61800-5-1: 2007**	Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy
• **IEC/EN 61800-5-2: 2007**	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements. Functional.
• **UL 508C**	UL Standard for Safety, Power Conversion Equipment, third edition

CE marking

The CE mark is attached to the drive to verify that the drive follows the provisions of the European Low Voltage and EMC Directives.

Compliance with the European EMC Directive

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard (EN 61800-3:2004) covers requirements stated for drives. See section *Compliance with EN 61800-3:2004* on page *391*.

Compliance with EN 61800-3:2004

Definitions

EMC stands for **E**lectro**m**agnetic **C**ompatibility. It is the ability of electrical/electronic equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality.

First environment includes establishments connected to a low-voltage network which supplies buildings used for domestic purposes.

Second environment includes establishments connected to a network not directly supplying domestic premises.

Drive of category C1: drive of rated voltage less than 1000 V, intended for use in the first environment.

Drive of category C2: drive of rated voltage less than 1000 V and intended to be installed and commissioned only by a professional when used in the first environment.

Note: A professional is a person or organization having necessary skills in installing and/or commissioning power drive systems, including their EMC aspects.

Category C2 has the same EMC emission limits as the earlier class first environment restricted distribution. EMC standard IEC/EN 61800-3 does not any more restrict the distribution of the drive, but the using, installation and commissioning are defined.

Drive of category C3: drive of rated voltage less than 1000 V, intended for use in the second environment and not intended for use in the first environment.

Category C3 has the same EMC emission limits as the earlier class second environment unrestricted distribution.

Category C1

The emission limits are complied with the following provisions:

1. The optional EMC filter is selected according to the ABB documentation and installed as specified in the EMC filter manual.
2. The motor and control cables are selected as specified in this manual.
3. The drive is installed according to the instructions given in this manual.
4. For the maximum motor cable length with 4 kHz switching frequency, see page 386.

WARNING! In a domestic environment, this product may cause radio inference, in which case supplementary mitigation measures may be required.

Category C2

The emission limits are complied with the following provisions:

1. The optional EMC filter is selected according to the ABB documentation and installed as specified in the EMC filter manual.
2. The motor and control cables are selected as specified in this manual.
3. The drive is installed according to the instructions given in this manual.
4. For the maximum motor cable length with 4 kHz switching frequency, see page 386.

WARNING! In a domestic environment, this product may cause radio inference, in which case supplementary mitigation measures may be required.

Category C3

The immunity performance of the drive complies with the demands of IEC/EN 61800-3, second environment (see page 391 for IEC/EN 61800-3 definitions).

The emission limits are complied with the following provisions:

1. The internal EMC filter is connected (the metal screw at EMC is in place) or the optional EMC filter is installed.
2. The motor and control cables are selected as specified in this manual.
3. The drive is installed according to the instructions given in this manual.
4. With the internal EMC filter: motor cable length 30 m (100 ft) with 4 kHz switching frequency. For the maximum motor cable length with an optional external EMC filter, see page 386.

WARNING! A drive of category C3 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

Note: It is not allowed to install a drive with the internal EMC filter connected on IT (ungrounded) systems. The supply network becomes connected to ground potential through the EMC filter capacitors which may cause danger or damage the drive.

Note: It is not allowed to install a drive with the internal EMC filter connected on a corner-grounded TN system as this would damage the drive.

UL marking

See the type designation label for the valid markings of your drive.

The UL mark is attached to the drive to verify that it meets UL requirements.

UL checklist

Input power connection – See section *Electric power network specification* on page *385*.

Disconnecting device (disconnecting means) – See *Selecting the supply disconnecting device (disconnecting means)* on page *40*.

Ambient conditions – The drives are to be used in a heated indoor controlled environment. See section *Ambient conditions* on page *389* for specific limits.

Input cable fuses – For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. To fulfil this requirement, use the UL classified fuses given in section *Power cable sizes and fuses* on page *377*.

For installation in Canada, branch circuit protection must be provided in accordance with Canadian Electrical Code and any applicable provincial codes. To fulfil this requirement, use the UL classified fuses given in section *Power cable sizes and fuses* on page *377*.

Power cable selection – See section *Selecting the power cables* on page *41*.

Power cable connections – For the connection diagram and tightening torques, see section *Connecting the power cables* on page *51*.

Overload protection – The drive provides overload protection in accordance with the National Electrical Code (US).

Braking – The drive has an internal brake chopper. When applied with appropriately sized brake resistors, the brake chopper will allow the drive to dissipate regenerative energy (normally associated with quickly decelerating a motor). Brake resistor selection is discussed in *Appendix: Resistor braking* on page *405*.

C-Tick marking

See the type designation label for the valid markings of your drive.

C-Tick marking is required in Australia and New Zealand. A C-Tick mark is attached to the drive to verify compliance with the relevant standard (IEC 61800-3:2004 – Adjustable speed electrical power drive systems – Part 3: EMC product standard including specific test methods), mandated by the Trans-Tasman Electromagnetic Compatibility Scheme.

The Trans-Tasman Electromagnetic Compatibility Scheme (EMCS) was introduced by the Australian Communication Authority (ACA) and the Radio Spectrum Management Group (RSM) of the New Zealand Ministry of Economic Development (NZMED) in November 2001. The aim of the scheme is to protect the radio frequency spectrum by introducing technical limits for emission from electrical/electronic products.

For fulfilling the requirements of the standard, see section *Compliance with EN 61800-3:2004* on page *391*.

TÜV NORD Safety Approved mark

The presence of the TÜV NORD Safety Approved mark verifies that the drive has been evaluated and certified by TÜV NORD according to the following standards for the realization of the Safe torque off function (STO): IEC 61508-1:2010, IEC 61508-2:2010; IEC/EN 62061:2005 and EN ISO 13849-1:2008. See *Appendix: Safe torque off (STO)*.

RoHS marking

The RoHS mark is attached to the drive to verify that the drive follows the provisions of the European RoHS Directive. RoHS = the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Compliance with the Machinery Directive

The drive is a machinery component that can be integrated into a wide range of machinery categories as specified in European Commission’s Guide to application of the Machinery Directive 2006/42/EC 2nd Edition – June 2010.

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Dimension drawings

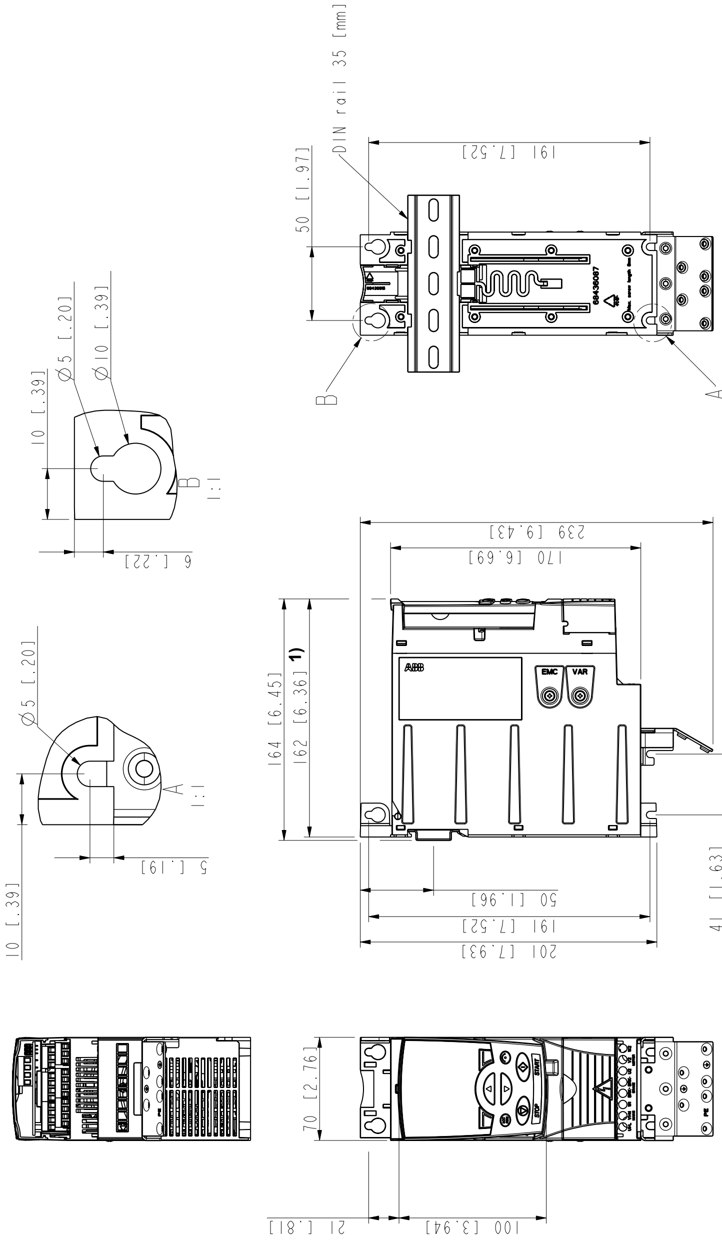
What this chapter contains

This chapter contains the dimension drawings of the drive.

Dimension drawings of the ACS355 are shown below. The dimensions are given in millimeters and [inches].

Frame sizes R0 and R1, IP20 (cabinet installation) / UL open

R1 and R0 are identical except for the fan at the top of R1.



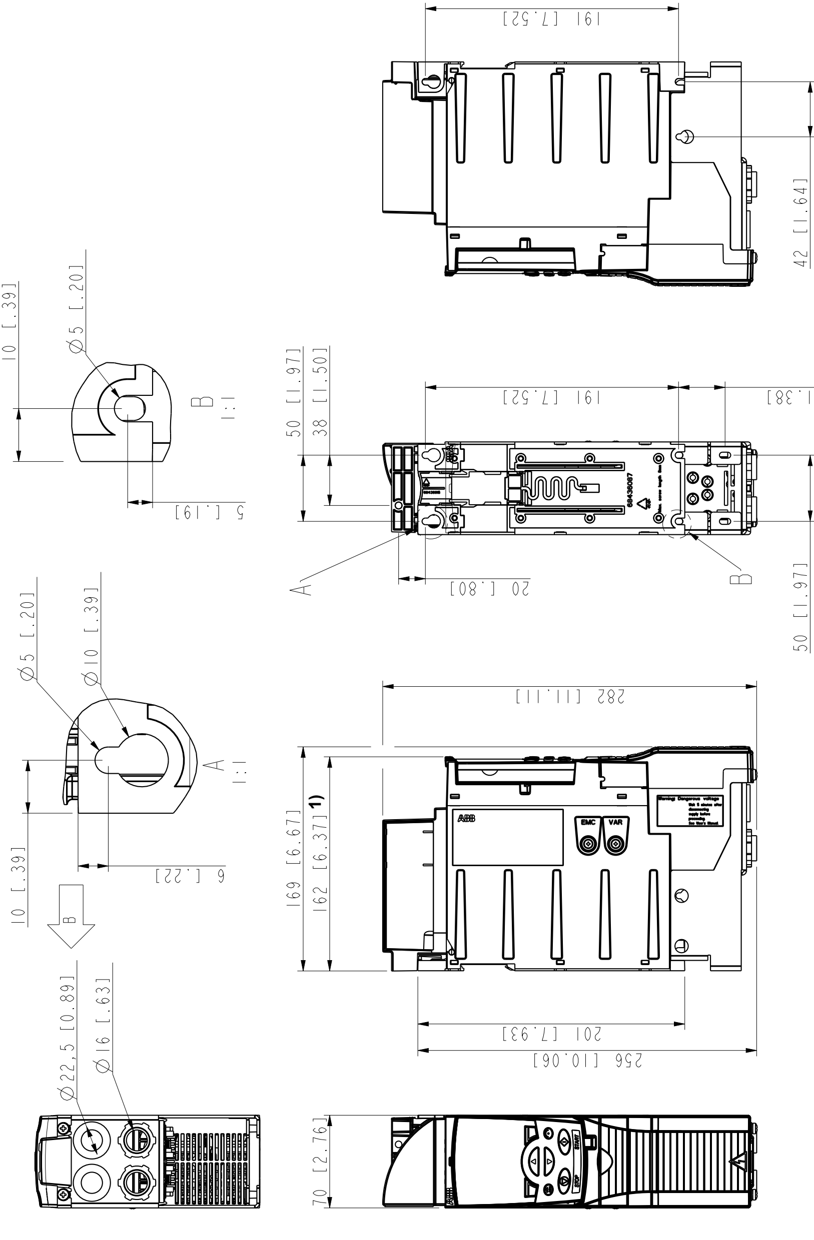
1) Extension modules add 26 mm (1.02 in) to the depth measure.

Frame sizes R0 and R1, IP20 (cabinet installation) / UL open

3AUA0000067784-A

Frame sizes R0 and R1, IP20 / NEMA 1

R1 and R0 are identical except for the fan at the top of R1.

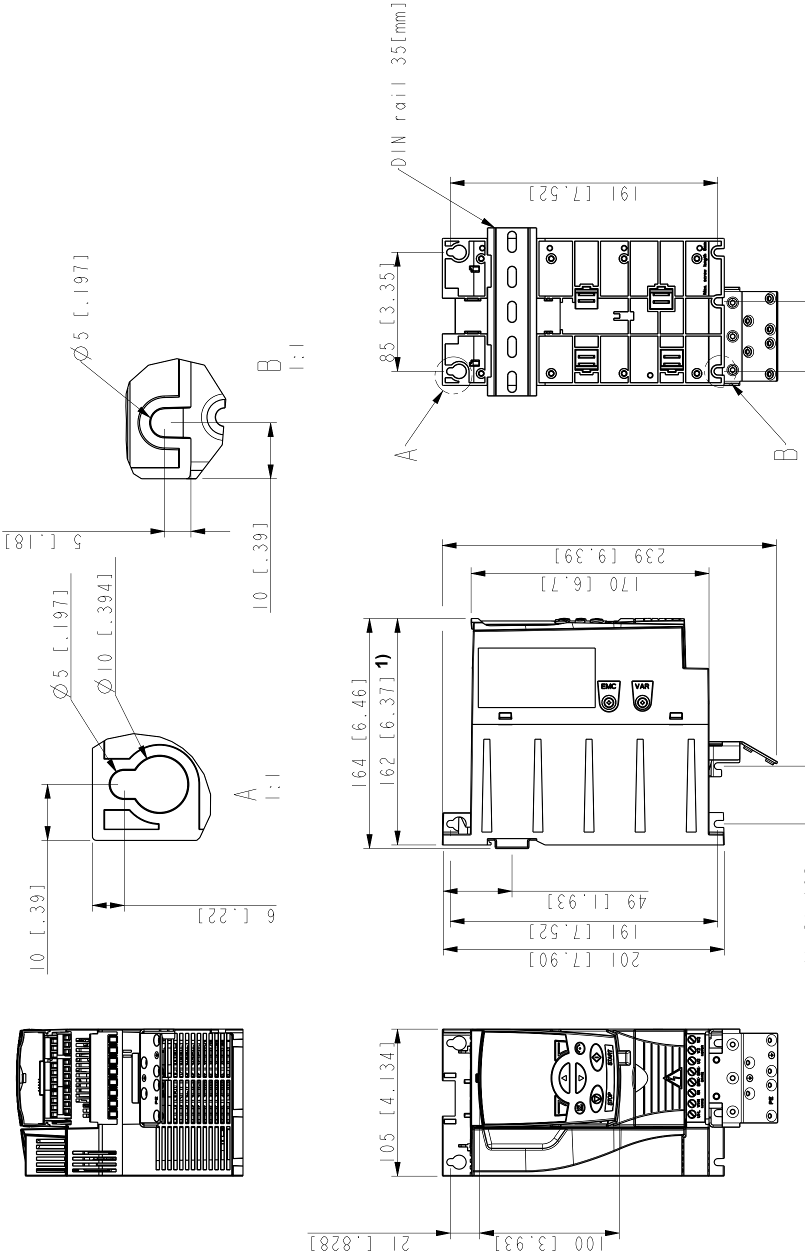


Frame sizes R0 and R1, IP20 / NEMA 1

1) Extension modules add 26 mm (1.02 in) to the depth measure.

3AUA0000067785-B

Frame size R2, IP20 (cabinet installation) / UL open

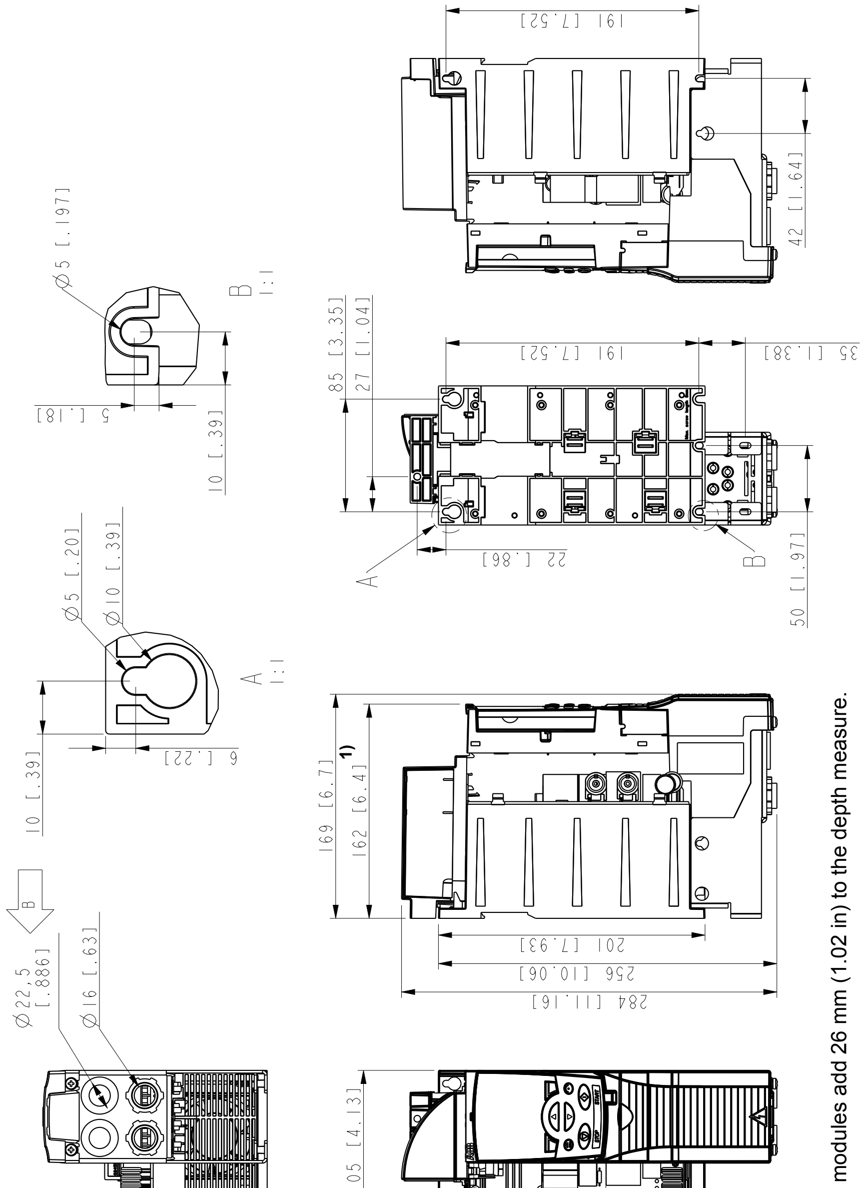


Frame size R2, IP20 (cabinet installation) / UL open

1) Extension modules add 26 mm (1.02 in) to the depth measure.

3AUA0000067782-A

Frame size R2, IP20 / NEMA 1

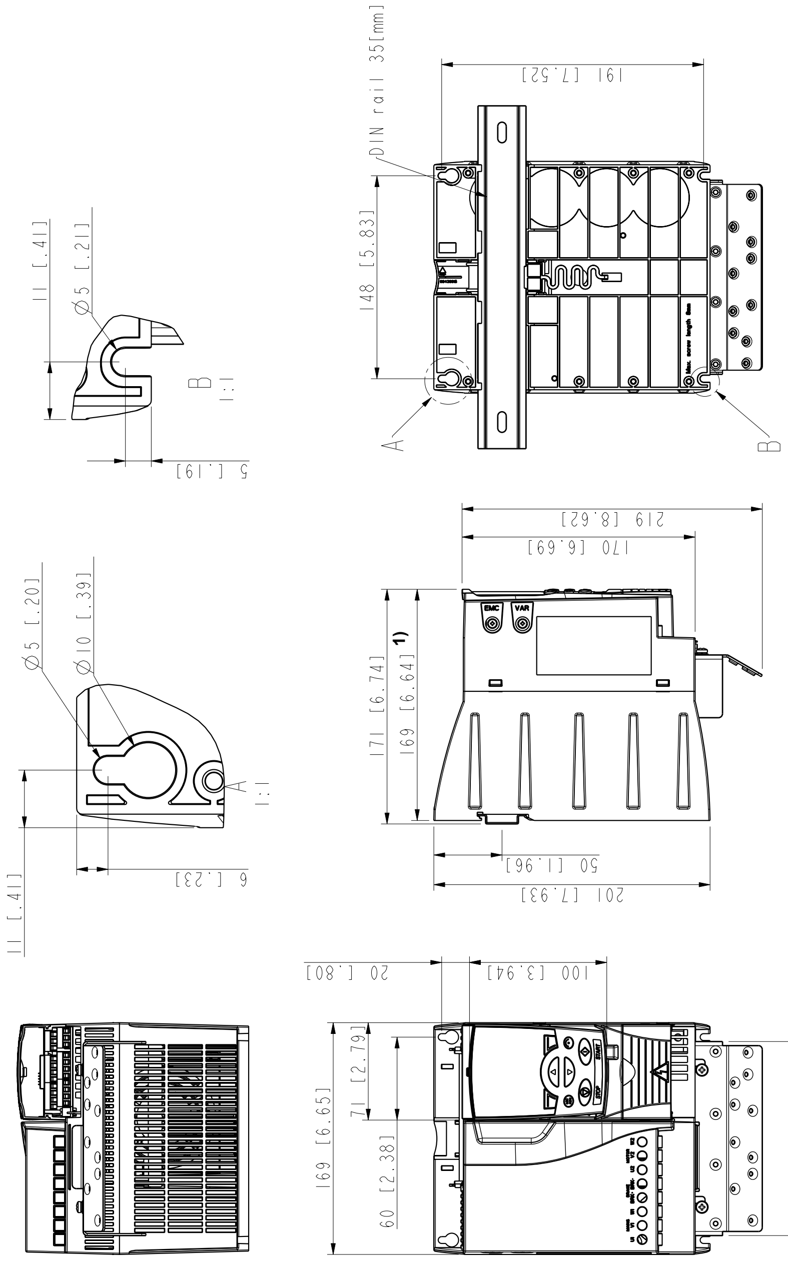


Frame size R2, IP20 / NEMA 1

1) Extension modules add 26 mm (1.02 in) to the depth measure.

3AUA0000067783-B

Frame size R3, IP20 (cabinet installation) / UL open

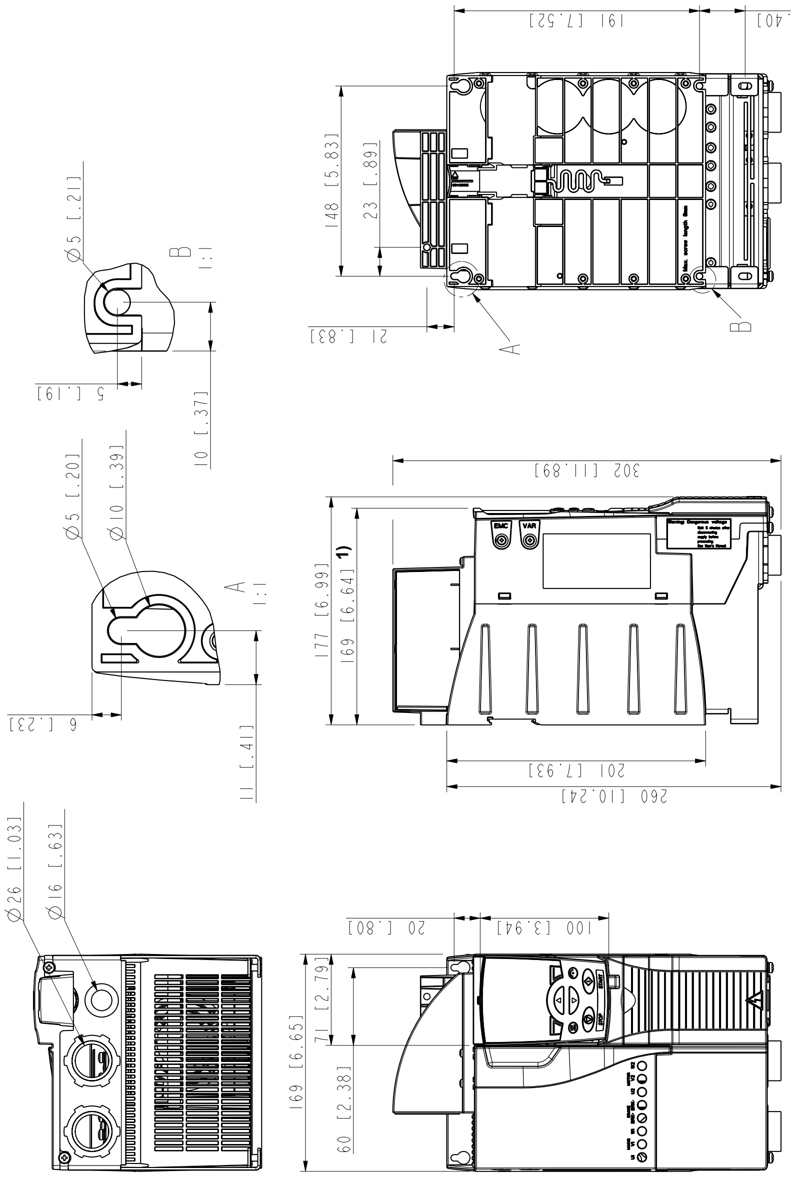


Frame size R3, IP20 (cabinet installation) / UL open

1) Extension modules add 26 mm (1.02 in) to the depth measure.

3AUA0000067786-A

Frame size R3, IP20 / NEMA 1

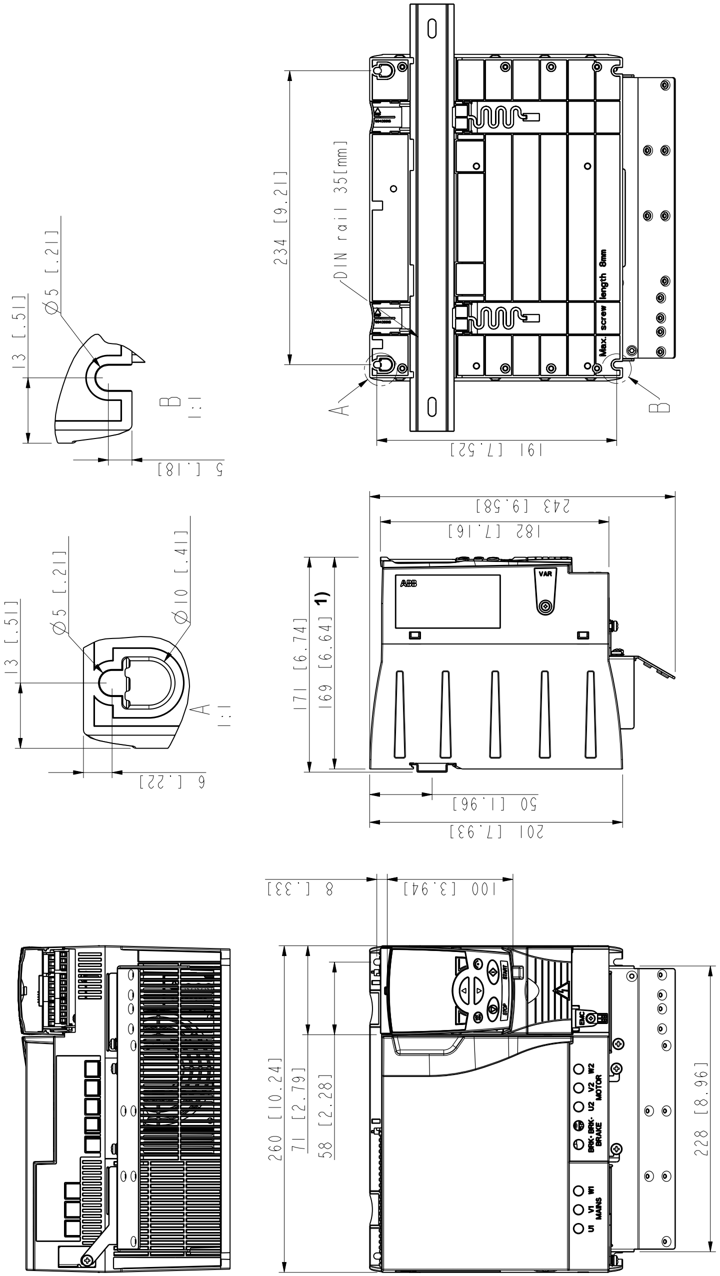


Frame size R3, IP20 / NEMA 1

1) Extension modules add 26 mm (1.02 in) to the depth measure.

3AUA0000067787-A

Frame size R4, IP20 (cabinet installation) / UL open

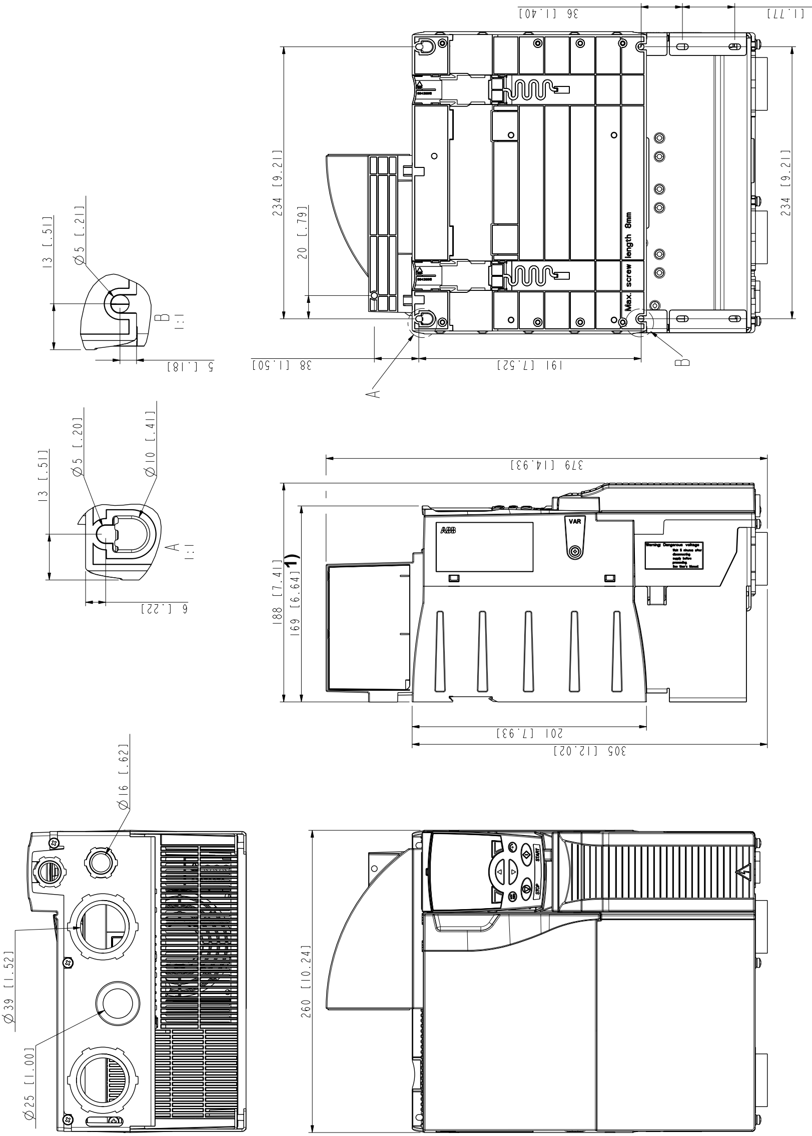


Frame size R4, IP20 (cabinet installation) / UL open

3AUA0000067836-A

[1] Extension modules add 26 mm (1.02 in) to the depth measure.

Frame size R4, IP20 / NEMA 1



Frame size R4, IP20 / NEMA 1

1) Extension modules add 26 mm (1.02 in) to the depth measure.

3AUA0000067883-A

19

Appendix: Resistor braking

What this chapter contains

The chapter tells how to select the brake resistor and cables, protect the system, connect the brake resistor and enable resistor braking.

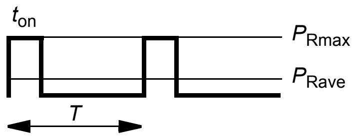
Planning the braking system

Selecting the brake resistor

ACS355 drives have an internal brake chopper as standard equipment. The brake resistor is selected using the table and equations presented in this section.

1. Determine the required maximum braking power P_{Rmax} for the application. P_{Rmax} must be smaller than P_{BRmax} given in the table on page *406* for the used drive type.
2. Calculate resistance R with Equation 1.
3. Calculate energy E_{Rpulse} with Equation 2.
4. Select the resistor so that the following conditions are met:
   - The rated power of the resistor must be greater than or equal to P_{Rmax}.
   - Resistance R must be between R_{min} and R_{max} given in the table for the used drive type.
   - The resistor must be able to dissipate energy E_{Rpulse} during the braking cycle T.

Equations for selecting the resistor:



Eq. 1. $U_N = 200…240 \text{ V}: \quad R = \dfrac{150000}{P_{Rmax}}$

$U_N = 380…415 \text{ V}: \quad R = \dfrac{450000}{P_{Rmax}}$

$U_N = 415…480 \text{ V}: \quad R = \dfrac{615000}{P_{Rmax}}$

Eq. 2. $E_{Rpulse} = P_{Rmax} \cdot t_{on}$

Eq. 3. $P_{Rave} = P_{Rmax} \cdot \dfrac{t_{on}}{T}$

For conversion, use 1 hp = 746 W.

where

R = selected brake resistor value (ohm)
P_{Rmax} = maximum power during the braking cycle (W)
P_{Rave} = average power during the braking cycle (W)
E_{Rpulse} = energy conducted into the resistor during a single braking pulse (J)
t_{on} = length of the braking pulse (s)
T = length of the braking cycle (s).

Resistor types shown in the table are pre-dimensioned resistors using the maximum braking power with cyclic braking shown in the table. Resistors are available from ABB. Information is subject to change without further notice.

Type ACS355-x = E/U [1]	R_{min}	R_{max}	P_{BRmax}		Selection table by resistor type						
					CBR-V / CBT-H [2]						Braking time [3]
	ohm	ohm	kW	hp	160	210	260	460	660	560	s
1-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)											
01x-02A4-2	70	390	0.37	0.5	•						90
01x-04A7-2	40	200	0.75	1	•						45
01x-06A7-2	40	130	1.1	1.5	•						28
01x-07A5-2	30	100	1.5	2	•						19
01x-09A8-2	30	70	2.2	3	•						14
3-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)											
03x-02A4-2	70	390	0.37	0.5	•						90
03x-03A5-2	70	260	0.55	0.75	•						60
03x-04A7-2	40	200	0.75	1	•						42
03x-06A7-2	40	130	1.1	1.5	•						29
03x-07A5-2	30	100	1.5	2	•						19
03x-09A8-2	30	70	2.2	3	•						14
03x-13A3-2	30	50	3.0	4			•				16
03x-17A6-2	30	40	4.0	5			•				12
03x-24A4- 2	18	25	5.5	7.5						•	45
03x-31A0-2	7	19	7.5	10						•	35
03x-46A2-2	7	13	11.0	15						•	23

Type ACS355- x = E/U 1)	R_{min}	R_{max}	P_{BRmax}		Selection table by resistor type						
					CBR-V / CBT-H 2)						Braking time 3)
	ohm	ohm	kW	hp	160	210	260	460	660	560	s
3-phase U_N = 380…480 V (380, 400, 415, 440, 460, 480 V)											
03x-01A2-4	200	1180	0.37	0.5		•					90
03x-01A9-4	175	800	0.55	0.75		•					90
03x-02A4-4	165	590	0.75	1		•					60
03x-03A3-4	150	400	1.1	1.5		•					37
03x-04A1-4	130	300	1.5	2		•					27
03x-05A6-4	100	200	2.2	3		•					17
03x-07A3-4	70	150	3.0	4				•			29
03x-08A8-4	70	110	4.0	5				•			20
03x-12A5-4	40	80	5.5	7.5				•			15
03x-15A6-4	40	60	7.5	10				•			10
03x-23A1-4	30	40	11	15					•		10
03x-31A0-4	16	29	15	20						•	16
03x-38A0-4	13	23	18.5	25						•	13
03x-44A0-4	13	19	22.0	30						•	10

00353783.xls K

1) E =EMC filter connected (metal EMC filter screw installed),
U =EMC filter disconnected (plastic EMC filter screw installed), US parametrization.

2) CBR-V / CBT-H resistor types available in selected countries.

3) Braking time = maximum allowed braking time in seconds at P_{BRmax} every 120 seconds, at 40 °C (104 °F) ambient temperature.

Symbols

R_{min} = minimum allowed brake resistor that can be connected to the brake chopper

R_{max} = maximum allowed brake resistor that allows P_{BRmax}

P_{BRmax} = maximum braking capacity of the drive, must exceed the desired braking power.

Ratings by resistor type	CBR-V	CBR-V	CBR-V	CBR-V	CBR-V	CBT-H
	160	210	260	460	660	560
Nominal power (W)	280	360	450	790	1130	2200
Resistance (ohm)	70	200	40	80	33	18

WARNING! Never use a brake resistor with a resistance below the minimum value specified for the particular drive. The drive and the internal chopper are not able to handle the overcurrent caused by the low resistance.

Selecting the brake resistor cables

Use a shielded cable with the conductor size specified in section *Power cable sizes and fuses* on page *377*. The maximum length of the resistor cable(s) is 5 m (16 ft).

Placing the brake resistor

Install all resistors in a place where they will cool.

WARNING! The materials near the brake resistor must be non-flammable. The surface temperature of the resistor is high. Air flowing from the resistor is of hundreds of degrees Celsius. Protect the resistor against contact.

Protecting the system in brake circuit fault situations

Protecting the system in cable and brake resistor short-circuit situations

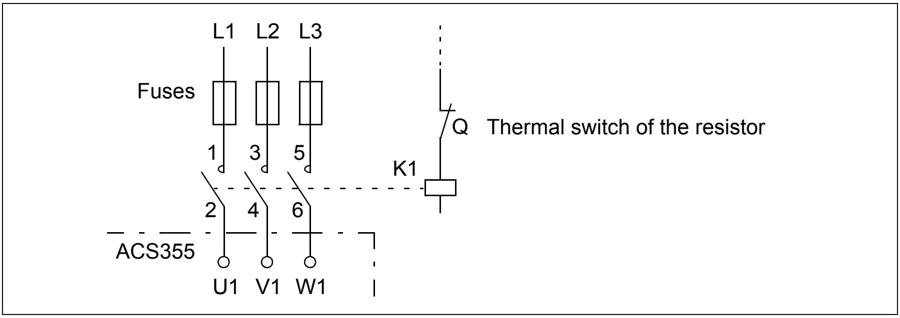
For short-circuit protection of the brake resistor connection, see *Brake resistor connection* on page *388*. Alternatively, a two-conductor shielded cable with the same cross-sectional area can be used.

Protecting the system in brake resistor overheating situations

The following setup is essential for safety – it interrupts the main supply in fault situations involving chopper shorts:

- Equip the drive with a main contactor.
- Wire the contactor so that it opens if the resistor thermal switch opens (an overheated resistor opens the contactor).

Below is a simple wiring diagram example.



Electrical installation

For the brake resistor connections, see the power connection diagram of the drive on page *51*.

Start-up

Note: When the brake resistor is used for the first time, it is possible that some smoke appears as the protective oil or lacquer on the resistor burns off. Therefore it is important to have adequate ventilation when the brake resistor is used for the first time.

To enable resistor braking, switch off the drive’s overvoltage control by setting parameter *2005 OVERVOLT CTRL* to 0 (*DISABLE*). If parameter *2005 OVERVOLT CTRL* is set to 2 (*EN WITH BRCH*) both braking chopper and overvoltage controller are enabled so that the braking chopper capability is used to its maximum and the overvoltage controller is activated above that.

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Appendix: Extension modules

What this chapter contains

The appendix describes common features and mechanical installation of the optional extension modules for the ACS355: MPOW-01 auxiliary power extension module, MTAC-01 pulse encoder interface module and MREL-01 output relay module.

The appendix also describes specific features and electrical installation for the MPOW-01; for information on the MTAC-01 and MREL-01, refer to the corresponding user's manual.

Extension modules

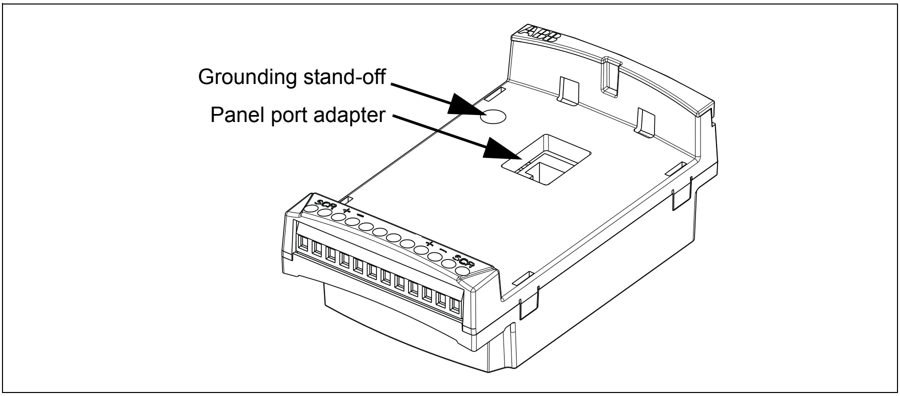
Description

Extension modules have similar enclosures and they are mounted between the control panel and the drive. Therefore, only one extension module can be used for a drive. ACS355 IP66/67 / UL Type 4X drives are not compatible with extension modules due to space restrictions.

The following optional extension modules are available for the ACS355. The drive automatically identifies the module (parameter *0181 EXTENSION* shows the value), which is ready for use after the installation and power-up.

- MTAC-01 pulse encoder interface module
- MREL-01 output relay module
- MPOW-01 auxiliary power extension module.

Generic extension module layout



Installation

Checking the delivery

The option package contains:
- extension module
- grounding stand-off with an M3 × 12 screw
- panel port adapter (fixed to the MPOW-01 module at the factory).

Installing the extension module

WARNING! Follow the safety instructions given in chapter *Safety* on page 17.

To install the extension module:

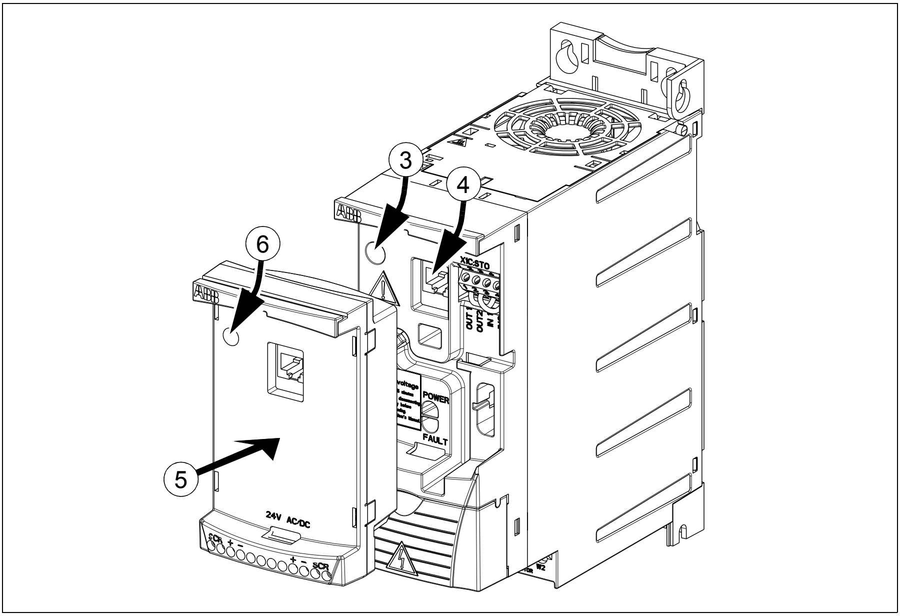
1. If not already off, remove input power from the drive.
2. Remove the control panel or panel cover: remove the terminal cover by simultaneously pushing the recess and sliding the cover off the frame.
3. Remove the grounding screw in the top left corner of the drive's control panel slot and install the grounding stand-off in its place.
4. For the MREL-01 and MTAC-01, ensure that the panel port adapter is attached to either the panel port of the drive or the mate part of the extension module. The adapter of the MPOW-01 is already fixed to the extension module at the factory.
5. Gently and firmly install the extension module to the drive's panel slot directly from the front.

Note: The signal and power connections to the drive are automatically made through a 6-pin connector.

6. Ground the extension module by inserting the screw removed from the drive in the top left corner of the extension module. Tighten the screw using a torque of 0.8 N·m (7 lbf·in).

Note: Correct insertion and tightening of the screw is essential for fulfilling the EMC requirements and proper operation of the extension module.

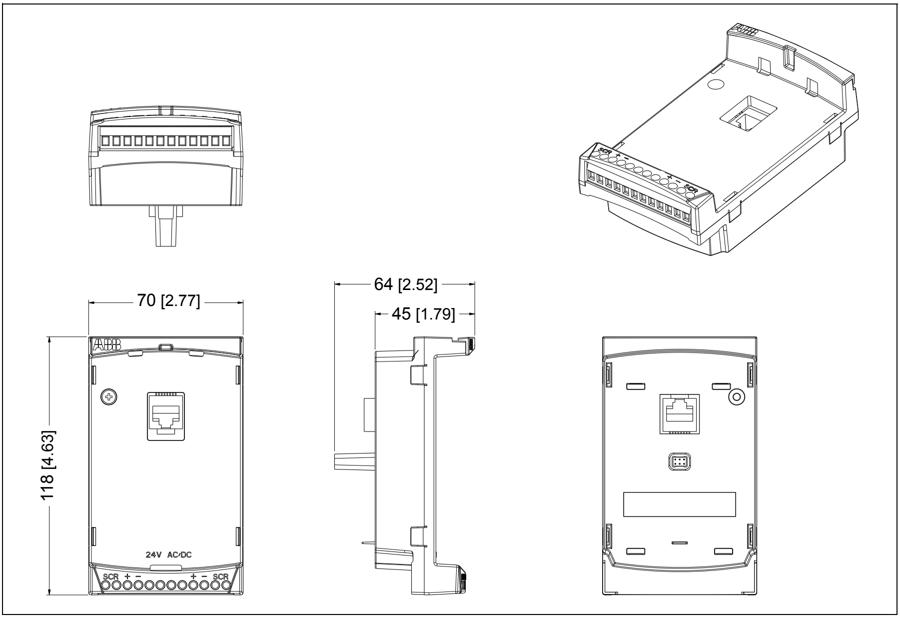
7. Install the control panel or panel cover on the extension module.
8. Electrical installation is module-specific. For MPOW-01, see section *Electrical installation* on page *415*. For MTAC-01, see *MTAC-01 pulse encoder interface module user's manual* (3AFE68591091 [English]), and for MREL-01, see *MREL-01 output relay module user's manual* (3AUA0000035957 [English]).



Technical data

Dimensions

Extension module dimensions are shown in the figure below.



Generic extension module specifications

- Enclosure degree of protection: IP20
- All materials are UL/CSA-approved.
- When used with ACS355 drives, the extension modules comply with EMC standard EN/IEC 61800-3:2004 for electromagnetic compatibility and EN/IEC 61800-5-1:2005 for electrical safety requirements.

MTAC-01 pulse encoder interface module

See *MTAC-01 pulse encoder interface module user's manual* (3AFE68591091 [English]) delivered with this option.

MREL-01 output relay module

See *MREL-01 output relay module user's manual* (3AUA0000035957 [English]) delivered with this option.

MPOW-01 auxiliary power extension module

Description

The MPOW-01 auxiliary power extension module is used in installations where the drive's control part is required to be powered during network failures and maintenance interruptions. The MPOW-01 provides auxiliary voltages to the control panel, fieldbus and I/O.

Note: If you change any of the drive parameters when the drive is powered through the MPOW-01, you have to force parameter saving with parameter *1607 PARAM SAVE* by setting the value to (1) *SAVE…*; otherwise all changed data will be lost.

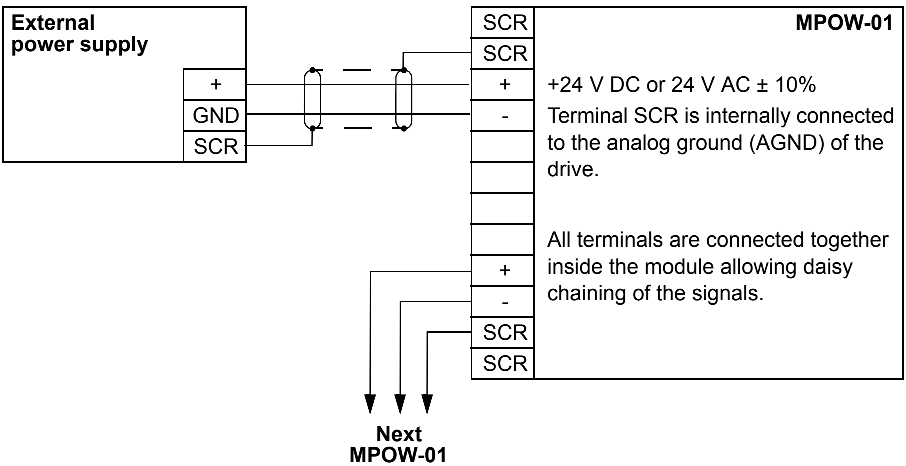
Electrical installation

Wiring

- Use 0.5…1.5 mm^2 (20…16 AWG) shielded cable.
- Connect the control wires according to the diagram in section *Terminal designations* below. Use a tightening torque of 0.8 N·m (7 lbf·in).

Terminal designations

The diagram below shows the MPOW-01 terminals and how the MPOW-01 module is connected to the external power supply and how the modules are daisy chained.



Technical data

Specifications

- Input voltage: +24 V DC or 24 V AC ± 10%
- Maximum load 1200 mA rms
- Power losses with maximum load 6 W
- Designed lifetime of the MPOW-01 module is 50 000 hours in the specified ambient conditions of the drive (see section *Ambient conditions* on page *389*).

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Appendix: Safe torque off (STO)

What this appendix contains

The appendix describes the Safe torque off (STO) function of the drive and gives instructions for its use.

Description

The Safe torque off function can be used, for example, to construct safety or supervision circuits that stop the drive in case of danger. Another possible application is a prevention of unexpected start-up switch that enables short-time maintenance operations like cleaning or work on non-electrical parts of the machinery without switching off the power supply to the drive.

Note: The Safe torque off function does not disconnect the voltage from the drive, see the warning on page *424*.

When activated, the Safe torque off function disables the control voltage of the power semiconductors of the drive output stage (A, see diagrams on page *419*), thus preventing the drive from generating the torque required to rotate the motor. If the motor is running when Safe torque off is activated, it coasts to a stop.

The Safe torque off function has a redundant architecture, that is, both channels must be used in the safety function implementation. The safety data given in this manual is calculated for redundant use, and does not apply if both channels are not used.

The Safe torque off function of the drive complies with these standards:

Standard	Name
EN 60204-1:2005 + A1:2008	*Safety of machinery – Electrical equipment of machines – Part 1: General requirements*
IEC 61326-3-1:2008	*Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications*
IEC 61508-1:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements*
IEC 61508-2:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*
IEC 61511:2003	*Functional safety – Safety instrumented systems for the process industry sector*
IEC/EN 61800-5-2:2007	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional*
IEC/EN 62061:2005 + A1:2013	*Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN ISO 13849-1:2008 + AC:2009	*Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*
EN ISO 13849-2:2012	*Safety of machinery – Safety-related parts of control systems – Part 2: Validation*

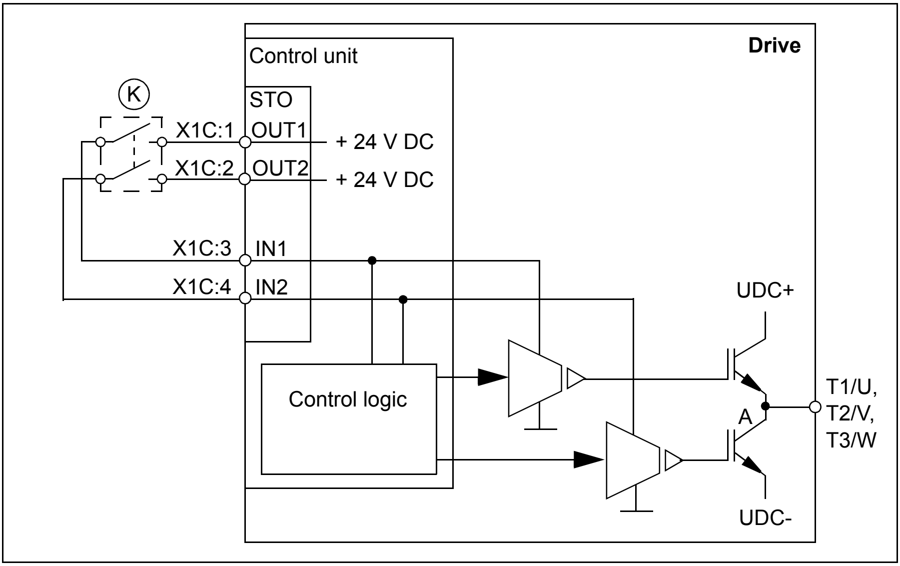
The Safe torque off function also corresponds to Prevention of unexpected start-up as specified by EN 1037:1995 + A1:2008 and Uncontrolled stop (stop category 0) as specified in EN 60204-1:2006 + AC:2010.

Compliance with the European Machinery Directive

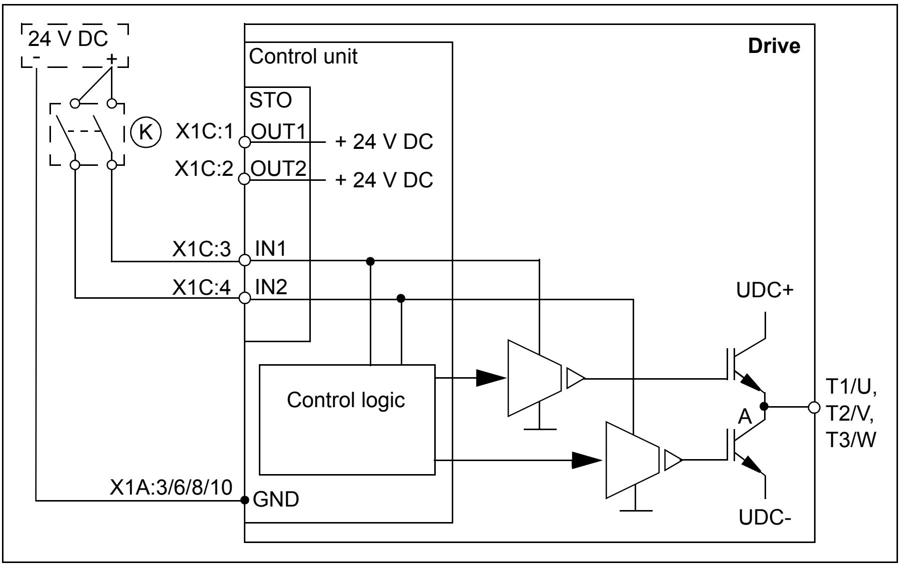
See section *Compliance with the Machinery Directive on page 394*.

Connection principle

Connection with internal +24 V DC power supply

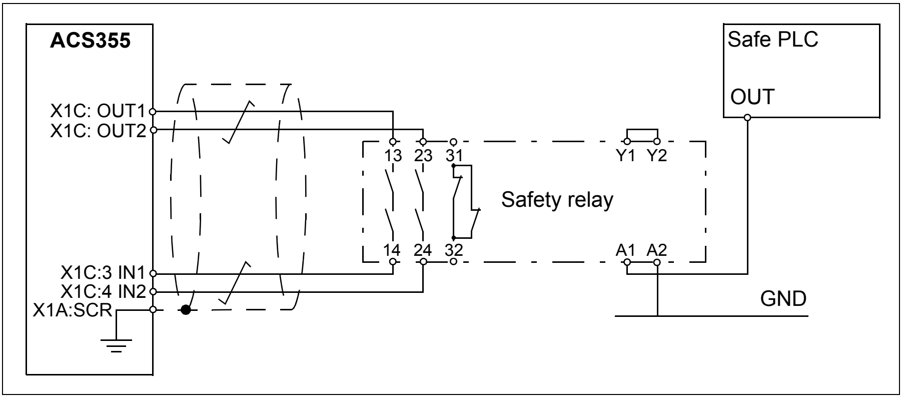


Connection with external +24 V DC power supply

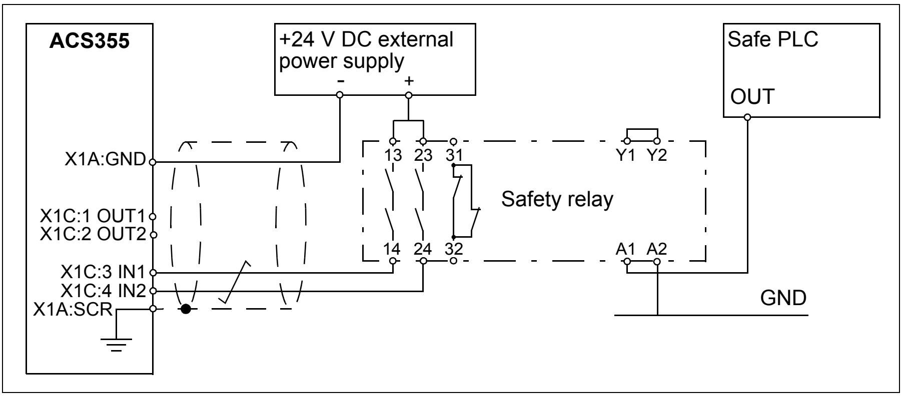


Wiring examples

An example of a Safe torque off wiring with internal +24 V DC power supply is shown below.



An example of a Safe torque off wiring with external +24 V DC power supply is shown below.



For information on the specifications of the STO input, see section *Control connection data* (page *385*).

Activation switch

In the wiring diagram above (page *419*), the activation switch has the designation (K). This represents a component such as a manually operated switch, an emergency stop push button switch, or the contacts of a safety relay or safety PLC.

- If a manually operated activation switch is used, the switch must be of a type that can be locked out to the open position.
- Inputs IN1 and IN2 must open/close within 200 ms of each other.

Cable types and lengths

- Double-shielded twisted-pair cable is recommended.
- Maximum cable length 300 m (984 ft) between activation switch (K) and drive control unit.

Note: A short-circuit in the wiring between the switch and an STO terminal causes a dangerous fault and therefore it is recommended to use a safety relay (including wiring diagnostics), or a wiring method (shield grounding, channel separation) which reduces or eliminates the risk caused by the short-circuit.

Note: The voltage at the INx terminals of each drive must be at least 13 V DC to be interpreted as “1”.

Grounding of protective shields

- Ground the shield in the cabling between the activation switch and the control board at the control board.
- Ground the shield in the cabling between two control boards at one control board only.

Operation principle

1. The Safe torque off activates (the activation switch is opened, or safety relay contacts open).
2. The STO inputs IN1 and IN2 on the drive control board de-energize.
3. The STO cuts off the control voltage from the drive IGBTs.
4. The control program generates an indication as defined by parameter 3025 STO OPERATION.

   The parameter selects which indications are given when one or both Safe torque off (STO) signals are switched off or lost. The indications also depend on whether the drive is running or stopped when this occurs.

   Note: This parameter does not affect the operation of the STO function itself. The STO function will operate regardless of the setting of this parameter: a running drive will stop upon removal of one or both STO signals, and will not start until both STO signals are restored and all faults reset.

   Note: The loss of only one STO signal always generates a fault as it is interpreted as a malfunction of STO hardware or wiring.
5. Motor coasts to a stop (if running). The drive cannot restart while the activation switch or safety relay contacts are open. After the contacts close, a new start command is required to start the drive.

Start-up including acceptance test

To ensure the safe operation of a safety function, validation is required. The final assembler of the machine must validate the function by performing an acceptance test. The acceptance test must be performed

- at initial start-up of the safety function
- after any changes related to the safety function (circuit boards, wiring, components, settings, etc.)
- after any maintenance work related to the safety function.

Competence

The acceptance test of the safety function must be carried out by a competent person with adequate expertise and knowledge of the safety function as well as functional safety, as required by IEC 61508-1 clause 6. The test procedures and report must be documented and signed by this person.

Acceptance test reports

You must store the signed acceptance test reports in the logbook of the machine. The report must include documentation of start-up activities and test results, references to failure reports and resolution of failures. You must store any new acceptance tests performed due to changes or maintenance in the logbook of the machine.

Acceptance test procedure

After wiring the Safe torque off function, validate its operation as follows.

Action	☑
WARNING! Follow the instructions in chapter *Safety*, page *17*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.	☐
Ensure that the drive can be run and stopped freely during start-up.	☐
Stop the drive (if running), switch the input power off and isolate the drive from the power line by a disconnector.	☐
Check the Safe torque off circuit connections against the wiring diagram.	☐
Close the disconnector and switch the power on.	☐
Test the operation of the STO function when the motor is stopped. • Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Ensure that the drive operates as follows: • Open the STO circuit. The drive generates an indication as defined in parameter 3025 STO OPERATION. For the description of the warning, see chapter *Fault tracing*. • Give a start command to verify that the STO function blocks the drive's operation. The drive displays a warning. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Test the operation of the STO function when the motor is running. • Start the drive and ensure the motor is running. • Open the STO circuit. The motor should stop. The drive generates an indication if one is defined for the 'running' state in parameter 3025 STO OPERATION. For the description of the warning, see chapter *Fault tracing*. • Reset any active faults and try to start the drive. • Ensure that the motor stays at a standstill and the drive operates as described above in testing the operation when the motor is stopped. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Document and sign the acceptance test report which verifies that the safety function is safe and accepted for operation.	☐

Use

1. Open the activation switch, or activate the safety functionality that is wired to the STO connection.
2. STO inputs on the drive control unit de-energize, and the drive control unit cuts off the control voltage from the drive IGBTs.
3. The control program generates an indication as defined by parameter 3025 STO OPERATION.
4. The motor coasts to a stop (if running). The drive will not restart while the activation switch or safety relay contacts are open.
5. Deactivate the STO by closing the activation switch, or resetting the safety functionality that is wired to the STO connection.
6. Reset any faults before restarting.

WARNING! The Safe torque off function does not disconnect the voltage of the main and auxiliary circuits from the drive. Therefore maintenance work on electrical parts of the drive or the motor can only be carried out after isolating the drive from the main supply.

WARNING! (With permanent magnet motors only) In case of a multiple IGBT power semiconductor failure, the drive system can produce an alignment torque which maximally rotates the motor shaft by 180/*p* degrees regardless of the activation of the Safe torque off function. *p* denotes the number of pole pairs.

Notes:

- If a running drive is stopped by using the Safe torque off function, the drive will cut off the motor supply voltage and the motor will coast to a stop. If this causes danger or is not otherwise acceptable, stop the drive and machinery using the appropriate stop mode before activating the Safe torque off function.
- The Safe torque off function overrides all other functions of the drive unit.
- The Safe torque off function is ineffective against deliberate sabotage or misuse.
- The Safe torque off function has been designed to reduce the recognized hazardous conditions. In spite of this, it is not always possible to eliminate all potential hazards. The assembler of the machine must inform the final user about the residual risks.

Maintenance

After the operation of the circuit is validated at start-up, the STO function shall be maintained by periodic proof testing. In high demand mode of operation, the maximum proof test interval is 20 years. In low demand mode of operation, the maximum proof test interval is 2 years. The test procedure is given in section *Acceptance test procedure* (page *423*).

In addition to proof testing, it is a good practice to check the operation of the function when other maintenance procedures are carried out on the machinery.

Include the Safe torque off operation test described above in the routine maintenance program of the machinery that the drive runs.

If any wiring or component change is needed after start up, or the parameters are restored, follow the test given in section *Acceptance test procedure* (page *423*).

Use only ABB approved spare parts.

Proof test interval

The safety integrity of the function does not require any proof testing within the specified lifetime of the safety function. Regardless of the mode of operation (high or low demand as defined in IEC 61508, EN/IEC 62061, IEC 61511 and EN ISO 13849-1), it is a good practice to check the operation of the safety function at least once a year. Do the test as described in section *Acceptance test procedure* on page *423*.

The person responsible for the design of the complete safety function should also note the Recommendation of Use CNB/M/11.050 published by the European co-ordination of Notified Bodies for Machinery concerning dual-channel safety-related systems with electromechanical outputs:

- When the safety integrity requirement for the safety function is SIL 3 or PL e (cat. 3 or 4), the proof test for the function must be performed at least every month.
- When the safety integrity requirement for the safety function is SIL 2 (HFT = 1) or PL d (cat. 3), the proof test for the function must be performed at least every 12 months.

This is a recommendation and depends on the required (not achieved) SIL/PL. For example, safety relays, contactor relays, emergency stop buttons, switches etc. are typically safety devices which contain electromechanical outputs. The STO circuit of the drive does not contain any electromechanical components.

Fault tracing

The indications given during the normal operation of the Safe torque off function are selected by parameter 3025 STO OPERATION.

The diagnostics of the Safe torque off function cross-compare the status of the two STO channels. In case the channels are not in the same state, a fault reaction function is performed and the drive trips on an “STO hardware failure” fault. An attempt to use the STO in a non-redundant manner, for example activating only one channel, will trigger the same reaction.

For the indications generated by the drive, see chapter *Fault tracing*, and for details on directing fault and warning indications to an output on the control unit for external diagnostics.

Any failures of the Safe torque off function must be reported to ABB.

Safety data

The safety data for the Safe torque off function is given below.

Note: The safety data is calculated for redundant use, and does not apply if both STO channels are not used.

Type ACS355-	Frame size	IEC 61508 and IEC/EN 61800-5-2						
		SIL	SC	PFH (1/h)	HFT	SFF (%)	T1 (a)	PFD (T1=2a)
1-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)								
01x-02A4-2	R0	3	3	6.20E-09	1	91	10	4.77E-08
01x-04A7-2	R1	3	3	6.20E-09	1	91	10	4.77E-08
01x-06A7-2	R1	3	3	6.20E-09	1	91	10	4.77E-08
01x-07A5-2	R2	3	3	6.16E-09	1	92	10	4.85E-08
01x-09A8-2	R2	3	3	6.16E-09	1	92	10	4.85E-08
3-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)								
03x-02A4-2	R0	3	3	6.20E-09	1	91	10	4.65E-04
03x-03A5-2	R0	3	3	6.20E-09	1	91	10	4.65E-04
03x-04A7-2	R1	3	3	6.20E-09	1	91	10	4.65E-04
03x-06A7-2	R1	3	3	6.20E-09	1	91	10	4.65E-04
03x-07A5-2	R1	3	3	6.20E-09	1	91	10	4.65E-04
03x-09A8-2	R2	3	3	6.16E-09	1	92	10	4.61E-04
03x-13A3-2	R2	3	3	6.16E-09	1	92	10	4.61E-04
03x-17A6-2	R2	3	3	6.16E-09	1	92	10	4.61E-04
03x-24A4-2	R3	3	3	6.16E-09	1	92	10	4.62E-04
03x-31A0-2	R4	3	3	6.16E-09	1	93	10	4.62E-04
03x-46A2-2	R4	3	3	6.16E-09	1	93	10	4.62E-04
3-phase U_N = 380…480 V (380, 400, 415, 440, 460, 480 V)								
03x-01A2-4	R0	3	3	6.16E-09	1	92	10	4.61E-04
03x-01A9-4	R0	3	3	6.16E-09	1	92	10	4.61E-04
03x-02A4-4	R1	3	3	6.16E-09	1	92	10	4.61E-04
03x-03A3-4	R1	3	3	6.16E-09	1	92	10	4.61E-04
03x-04A1-4	R1	3	3	6.16E-09	1	92	10	4.61E-04
03x-05A6-4	R1	3	3	6.16E-09	1	92	10	4.61E-04
03x-07A3-4	R1	3	3	6.16E-09	1	92	10	4.61E-04
03x-08A8-4	R1	3	3	6.16E-09	1	92	10	4.61E-04
03x-12A5-4	R3	3	3	6.16E-09	1	92	10	4.62E-04
03x-15A6-4	R3	3	3	6.16E-09	1	92	10	4.62E-04
03x-23A1-4	R3	3	3	6.16E-09	1	92	10	4.62E-04
03x-31A0-4	R4	3	3	6.16E-09	1	93	10	4.62E-04
03x-38A0-4	R4	3	3	6.16E-09	1	93	10	4.62E-04
03x-44A0-4	R4	3	3	6.16E-09	1	93	10	4.62E-04

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Type ACS355-	Frame size	EN ISO 13849-1					IEC/EN 62061	IEC 61511
		PL	CCF (%)	$MTTF_d$ [1] (a)	DC [2] (%)	Category	SILCL	SIL
1-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)								
01x-02A4-2	R0	e	80	3419	>90%	3	3	3
01x-04A7-2	R1	e	80	3419	>90%	3	3	3
01x-06A7-2	R1	e	80	3419	>90%	3	3	3
01x-07A5-2	R2	e	80	3491	>90%	3	3	3
01x-09A8-2	R2	e	80	3491	>90%	3	3	3
3-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)								
03x-02A4-2	R0	e	80	3419	>90%	3	3	3
03x-03A5-2	R0	e	80	3419	>90%	3	3	3
03x-04A7-2	R1	e	80	3419	>90%	3	3	3
03x-06A7-2	R1	e	80	3419	>90%	3	3	3
03x-07A5-2	R1	e	80	3419	>90%	3	3	3
03x-09A8-2	R2	e	80	3491	>90%	3	3	3
03x-13A3-2	R2	e	80	3491	>90%	3	3	3
03x-17A6-2	R2	e	80	3491	>90%	3	3	3
03x-24A4-2	R3	e	80	3488	>90%	3	3	3
03x-31A0-2	R4	e	80	3486	>90%	3	3	3
03x-46A2-2	R4	e	80	3486	>90%	3	3	3
3-phase U_N = 380…480 V (380, 400, 415, 440, 460, 480 V)								
03x-01A2-4	R0	e	80	3491	>90%	3	3	3
03x-01A9-4	R0	e	80	3491	>90%	3	3	3
03x-02A4-4	R1	e	80	3491	>90%	3	3	3
03x-03A3-4	R1	e	80	3491	>90%	3	3	3
03x-04A1-4	R1	e	80	3491	>90%	3	3	3
03x-05A6-4	R1	e	80	3491	>90%	3	3	3
03x-07A3-4	R1	e	80	3491	>90%	3	3	3
03x-08A8-4	R1	e	80	3491	>90%	3	3	3
03x-12A5-4	R3	e	80	3488	>90%	3	3	3
03x-15A6-4	R3	e	80	3488	>90%	3	3	3
03x-23A1-4	R3	e	80	3488	>90%	3	3	3
03x-31A0-4	R4	e	80	3486	>90%	3	3	3
03x-38A0-4	R4	e	80	3486	>90%	3	3	3
03x-44A0-4	R4	e	80	3486	>90%	3	3	3

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[1] 100 years must be used for calculation of a safety loop.

[2] According to standard EN ISO 13849-1 table E.1

- The following temperature profile is used in safety value calculations:
  - 670 on/off cycles per year with $\triangle T$ = 71.66 °C
  - 1340 on/off cycles per year with $\triangle T$ = 61.66 °C
  - 30 on/off cycles per year with $\triangle T$ = 10.0 °C

- 32 °C board temperature at 2.0% of time
- 60 °C board temperature at 1.5% of time
- 85 °C board temperature at 2.3% of time.
- The STO is a type A safety component as defined in IEC 61508-2.
- Relevant failure modes:
  - The STO trips spuriously (safe failure)
  - The STO does not activate when requested

  A fault exclusion on the failure mode “short circuit on printed circuit board” has been made (EN 13849-2, table D.5). The analysis is based on an assumption that one failure occurs at one time. No accumulated failures have been analyzed.
- STO reaction time (shortest detectable break): 10 microseconds
- STO response time: 2 ms (typical), 5 ms (maximum)
- Fault detection time: Channels in different states for longer than 200 ms
- Fault reaction time: Fault detection time + 10 ms
- STO fault indication (parameter 3025) delay: < 200 ms
- STO warning indication (parameter 3025) delay: < 200 ms
- Maximum cable length 300 m (984 ft) between activation switch (K) and drive control unit.
- The voltage at the INx terminals of each drive must be at least 13 V DC to be interpreted as “1”.

Abbreviations

Abbreviation	Reference	Description
CCF	EN ISO 13849-1	Common cause failure (%)
DC	EN ISO 13849-1	Diagnostic coverage
HFT	IEC 61508	Hardware fault tolerance
$MTTF_d$	EN ISO 13849-1	Mean time to dangerous failure: (The total number of life units) / (the number of dangerous, undetected failures) during a particular measurement interval under stated conditions
PFD	IEC 61508	Probability of failure on demand
PFH	IEC 61508	Probability of dangerous failures per hour
PL	EN ISO 13849-1	Performance level. Levels a…e correspond to SIL
SC	IEC 61508	Systematic capability
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level (1…3)
SILCL	EN 62061	Maximum SIL (level 1…3) that can be claimed for a safety function or subsystem
STO	IEC/EN 61800-5-2	Safe torque off
T1	IEC 61508	Proof test interval. T1 is a parameter used to define the probabilistic failure rate (PFH or PFD) for the safety function or subsystem. Performing a proof test at a maximum interval of T1 is required to keep the SIL capability valid. The same interval must be followed to keep the PL capability (EN ISO 13849) valid. Note that any T1 values given cannot be regarded as a guarantee or warranty. See also section *Maintenance* (page *425*).

Declaration of conformity

Declaration of conformity (3AXD10000414701) is available on the Internet. See section *Document library on the Internet* on the inside of the back cover.

Certificate

TÜV certificate (3AXD00000600767) is available on the Internet. See section *Document library on the Internet* on the inside of the back cover.

22

Appendix: Permanent magnet synchronous motors (PMSMs)

What this chapter contains

This chapter gives basic guidelines on how the ACS355 drive parameters should be set when using permanent magnet synchronous motors (PMSMs). In addition, some hints are given for tuning the motor control performance.

Setting the parameters

With PMSMs special attention must be paid on setting the motor nominal values correctly in parameter group *99 START-UP DATA*. It is always recommended to use vector control. If the nominal back-emf of the motor is not available, a full ID run should be performed for improving performance.

The following table lists the basic parameter settings needed for permanent magnet synchronous motors.

No.	Name	Value	Description
9903	*MOTOR TYPE*	2	Permanent magnet synchronous motor
9904	*MOTOR CTRL MODE*	1 2	VECTOR: SPEED VECTOR:TORQ **Note**: Scalar control mode (3) can also be selected, but it is not recommended because in the scalar control mode the permanent magnet synchronous motor may get unstable and damage either the process, the motor or the drive.
9905	*MOTOR NOM VOLT*		**Note**: If the back emf voltage of the motor is not available, set the rated value here and run the ID run. If the voltage is given as a proportional value, such as 103 V/1000 rpm in a 3000 rpm motor, set 309 V here. Sometimes the value is given as the peak value. In this case, divide the value by the square root of 2 (1.41). **Note**: It is recommended to use the back emf voltage. If it is not used, a full ID run must be performed.
9906	*MOTOR NOM CURR*		Rated current of the motor. Do not use the peak value.
9907	*MOTOR NOM FREQ*		Rated electrical frequency of the motor. If the frequency is not given in the motor rating plate, it can be calculated using the following formula: frequency [Hz] = speed [rpm] x (number of pole pairs) / 60
9908	*MOTOR NOM SPEED*		Rated mechanical speed of the motor. If it is not given, it can be calculated using the following formula: speed [rpm] = frequency [Hz] x 60 / (number of pole pairs)
9909	*MOTOR NOM POWER*		Motor nominal power. If it is not given, it can be calculated using the following formula: Power [kW] = Rated torque [Nm] x 2 x pi x rated speed [rpm] / 60000
2102	*STOP FUNCTION*	RAMP	It is recommended to use ramp stop with a PMSM.

Start mode

The default value of parameter *2101 START FUNCTION* is 1 (AUTO). In most cases this is suitable for starting the rotation. If fast start with low inertia is required, it is recommended to set parameter *2101 START FUNCTION* to 2 (DC MAGN).

Smooth start

The Smooth start function can be used if the motor is not able to start or when rotation at low speeds needs to be improved. The following table lists the needed parameter settings.

No.	Name	Value	Description	Default
2621	*SMOOTH START*	0 1 2	Disabled Enabled always Start only	0
2622	*SMOOTH START CUR*	10…100%	Current applied to the motor when the Smooth start is active. Increasing the current helps enable starting with a load or with a large inertia. Decreasing the current can prevent the rotor from turning into a wrong direction during the start.	50%
2623	*SMOOTH START FRQ*	2…100%	Set the smooth start frequency range as small as possible. This should be tuned so that the rotation is stable throughout the whole speed range.	10%

Speed controller tuning

In vector control mode, it is recommended to tune the speed controller. In applications where the motor can be rotated freely, automatic tuning can be used. See parameter *2305 AUTOTUNE RUN* for more information.

Usually it is enough to adjust the proportional gain (parameter *2301 PROP GAIN*) of the speed controller to a higher value. The default value is 5 which results in rather conservative speed controller tuning. Increase the proportional gain value by 5 until the performance is satisfactory. If the application becomes unstable, divide the last gain value by 2, and you have reached rather robust speed controller tuning.

Note: It is recommended to use encoder feedback if accurate torque control, high torque production, or sustained operation is required at low speeds (below 20% of the motor nominal speed).

Adjusting motor speed estimation gain in case of an over current failure

The inertia of the PM motor application may cause over current trips. If the drive fails constantly to over current with the PM motor (Fault 01), the speed estimation gain may need to be adjusted. This is done by changing the parameter *2626 SPD EST BW TRIM*.

Further information

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/searchchannels.

Product training

For information on ABB product training, navigate to new.abb.com/service/training.

Providing feedback on ABB Drives manuals

Your comments on our manuals are welcome. Navigate to new.abb.com/drives/manuals-feedback-form.

Document library on the Internet

You can find manuals and other product documents in PDF format on the Internet at www.abb.com/drives/documents.

Contact us

www.abb.com/drives
www.abb.com/drivespartners

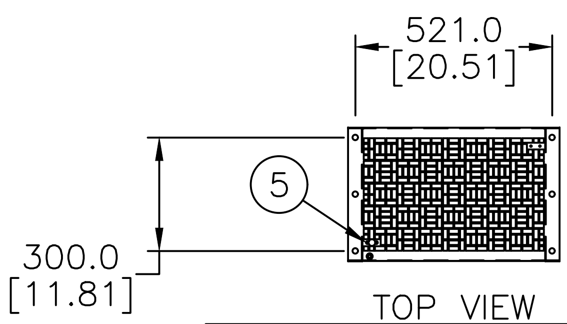
3AUA0000066143 Rev C (EN) EFFECTIVE: 2015-04-30

3AUA0000066143C

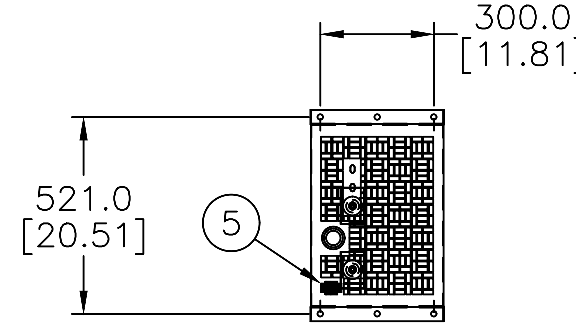
Power and productivity
for a better world™

PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	EN0126D-I-NS	ENCLOSURE, NARROW SINGLE
2	1	DB0900-02-XX	RESISTOR BANK ASSEMBLY
3	1	DB0900-03-01	BUS BAR SET, SINGLE
4	2	ISSTE35M10-50	CERAMIC INSULATOR
5	1	MP0052A	THERMAL SWITCH KIT
6	1	BPA1500	HUB, PLASTIC 1.50 INCH
7	1	NP003	DANGER/WARNING PLATE
8	1	DB0900-99	ASSEMBLY HARDWARE KIT
* 8.A	2	MP0021-3	TERMINAL TAGS, SST
* 8.B	3	CLPLP188	CLAMP, LOOP, 3/16" ID, 1"L
* 8.C	2	THT-19-486-1	LABEL STOCK, BLANK, 2"X3"

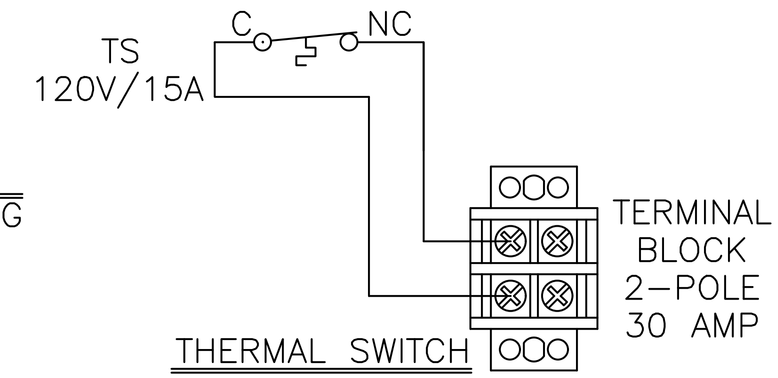
*ITEMS SHOWN FOR CLARITY, INCLUDED IN ASSEMBLY HARDWARE KIT



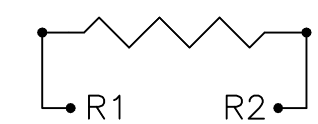
TOP VIEW
COVERS & HOOD REMOVED



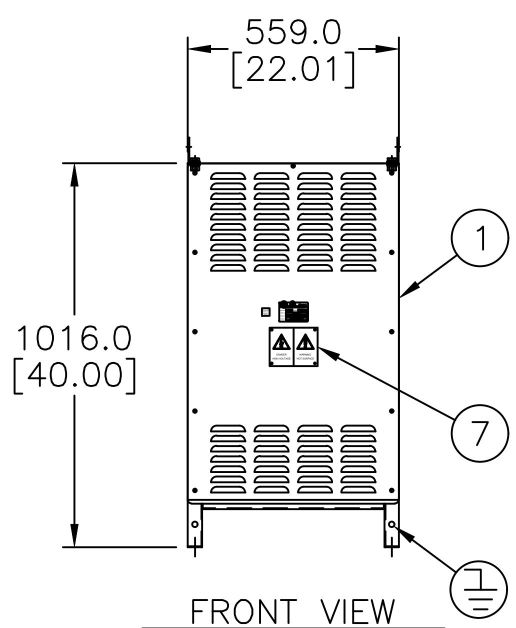
BOTTOM VIEW B - B
ACCESS AND MOUNTING



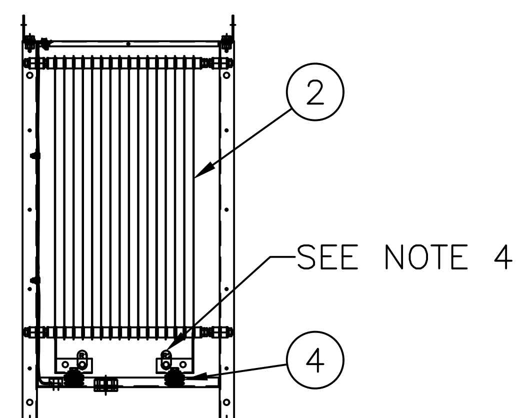
THERMAL SWITCH
SCHEMATIC



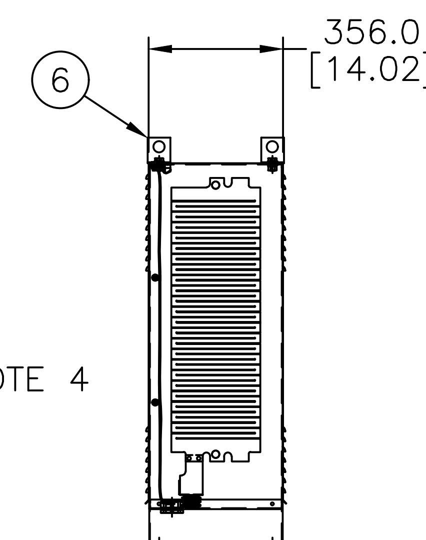
RESISTOR SCHEMATIC



FRONT VIEW
ALL COMPONENTS

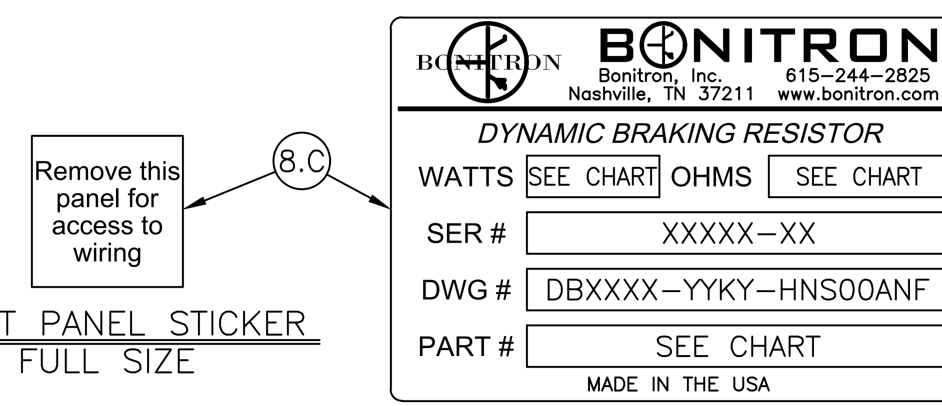


FRONT VIEW
COVERS REMOVED



SIDE VIEW
SIDE REMOVED

B B



FRONT PANEL STICKER
FULL SIZE

ID STICKER
FULL SIZE

DYNAMIC BRAKING RESISTOR
SEE PAGE 2 FOR SPECIFIC RATINGS

NOTES:
1) NEMA 1/IP20 GALVANIZED INDOOR ENCL.
2) LIFT UNIT ONLY BY LIFTING EYES ON TOP OF ENCL. – DO NOT LIFT FROM BOTTOM.
3) LABEL CONNECTORS WITH METAL TAGS AS SHOWN ON THE RESISTOR SCHEMATIC.
4) NUMBER OF GRIDS AND TERMINAL LOCATIONS VARY BASED ON KILOWATT RATING.

ALL DIMENSIONS /SPECIFICATIONS ARE REFLECTED IN MILLIMETERS UNLESS OTHERWISE SPECIFIED. DIMENSIONS IN BRACKETS [ ] ARE IN INCHES.

ZONE	REV	DESCRIPTION	DATE	CHGD BY
–	–	–	–	–

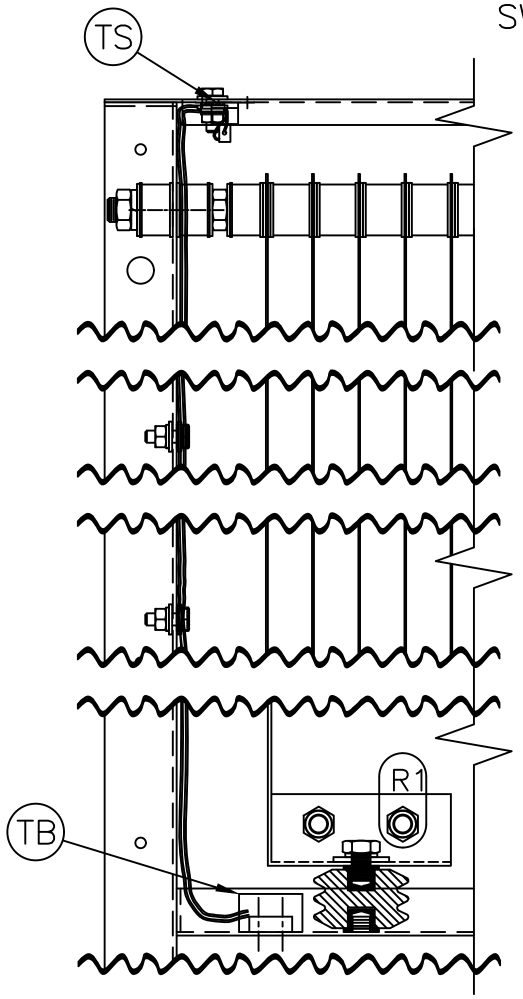
REVISIONS

BONITRON
Bonitron, Inc. 521 Fairground Court Nashville, TN 37211 USA
Phone 615-244-2825 Email info@bonitron.com www.bonitron.com
THIRD ANGLE

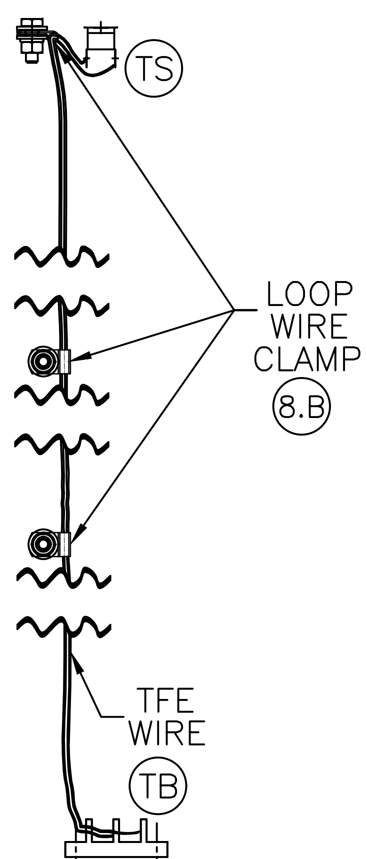
NEXT ASSY	
SIMILAR TO	
DRAWN BY	EMC
DATE	31 JAN 2019
DWG NAME	HPR70-STYLE DYNAMIC BRAKING RESISTOR
SIZE	B
DRAWING NO.	DBXXXX-YYKY-HNS00ANF
REV	0
APPROVED BY:	JJN
SCALE	1/20
SHEET	1 OF 2

VAC	DUTY	OHMS	KILO-WATTS	PEAK AMPS	BONITRON PART #	POST GLOVER PART #	ITEM 2 "XX"	DIM "A"	MEGA-JOULES
230	10%	1.0	19.2	375	L200A	DB1D00-19K2-HNS00ANF	12	6.66	2.79
230	50%	6.3	19.2	60	L030B	DB6D30-19K2-HNS00ANF	12	6.66	2.76
230	50%	4.9	19.2	77	L040B	DB4D90-19K2-HNS00ANF	12	6.66	2.78
230	50%	3.9	25.6	96	L050B	DB3D90-25K6-HNS00ANF	16	10.51	3.69
230	100%	7.5	19.2	50	L025C	DB7D50-19K2-HNS00ANF	12	6.66	2.73
460	10%	5.0	19.2	150	H150A	DB5D00-19K2-HNS00ANF	12	6.66	2.78
460	10%	3.8	22.4	197	H200A	DB3D80-22K4-HNS00ANF	14	8.59	3.24
460	10%	3.0	25.6	250	H250A	DB3D00-25K6-HNS00ANF	16	10.51	3.61
460	50%	25	19.2	30	H030B	DB25D0-19K2-HNS00ANF	12	6.66	2.41
460	50%	19	22.4	39	H040B	DB19D0-22K4-HNS00ANF	14	8.59	2.96
460	100%	38	19.2	20	H020C	DB38D0-19K2-HNS00ANF	12	6.66	2.27
460	100%	30	19.2	25	H025C	DB30D0-19K2-HNS00ANF	12	6.66	2.35
460	100%	25	25.6	30	H030C	DB25D0-25K6-HNS00ANF	16	10.51	3.33
575	10%	5.9	22.4	159	C200A	DB5D90-22K4-HNS00ANF	14	8.59	3.24
575	10%	4.7	25.6	200	C250A	DB4D70-25K6-HNS00ANF	16	10.51	3.71
575	50%	29	22.4	32	C040B	DB29D0-22K4-HNS00ANF	14	8.59	2.82
575	100%	59	25.6	16	C020C	DB59D0-25K6-HNS00ANF	16	10.51	2.94
575	100%	47	22.4	20	C025C	DB47D0-22K4-HNS00ANF	14	8.59	2.61
575	100%	39	25.6	24	C030C	DB39D0-25K6-HNS00ANF	16	10.51	3.15

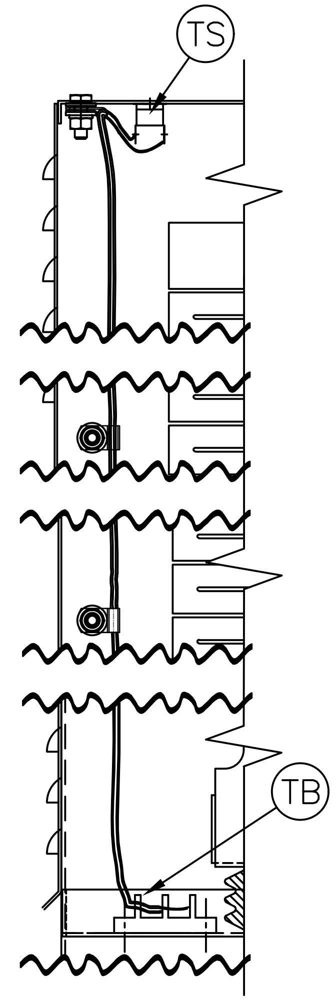
WIRE FOR THERMAL SWITCH ROUTES THROUGH LOOP WIRE CLAMPS



FRONT VIEW
SCALE 1/4



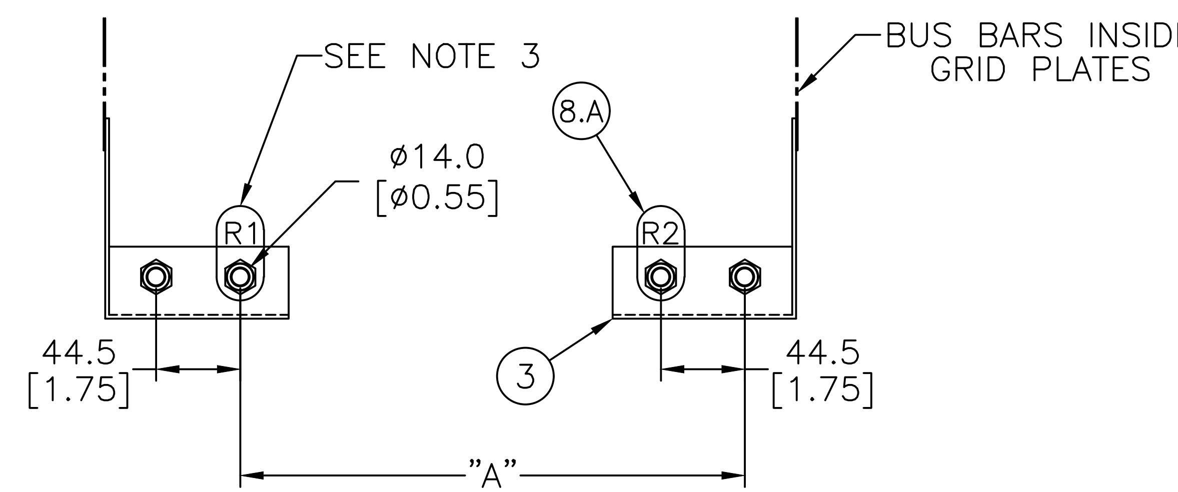
WIRING DIAGRAM



SIDE VIEW
SCALE 1/4

TB– TERMINAL BLOCK MOUNTS FRONT LEFT OF BOTTOM PANEL AS SHOWN ABOVE

TS– THERMAL SWITCH MOUNTS FRONT LEFT OF PERF TOP PANEL AS SHOWN ABOVE



EXTERNAL CONNECTION
NEMA 2-HOLE
SCALE 1/4

NOTES:
1) NEMA 1/IP20 GALVANIZED INDOOR ENCL.
2) LIFT UNIT ONLY BY LIFTING EYES ON TOP OF ENCL. – DO NOT LIFT FROM BOTTOM.
3) LABEL CONNECTORS WITH METAL TAGS AS SHOWN ON THE RESISTOR SCHEMATIC.
4) NUMBER OF GRIDS AND TERMINAL LOCATIONS VARY BASED ON KILOWATT RATING.

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ZONE	REV	DESCRIPTION	DATE	CHGD BY
–	–	–	–	–

REVISIONS

BONITRON

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521 Fairground Court
Nashville, TN 37211 USA
Phone 615-244-2825
Email info@bonitron.com
www.bonitron.com

THIRD ANGLE

NEXT ASSY
SIMILAR TO
DRAWN BY EMC
DATE 31 JAN 2019

DWG NAME HPR70-STYLE DYNAMIC BRAKING RESISTOR

SIZE B | DRAWING NO. DBXXXX-YYKY-HNS00ANF | REV 0

APPROVED BY: JIN | SCALE 1/20 | SHEET 2 OF 2

Start-up and safety information for eletric motors

(in accordance with low-voltage directive 2014/35/EU)

MOTOREN

1. General Notes

Risk due to live and rotating parts and possibly hot surface of the motor! Installation, start-up, maintenance and repair should only be carried out by qualified personnel with suitable training and experience. The installation and accident prevention regulations valid in each case should be observed.

2. Use in accordance with the Instructions

The motors comply with the standards of series EN 60034 and are designed for use in industrial installations. Increased requirements for protection, for example for use in nonindustrial units, should be guaranteed during the installation. Use in a hazardous area is only allowed if the motor is expressly intended for this purpose (observe nameplate). Permitted ambient temperatures of -20°C to +40°C with installation heights ≤ 1000 sea level. Motors may only be used according to the specitications on the rating plate.

3. Transportation, Storage

Following receipt, any damage in transit which is detected should basically be recorded in writing and notified to the haulage company at once. Eye-bolts are only designed for the tare weight of the motor. Use suitable, adequately dimensioned handling means to lift the completely assembled drive unit. Remove transport safety devices, if there are any, before start-up. The storage site should, where possible, be dry, clean, constant in temperature and free from vibration (bearing stillstand damages). In the event of a more prolonged period of storage, the useful life of the grease of the bearings is reduced. Prior to start-up following a more prolonged period of storage, the insulation resistance of the winding should be measured. In the event of values of ≤ 1 KΩ per volt rated voltage, dry the winding.

4. Installation

With conventional motors, all fastening bases should be laid flat; where applicable, thin sheets should be placed underneath to provide balance. In the case of flange- mounted motors observe the run-out of the mating flange. In the case of direct coupling operation, align the shafts axially and radially against each other.

Cooling air must be able to flow in and out unhindered. Outgoing air, even of adjacent units, should not immediately be taken back in. For models with a shaft end downwards, an overhead cover is recommended. With shaft ends upwards, a covering should be provided on the installation to prevent foreign bodies from falling into the ventilator.

5. Electrical Connection

Carry out all work only when the motor is standstill, disconnected and secured against automatic restarting. In this instance, watch for any additional or auxiliary circuits which may be present, in particular anti-condensation heaters. Mains voltage and frequency must agree with the data on the name plate. Tolerances of ±5% voltage deviation and/ or ±2% frequency deviation are allowed (EN 60034) and effect warming up and electro-magnetic compatibility where the limit values are transgressed. The connection must be secure, corresponding with the circuit diagram situated on the motor. Unwanted cable lead-ins and the terminal boxes themselves must be sealed so as to be dust-proof and water tight. Make a safe protective conductor connection!

6. Start-up

Turn rotors by hand and, in so doing, watch for any unusual friction sounds. Check direction of rotation; in an uncoupled state. Only fit and remove driven component with suitable devices -and, as required, cover with protection against accidental contact. Adjust coupling play and belt voltage according to the specifications of the manufacturer. The balance of the rotor is indicated on the shaft end face (H=half feather key, F=full feather key) and in the confirmation of order. When installing the driven component, observe appropriate type of counterbalancing. During trial operation without driving elements, lock feather keys. In the case of brake motors, the smooth operation of the brake should be checked prior to start-up.

7. Operation

In the case of changed conditions compared with normal operation, for example an increased temperature, noises or oscillations, the motor should, in case of doubt, be switched off. The cause of the fault should be determined and possibly -the manufacturer be contacted to discuss the matter. Protective equipment, even during trial operation, should not be taken out of operation. Clean the surface of the motor on a regular basis where there is a severe accunulation of dirt. Closed condensation water holes, if there are any, should be opened from time to time. In motors without any regreasing facility, the grease and/or bearing should be replaced in accordance with the specifications of the manufacturer, but no later than after 3 years.

In motors which have a regreasing facility the regreasing time, the quantity and quality of the grease are indicated on a lubrication label on the motor. Regrease only when the rotor is revolving so that the new grease is distributed in the bearing.

8. Additional Information

Details on any other possible additional facilities should be observed! Further information can be obtained from our detailed operating instructions. These will be sent to you on request. Please quote the motor model and number.

EMOD Motoren GmbH	Art.-No.	81551
Zur Kuppe 1	Ident.-No.	I.51.800.001
D-36364 Bad Salzschlirf	Edition	08.17

This start-up and safety information should be kept in a safe place!

IDEC

B-1229-1(0)

INSTRUCTION SHEET

LD6A Series

Confirm that the delivered product is what you have ordered. Read this instruction sheet to make sure of correct operation. Make sure that the instruction sheet is kept by the end user.

SAFETY PRECAUTIONS

In this operation instruction sheet, safety precautions are categorized in order of importance to Warning and Caution :

⚠ WARNING

Warning notices are used to emphasize that improper operation may cause severe personal injury or death.

⚠ CAUTION

Caution notices are used where inattention might cause personal injury or damage to equipment.

⚠ WARNING

- Read the specifications described on this sheet to make sure that the operating conditions are correct.
- Before designing the final equipment and powering up the LD6A Series, confirm the specifications decribed on this sheet. If there is any uncertainty in the description, contact IDEC before powering up the LD6A Series.
- Do not disassemble, repair, or modify the LD6A Series, otherwise severe accidents may result, such as electric shocks, damage, fire, or malfunction.
- Make sure that the LD6A Series does not fall during transportation, installation, and operation, otherwise damage may result.
- Do not pull out or push in the cable of the LD6A Series, otherwise damage may result. Give a slack to the cable while wiring.
- Turn off the power to the LD6A Series before mounting, dismounting, wiring, and assembling the LED unit. Make sure of correct wiring, otherwise electric shocks or fire may result.
- All LD6A Series are manufactured under IDEC's rigorous quality control system, but users must add failsafe provision to the control system using the LD6A Series in applications where heavy damage or personal injury may be caused in case the LD6A Series should fail.

⚠ CAUTION

- Apply a voltage within the rated value.
- Do not apply an excessive force to the LD6A Series. Do not leave a damaged LD6A Series unattended or use a damaged LD6A.
- Make sure of the correct operating temperature, which is the temperature around the LD6A Series. Otherwise internal temperature rise may result in damage.
- Do not use or store the LD6A Series in a place subjected to vibrations and shocks.
- Do not loosen screws, otherwise the protection characteristics will be impaired.
- For use on a flat surface of a Type 1 enclosure.
- Maximum surrounding air temperature rating 55ºC.

1 Type

LD6A-5WZQB-RYGSWC

Tiers
1: 1 tier
2: 2 tiers
3: 3 tiers
4: 4 tiers
5: 5 tiers

Installation
G: Frame Mount
W: Wall Mount
D: Direct Mount
P: Pole Mount (with stand)
K:Pole Mount (with L-shaped bracket)

Function
Blank:Continuous Lighting
Z :Continuous Lighting, Flashing, Buzzer

Body Color
B: Dark Gray
W: Light Gray

Illumination
R: Red
Y: Yellow
S: Blue
G: Green
W: Pure White

Lens Color
Blank: Normal
C: Clear

Rated Voltage
Q: 24V AC/DC

2 Specifications

Rated Voltage	24V AC/DC Class 2
Rated Insulation Voltage	60V
LED Rated Current	Red, Yellow: 25 mA Green, Blue: 30 mA Pure White: 20 mA
Power Consumption	Red, Yellow: 0.6W Green, Blue: 0.75W Pure White: 0.5W
Applicable Standard	UL 508, CSA C22.2 No.14 IEC60947-5-1, EN60947-5-1, JIS C 8201-5-1
Operating Temperature *1	-25 ºC to +55 ºC (no freezing)
Operating Humidity	45 % to 85 % (no condensation)
Storage Temperature	-40 ºC to +75 ºC (no freezing)
Operating Atomosphere	Free from corrosive gases
Operating Location	Indoor use only
Overvoltage Category	Ⅲ (IEC 60664-1)
Impulse Withstand Voltage (Uimp)	800V (IEC 60947-1 / JIS C8201-1)
Insulation Resistance	100 MΩ minimum (500V DC megger)
Dielectric Strength	1000V AC, 1 minute (between live and dead parts)
Vibration Resistance (operating extremes)	10 to 55 Hz, amplitude 0.5 mm
Shock Resistance	147 m/s², 6 shocks each in 6 directions
Life *2	30,000 hours (until the brightness reduces to 50% the initial value when lit at complete direct current of the rated voltage in 25 ºC environment)
Degree of Protection	IP65:Continuous Lighting IP54:Continuous Lighting, Flashing, Buzzer Pole Mount (with L-shaped bracket)-without L-shaped bracket IP23:Pole Mount (with L-shaped bracket)-with L-shaped bracket (IEC 60529) *
Flashing Cycle	approx. 105 cycles per minute (1.75Hz)
Sound Pressure (at 1m)	70～90 dB（3.3kHz）
Buzzer Cycle	Buzzer 1: approx. 700 cycles per minute Buzzer 2: approx. 35 cycles per minute
Buzzer Power Consumption	110mA
Buzzer Inrush Current	250mA max.(DC), 400mA max.(AC)

*1 The highest temperature is limited to 50 ºC when all tiers are lit continuously in the following combinations:
Two or more tiers including blue and green (Example: Red-Green-Blue, Green-Green-Red)
Four or five tiers (Example: Red-Yellow-Green-Pure White, Red-Yellow-Blue-Green-Pure White)
*2 Note that the durability of the LED is greatly attected by the operating conditions.
Note that the durability of the LED and Buzzer is greatly affected by the operating conditions.

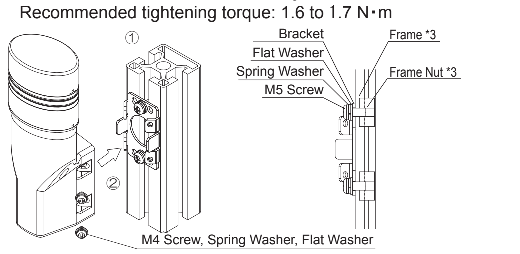
3 Mounting

- See the figure on the upper right for the installation of the LD6A series.
- For details on mounting holes, see Mounting Hole Layout.

●In order to make the buzzer sound more effective, face the unit to the front. (Continuous Lighting, Flashing, Buzzer)

●Frame Mount

①Insert two frame nuts in the frame, and attach the bracket using two M5 screws. Recommended tightening torque: 2.6 to 2.7 N・m
②Mount the LD6A to the bracket using four M4 screws. Recommended tightening torque: 1.6 to 1.7 N・m



Supplied Parts (Frame Mount)

M4 Screw	:4
Spring Washer	:4
Flat Washer	:4
M5 Screw	:2
Spring Washer	:2
Flat Washer	:2
Bracket	:1

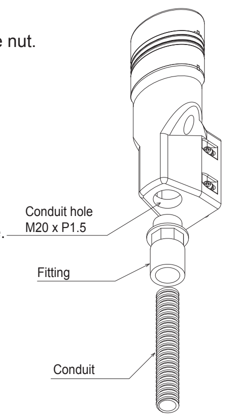
*3 See below for typical examples of Frames and Nuts. Consult the manufacturer for the installation method of the frame nut.

- Examples of recommended frames and frame nuts

Frame Size	Frame	Frame Nut	Manufacturer
□30 mm *4	SFF-302	SFB-001 SFB-4B5 SFB-101	SUS Corporation
□40 mm	SFF-402	SFB-008 SFB-4A5 SFB-108	SUS Corporation

*4 When using a □ 30 mm frame, the LD6A body protrudes from the frame.

- For Frame Mount
Use flexible conduit only, otherwise the waterproof characteristic will be impaired.
Refer to the "Example of Flexible Conduit" shown below.

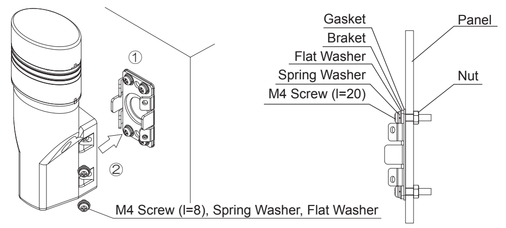


- Example of Flexible Conduit

Conduit hole Size	Fitting	Conduit	Manufacturer
M20	AL16/M20/A/BL	PAFS16BL	ADAPTAFLEX

●Wall Mount

①Make four tapped holes in the mounting panel, and mount the bracket and gasket using four screws (M4 x 20). Recommended tightening torque: 1.6 to 1.7 N・m
②Mount the LD6A to the bracket using four screws (M4 x 8). Recommended tightening torque: 1.6 to 1.7 N・m

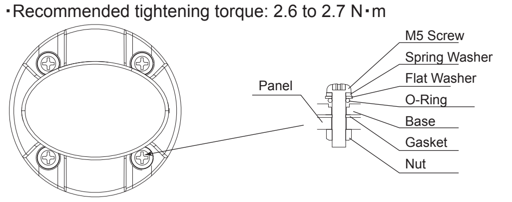


Supplied Parts (Wall Mount)

M4 Screw (l=20)	:4
M4 Screw (l=8)	:4
Flat Washer (M4)	: 8
Spring Washer (M4)	: 8
Nut (M4)	: 4
Bracket	: 1
Gasket	: 1

●Direct Mount

- Recommended tightening torque: 2.6 to 2.7 N・m

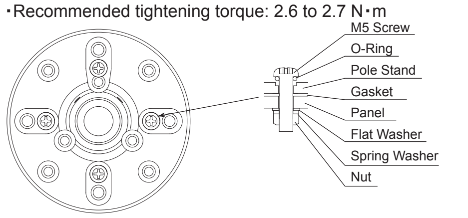


Supplied Parts (Direct Mount)

M5 Screw	: 4
Spring Washer(M5)	: 4
Flat Washer (M5)	: 4
Nut (M5)	: 4
O-Ring	: 4
Gasket	: 1

●Pole Mount

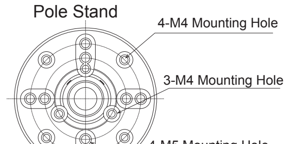
- The pole mount type can be installed in four ways. The recommended mounting method is described below.
- Recommended tightening torque: 2.6 to 2.7 N・m



Supplied Parts (Pole Mount)

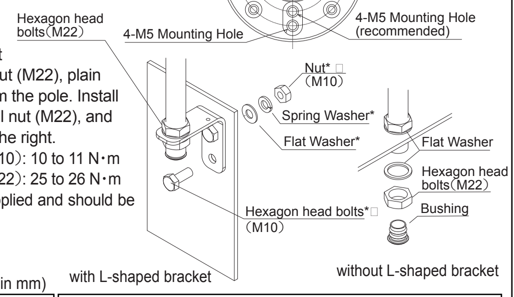
M5 Screw	: 4
Spring Washer (M5)	: 4
Flat Washer (M5)	: 4
Nut (M5)	: 4
O-Ring	: 4
Gasket	: 1

Pole Stand

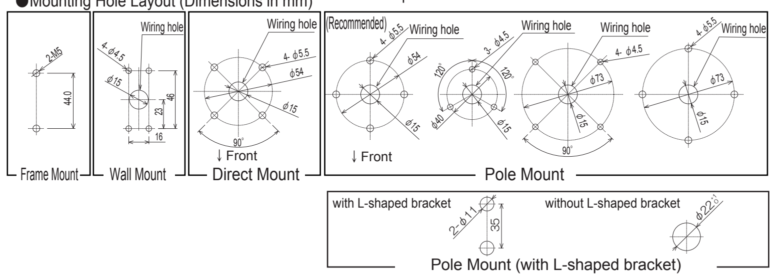


●Pole Mount (with stand)

- Installing without L-shaped bracket
Remove the bushing, hexagonal nut (M22), plain washer, and L-shaped bracket from the pole. Install in order of plain washer, hexagonal nut (M22), and bushing as shown in the figure at the right.
- Recommended tightening torque（M10）: 10 to 11 N・m
- Recommended tightening torque（M22）: 25 to 26 N・m
- The parts marked with * are not supplied and should be prepared by the user.

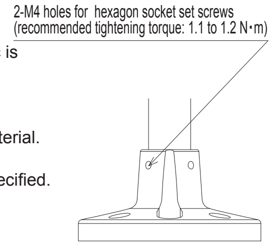


●Mounting Hole Layout (Dimensions in mm)



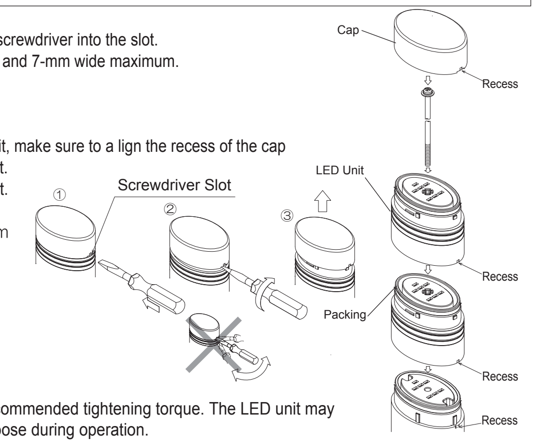
⚠ CAUTION

- Mount the LD6A light on a flat surface not subjected to vibrations.
- Do not mount the LD6A light upside-down or horizontally.
- Do not leave the LD6A unit without a cap or unassembled.
- Install the supplied gasket, otherwise waterproof characteristic is impaired.
- Mount the LD6A light on a flat surface, otherwise waterproof characteristic is impaired.
- Do not apply any chemicals which may corrode the plastic material.
- Deburr the wiring holes.
- Do not loosen the screws for which tightening torque is not specified.
- If the LD6A light is subjected to strong vibrations, the hexagon socket set screws may become loose. Apply screw lock paint. See the figure at right.



4 Assembling the LED Units

- Turn off the power.
- Remove the cap. Insert a flat screwdriver into the slot. Use a screwdriver 1-mm thick and 7-mm wide maximum.
- Pull out the cap by hand.
- Loosen the screw in center.
- Rearrange the LED units.
- When assembling the LED unit, make sure to a lign the recess of the cap with the recess of the LED unit. Otherwise, damage may result.
- Screw tightening torque : 0.4 to 0.5 N・m

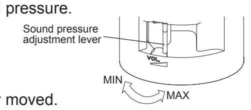


⚠ CAUTION

- Tighten the screws to the recommended tightening torque. The LED unit may be damaged if the screw is loose during operation.
- Do not touch the metal tabs of the LED unit. When a hand touches the metal tabs, static electricity may damage the LED elements inside.
- Use a maximum of 5 tiers.
- Use an appropriate screw depending on the number of tiers. (optional)
- Note the correct orientation when assembling the LED units.
- Do not remove the packing from the LED unit. Waterproof characteristics will be impaired.

5 Sound pressure adjustment (Continuous Lighting, Flashing, Buzzer)

Move the sound pressure lever to the right and left to adjust the sound pressure. The sound pressure is at maximum when the lever is set to the right. (See figure at the right)



⚠ CAUTION

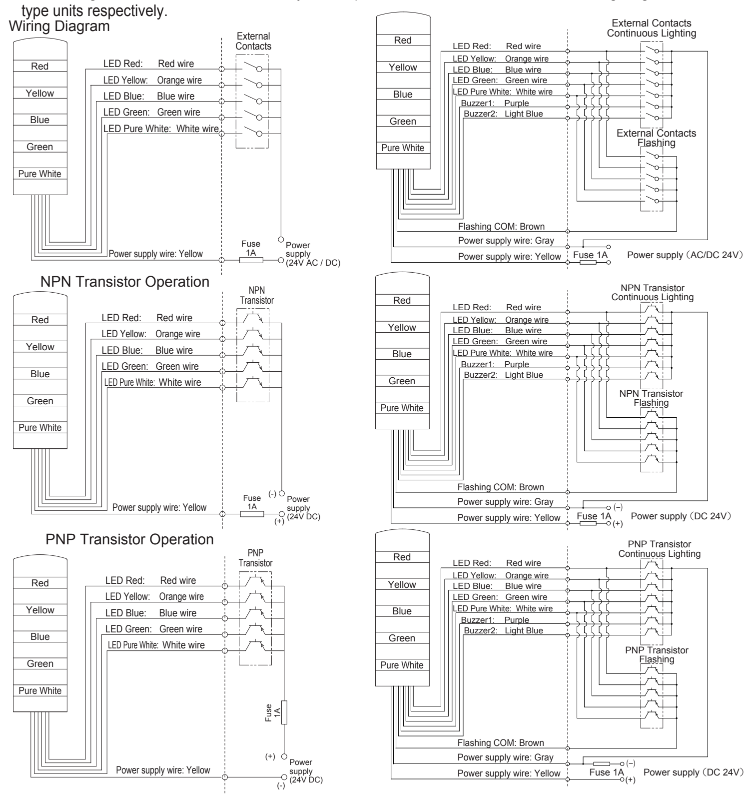
- The sound pressure adjustment lever may be damaged if it is forcibly moved.

6 Wiring

⚠ CAUTION

- Connect the wires as shown below. Incorrect wiring may damage the internal circuit.
- Connect the wires to external contacts as needed for the number of tiers.
- When using four tiers or less, insulate the unused wires.
- Connect an appropriate fuse to the power line as shown in the figure below.
- Use a UL listed external fuse holder.
- Use a Class 2 power supply only.
- When using the same color for two or more tiers, only one wire is used to light all tiers of the same color. Determine the contact capacity in consideration of the LED rated current.
- Do not apply voltage to flashing (brown) lines.
- Do not connect flashing (brown) lines with power lines. The internal circuit may be damaged.
- Do not turn on the continuous lighting and flashing contacts simultaneously. Use separate outside contacts.
- When operating several continuous lighting, flashing, buzzer type units simultaneously, use separate outside contacts.
- When using buzzers 1 and 2 simultaneously, use separate outside contacts for continuous lighting and buzzer type units respectively.

Wiring Diagram



Wire Color — Wire size：AWG22

	Wire Color
LED Unit Color - Red	Red
LED Unit Color - Yellow	Orange
LED Unit Color - Blue	Blue
LED Unit Color - Green	Green
LED Unit Color - Pure White	White
Power supply wire	Yellow

Wire size：AWG22

Continuous Lighting, Flashing, Buzzer	Wire Color
LED Unit Color - Red	Red
LED Unit Color - Yellow	Orange
LED Unit Color - Blue	Blue
LED Unit Color - Green	Green
LED Unit Color - Pure White	White
Buzzer1	Purple
Buzzer2	Light Blue
Flashing	Brown
Power supply wire	Gray
Power supply wire	Yellow

Fuse

Rated current
1A

Rated Contact for Continuous Lighting

Contact Capacity for AC (per one tire)	Current Capacity	100 mA minimum
	Dielectric Strength	AC 35V minimum
Contact Capacity for DC/ Transistor Rating (per one tire)	Current Capacity	100 mA minimum
	Dielectric Strength	35V minimum
	Leakage Current	0.1 mA maximum

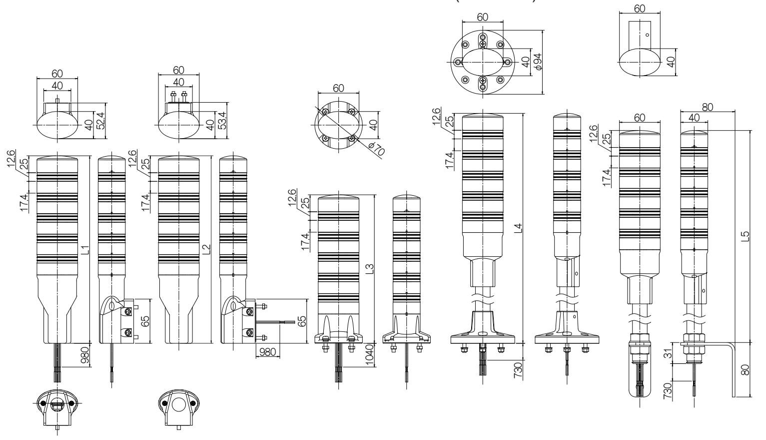
Rated Contact for Buzzer

Contact Capacity for AC (per one sound)	Current Capacity	400 mA minimum
	Dielectric Strength	AC 35V minimum
Contact Capacity for DC/ Transistor Rating (per one sound)	Current Capacity	300 mA minimum
	Dielectric Strength	35V minimum
	Leakage Current	0.1 mA maximum

7 Dimensions

- Continuous Lighting

- Frame Mount ・Wall Mount ・Direct Mount ・Pole Mount (with stand) ・Pole Mount (with L-shaped bracket)

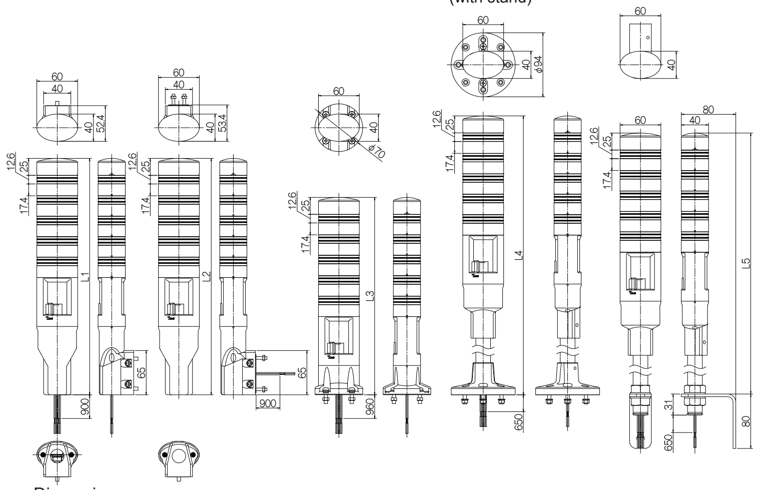


- Dimensions

Tiers	Frame Mount (L1)	Wall Mount (L2)	Direct Mount (L3)	Pole Mount (L4)	Pole Mount (L5)
1	156	156	98	408	372
2	186	186	128	438	402
3	216	216	158	468	432
4	246	246	188	498	462
5	276	276	218	528	492

- Continuous Lighting, Flashing, Buzzer

- Frame Mount ・Wall Mount ・Direct Mount ・Pole Mount (with stand) ・Pole Mount (with L-shaped bracket)



- Dimensions

Tiers	Frame Mount (L1)	Wall Mount (L2)	Direct Mount (L3)	Pole Mount (L4)	Pole Mount (L5)
1	228	228	170	480	444
2	258	258	200	510	474
3	288	288	230	540	504
4	318	318	260	570	534
5	348	348	290	600	564

7 Precautions for Disposal

- Dispose of the LD6A Series as an industrial waste.

IDEC CORPORATION

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2009.10

M.G.M. motori elettrici S.p.A.

Wiring diagram SM(X) YY/Y(9w) motor
Schéma de connexion SM(X) YY/Y(9w)

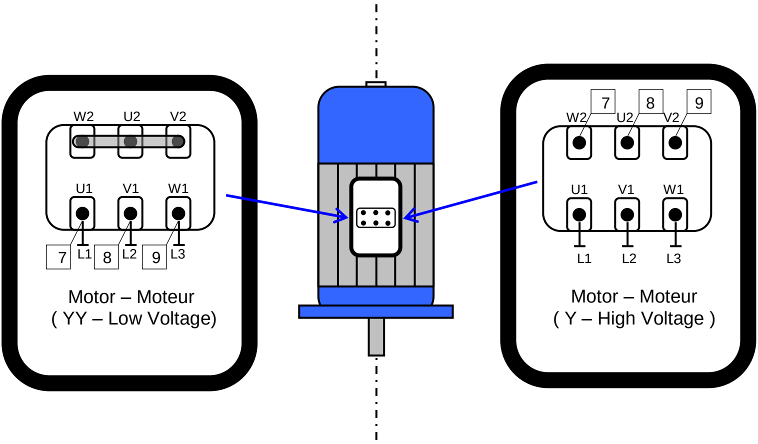
ENG: Before connecting the motor to the power supply it is necessary to connect the earth wire in accordance with the standards and regulations in force by trained personnel to prevent serious electrical shocks.

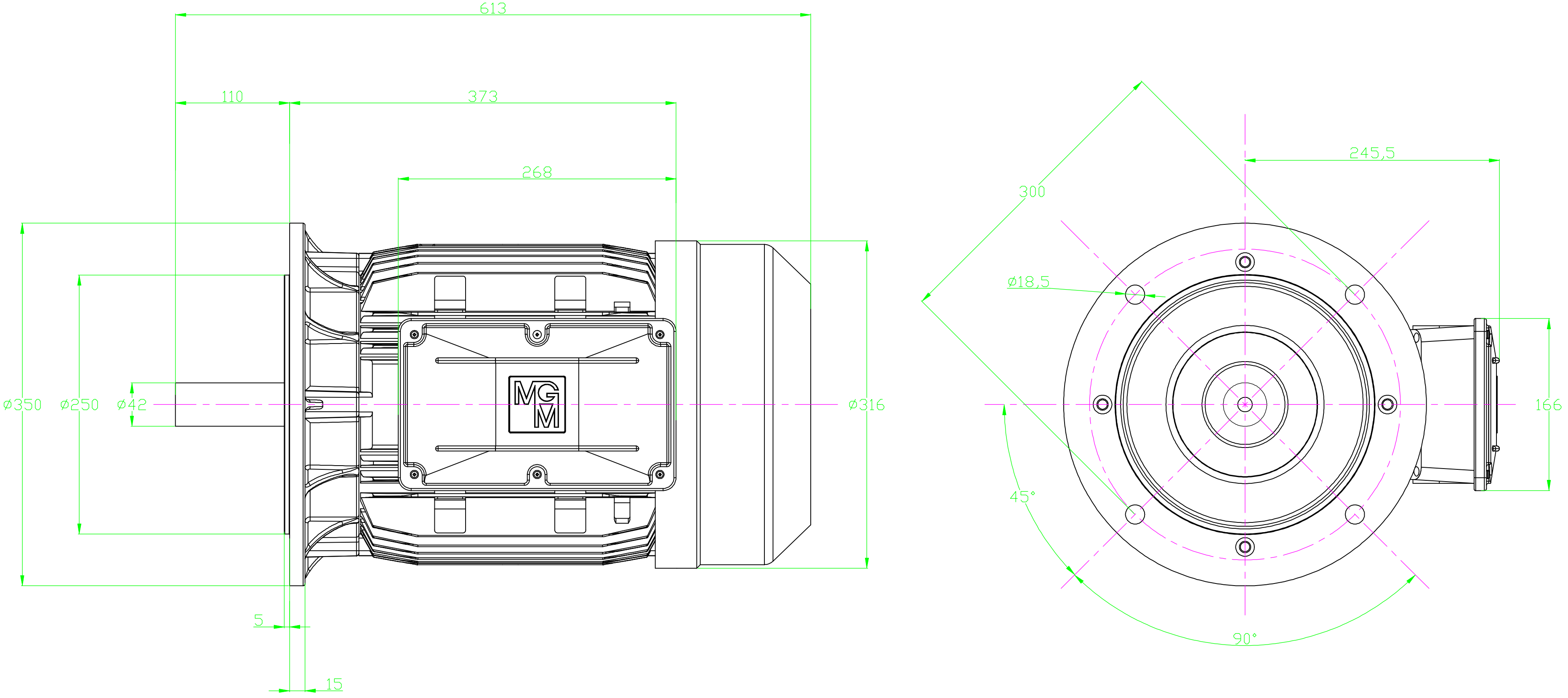
FR : Avant de brancher le moteur au secteur d'alimentation, il est nécessaire de mettre le moteur à la terre en respectant les normes en vigueur. Celui-ci doit être installé par un personnel qualifié afin de prévenir tout incident électrique.

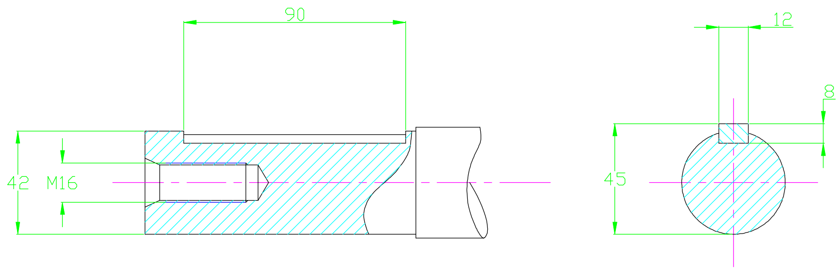
YY connection 9w = Double star connection = Motor low voltage (9 wires).
Y connection 9w = Star connection = Motor high voltage (9 wires).

ENG: Connect power supply for the motor to U1, V1, W1 as shown on the diagram below.
To change from YY to Y, remove the links connecting U2, V2, W2 and move only the wires marked with 7 (violet marker), 8 (grey marker) and 9 (white marker) from U1, V1, W1 to W2, U2, V2 respectively.
Interchange any two line leads to reverse rotation.
To change from Y to YY, follow the above procedure in reverse order.
Supply nameplate voltage.

FR: Alimentez les bornes U1, V1, W1 du boitier de connexion, comme dans le diagramme ci-dessous.
Pour changer le voltage de YY à Y, enlevez les cavaliers qui relient les bornes U2, V2, W2 et déplacer seulement les trois câbles marqués avec les numéros 7 (identificateur violet), 8 (identificateur gris) et 9 (identificateur blanc) de U1, V1, W1 à W2, U2, V2 respectivement.
Pour changer le sens de rotation du moteur, inverser deux phases de l'alimentation.
Pour changer le voltage de Y à YY, suivez à l’inverse le processus précédent.
Alimenter à la tension indiquée sur la plaque signalétique.







Materiale		Osservazioni	
Trattamenti termici sul pezzo		Questo disegno e' di proprieta' della ditta MGM di Serravalle Pistoiese. Ogni riproduzione anche parziale e' vietata	
Grezzo	In lavorazione		

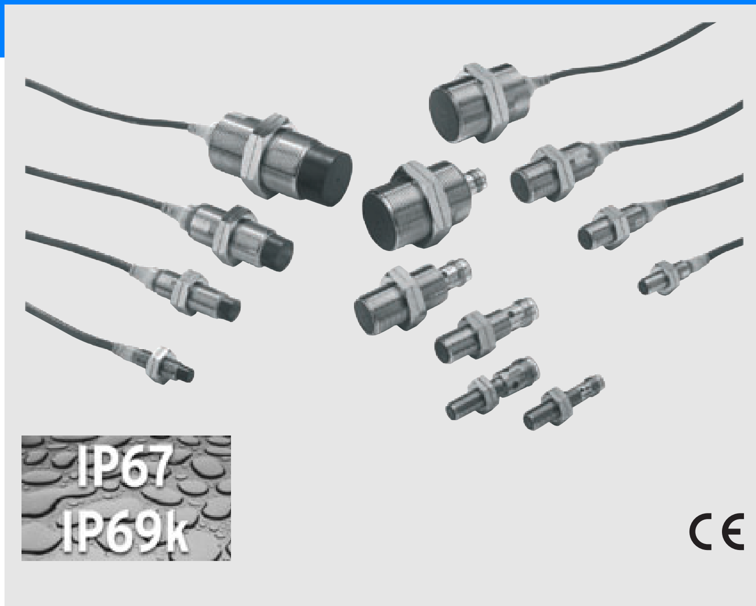
	DATA	FIRMA
Disegno	29/03/10	A.M.
Controllo		
Approv.		

M.G.M. Motori Elettrici S.p.A.
Serravalle Pistoiese
www.mgmrestop.com

SM 160 M B5

N. Modello	Peso del pezzo Kg		SCALA	1:1	DISEGNO
	Grezzo	Finito	SOSTITUISCE IL		
			SOSTITUITO DAL		

Cylindrical Proximity Sensor
E2A



High quality for extra long life in daily use

- sensing distance approximately 1.5 to 2 times longer than standard CENELEC proximity sensors
- designed and tested for extra long life
- IP67 and IP69k for highest protection in wet environments
- consistent high quality level
- DC 3-wire and DC 2-wire models
- Normally open (NO), normally closed (NC) and antivalent (NO+NC) models
- up to 30mm sensing distance
- Stainless steel and brass housings
- Pre-wired versions with different cable materials and diameters, M8 and M12 connector types, pre-wired types with cable end connectors

Ordering Information

DC 3-wire models (NO + NC: DC 4-wire) *2

Size		Sensing distance	Connection	Body material	Thread length (overall length)	Output configuration	Operation mode NO	Operation mode NC
M8	Shielded	2.0 mm	Pre-wired	Stainless steel*1	27 (40)	PNP	E2A-S08KS02-WP-B1 2M	E2A-S08KS02-WP-B2 2M
						NPN	E2A-S08KS02-WP-C1 2M	E2A-S08KS02-WP-C2 2M
					49 (62)	PNP	E2A-S08LS02-WP-B1 2M	E2A-S08LS02-WP-B2 2M
						NPN	E2A-S08LS02-WP-C1 2M	E2A-S08LS02-WP-C2 2M
			M12 connector		27 (43)	PNP	E2A-S08KS02-M1-B1	E2A-S08KS02-M1-B2
						NPN	E2A-S08KS02-M1-C1	E2A-S08KS02-M1-C2
					49 (65)	PNP	E2A-S08LS02-M1-B1	E2A-S08LS02-M1-B2
						NPN	E2A-S08LS02-M1-C1	E2A-S08LS02-M1-C2
			M8 connector (3-pin)		27 (39)	PNP	E2A-S08KS02-M5-B1	E2A-S08KS02-M5-B2
						NPN	E2A-S08KS02-M5-C1	E2A-S08KS02-M5-C2
					49 (61)	PNP	E2A-S08LS02-M5-B1	E2A-S08LS02-M5-B2
						NPN	E2A-S08LS02-M5-C1	E2A-S08LS02-M5-C2
			M8 connector (4-pin)		27 (39)	PNP	E2A-S08KS02-M3-B1	E2A-S08KS02-M3-B2
						NPN	E2A-S08KS02-M3-C1	E2A-S08KS02-M3-C2
					49 (61)	PNP	E2A-S08LS02-M3-B1	E2A-S08LS02-M3-B2
						NPN	E2A-S08LS02-M3-C1	E2A-S08LS02-M3-C2
	Non-shielded	4.0 mm	Pre-wired		27 (40)	PNP	E2A-S08KN04-WP-B1 2M	E2A-S08KN04-WP-B2 2M
						NPN	E2A-S08KN04-WP-C1 2M	E2A-S08KN04-WP-C2 2M
					49 (62)	PNP	E2A-S08LN04-WP-B1 2M	E2A-S08LN04-WP-B2 2M
						NPN	E2A-S08LN04-WP-C1 2M	E2A-S08LN04-WP-C2 2M
			M12 connector		27 (43)	PNP	E2A-S08KN04-M1-B1	E2A-S08KN04-M1-B2
						NPN	E2A-S08KN04-M1-C1	E2A-S08KN04-M1-C2
					49 (65)	PNP	E2A-S08LN04-M1-B1	E2A-S08LN04-M1-B2
						NPN	E2A-S08LN04-M1-C1	E2A-S08LN04-M1-C2
			M8 connector (3-pin)		27 (39)	PNP	E2A-S08KN04-M5-B1	E2A-S08KN04-M5-B2
						NPN	E2A-S08KN04-M5-C1	E2A-S08KN04-M5-C2
					49 (61)	PNP	E2A-S08LN04-M5-B1	E2A-S08LN04-M5-B2
						NPN	E2A-S08LN04-M5-C1	E2A-S08LN04-M5-C2
			M8 connector (4 pin)		27 (39)	PNP	E2A-S08KN04-M3-B1	E2A-S08KN04-M3-B2
						NPN	E2A-S08KN04-M3-C1	E2A-S08KN04-M3-C2
					49 (61)	PNP	E2A-S08LN04-M3-B1	E2A-S08LN04-M3-B2
						NPN	E2A-S08LN04-M3-C1	E2A-S08LN04-M3-C2

Size		Sensing distance	Connec-tion	Body material	Thread length (overall length)	Output confi-guration	Operation mode NO	Operation mode NC	Operation mode NO + NC
M12	Shiel-ded	4.0 mm	Pre-wired	Brass*3	34 (50)	PNP	E2A-M12KS04-WP-B1 2M	E2A-M12KS04-WP-B2 2M	E2A-M12KS04-WP-B3 2M
						NPN	E2A-M12KS04-WP-C1 2M	E2A-M12KS04-WP-C2 2M	E2A-M12KS04-WP-C3 2M
					56 (72)	PNP	E2A-M12LS04-WP-B1 2M	E2A-M12LS04-WP-B2 2M	E2A-M12LS04-WP-B3 2M
						NPN	E2A-M12LS04-WP-C1 2M	E2A-M12LS04-WP-C2 2M	E2A-M12LS04-WP-C3 2M
			M12 connector	Brass*3	34 (48)	PNP	E2A-M12KS04-M1-B1	E2A-M12KS04-M1-B2	E2A-M12KS04-M1-B3
						NPN	E2A-M12KS04-M1-C1	E2A-M12KS04-M1-C2	E2A-M12KS04-M1-C3
					56 (70)	PNP	E2A-M12LS04-M1-B1	E2A-M12LS04-M1-B2	E2A-M12LS04-M1-B3
						NPN	E2A-M12LS04-M1-C1	E2A-M12LS04-M1-C2	E2A-M12LS04-M1-C3
			M8 connector (3-pin)	Brass*3	34 (48)	PNP	E2A-M12KS04-M5-B1	E2A-M12KS04-M5-B2	n.a.
						NPN	E2A-M12KS04-M5-C1	E2A-M12KS04-M5-C2	n.a.
					56 (70)	PNP	E2A-M12LS04-M5-B1	E2A-M12LS04-M5-B2	n.a.
						NPN	E2A-M12LS04-M5-C1	E2A-M12LS04-M5-C2	n.a.
			M8 connector (4-pin)	Brass*3	34 (48)	PNP	E2A-M12KS04-M3-B1	E2A-M12KS04-M3-B2	n.a.
						NPN	E2A-M12KS04-M3-C1	E2A-M12KS04-M3-C2	n.a.
					56 (70)	PNP	E2A-M12LS04-M3-B1	E2A-M12LS04-M3-B2	n.a.
						NPN	E2A-M12LS04-M3-C1	E2A-M12LS04-M3-C2	n.a.
	Non-shiel-ded	8.0 mm	Pre-wired	Brass*3	34 (50)	PNP	E2A-M12KN08-WP-B1 2M	E2A-M12KN08-WP-B2 2M	E2A-M12KN08-WP-B3 2M
						NPN	E2A-M12KN08-WP-C1 2M	E2A-M12KN08-WP-C2 2M	E2A-M12KN08-WP-C3 2M
					56 (72)	PNP	E2A-M12LN08-WP-B1 2M	E2A-M12LN08-WP-B2 2M	E2A-M12LN08-WP-B3 2M
						NPN	E2A-M12LN08-WP-C1 2M	E2A-M12LN08-WP-C2 2M	E2A-M12LN08-WP-C3 2M
			M12 connector	Brass*3	34 (48)	PNP	E2A-M12KN08-M1-B1	E2A-M12KN08-M1-B2	E2A-M12KN08-M1-B3
						NPN	E2A-M12KN08-M1-C1	E2A-M12KN08-M1-C2	E2A-M12KN08-M1-C3
					56 (70)	PNP	E2A-M12LN08-M1-B1	E2A-M12LN08-M1-B2	E2A-M12LN08-M1-B3
						NPN	E2A-M12LN08-M1-C1	E2A-M12LN08-M1-C2	E2A-M12LN08-M1-C3
			M8 connector (3-pin)	Brass*3	34 (48)	PNP	E2A-M12KN08-M5-B1	E2A-M12KN08-M5-B2	n.a.
						NPN	E2A-M12KN08-M5-C1	E2A-M12KN08-M5-C2	n.a.
					56 (70)	PNP	E2A-M12LN08-M5-B1	E2A-M12LN08-M5-B2	n.a.
						NPN	E2A-M12LN08-M5-C1	E2A-M12LN08-M5-C2	n.a.
			M8 connector (4-pin)	Brass*3	34 (48)	PNP	E2A-M12KN08-M3-B1	E2A-M12KN08-M3-B2	n.a.
						NPN	E2A-M12KN08-M3-C1	E2A-M12KN08-M3-C2	n.a.
					56 (70)	PNP	E2A-M12LN08-M3-B1	E2A-M12LN08-M3-B2	n.a.
						NPN	E2A-M12LN08-M3-C1	E2A-M12LN08-M3-C2	n.a.
M18	Shiel-ded	8.0 mm	Pre-wired	Brass*3	39 (59)	PNP	E2A-M18KS08-WP-B1 2M	E2A-M18KS08-WP-B2 2M	E2A-M18KS08-WP-B3 2M
						NPN	E2A-M18KS08-WP-C1 2M	E2A-M18KS08-WP-C2 2M	E2A-M18KS08-WP-C3 2M
					61 (81)	PNP	E2A-M18LS08-WP-B1 2M	E2A-M18LS08-WP-B2 2M	E2A-M18LS08-WP-B3 2M
						NPN	E2A-M18LS08-WP-C1 2M	E2A-M18LS08-WP-C2 2M	E2A-M18LS08-WP-C3 2M
			M12 connector	Brass*3	39 (53)	PNP	E2A-M18KS08-M1-B1	E2A-M18KS08-M1-B2	E2A-M18KS08-M1-B3
						NPN	E2A-M18KS08-M1-C1	E2A-M18KS08-M1-C2	E2A-M18KS08-M1-C3
					61 (75)	PNP	E2A-M18LS08-M1-B1	E2A-M18LS08-M1-B2	E2A-M18LS08-M1-B3
						NPN	E2A-M18LS08-M1-C1	E2A-M18LS08-M1-C2	E2A-M18LS08-M1-C3
			M8 connector (3-pin)	Brass*3	39 (53)	PNP	E2A-M18KS08-M5-B1	E2A-M18KS08-M5-B2	n.a.
						NPN	E2A-M18KS08-M5-C1	E2A-M18KS08-M5-C2	n.a.
					61 (75)	PNP	E2A-M18LS08-M5-B1	E2A-M18LS08-M5-B2	n.a.
						NPN	E2A-M18LS08-M5-C1	E2A-M18LS08-M5-C2	n.a.
			M8 connector (4-pin)	Brass*3	39 (53)	PNP	E2A-M18KS08-M3-B1	E2A-M18KS08-M3-B2	n.a.
						NPN	E2A-M18KS08-M3-C1	E2A-M18KS08-M3-C2	n.a.
					61 (75)	PNP	E2A-M18LS08-M3-B1	E2A-M18LS08-M3-B2	n.a.
						NPN	E2A-M18LS08-M3-C1	E2A-M18LS08-M3-C2	n.a.
	Non-shiel-ded	16.0 mm	Pre-wired	Brass*3	39 (59)	PNP	E2A-M18KN16-WP-B1 2M	E2A-M18KN16-WP-B2 2M	E2A-M18KN16-WP-B3 2M
						NPN	E2A-M18KN16-WP-C1 2M	E2A-M18KN16-WP-C2 2M	E2A-M18KN16-WP-C3 2M
					61 (81)	PNP	E2A-M18LN16-WP-B1 2M	E2A-M18LN16-WP-B2 2M	E2A-M18LN16-WP-B3 2M
						NPN	E2A-M18LN16-WP-C1 2M	E2A-M18LN16-WP-C2 2M	E2A-M18LN16-WP-C3 2M
			M12 connector	Brass*3	39 (53)	PNP	E2A-M18KN16-M1-B1	E2A-M18KN16-M1-B2	E2A-M18KN16-M1-B3
						NPN	E2A-M18KN16-M1-C1	E2A-M18KN16-M1-C2	E2A-M18KS16-M1-C3
					61 (75)	PNP	E2A-M18LN16-M1-B1	E2A-M18LN16-M1-B2	E2A-M18LS16-M1-B3
						NPN	E2A-M18LN16-M1-C1	E2A-M18LN16-M1-C2	E2A-M18LS16-M1-C3
			M8 connector (3-pin)	Brass*3	39 (53)	PNP	E2A-M18KN16-M5-B1	E2A-M18KN16-M5-B2	n.a.
						NPN	E2A-M18KN16-M5-C1	E2A-M18KN16-M5-C2	n.a.
					61 (75)	PNP	E2A-M18LN16-M5-B1	E2A-M18LN16-M5-B2	n.a.
						NPN	E2A-M18LN16-M5-C1	E2A-M18LN16-M5-C2	n.a.
			M8 connector (4-pin)	Brass*3	39 (53)	PNP	E2A-M18KN16-M3-B1	E2A-M18KN16-M3-B2	n.a.
						NPN	E2A-M18KN16-M3-C1	E2A-M18KN16-M3-C2	n.a.
					61 (75)	PNP	E2A-M18LN16-M3-B1	E2A-M18LN16-M3-B2	n.a.
						NPN	E2A-M18LN16-M3-C1	E2A-M18LN16-M3-C2	n.a.

Size		Sensing distance	Connec-tion	Body material	Thread length (overall length)	Output confi-guration	Operation mode NO	Operation mode NC	Operation mode NO + NC
M30	Shiel-ded	15.0 mm	Pre-wired	Brass*3	44 (64)	PNP	E2A-M30KS15-WP-B1 2M	E2A-M30KS15-WP-B2 2M	E2A-M30KS15-WP-B3 2M
						NPN	E2A-M30KS15-WP-C1 2M	E2A-M30KS15-WP-C2 2M	E2A-M30KS15-WP-C3 2M
					66 (86)	PNP	E2A-M30LS15-WP-B1 2M	E2A-M30LS15-WP-B2 2M	E2A-M30LS15-WP-B3 2M
						NPN	E2A-M30LS15-WP-C1 2M	E2A-M30LS15-WP-C2 2M	E2A-M30LS15-WP-C3 2M
			M12 connector	Brass*3	44 (58)	PNP	E2A-M30KS15-M1-B1	E2A-M30KS15-M1-B2	E2A-M30KS15-M1-B3
						NPN	E2A-M30KS15-M1-C1	E2A-M30KS15-M1-C2	E2A-M30KS15-M1-C3
					66 (80)	PNP	E2A-M30LS15-M1-B1	E2A-M30LS15-M1-B2	E2A-M30LS15-M1-B3
						NPN	E2A-M30LS15-M1-C1	E2A-M30LS15-M1-C2	E2A-M30LS15-M1-C3
			M8 connector (3-pin)	Brass*3	44 (58)	PNP	E2A-M30KS15-M5-B1	E2A-M30KS15-M5-B2	n.a.
						NPN	E2A-M30KS15-M5-C1	E2A-M30KS15-M5-C2	n.a.
					66 (80)	PNP	E2A-M30LS15-M5-B1	E2A-M30LS15-M5-B2	n.a.
						NPN	E2A-M30LS15-M5-C1	E2A-M30LS15-M5-C2	n.a.
			M8 connector (4-pin)	Brass*3	44 (58)	PNP	E2A-M30KS15-M3-B1	E2A-M30KS15-M3-B2	n.a.
						NPN	E2A-M30KS15-M3-C1	E2A-M30KS15-M3-C2	n.a.
					66 (80)	PNP	E2A-M30LS15-M3-B1	E2A-M30LS15-M3-B2	n.a.
						NPN	E2A-M30LS15-M3-C1	E2A-M30LS15-M3-C2	n.a.
	Non-shiel-ded	20.0 mm	Pre-wired	Brass*3	44 (64) (See note.)	PNP	E2A-M30KN20-WP-B1 2M	E2A-M30KN20-WP-B2 2M	E2A-M30KN20-WP-B3 2M
						NPN	E2A-M30KN20-WP-C1 2M	E2A-M30KN20-WP-C2 2M	E2A-M30KN20-WP-C3 2M
		30.0 mm			66 (86)	PNP	E2A-M30LN30-WP-B1 2M	E2A-M30LN30-WP-B2 2M	E2A-M30LN30-WP-B3 2M
						NPN	E2A-M30LN30-WP-C1 2M	E2A-M30LN30-WP-C2 2M	E2A-M30LN30-WP-C3 2M
		20.0 mm	M12 connector	Brass*3	44 (58) (See note.)	PNP	E2A-M30KN20-M1-B1	E2A-M30KN20-M1-B2	E2A-M30KN20-M1-B3
						NPN	E2A-M30KN20-M1-C1	E2A-M30KN20-M1-C2	E2A-M30KN20-M1-C3
		30.0 mm			66 (80)	PNP	E2A-M30LN30-M1-B1	E2A-M30LN30-M1-B2	E2A-M30LN30-M1-B3
						NPN	E2A-M30LN30-M1-C1	E2A-M30LN30-M1-C2	E2A-M30LN30-M1-C3
		20.0 mm	M8 connector (3-pin)	Brass*3	44 (58) (See note.)	PNP	E2A-M30KN20-M5-B1	E2A-M30KN20-M5-B2	n.a.
						NPN	E2A-M30KN20-M5-C1	E2A-M30KN20-M5-C2	n.a.
		30.0 mm			66 (80)	PNP	E2A-M30LN30-M5-B1	E2A-M30LN30-M5-B2	n.a.
						NPN	E2A-M30LN30-M5-C1	E2A-M30LN30-M5-C2	n.a.
		20.0 mm	M8 connector (4-pin)	Brass*3	44 (58) (See note.)	PNP	E2A-M30KN20-M3-B1	E2A-M30KN20-M3-B2	n.a.
						NPN	E2A-M30KN20-M3-C1	E2A-M30KN20-M3-C2	n.a.
		30.0 mm			66 (80)	PNP	E2A-M30LN30-M3-B1	E2A-M30LN30-M3-B2	n.a.
						NPN	E2A-M30LN30-M3-C1	E2A-M30LN30-M3-C2	n.a.

*1. Material specifications for stainless steel housing case: 1.4305 (W.-No.), SUS 303 (AISI), 2346 (SS). Please contact your OMRON representative for other stainless steel materials.
*2. Please contact your OMRON representative for DC 2-wire models.
*3. Stainless steel models are also available. Please contact your OMRON representative.

Note: M30 non-shielded Models with double sensing distance and short barrels cannot be mounted due to the necessary separation distance from the surrounding metal. Standard sensing models are thus available.

Connectivity

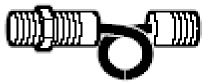
The E2A sensors are available with the following connectors and cable materials:

Pre-wired models

Standard cable lengths are 2m and 5m.
For other cable lengths please contact your OMRON representative.

Standard cable material: PVC (dia 4mm)	-WP
Other available cable materials and sizes:	
- PVC (dia 6mm)	-WS
- PUR/PVC – PUR jacket (dia 4mm)	-WA
- PUR/PVC – PUR jacket (dia 6mm)	-WB
- PVC robotic cable (dia 4mm)	-WR

Pre-wired models with cable end connectors



All pre-wired models can be fitted with cable and connectors.

Standard cable end connectors:	
- M12	M1J
- M8 (4 pin)	M3J
- M8 (3 pin)	M5J

Other cable end connectors are available on request.

Connector models

Standard connectors: M12, M8 (4 or 3 pin)	-M1, -M3, -M5

Model Number Legend

E2A□-□□□□□-□-□□-□□

1 2 3 4 5 6 7 8 9 10 11 12

Example:	E2A-M12LS04-M1-B1	Standard, M12, long barrel, shielded, Sn=4 mm, M12 connector, PNP-NO
	E2A-S08KN04-WP-B1 5M	Standard, M8 stainless steel, short barrel, non-shielded, Sn=4 mm, pre-wired PVC cable, PNP-NO, cable length=5 m

1. Basic name

E2A

2. Sensing technology

Blank: Standard double distance

3. Housing shape and material

M: Cylindrical, metric threaded, brass

S: Cylindrical, metric threaded, stainless steel

4. Housing size

08: 8 mm

12: 12 mm

18: 18 mm

30: 30 mm

5. Barrel length

K: Standard length

L: Long body

6. Shield

S: Shielded

N: Non-shielded

7. Sensing distance

Numeral: Sensing distance: e.g. 02=2 mm, 16=16 mm

8. Kind of connection

WP: pre-wired, PVC, dia 4mm (standard)

WS: pre-wired, PVC, dia 6mm

WR: pre-wired, PVC, robotic cable, dia 4mm

WA: pre-wired, PUR/PVC (PUR jacket), dia 4mm

WB: pre-wired, PUR/PVC (PUR jacket), dia 6mm

M1: M12 connector (4 pin) *

M3: M8 connector (4 pin)

M5: M8 connector (3 pin)

M1J pre-wired with M12 cable end connector (4 pin)

M3J pre-wired with M8 cable end connector (4 pin)

M5J pre-wired with M8 cable end connector (3 pin)

9. Power source and output

B: DC, 3-wire, PNP open collector

C: DC, 3-wire, NPN open collector

D: DC, 2-wire

E: DC, 3-wire, NPN voltage output

F: DC, 3-wire, PNP voltage output

10.Operation mode

1: Normally open (NO)

2: Normally closed (NC)

3: Antivalent (NO+NC)

11.Specials (e.g., cable material, oscillating frequency)

12.Cable length

Blank: Connector type

Numeral: Cable length

Note: *In case of DC 2-wire models the M12 connector identifier is '-M1G'

Specifications

DC 3-wire Models / DC 4-wire (NO+NC)

Size		M8		M12	
Type		Shielded	Non-shielded	Shielded	Non-shielded
Item		E2A-S08□S02-□□-B1 E2A-S08□S02-□□-C1	E2A-S08□N04-□□-B1 E2A-S08□N04-□□-C1	E2A-M12□S04-□□-B□ E2A-M12□S04-□□-C□ E2A-S12□S04-□□-B□ E2A-S12□S04-□□-C□	E2A-M12□N08-□□-B□ E2A-M12□N08-□□-C□ E2A-S12□N08-□□-B□ E2A-S12□N08-□□-C□
Sensing distance		2 mm ± 10%	4 mm ± 10%	4 mm ± 10%	8 mm ± 10%
Setting distance		0 to 1.6 mm	0 to 3.2 mm	0 to 3.2 mm	0 to 6.4 mm
Differential travel		10% max. of sensing distance			
Target		Ferrous metal (The sensing distance decreases with non-ferrous metal.)			
Standard target (mild steel ST37)		8×8×1 mm	12×12×1 mm	12×12×1 mm	24×24×1 mm
Response frequency (See note 1.)		1,500 Hz	1,000 Hz	1,000 Hz	800 Hz
Power supply voltage (operating voltage range)		12 to 24 VDC. Ripple (p-p): 10% max. (10 to 32 VDC)			
Current consumption (DC 3-wire)		10 mA max.			
Output type		-B models: PNP open collector -C models: NPN open collector			
Control output	Load current (See note 2.)	200 mA max. (32 VDC max.)			
	Residual voltage	2 V max. (under load current of 200 mA with cable length of 2 m)			
Indicator		Operation indicator (Yellow LED)			
Operation mode (with sensing object approaching)		-B1/-C1 models: NO -B2/-C2 models: NC -B3/ -C3 models: NO+NC For details, refer to the timing charts. (See note 4.)			
Protection circuit		Power source circuit reverse polarity protection, Surge suppressor, Short-circuit protection		Output reverse polarity protection, Power source circuit reverse polarity protection, Surge suppressor, Short-circuit protection	
Ambient air temperature		Operating: -40° C to 70° C, Storage: -40° C to 85° C (with no icing or condensation)			
Temperature influence (See note 2.)		±10% max. of sensing distance at 23° C within temperature range of -25° C to 70° C ±15% max. of sensing distance at 23° C within temperature range of -40° C to 70° C			
Ambient humidity		Operating: 35% to 95%, Storage: 35% to 95%			
Voltage influence		±1% max. of sensing distance in rated voltage range ±15%			
Insulation resistance		50 MΩ min. (at 500 VDC) between current carry parts and case			
Dielectric strength		1,000 VAC at 50/60 Hz for 1 min between current carry parts and case			
Vibration resistance		10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y and Z directions			
Shock resistance		500 m/s^2, 10 times each in X, Y and Z directions		1,000 m/s^2, 10 times each in X, Y and Z directions	
Standard and listings (See note 3.)		IP67 after IEC 60529 IP69k after DIN 40050 EMC after EN60947-5-2			
Connection method		Pre-wired models (standard is dia 4mm PVC cable with length = 2m). Please see chapter 'Connectivity' for details on different cable materials and lenghts and M8 or M12 connectors.			
Weight (packaged)	Pre-wired model	Approx. 65 g		Approx. 85 g	
	Connector model	M12 connector models: Approx. 20 g M8 connector models: Approx. 15 g		Approx. 35 g	
Material	Case	Stainless steel		Brass-nickel plated or stainless steel	
	Sensing surface	PBT			
	Cable	Standard cable is PVC dia 4mm. For other cable materials or diameters please refer to chapter 'Connectivity'			
	Clamping nut	Brass-nickel plated		Brass-nickel plated for brass models stainless steel for steel models	

Note 1. The response frequency is an average value. Measurement conditions are as follows: standard target, a distance of twice the standard target distance between targets, and a setting distance of half the sensing distance.

2. When using any model at an ambient temperature between -40°C and -25°C and a power voltage between 30 and 32 VDC, use a load current of 100 mA max.,

3. For USA and Canada: use class 2 circuit only.

4. -B3/ -C3 NO+NC models are available in M12, M18 and M30 housings with M12 connectors, pre-wired and with cable end connectors.

DC 3-wire Models / DC 4-wire (NO+NC)

	Size	M18		M30		
	Type	Shielded	Non-shielded	Shielded	Non-shielded	Non-shielded
	Item	E2A-M18□S08-□□-B□ E2A-M18□S08-□□-C□ E2A-S18□S08-□□-B□ E2A-S18□S08-□□-C□	E2A-M18□N16-□□-B□ E2A-M18□N16-□□-C□ E2A-S18□N16-□□-B□ E2A-S18□N16-□□-C□	E2A-M30□S15-□□-B□ E2A-M30□S15-□□-C□ E2A-S30□S15-□□-B□ E2A-S30□S15-□□-C□	E2A-M30KN20-□□-B□ E2A-M30KN20-□□-C□ E2A-S30KN20-□□-B□ E2A-S30KN20-□□-C□	E2A-M30LN30-□□-B□ E2A-M30LN30-□□-C□ E2A-S30LN30-□□-B□ E2A-S30LN30-□□-C□
Sensing distance		8 mm±10%	16 mm±10%	15 mm±10%	20 mm±10%	30 mm±10%
Setting distance		0 to 6.4 mm	0 to 12.8 mm	0 to 12 mm	0 to 16 mm	0 to 24 mm
Differential travel		10% max. of sensing distance				
Target		Ferrous metal (The sensing distance decreases with non-ferrous metal.)				
Standard target (mild steel ST37)		24×24×1 mm	48×48×1 mm	45×45×1 mm	60×60×1 mm	90×90×1 mm
Response frequency (See note 1.)		500 Hz	400 Hz	250 Hz	100 Hz	100 Hz
Power supply voltage (operating voltage range)		12 to 24 VDC. Ripple (p-p): 10% max. (10 to 32 VDC)				
Current consumption (DC 3-wire)		10 mA max.				
Output type		-B models: PNP open collector -C models: NPN open collector				
Control output	Load current (See note 2.)	200 mA max. (32 VDC max.)				
	Residual voltage	2 V max. (under load current of 200 mA with cable length of 2 m)				
Indicator		Operation indicator (Yellow LED)				
Operation mode (with sensing object approaching)		-B1/-C1 models: NO -B2/-C2 models: NC -B3/ -C3 models: NO+NC For details, refer to the timing charts.				
Protection circuit		Output reverse polarity protection, Power source circuit reverse polarity protection, Surge suppressor, Short-circuit protection				
Ambient air temperature		Operating: -40°C to 70°C, Storage: -40°C to 85°C (with no icing or condensation)				
Temperature influence (See note 2.)		±10% max. of sensing distance at 23°C within temperature range of -25°C to 70°C ±15% max. of sensing distance at 23°C within temperature range of -40°C to 70°C				
Ambient humidity		Operating: 35% to 95%, Storage: 35% to 95%				
Voltage influence		±1% max. of sensing distance in rated voltage range ±15%				
Insulation resistance		50 MΩ min. (at 500 VDC) between current carry parts and case				
Dielectric strength		1,000 VAC at 50/60 Hz for 1 min between current carry parts and case				
Vibration resistance		10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y and Z directions				
Shock resistance		1,000 m/s^2, 10 times each in X, Y and Z directions				
Standard and listings (See note 3.)		IP67 after IEC 60529 IP69k after DIN 40050 EMC after EN60947-5-2				
Connection method		Pre-wired models (standard is dia 4mm PVC cable with length = 2m). Please see chapter 'Connectivity' for details on different cable materials and lenghts and M8 or M12 connectors.				
Weight (pak-kaged)	Pre-wired model	Approx. 160 g		Approx. 280 g	Approx. 280 g	Approx. 370 g
	Connector model	Approx. 70 g		Approx. 200 g	Approx. 200 g	Approx. 260 g
Material	Case	Brass-nickel plated or stainless steel				
	Sensing surface	PBT				
	Cable	Standard cable is PVC dia 4mm. For other cable materials or diameters please refer to chapter 'Connectivity'				
	Clamping nut	brass-nickel plated for brass models stainless steel for steel models				

Note 1. The response frequency is an average value. Measurement conditions are as follows: standard target, a distance of twice the standard target distance between targets, and a setting distance of half the sensing distance.

2. When using any model at an ambient temperature between -40°C and -25°C and a power voltage between 30 and 32 VDC, use a load current of 100 mA max.

3. For USA and Canada: use class 2 circuit only.

DC 2-wire Models

	Size	M8		M12	
	Type	Shielded	Non-shielded	Shielded	Non-shielded
	Item	E2A-S08□S02-D□	E2A-S08□N04-D□	E2A-M12□S04-D□ E2A-S12□S04-D□	E2A-M12□N08-D□ E2A-S12□N08-D□
Sensing distance		2 mm ± 10%	4 mm ± 10%	4 mm ± 10%	8 mm ± 10%
Setting distance		0 to 1.6 mm	0 to 3.2 mm	0 to 3.2 mm	0 to 6.4 mm
Differential travel		10% max. of sensing distance			
Target		Ferrous metal (The sensing distance decreases with non-ferrous metal.)			
Standard target		8×8×1 mm	12×12×1 mm	12×12×1 mm	24×24×1 mm
Response frequency (See note 1.)		1,500 Hz	1,000 Hz	1,000 Hz	800 Hz
Power supply voltage (operating voltage range)		12 to 24 VDC. Ripple (p-p): 10% max. (10 to 32 VDC)			
Leakage current		0.8 mA max.			
Output type		DC 2 wire type			
Control output	Load current (See note 2.)	3 to 100 mA			
	Residual voltage	3 V max. (under load current of 100 mA with cable length of 2 m)			
Indicator (see timing chart)		NO type: Operation indicator (Yellow), Setting indicator (Red) NC type: Operation indicator (Yellow)			
Operation mode		-D1 models: NO -D2 models: NC			
Protection circuit		Surget suppressor, Short circuit protection			
Ambient temperature		Operating: -40° C to 70° C, Storage: -40° C to 85° C (with no icing or condensation)			
Temperature influence		±10% max. of sensing distance at 23° C within temperature range of -25° C to 70° C ±15% max. of sensing distance at 23° C within temperature range of -40° C to 70° C			
Ambient humidity		Operating: 35% to 95%, Storage: 35% to 95%			
Voltage influence		±1% max. of sensing distance in rated voltage range ±15%			
Insulation resistance		50 MΩ min. (at 500 VDC) between current carry parts and case			
Dielectric strength		1,000 VAC at 50/60 Hz for 1 min between current carry parts and case			
Vibration resistance		10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y and Z directions			
Shock resistance		500 m/s^2, 10 times each in X, Y and Z directions		1,000 m/s^2, 10 times each in X, Y and Z directions	
Standard and listings (See note 3.)		IP67 after IEC 60529 IP69k after DIN 40050 EMC after EN60947-5-2			
Connection method		Pre-wired models (standard is dia 4mm PVC cable with length = 2m). Please see chapter 'Connectivity' for details on different cable materials and lenghts and M8 or M12 connectors.			
Weight (packaged)	Pre-wired model	Approx. 65 g		Approx. 85 g	
	Connector model	M12 connector models: Approx. 20 g M8 connector models: Approx. 15 g		Approx. 35 g	
Material	Case	Stainless steel		Brass-nickel plated or stainless steel	
	Sensing surface	PBT			
	Cable	Standard cable is PVC dia 4mm. For other cable materials or diameters please refer to chapter 'Connectivity'			
	Clamping nut	Brass-nickel plated		Brass-nickel plated for brass models stainless steel for steel models	

Note 1. The response frequency is an average value. Measurement conditions are as follows: standard target, a distance of twice the standard target distance between targets, and a setting distance of half the sensing distance.

2. When using any model at an ambient temperature between -40°C and -25°C and a power voltage between 30 and 32 VDC, use a load current of 50 mA max.

3. For USA and Canada: use class 2 circuit only.

DC 2-wire Models

	Size	M18		M30	
	Type	Shielded	Non-shielded	Shielded	Non-shielded
	Item	E2A-M18□S08-D□ E2A-S18□S08-D□	E2A-M18□N16-D□ E2A-S18□N16-D□	E2A-M30□S15-D□ E2A-S30□S15-D□	E2A-M30□N30-D□ E2A-M30□N20-D□ E2A-S30□N30-D□ E2A-S30□N20-D□
Sensing distance		8 mm ± 10%	16 mm ± 10%	15 mm ± 10%	Short body: 20 m ± 10% Long body: 30 m± 10%
Setting distance		0 to 6.4 mm	0 to 12.8 mm	0 to 12 mm	Short body: 0 to 16 mm Long body: 0 to 24 mm
Differential travel		10% max. of sensing distance			
Target		Ferrous metal (The sensing distance decreases with non-ferrous metal.)			
Standard target		24x24x1 mm	48x48x1 mm	45x45x1 mm	Short body: 60x60x1 mm Long body: 90x90x1mm
Response frequency (See note 1.)		500 Hz	400 Hz	250 Hz	100 Hz
Power supply voltage (operating voltage range)		12 to 24 VDC. Ripple (p-p): 10% max. (10 to 32 VDC)			
Leakage current		0.8 mA max.			
Output type		DC 2 wire type			
Control output	Load current (See note 2.)	3 to 100 mA			
	Residual voltage	3 V max. (under load current of 100 mA with cable length of 2 m)			
Indicator (see timing chart)		NO type: Operation indicator (Yellow), Setting indicator (Red) NC type: Operation indicator (Yellow)			
Operation mode		-D1 models: NO -D2 models: NC			
Protection circuit		Surget suppressor, Short circuit protection			
Ambient temperature		Operating: -40° C to 70° C, Storage: -40° C to 85° C (with no icing or condensation)			
Temperature influence		±10% max. of sensing distance at 23° C within temperature range of -25° C to 70° C ±15% max. of sensing distance at 23° C within temperature range of -40° C to 70° C			
Ambient humidity		Operating: 35% to 95%, Storage: 35% to 95%			
Voltage influence		±1% max. of sensing distance in rated voltage range ±15%			
Insulation resistance		50 MΩ min. (at 500 VDC) between current carry parts and case			
Dielectric strength		1,000 VAC at 50/60 Hz for 1 min between current carry parts and case			
Vibration resistance		10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y and Z directions			
Shock resistance		500 m/s^2, 10 times each in X, Y and Z directions			
Standard and listings (See note 3.)		IP67 after IEC 60529 IP69k after DIN 40050 EMC after EN60947-5-2			
Connection method		Pre-wired models (standard is dia 4mm PVC cable with length = 2m). Please see chapter 'Connectivity' for details on different cable materials and lenghts and M8 or M12 connectors.			
Weight (packaged)	Pre-wired model	Approx. 160 g		Approx. 280 g	short body: 280 g long body: 370 g
	Connector model	Approx. 70 g		Approx. 200 g	short body: 200 g long body: 260 g
Material	Case	Brass-nickel plated or stainless steel			
	Sensing surface	PBT			
	Cable	Standard cable is PVC dia 4mm. For other cable materials or diameters please refer to chapter 'Connectivity'			
	Clamping nut	brass-nickel plated for brass models stainless steel for steel models			

Note 1. The response frequency is an average value. Measurement conditions are as follows: standard target, a distance of twice the standard target distance between targets, and a setting distance of half the sensing distance.

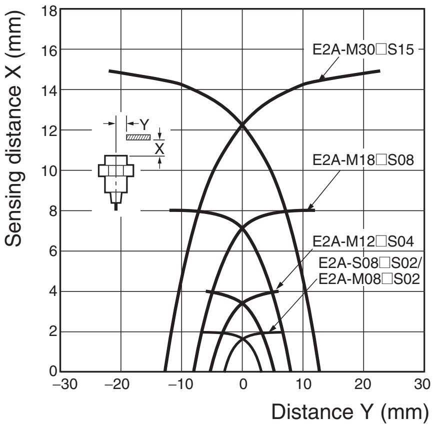
2. When using any model at an ambient temperature between -40°C and -25°C and a power voltage between 30 and 32 VDC, use a load current of 50 mA max.

3. For USA and Canada: use class 2 circuit only.

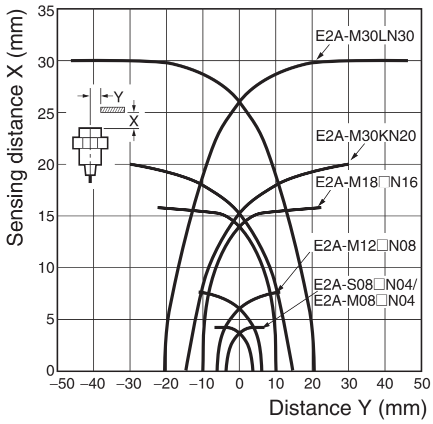
Engineering Data

Operating Range (Typical)

Shielded Models



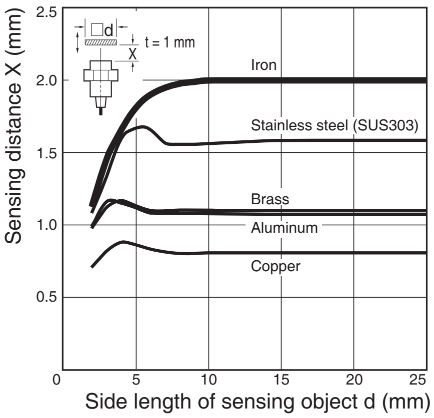
Non-shielded Models



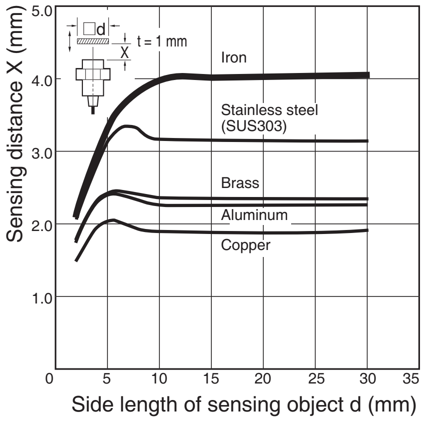
Influence of Sensing Object Size and Materials

Shielded Models

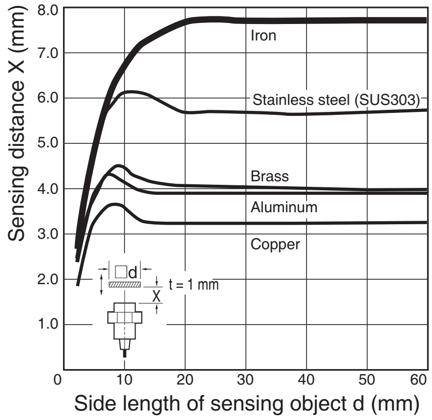
E2A-S08□S02



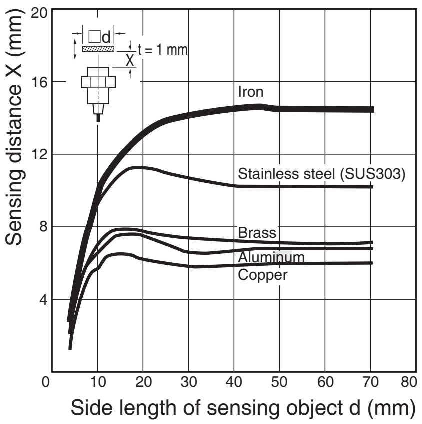
E2A-M12□S04/ E2A-S12□S04



E2A-M18□S08/E2A-S18□S08

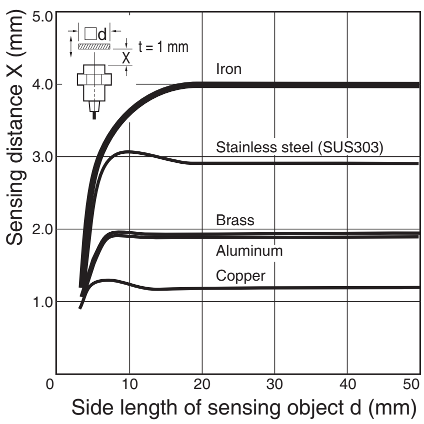


E2A-M30□S15/ E2A-S30□S15

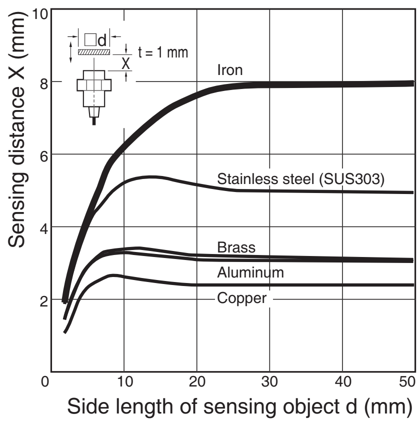


Non-shielded Models

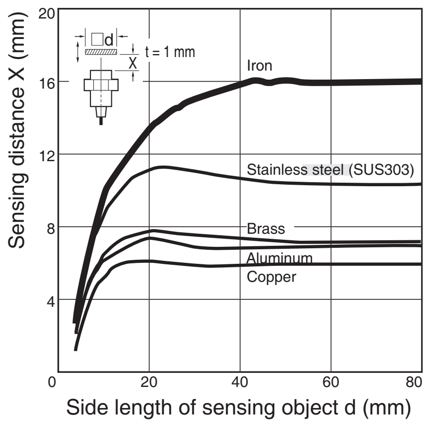
E2A-S08□N04



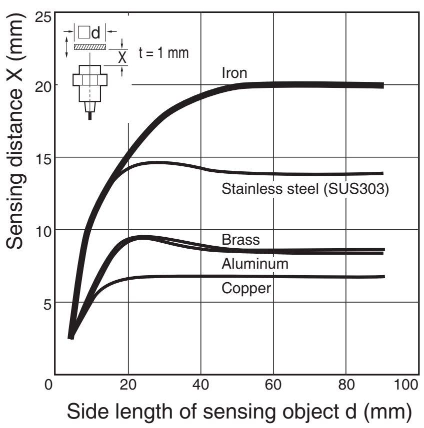
E2A-M12□N08/E2A-S12□N08



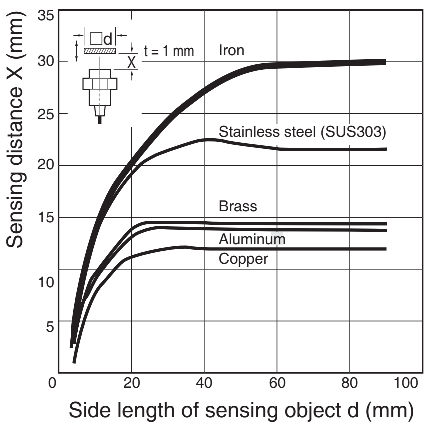
E2A-M18□N16/E2A-S18□N16



E2A-M30KN20/E2A-S30KN20



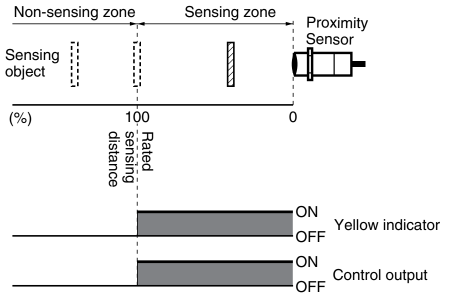
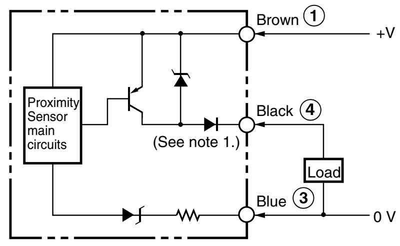
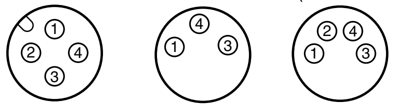
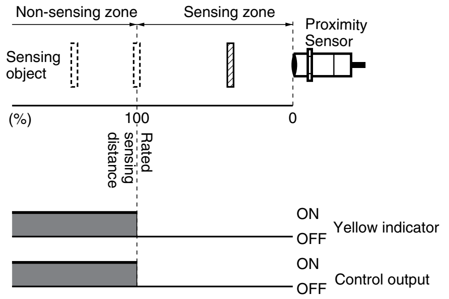
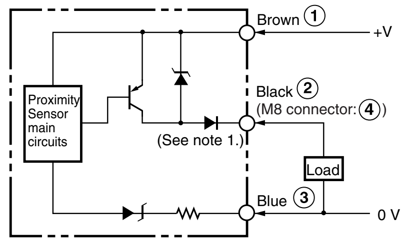
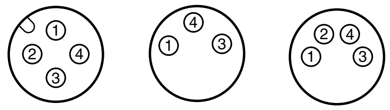
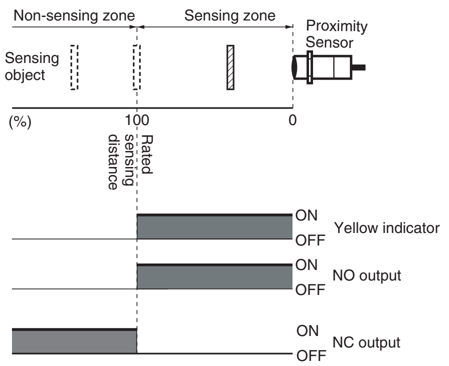
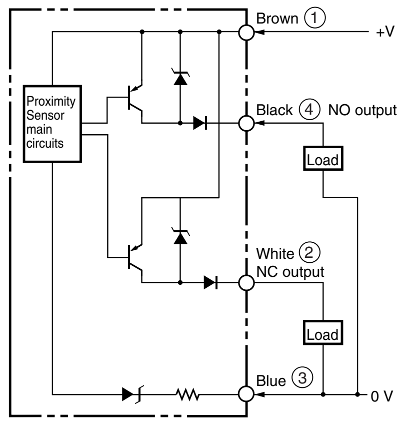
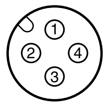
E2A-M30LN30/E2A-S30LN30



Operation

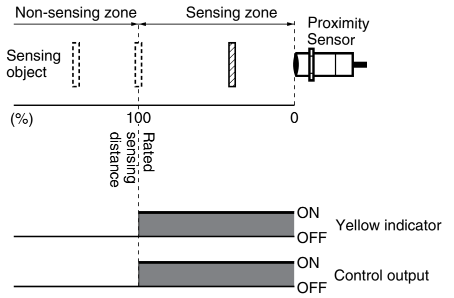
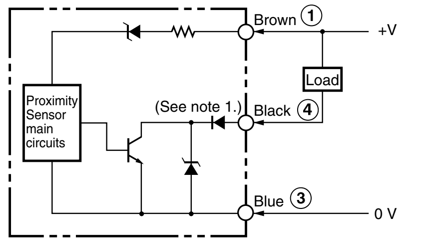
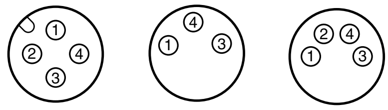
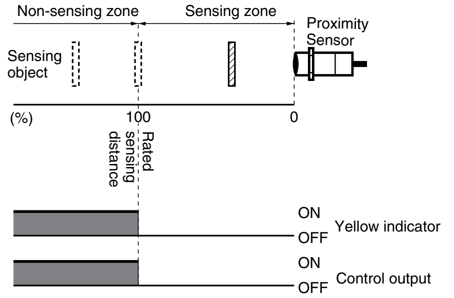
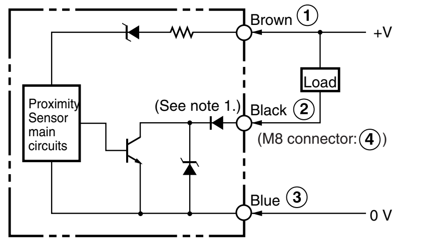
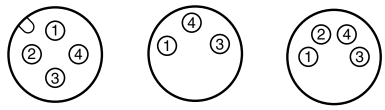
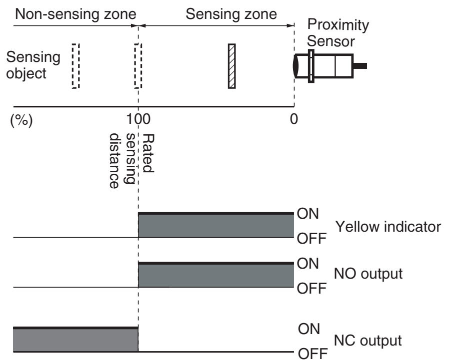
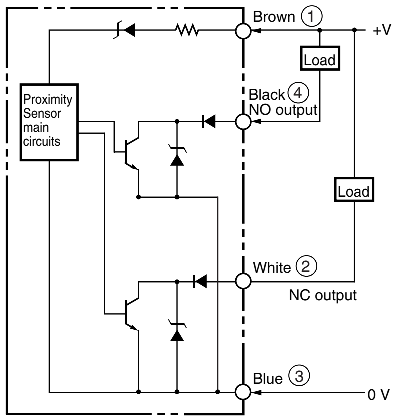
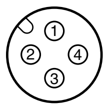
DC 3-wire models

PNP Output

Operation mode	Model	Timing chart	Output circuit
NO	E2A-□-□-B1		 **Note 1:** With M8 connector models, there is no output reverse polarity protection diode. M12 Connector Pin Arrangement (See note 2.) / M8 connector (3 pin) Pin Arrangement / M8 Connector (4 pin) Pin Arrangement (See note 2.)  **Note 2:** Pin 2 of the M12 connector and M8 connector is not used.
NC	E2A-□-□-B2		 **Note 1:** With M8 connector models, there is no output reverse polarity protection diode. M12 Connector Pin Arrangement (See note 2.) / M8 connector (3 pin) Pin Arrangement / M8 Connector (4 pin) Pin Arrangement (See note 2.)  **Note 2:** Pin 4 of the M12 connector and M8 connector is not used.
NO + NC	E2A-□-□-B3		 M12 Connector Pin Arrangement 

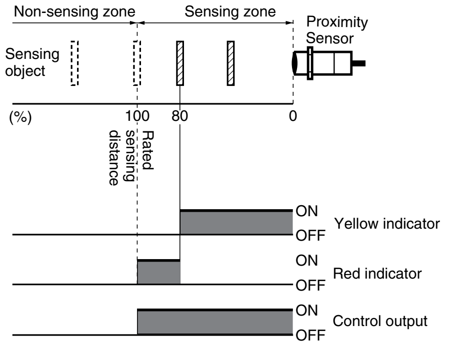
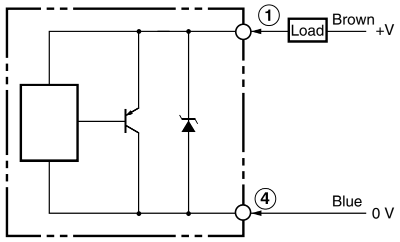
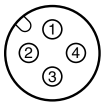
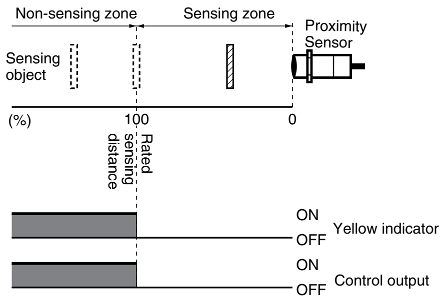
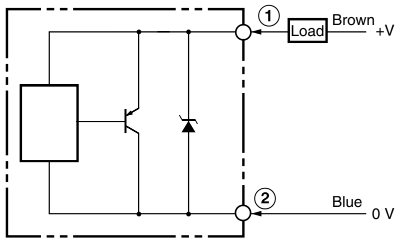
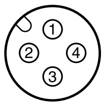
DC 3-wire models

NPN Output

Operation mode	Model	Timing chart	Output circuit
NO	E2A-□-□-C1		 **Note 1:** With M8 connector models, there is no output reverse polarity protection diode. M12 Connector Pin Arrangement (See note 2.) M8 connector (3 pin) Pin Arrangement M8 Connector (4 pin) Pin Arrangement (See note 2.)  **Note 2:** Pin 2 of the M12 connector and M8 connector is not used.
NC	E2A-□-□-C2		 **Note 1:** With M8 connector models, there is no output reverse polarity protection diode. M12 Connector Pin Arrangement (See note 2.) M8 connector (3 pin) Pin Arrangement M8 Connector (4 pin) Pin Arrangement (See note 2.)  **Note 2:** Pin 4 of the M12 connector and M8 connector is not used.
NO + NC	E2A-□-□-C3		 M12 Connector Pin Arrangement 

DC 2-wire models

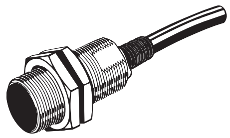
Output Circuit Diagrams (Operation)

Operation mode	Model	Timing chart	Output circuit
NO	E2A-☐-**D**1		 Load can be connected to +V or 0V side. M12 Connector Pin Arrangement 
NC	E2A-☐-**D**2		 Load can be connected to +V or 0V side. M12 Connector Pin Arrangement 

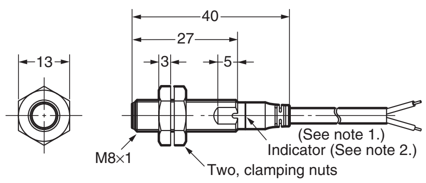
Dimensions

Note: All units are in millimeters unless otherwise indicated.

Pre-wired Models (Shielded)

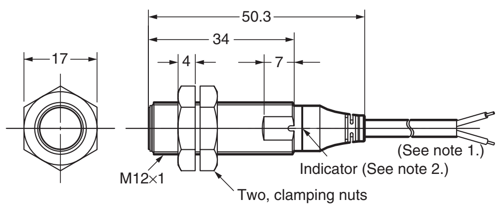


E2A-S08KS02-WP-□□



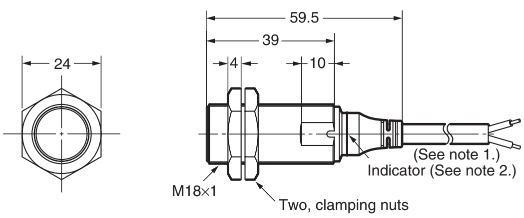
Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)

E2A-M12KS04-WP-□□/E2A-S12KS04-WP-□



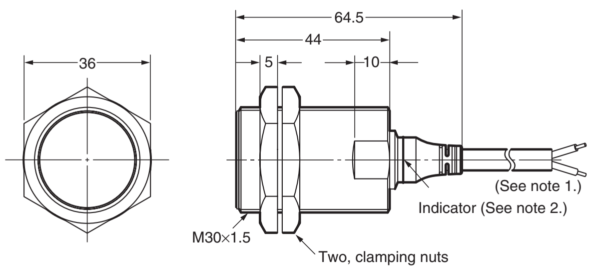
Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)
3. for NO+NC (-B3 / -C3) models the total length is 4 mm longer

E2A-M18KS08-WP-□□/E2A-S18KS08-WP-□



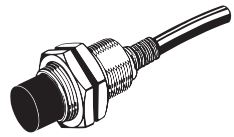
Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)

E2A-M30KS15-WP-□□/E2A-S30KS15-WP-□

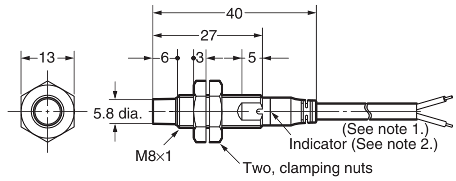


Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)

Pre-wired Models (Non-shielded)

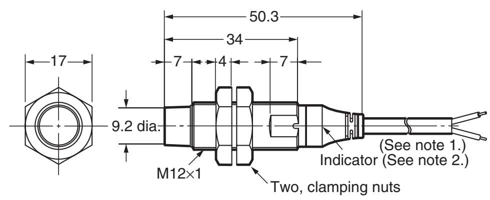


E2A-S08KN04-WP-□□



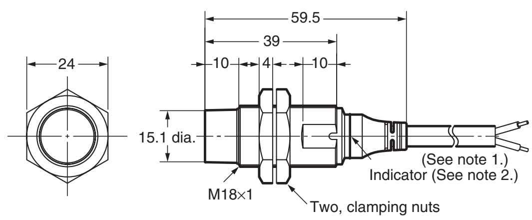
Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)

E2A-M12KN08-WP-□□/E2A-S12KN08-WP-□



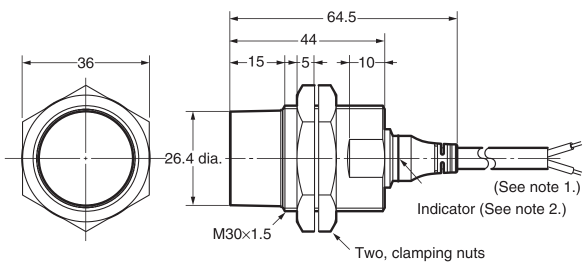
Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)
3. for NO+NC (-B3 / -C3) models the total length is 4 mm longer

E2A-M18KN16-WP-□□/E2A-S18KN16-WP-□



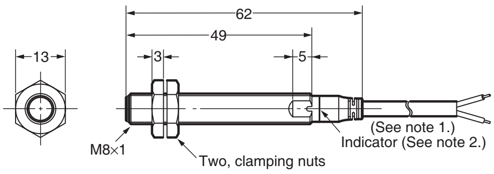
Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)

E2A-M30KN20-WP-□□/E2A-S30KN20-WP-□



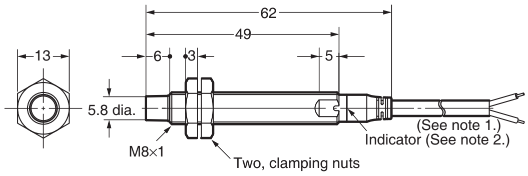
Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)

E2A-S08LS02-WP-□□



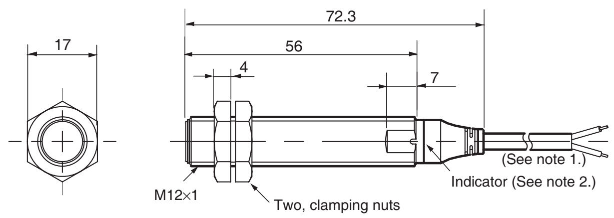
Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)

E2A-S08LN04-WP-□□



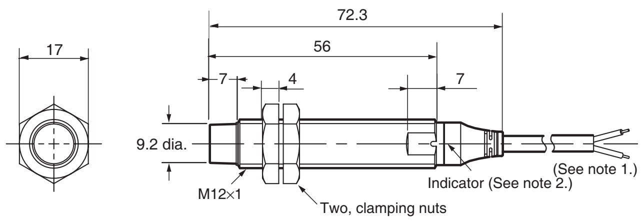
Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)

E2A-M12LS04-WP-□□/E2A-S12LS04-WP-□



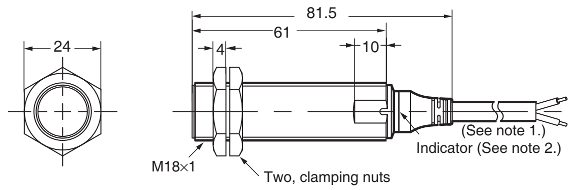
Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)

E2A-M12LN08-WP-□□/E2A-S12LN08-WP-□



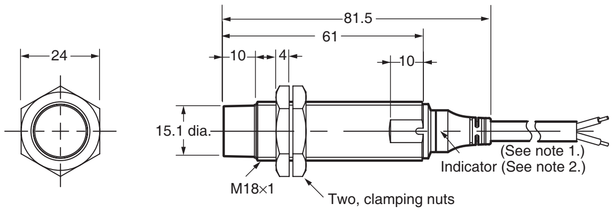
Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)

E2A-M18LS08-WP-□□/E2A-S18LS08-WP-□



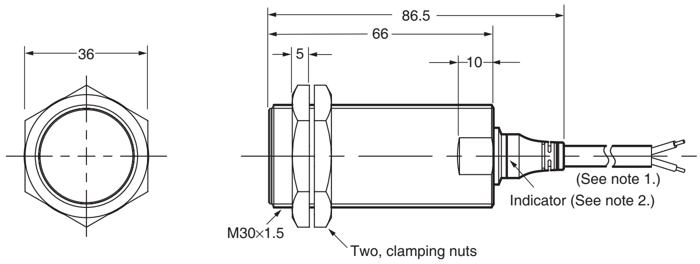
Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)

E2A-M18LN16-WP-□□/E2A-S18LN16-WP-□



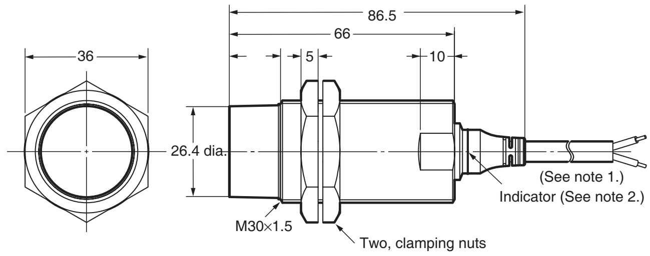
Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)

E2A-M30LS15-WP-□□/E2A-S30LS15-WP-□



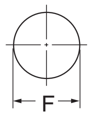
Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)

E2A-M30LN30-WP-□□/E2A-S30LN30-WP-□



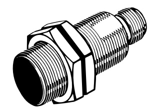
Note 1. 4-dia. vinyl-insulated round cable with 3 conductors (conductor cross section: 0.3 mm²; insulator diameter: 1.3 mm); standard length: 2 m
2. Operation indicator (yellow)

Mounting Hole Cutout Dimensions

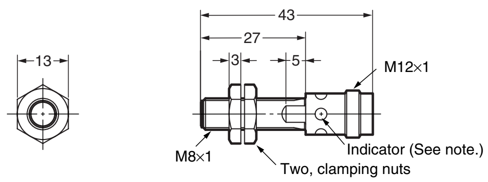


External diameter of Proximity Sensor	Dimension F (mm)
M8	8.5 dia. $^{+0.5}_{0}$
M12	12.5 dia. $^{+0.5}_{0}$
M18	18.5 dia. $^{+0.5}_{0}$
M30	30.5 dia. $^{+0.5}_{0}$

M12 Connector Models (Shielded)

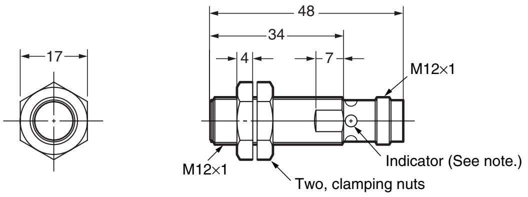


E2A-S08KS02-M1-□□



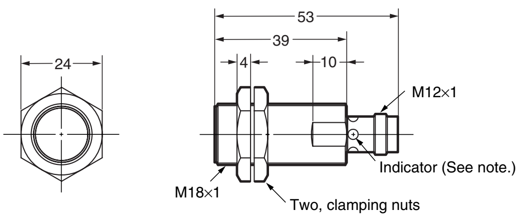
Note: Operation indicator (yellow LED, 4×90°)

E2A-M12KS04-M1-□□/E2A-S12KS04-M1-□



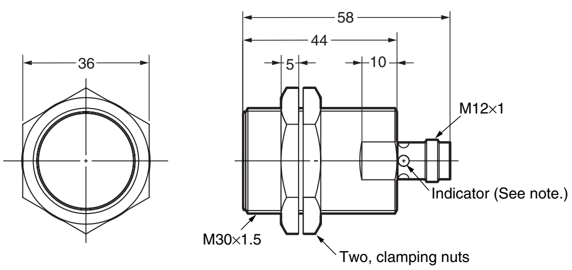
Note 1: Operation indicator (yellow LED, 4×90°)
Note 2: for NO+NC (-B3 / -C3) models the total length is 4 mm longer

E2A-M18KS08-M1-□□/E2A-S18KS08-M1-□



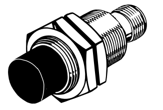
Note: Operation indicator (yellow LED, 4×90°)

E2A-M30KS15-M1-□□/E2A-S30KS15-M1-□

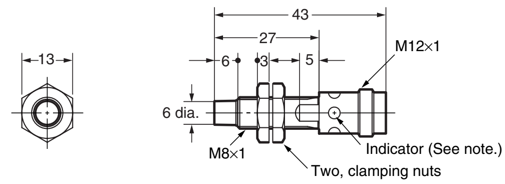


Note: Operation indicator (yellow LED, 4×90°)

M12 Connector Models (Non-shielded)

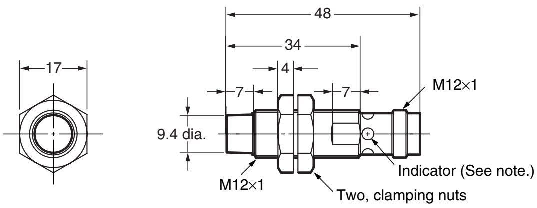


E2A-S08KN04-M1-□□



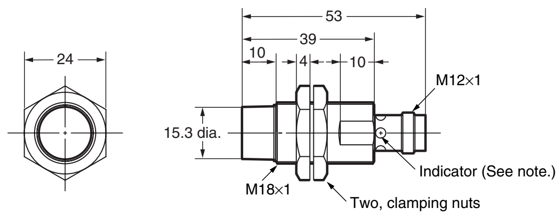
Note: Operation indicator (yellow LED, 4×90°)

E2A-M12KN08-M1-□□/E2A-S12KN08-M1-□



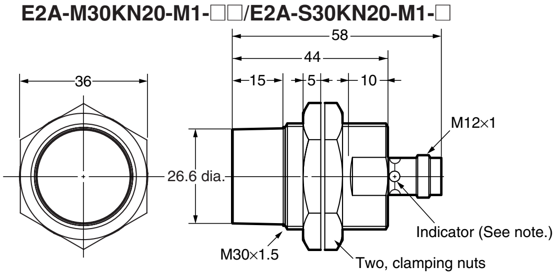
Note 1: Operation indicator (yellow LED, 4×90°)
Note 2: for NO+NC (-B3 / -C3) models the total length is 4 mm longer

E2A-M18KN16-M1-□□/E2A-S18KN16-M1-□



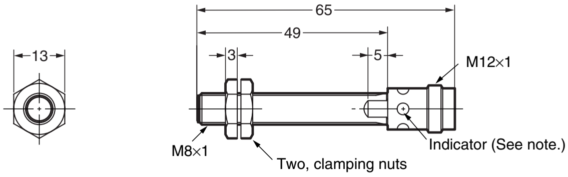
Note: Operation indicator (yellow LED, 4×90°)

E2A-M30KN20-M1-□□/E2A-S30KN20-M1-□



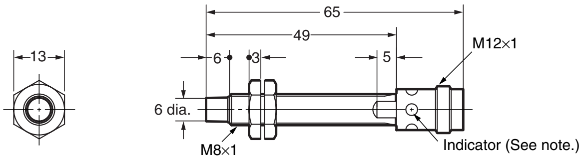
Note: Operation indicator (yellow LED, 4×90°)

E2A-S08LS02-M1-□□



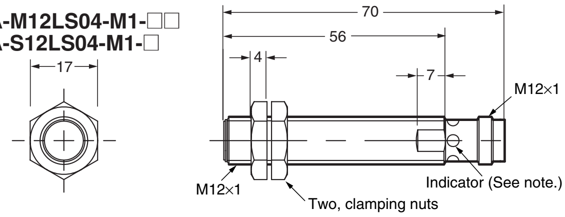
Note: Operation indicator (yellow LED, 4×90°)

E2A-S08LN04-M1-□□



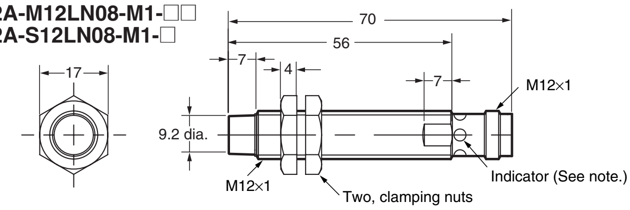
Note: Operation indicator (yellow LED, 4×90°)

E2A-M12LS04-M1-□□
E2A-S12LS04-M1-□



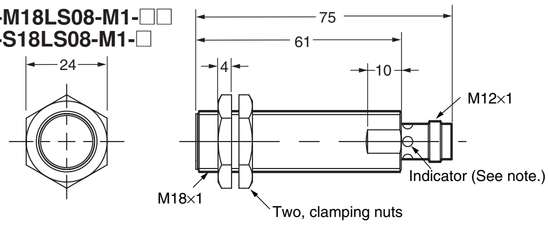
Note: Operation indicator (yellow LED, 4×90°)

E2A-M12LN08-M1-□□
E2A-S12LN08-M1-□



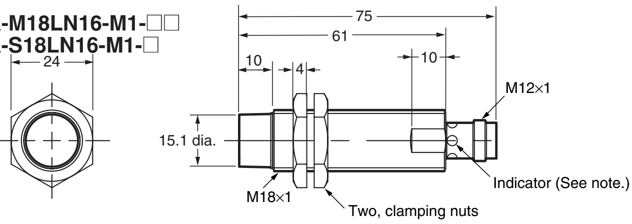
Note: Operation indicator (yellow LED, 4×90°)

E2A-M18LS08-M1-□□
E2A-S18LS08-M1-□



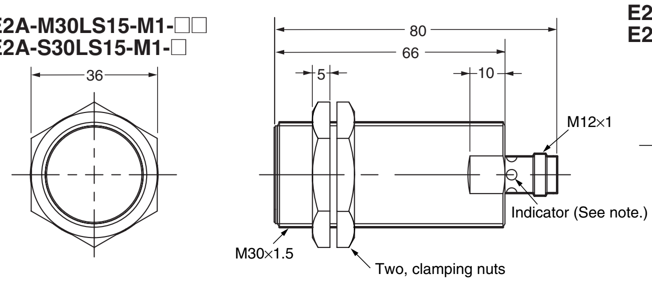
Note: Operation indicator (yellow LED, 4×90°)

E2A-M18LN16-M1-□□
E2A-S18LN16-M1-□



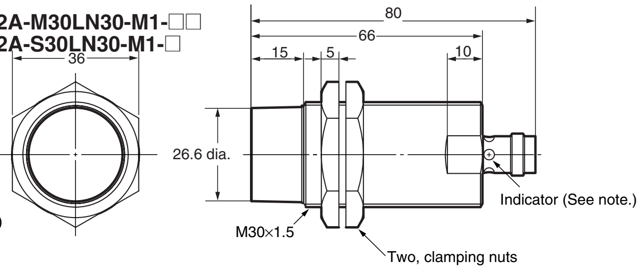
Note: Operation indicator (yellow LED, 4×90°)

E2A-M30LS15-M1-□□
E2A-S30LS15-M1-□



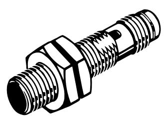
Note: Operation indicator (yellow LED, 4×90°)

E2A-M30LN30-M1-□□
E2A-S30LN30-M1-□

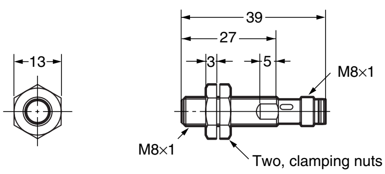


Note: Operation indicator (yellow LED, 4×90°)

M8 Connector Models (Shielded)

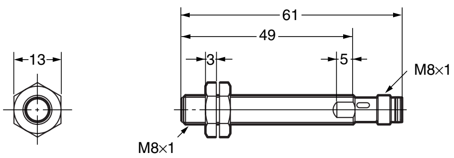


E2A-S08KS02-M5-□□/E2A-S08KS02-M3-□



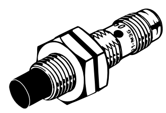
Note: Operation indicator (yellow LED, 4×90°)

E2A-S08LS02-M5-□□/E2A-S08LS02-M3-□

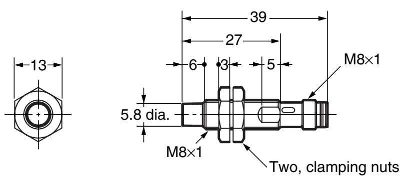


Note: Operation indicator (yellow LED, 4×90°)

M8 Connector Models (Non-shielded)

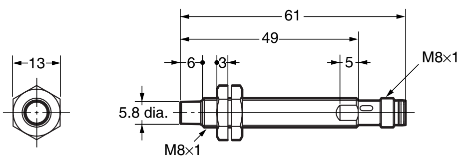


E2A-S08KN04-M5-□□/E2A-S08KN04-M3-□



Note: Operation indicator (yellow LED, 4×90°)

E2A-S08LN04-M5-□□/E2A-S08LN04-M3-□



Note: Operation indicator (yellow LED, 4×90°)

Note: Please contact your OMRON sales representative for dimension drawings not listed here.

Precautions

Safety Precautions

Power Supply

Do not impose an excessive voltage on the E2A, otherwise it may be damaged. Do not impose AC current (100 to 240 VAC) on any DC model, otherwise it may be damaged.

Load Short-circuit

Do not short-circuit the load, or the E2A may be damaged.

The E2A's short-circuit protection function will be valid if the polarity of the supply voltage imposed is correct and within the rated voltage range.

Wiring

Be sure to wire the E2A and load correctly, otherwise it may be damaged.

Connection with No Load

Be sure to insert loads when wiring. Make sure to connect a proper load to the E2A in operation, otherwise it may damage internal elements.

Do not expose the product to flammable or explosive gases.

Do not disassemble, repair, or modify the product.

Correct Use

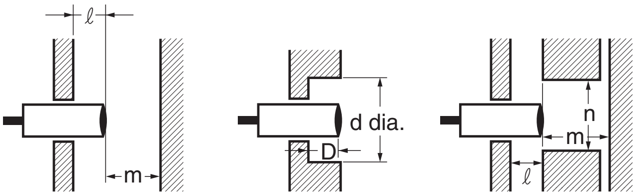
Designing

Power Reset Time

The Proximity Sensor is ready to operate within 100 ms (160ms for NO+NC -B3 / -C3 types) after power is supplied. If power supplies are connected to the Proximity Sensor and load respectively, be sure to supply power to the Proximity Sensor before supplying power to the load.

Effects of Surrounding Metal

When mounting the E2A within a metal panel, ensure that the clearances given in the following table are maintained.



(Unit: mm)

Type	Dimension	M8	M12	M18	M30 Short barrel	M30 Long barrel
Shielded	l	0	0	0 (See note 1.)	0 (See note 2.)	
	m	4.5	12	24	45	
	d	---	---	27	45	
	D	0	0	1.5	4	
	n	12	18	27	45	
Non-shielded	l	12	15	22	30	40
	m	8	20	48	70	90
	d	24	40	70	90	120
	D	12	15	22	30	40
	n	24	40	70	90	120

Note 1. In the case of using the supplied nuts.
If true flash mounting is necessary, apply a free zone of 1.5 mm.

2. In the case of using the supplied nuts.
If true flush mounting is necessary, apply a free zone of 4 mm.

Power OFF

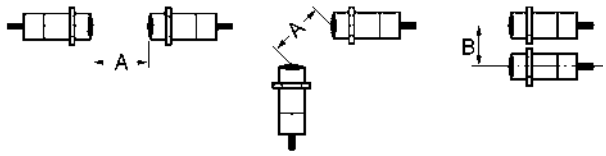
The Proximity Sensor may output a pulse signal when it is turned OFF. Therefore, it is recommended that the load be turned OFF before turning OFF the Proximity Sensor.

Power Supply Transformer

When using a DC power supply, make sure that the DC power supply has an insulated transformer. Do not use a DC power supply with an auto-transformer.

Mutual Interference

When installing two or more Sensors face-to-face or side-by-side, ensure that the minimum distances given in the following table are maintained.



(Unit: mm)

Type	Dimension	M8	M12	M18	M30 Short barrel	M30 Long barrel
Shielded	A	20	30	60	110	
	B	15	20	35	70	
Non-shielded	A	80	120	200	300	300
	B	60	100	120	200	300

Wiring

High-tension Lines

Wiring through Metal Conduit**:**
If there is a power or high-tension line near the cable of the Proximity Sensor, wire the cable through an independent metal conduit to prevent against Proximity Sensor damage or malfunctioning.

Cable Extension

Standard cable length is less than 200 m.

The tractive force is 50 N.

Mounting

The Proximity Sensor must not be subjected to excessive shock with a hammer when it is installed, otherwise the Proximity Sensor may be damaged or lose its water-resistivity.

Do not tighten the nut with excessive force. A washer must be used with the nut.

Type		Torque
M8	Stainless steel type	9 Nm
	Brass type	4 Nm
M12		30 Nm
M18		70 Nm
M30		180 Nm

Maintenance and Inspection

Periodically perform the following checks to ensure stable operation of the Proximity Sensor over a long period of time.

1. Check for mounting position, dislocation, looseness, or distortion of the Proximity Sensor and sensing objects.
2. Check for loose wiring and connections, improper contacts, and line breakage.
3. Check for attachment or accumulation of metal powder or dust.
4. Check for abnormal temperature conditions and other environmental conditions.
5. Check for proper lighting of indicators (for models with a set indicator.)

Never disassemble or repair the Sensor.

Environment

Water Resistivity

The Proximity Sensors are tested intensively on water resistance, but in order to ensure maximum performance and life expectancy avoid immersion in water and provide protection from rain or snow.

Operating Environment

Ensure storage and operation of the Proximity Sensor within the given specifications.

Inrush Current

A load that has a large inrush current (e.g., a lamp or motor) will damage the Proximity Sensor, in which case connect the load to the Proximity Sensor through a relay.

<SUITABILITY FOR USE>

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of the products in the customer's application or use of the products.

Take all necessary steps to determine the suitability of the product for the systems, machines, and equipment with which it will be used.

<CHANGE IN SPECIFICATIONS>

Product specifications and accessories may be changed at any time based on improvements and other reasons. Consult with your OMRON representative at any time to confirm actual specifications of purchased product.

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. D03E-EN-02A In the interest of product improvement, specifications are subject to change without notice.

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Cat. No. D03E-EN-02A **05/08** Specifications are subject to change without notice. Printed in U.S.A.

MODEL 115 SINGLE AXIS JOYSTICK

The Model 115 provides a weather-resistant, heavy-duty mechanism to convert operators' manual commands into electrical output over and extended life.

What makes the Model 115 unique is its low profile below-panel mounting design, which saves space in an already compact package. The aluminum frame resists deformation due to extreme temperature changes, and allows our valve drive boards to be mounted on the side for added convenience. The simple design of the 115 provides a sturdy foundation, while offering a wide array of mechanical and electrical options. A choice of several other hand grip styles are also available.

MECHANICS

Like all of our joysticks, the Model 115 uses thick-walled glass-reinforced nylon components, which provides an extremely high tensile strength, with excellent resistance to corrosion and wear. A helical compression spring centering mechanism has been opted for in place of torsion springs, which compensates for wear and eliminates the center-stop of a torsion spring-centering lever. The .375 inch diameter shaft is made of a special relief annealed seamless steel tubing that has been hardened and treated to resist corrosion. The shaft pivot is an oversized .75 inch diameter oil-impregnated bronze bushing, which further adds rigidity to the mechanism, making the Model 115 among the most durable control in its class.

ELECTRONICS

The Model 115 of course uses Hall Effect sensors as a standard (potentiometric and switched outputs are also available), which eliminates any contact between moving electrical parts while further improving overall precision. Silicone dipping and potting further protects the electronics from direct exposure to the environmental corrosives.

KEY ADVANTAGES

- Contactless Hall Effect Technology
- Below-Panel Mounted, Low Profile Design
- Robust Weather-Resistant Construction
- Friction Options Available
- EMI & RFI resistant

ADDITIONAL OPTIONS

Please see our web site for more information on our product line (www.pqcontrols.com)

SHOWN WITH BALL KNOB

SPECIFICATIONS

Electrical:
Input: 5 VDC or 10-30 VDC Contactless Hall Effect (see electrical options page for other options)
Output: Max (+) Travel: 4.0 V DC
Max (-) Travel: 1.0 V DC
Centered: 2.5 VDC
Output Impedance: 220 OHMS
All inputs & outputs fully protected.
Other outputs:
(see page 2 for other options available)

Mechanical:
Travel: Bidirectional ± 30°
Unidirectional + 60°
Operating Force*: Light spring: 1.73 lb
Standard spring: 3.92 lb
Heavy spring: 4.88 lb
** Force values are based on a 4.38" Moment Arm*
Friction and neutral detent available; friction drag approximately 3 lbs force.

Environmental:
Temperature: - 40° to 85° C (-40° to 185° F)
Weather Resistance: Control is weather tight when mounted to panel using gasket supplied. Electronics are epoxy potted or silicone dipped. Material is UV protected.

MODEL 115 SINGLE AXIS JOYSTICK

M115 PART NUMBERING

Hall Effect Only. For special configurations or potentiometer applications, please call for assistance

M115	SL	15	F	56

- 504 - UNI

MODEL
M115 Single Axis Joystick

CENTER LOCK
SL (Slide Lock)
NL (No Lock)
DL (Defeated Lock)*
**Defeated lock may be removed in-field*

UNIDIRECTIONAL (Optional)
UNI = Output swing is from neutral to full positive output [2]
UFS = Output swing is from full negative to full positive [3]

INTEGRATED VALVE DRIVER
504 Valve Drive Board
For valves without integrated electronics.
504 is pre-programmed to customers valve [1]
Must use Electrical Option 58

ELECTRICAL OPTION

MECHANICAL OPTION
S (Spring to center)
F (Friction hold)
FD (Friction hold w/ center detent)

GRIP STYLE

05 = 1-AXIS, NO HANDGRIP
07 = 1-AXIS, LEVER KNOB
15 = 1-AXIS, BALL KNOB
PALM GRIP Available in: BLACK (Standard)
ORANGE (Add –OR at the end of the Part Number)
YELLOW (Add –YL at the end of the Part Number)
28 = 1-AXIS, RSG GRIP (ROCKER LEFT, RIGHT)
29 = 1-AXIS, RSG GRIP (ROCKER PUSH-BUTTON)
30 = 1-AXIS, RSTG ROCKER GRIP
31 = 1-AXIS, RSTG ROCKER GRIP WITH LEFT SIDE PUSH-BUTTON
32 = 1-AXIS, RSTG NO ROCKER, TRIGGER ONLY
33 = 1-AXIS, RSTG NO ROCKER, TRIGGER & LEFT SIDE PUSH-BUTTON
35 = 1-AXIS, RSTG NO ROCKER, TRIGGER & TOP PUSH-BUTTON
36 = 1-AXIS, RSTG ROCKER GRIP WITH RIGHT SIDE PUSH BUTTON
38 = 1-AXIS, TRS GRIP
39 = 1-AXIS, RSTG, NO RCKR, TRIGGER, TOP & LEFT SIDE P-B
41 = 1-AXIS, RSTG, ROCKER GRIP W/TRIGGER & MAINT'D LEFT SIDE PB
43 = 1-AXIS, MSG, 3 TOGGLE SWITCHES
44 = 1-AXIS, MSG, 4 TOGGLE SWITCHES
45 = 2-AXIS, MSG, 4 PUSH-BUTTONS TWIST
46 = 1-AXIS, MSG, 6 PUSH-BUTTONS
47 = 2-AXIS, MSG, 6 PUSH-BUTTONS TWIST
48 = 1-AXIS, MSG, 3 PUSH-BUTTONS
49 = 1-AXIS, MSG, 4 PUSH-BUTTONS
50 = 1-AXIS, TRS, NO ROCKER SWITCHES (PLASTIC CAP)
51 = 2-AXIS, MSG, 6 TOGGLE SWITCHES TWIST
52 = 1-AXIS, MSG, 4 TOGGLE & 2 PUSH BUTTON SWITCHES
53 = 1-AXIS, PISTOL, TRIGGER, PUSH-BUTTON ON TOP
54 = 2-AXIS, PISTOL, TWIST, TRIGGER WITH PUSH BUTTON ON TOP
57 = 2-AXIS, PISTOL, TRIGGER, SWTCH ROCKER & PRPRTNL TWIST
58 = 1-AXIS, MFHG, HALL TRIGGER
59 = 2-AXIS, PISTOL, TRIGGER, PROPORTIONAL TWIST
61 = 2-AXIS, PISTOL, TRIGGER, PROPORTIONAL ROCKER
62 = 1-AXIS, PISTOL, TRIGGER & SWITCHED ROCKER
63 = 1-AXIS, PISTOL, TRIGGER, NO PUSH-BUTTON ON CAP
64 = 2-AXIS, ERGO, TRIGGER & PROPORTIONAL ROCKER
65 = 1-AXIS, PISTOL, TRIGGER & SWTCH RCKR, 2 PSH-BTTNS (L)
66 = 2-AXIS, PISTOL, TRIGGER & PRPRTNL RCKR, 2 PSH-BTTNS (L/R)
67 = 1-AXIS, PISTOL, TRIGGER & SWTCH SEP COMMONS, RCKR, 2 PSH-BTTNS (L)
-Reference pqcontrols.com for additional handle options
Not all options are listed. Please call for further assistance.

ELECTRICAL OPTIONS

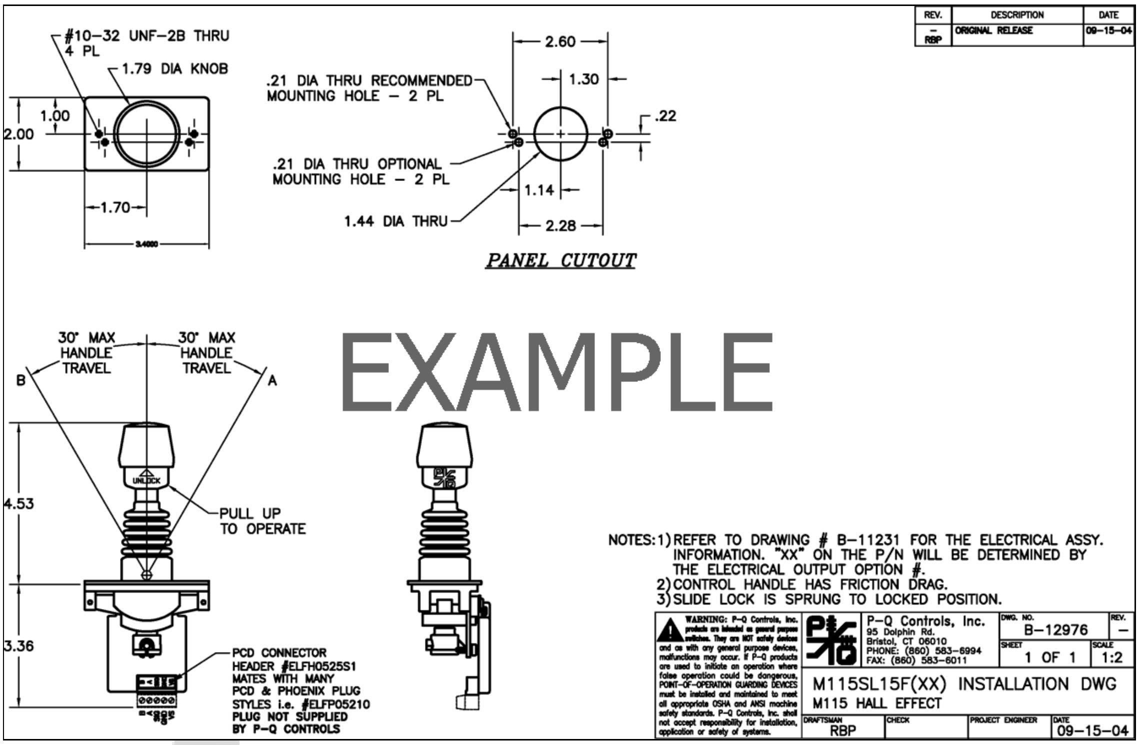
56 = 10-30VDC, 2.5V NTRL ± 1.5V, 1.5 AMP DIR. AUX OUT
57 = 10-30VDC, 2.5V NTRL ± 1.25V, 1.5 AMP DIR. AUX OUT
58 = 5VDC, ± 30%, NO DIRECTIONAL AUX OUT
59 = 5VDC, ± 40%, NO DIRECTIONAL AUX OUT
60 = 18-60VDC, SEVCON, 1.5 AMP DIR. AUX OUT
61 = 10-30VDC, 2.5V NTRL ± 2.0V, 1.5 AMP DIR AUX OUT
62 = 10-30VDC, DANFOSS
63 = 10-30VDC, 0.0V NTRL + 10.0V, 1.5 AMP DIR AUX OUT
64 = 10-30VDC, 2.5V NTRL ± 1.5V, 1.5 AMP **50%** DIR. AUX OUT
65 = 18-60VDC, PWR PAK SVCN, 0.2 AMP SINK DIR. AUX OUT
67 = 10-30VDC, 0.0V NTRL + 5.0V, 1.5 AMP DIR AUX OUT
68 = 10-30VDC, 2.5V NTRL ± 2.0V, 1.5 AMP **50%** DIR. AUX OUT
69 = 5VDC, ± 10%, NO DIRECTIONAL AUX OUT
70 = 5VDC, ± 25%, NO DIRECTIONAL AUX OUT
71 = 10-30VDC, 4-20mADC (4mADC NTRL, 20mADC ends) 1.5 AMP DIR. AUX OUT
72 = 10-30VDC, 4-20mADC (12mADC NEUT, 4 and 20mADC ends) 1.5 AMP DIR. AUX OUT
73 = SPLIT SUPPLY INPUT (0vdc NEUT, POS. VS & NEG. VS @ ENDS) 15mAMP DIR. AUX OUT
74 = 10-30VDC, 5.0V NEUTRAL ± 5.0V SWING, 1.5 AMP DIR AUX OUT
75 = 18-60VDC, 0.0V NEUTRAL ± 5.0V SWING, 1.5 AMP DIR AUX OUT
76 = 5VDC, 40% SIGNAL SWIING, 1.5 AMP DIR AUX OUT
77 = 5VDC, 25% SIGNAL SWING, NO DIRECTIONAL AUX OUT
78 = 10-30VDC, 0-20mADC (0 mADC NEUT, 20mADC ends) 1.5 AMP DIR. AUX OUT
79 = 10-30VDC, PWM out sig 50%duty cycle NEUTRAL 10% and 90% ends, no DIR. AUX OUT
80 = 10-30VDC, 4-20mADC (4mADC±1mA NEUT, 20mADC±1mA ends) 1.5 AMP DIR. AUX OUT
82 = 10-30VDC, 5V NEUTRAL ± 4.5V SWING
83 = 5VDC, USB board
84 = 10-30VDC, CANbus (J1939) board
85 = SPLIT SUPPLY INPUT (0vdc NEUT, POS. VS & NEG. VS @ ENDS) 15mAMP **5%** DIR. AUX OUT
86 = 5VDC ± 40% WITH INVERTED OUT, 1.5 AMP SINKING DIR AUX OUT

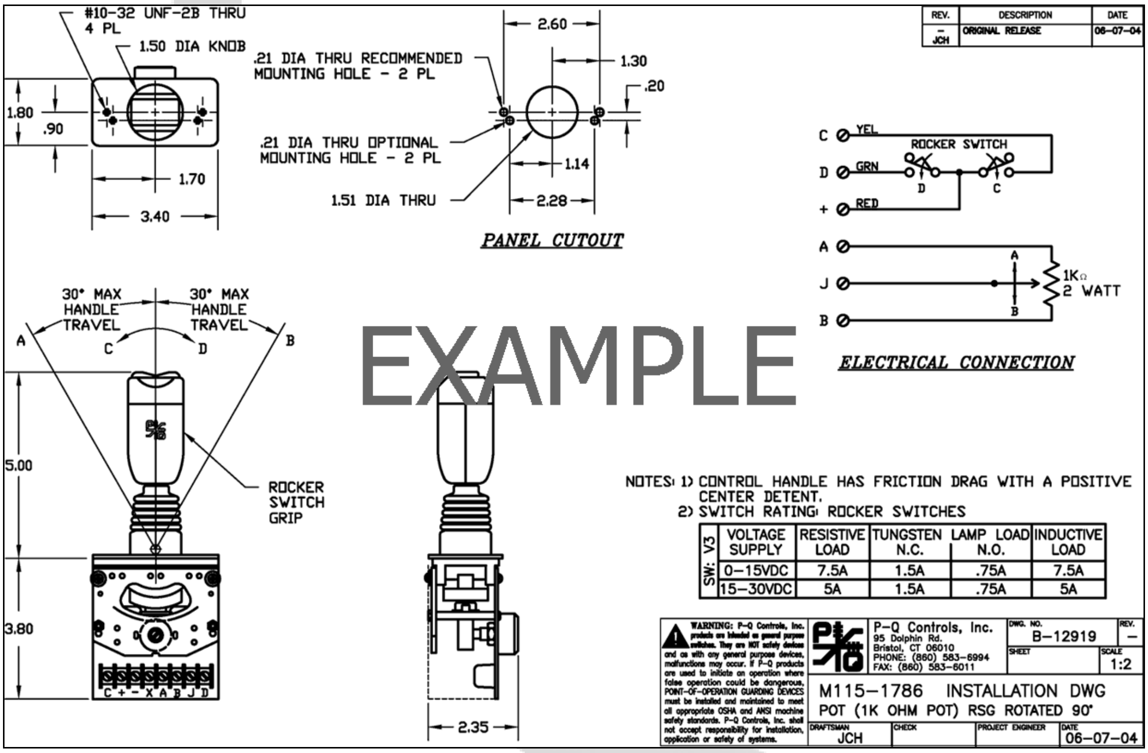
If you do not see your option listed, please call for assistance. Valve Drive Board may be required to control most hydraulic valves (M504 optional, other models sold separately)

For more details of electrical options, please see pages 4-7 of Datasheet M115.

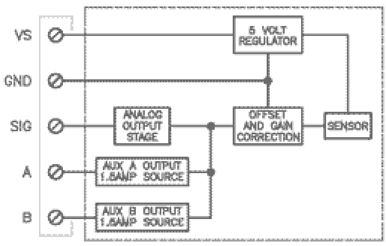
[1] For systems with hydraulic valves, please fill out our Valve Verification Form at; www.pqcontrols.com/data/valve_verification.pdf
[2] Standard output swing is from neutral to full positive output
Ex. Option 58- Neutral output of 2.5V to full positive output of 4V
[3] –**UFS** - Ex. Option 58 Full negative output of 1V to full positive of 4V

MODEL 115 SINGLE AXIS JOYSTICK





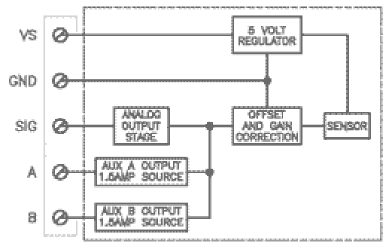
MODEL 115 SINGLE AXIS JOYSTICK



OPTION 56 (30%) EQUIVALENT OUTPUT

M212 = OUTPUTS X2

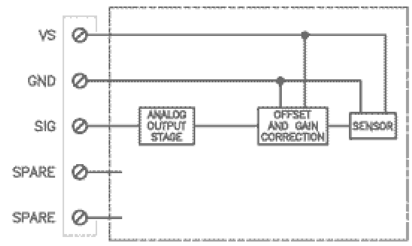
1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 2.50V ±0.05V.
FULL POSITIVE DEFLECTION – 4.00V ± 0.15V.
FULL NEGATIVE DEFLECTION – 1.00V ± 0.15V.
3) AUX A OUTPUT SWITCHES ON @ APPROX. 2.82V WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON @ APPROX. 2.2V WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).



OPTION 57 (25%) EQUIVALENT OUTPUT

M212 = OUTPUTS X2

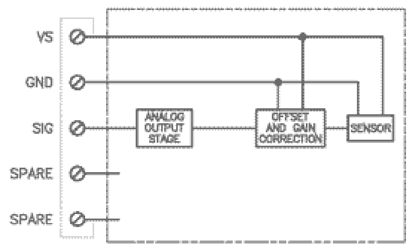
1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 2.50V ±0.05V.
FULL POSITIVE DEFLECTION – 3.75V ± 0.12V.
FULL NEGATIVE DEFLECTION – 1.25V ± 0.12V.
3) AUX A OUTPUT SWITCHES ON @ APPROX. 2.82V WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON @ APPROX. 2.2V WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).



OPTION 58 (30%) EQUIVALENT OUTPUT

M212 = OUTPUTS X2

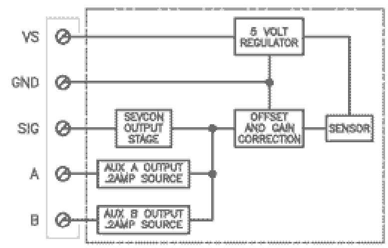
1) VOLTAGE SUPPLY IS TO BE 5VDC.
2) CURRENT CONSUMPTION: 14mA @ 5VDC.
OUTPUT: CENTERED – 2.50V ±0.05V.
FULL POSITIVE DEFLECTION – 4.00V ± 0.15V.
FULL NEGATIVE DEFLECTION – 1.00V ± 0.15V.



OPTION 59 (40%) EQUIVALENT OUTPUT

M212 = OUTPUTS X2

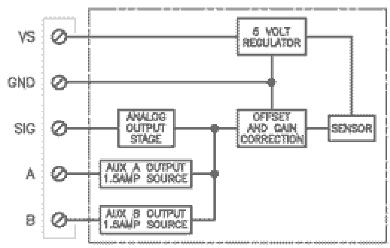
1) VOLTAGE SUPPLY IS TO BE 5VDC.
2) CURRENT CONSUMPTION: 14mA @ 5VDC.
OUTPUT: CENTERED – 2.50V ±0.05V.
FULL POSITIVE DEFLECTION – 4.50V ± 0.2V.
FULL NEGATIVE DEFLECTION – 0.50V ± 0.2V.



OPTION 60 (SEVCON) EQUIVALENT OUTPUT

M212 = OUTPUTS X2

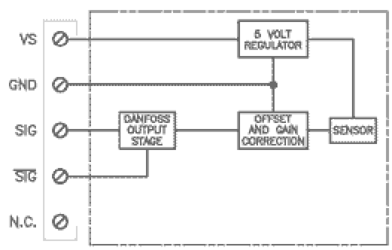
1) VOLTAGE SUPPLY IS TO BE 18–60VDC.
2) CURRENT CONSUMPTION: 20mA @ 24VDC.
OUTPUT: CENTERED – 4.05–4.35VDC.
CW & CCW TRIP – 3.3–3.6VDC.
CW & CCW MAX – 0.0VDC.
3) AUX A OUTPUT SWITCHES ON WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).



OPTION 61 (40%) EQUIVALENT OUTPUT

M212 = OUTPUTS X2

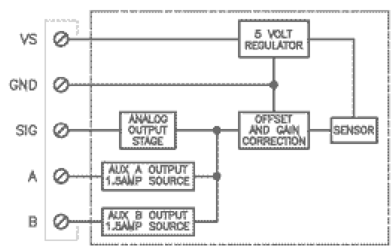
1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 2.50V ±0.05V.
FULL POSITIVE DEFLECTION – 4.50V ± 0.2V.
FULL NEGATIVE DEFLECTION – 0.50V ± 0.2V.
3) AUX A OUTPUT SWITCHES ON @ APPROX. 2.82V WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON @ APPROX. 2.2V WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).



OPTION 62 (DANFOSS) EQUIVALENT OUTPUT

M212 = OUTPUTS X2

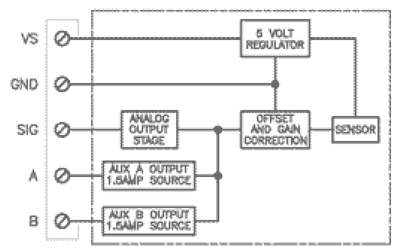
1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) SIG = NORMAL OUTPUT S̅I̅G̅ = INVERTED OUTPUT.
3) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 50% OF VSUPPLY.
FULL POSITIVE DEFLECTION – 75% OF VSUPPLY.
FULL NEGATIVE DEFLECTION – 25% OF VSUPPLY.



OPTION 63 EQUIVALENT OUTPUT

M212 = OUTPUTS X2

1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 0.00V ±0.5V.
FULL POSITIVE DEFLECTION – 10.00V ± 1.00V.
FULL NEGATIVE DEFLECTION – 10.00V ± 1.00V.
3) AUX A OUTPUT SWITCHES ON @ APPROX. 2.00V WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON @ APPROX. 2.00V WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).

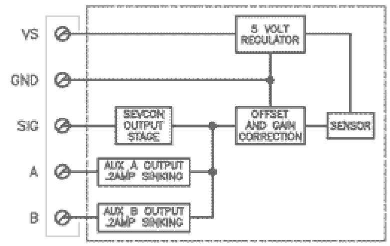


OPTION 64 (30% SWING, 50% AUX) OUTPUT

M212 = OUTPUTS X2

1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 2.50V ±0.05V.
FULL POSITIVE DEFLECTION – 4.00V ± 0.15V.
FULL NEGATIVE DEFLECTION – 1.00V ± 0.15V.
3) AUX A OUTPUT SWITCHES ON @ APPROX. 3.25V WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON @ APPROX. 1.75V WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).

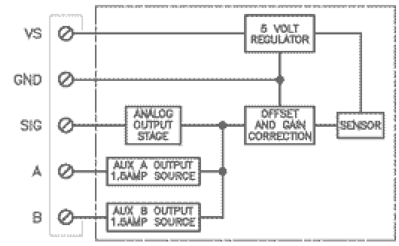
MODEL 115 SINGLE AXIS JOYSTICK



OPTION 65 (PWR PAK) EQUIVALENT OUTPUT

M212 = OUTPUTS X2

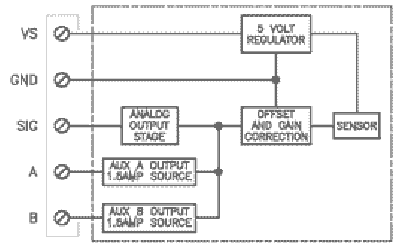
1) VOLTAGE SUPPLY IS TO BE 18–60VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 4.05–4.35VDC.
CW & CCW TRIP – 3.3–3.6VDC.
CW & CCW MAX – 0.0VDC.
3) AUX A OUTPUT SWITCHES ON WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).



OPTION 67 EQUIVALENT OUTPUT

M212 = OUTPUTS X2

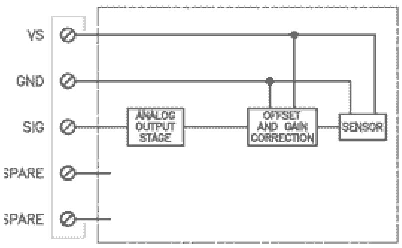
1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 0.00V ±0.25V.
FULL POSITIVE DEFLECTION – 5.00V ± 0.50V.
FULL NEGATIVE DEFLECTION – 5.00V ± 0.50V.
3) AUX A OUTPUT SWITCHES ON @ APPROX. 1.00V WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON @ APPROX. 1.00V WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).



OPTION 68 (40% SWING, 50% AUX) OUTPUT

M212 = OUTPUTS X2

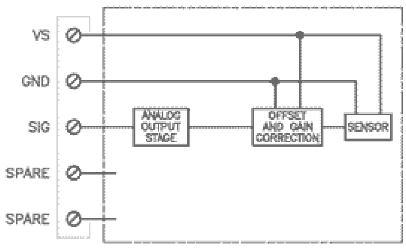
1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 2.50V ±0.05V.
FULL POSITIVE DEFLECTION – 4.50V ± 0.2V.
FULL NEGATIVE DEFLECTION – 0.50V ± 0.2V.
3) AUX A OUTPUT SWITCHES ON @ APPROX. 3.30V WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON @ APPROX. 1.70V WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).



OPTION 69 (10%) EQUIVALENT OUTPUT

M212 = OUTPUTS X2

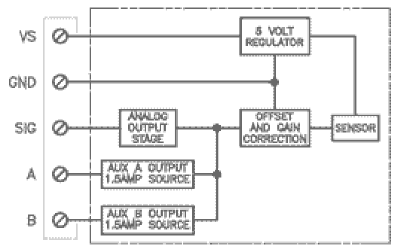
1) VOLTAGE SUPPLY IS TO BE 5VDC.
2) CURRENT CONSUMPTION: 14mA @ 5VDC.
OUTPUT: CENTERED – 2.50V ±0.05V.
FULL POSITIVE DEFLECTION – 3.00V ± 0.05V.
FULL NEGATIVE DEFLECTION – 2.00V ± 0.05V.



OPTION 70 (25%) EQUIVALENT OUTPUT

M212 = OUTPUTS X2

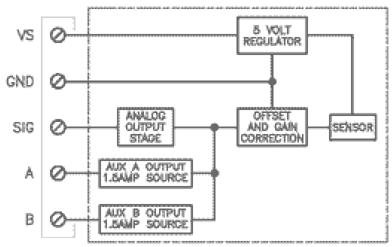
1) VOLTAGE SUPPLY IS TO BE 5VDC.
2) CURRENT CONSUMPTION: 14mA @ 5VDC.
OUTPUT: CENTERED – 2.50V ±0.05V.
FULL POSITIVE DEFLECTION – 3.75V ± 0.12V.
FULL NEGATIVE DEFLECTION – 1.25V ± 0.12V.



OPTION 71 EQUIVALENT OUTPUT

M212 = OUTPUTS X2

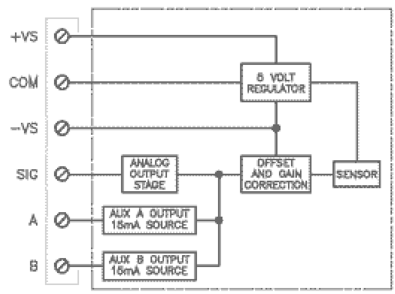
1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 4.0mA ±0.8mA.
FULL POSITIVE DEFLECTION – 18.4mA ± 1.6mA.
FULL NEGATIVE DEFLECTION – 18.4mA ± 1.6mA.
3) AUX A OUTPUT SWITCHES ON @ APPROX. 7.2mA WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON @ APPROX. 7.2mA WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).



OPTION 72 EQUIVALENT OUTPUT

M212 = OUTPUTS X2

1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 12.0mA ±0.4mA.
FULL POSITIVE DEFLECTION – 20.0mA ± 0.8mA.
FULL NEGATIVE DEFLECTION – 4.0mA ± 0.8mA.
3) AUX A OUTPUT SWITCHES ON @ APPROX. 13.8mA WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON @ APPROX. 10.2mA WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).

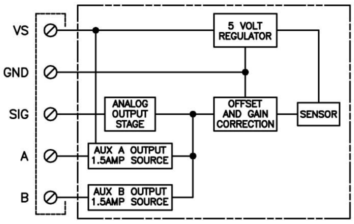


OPTION 73 EQUIVALENT OUTPUT

M212 = OUTPUTS X2

1) VOLTAGE SUPPLY IS TO BE ±10VDC TO ±15VDC.
2) CURRENT CONSUMPTION: 20mA.
OUTPUT (±10VS): CENTERED: 0.0VDC ±0.5VDC.
FULL POSITIVE DEFLECTION: 10VDC ±1.0VDC.
FULL NEGATIVE DEFLECTION: –10VDC ±1.0VDC.
3) AUX A OUTPUT SWITCHES ON @ APPROX. 2.0VDC WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON @ APPROX. –2.0VDC WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).
AUX OUTPUTS ARE SOURCING @ 15mADC MAX.

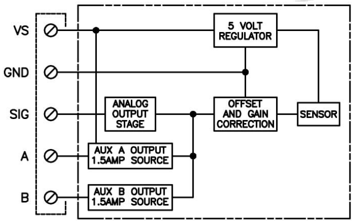
MODEL 115 SINGLE AXIS JOYSTICK



OPTION 74 EQUIVALENT OUTPUT

M212 = OUTPUTS X2

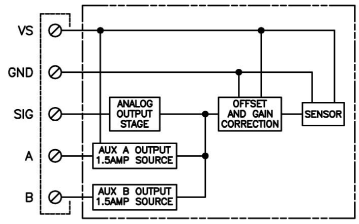
NOTES:1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 5.00V ±0.25V.
FULL POSITIVE DEFLECTION – 10.00V ± 0.5V.
FULL NEGATIVE DEFLECTION – 0.00V ± 0.5V.
3) AUX B OUTPUT SWITCHES ON VS –0.7VDC @ APPROX. 6V THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX A WITH OUTPUT SWITCHES ON VS –0.7VDC @ APPROX. 4V WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).



OPTION 75 EQUIVALENT OUTPUT

M212 = OUTPUTS X2

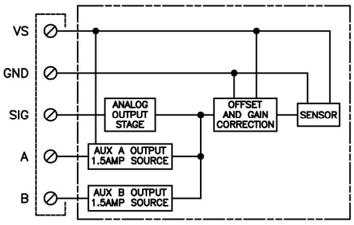
NOTES:1) VOLTAGE SUPPLY IS TO BE 18–60VDC.
2) CURRENT CONSUMPTION: 15mA @ 24VDC.
OUTPUT: CENTERED – 0.00V ±0.25V.
FULL POSITIVE DEFLECTION – 5.00V ± 0.5V.
FULL NEGATIVE DEFLECTION – 5.00V ± 0.5V.
3) AUX B OUTPUT SWITCHES ON VS –0.7VDC @ APPROX. 1V THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX A WITH OUTPUT SWITCHES ON VS –0.7VDC @ APPROX. 1V WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).



OPTION 76 (40%) EQUIVALENT OUTPUT

M212 = OUTPUTS X2

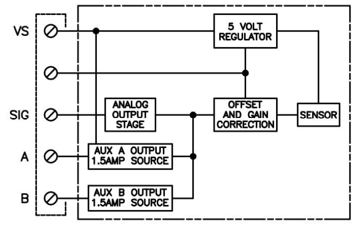
NOTES:1) VOLTAGE SUPPLY IS TO BE 5VDC.
2) CURRENT CONSUMPTION: 14mA @ 5VDC.
OUTPUT: CENTERED – 2.50V ±0.05V.
FULL POSITIVE DEFLECTION – 4.50V ± 0.15V.
FULL NEGATIVE DEFLECTION – .50V ± 0.15V.
3) AUX A OUTPUT SWITCHES ON VS –0.7VDC @ APPROX. 2.82V WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON VS –0.7VDC @ APPROX. 2.2V WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).



OPTION 77 (40%) EQUIVALENT OUTPUT

M212 = OUTPUTS X2

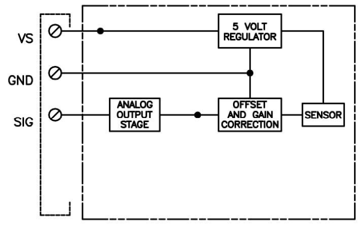
1) VOLTAGE SUPPLY IS TO BE 5VDC.
2) CURRENT CONSUMPTION: 14mA @ 5VDC.
OUTPUT: CENTERED – 2.50V ±0.0625V.
FULL POSITIVE DEFLECTION – 3.75V ± 0.125V.
FULL NEGATIVE DEFLECTION – 1.25V ± 0.125V.
3) AUX A OUTPUT SWITCHES ON VS –0.7VDC @ APPROX. 2.82V WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON VS –0.7VDC @ APPROX. 2.2V WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).



OPTION 78 EQUIVALENT OUTPUT

M212 = OUTPUTS X2

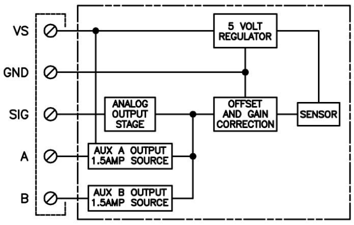
NOTES:1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 0.0mA ±0.5mA.
FULL POSITIVE DEFLECTION – 20mA ± 0.5mA.
FULL NEGATIVE DEFLECTION – 20mA ± 0.5mA.
3) AUX A OUTPUT SWITCHES ON VS –0.7VDC @ APPROX. 4mA WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON VS –0.7VDC @ APPROX. 4mA WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).



OPTION 79 EQUIVALENT OUTPUT

M212 = OUTPUTS X2

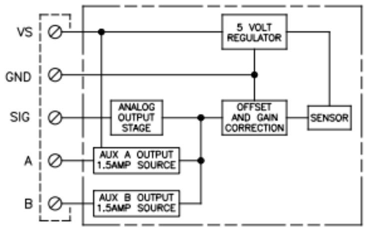
1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 50% +/– 4% PWM DUTY CYCLE
FULL POSITIVE DEFLECTION – 90% +/–2% PWM DUDY CYCLE
FULL NEGATIVE DEFLECTION – 10% +/– 2% PWM DUDY CYCLE



OPTION 80 EQUIVALENT OUTPUT

M212 = OUTPUTS X2

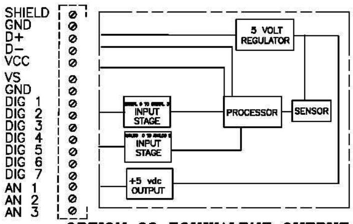
1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 4.0mA ±0.8mA.
FULL POSITIVE DEFLECTION – 20mA ± 1mA.
FULL NEGATIVE DEFLECTION – 20mA ± 1mA.
3) AUX A OUTPUT SWITCHES ON VS –0.7VDC @ APPROX. 7.2mA WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON VS –0.7VDC @ APPROX. 7.2mA WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).



OPTION 82 EQUIVALENT OUTPUT

M212 = OUTPUTS X2

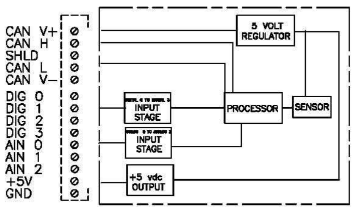
1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
OUTPUT: CENTERED – 5VDC ± 0.1VDC
FULL POSITIVE DEFLECTION – 9.5vdc ± 0.1vdc
FULL NEGATIVE DEFLECTION – 0.5vdc ± 0.1vdc
3) AUX B OUTPUT SWITCHES ON VS –0.7VDC @ APPROX. 5.9vdc WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX A OUTPUT SWITCHES ON VS –0.7VDC @ APPROX. 4.1vdc WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–).



OPTION 83 EQUIVALENT OUTPUT

M212 = OUTPUTS X2
USB BOARD

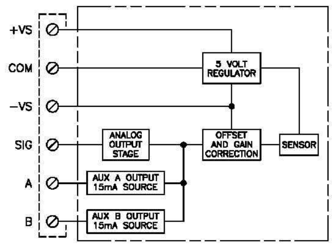
1) VOLTAGE SUPPLY IS TO BE 5VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
3) SENSOR CAL: CENTERED – 2.50VDC ± 0.075vdc.
FULL POSITIVE DEFLECTION – 4.00 ± 0.15vdc.
FULL NEGATIVE DEFLECTION – 1.00 ± 0.15vdc
4) MAX VOLTAGE FOR THE ANALOG AND DIGITAL INPUTS: 5 VDC
4 ANALOG INPUTS INCLUDING ON BOARD SENSOR
7 DIGITAL INPUTS



OPTION 84 EQUIVALENT OUTPUT

M212 = OUTPUTS X2
CAN/J1939 MCB200 BOARD ADDRESS = 33 (STANDARD)

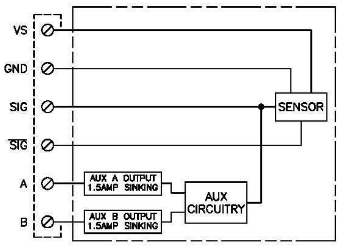
1) VOLTAGE SUPPLY IS TO BE 10–30VDC.
2) CURRENT CONSUMPTION: 20mA @ 12VDC.
3) SENSOR CAL: CENTERED – 2.50VDC ± 0.075V.
FULL POSITIVE DEFLECTION – 4.00 ± 0.15V.
FULL NEGATIVE DEFLECTION – 1.00 ± 0.15V.
4) MAX VOLTAGE FOR THE ANALOG AND DIGITAL INPUTS: 5 VDC
4 ANALOG INPUTS INCLUDING ON BOARD SENSOR
4 DIGITAL INPUTS



OPTION 85 EQUIVALENT (5% AUX) OUTPUT

M212 = OUTPUTS X2

1) VOLTAGE SUPPLY IS TO BE ±10VDC TO ±15VDC.
2) CURRENT CONSUMPTION: 20mA.
OUTPUT (±10VS): CENTERED: 0.0VDC ±0.5VDC.
FULL POSITIVE DEFLECTION: 10VDC ±1.0VDC.
FULL NEGATIVE DEFLECTION: –10VDC ±1.0VDC.
3) AUX A OUTPUT SWITCHES ON @ APPROX. 0.5VDC WITH THE POSITIVE ANALOG OUTPUTS (X+, Y+). AUX B OUTPUT SWITCHES ON @ APPROX. –0.5VDC WITH THE NEGATIVE ANALOG OUTPUTS (X–, Y–). AUX OUTPUTS ARE SOURCING @ 15mADC MAX.



OPTION 86 EQUIVALENT OUTPUT

M212 = OUTPUTS X2

NOTES: 1) VOLTAGE SUPPLY IS TO BE 5VDC.
2) SIG = NORMAL OUTPUT $\overline{\text{SIG}}$ = INVERTED OUTPUT.
3) CURRENT CONSUMPTION: 16mA @ 5VDC.
OUTPUT: CENTERED – 2.50V +/–0.05V
FULL POSITIVE DEFLECTION – 4.50V +/–0.10V.
FULL NEGATIVE DEFLECTION – 0.50V +/–0.10V.
4) AUX A OUTPUT SWITCHES ON WHEN THE SIG IS @ APPROX. 2.9VDC.
AUX B OUTPUT SWITCHES ON WHEN THE SIG IS @ APPROX. 2.1VDC.

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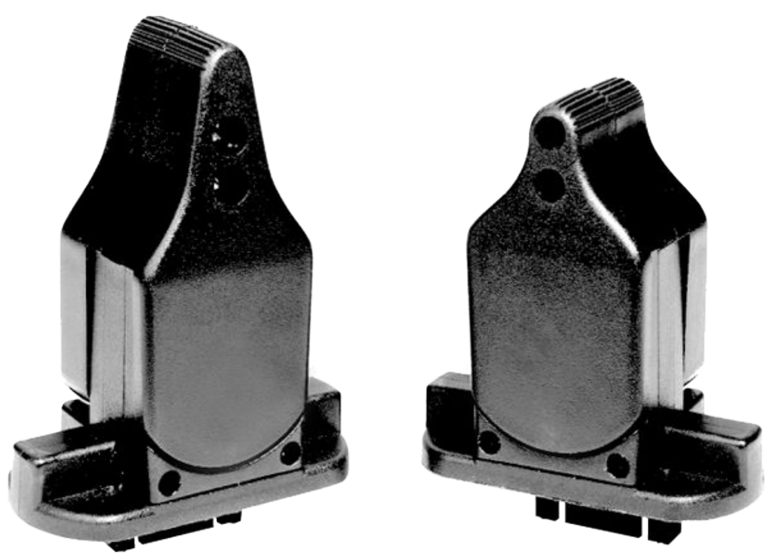
Technical Information

Joysticks
JS120 Single Axis Fingertip Joystick



Revision history

Table of revisions

Date	Changed	Rev
December 2016	Corrected pinout drawing	0303
April 2016	Updated to Engineering Tomorrow design	0302
November 2015	Converted to Danfoss layout	0301
July 2009	Corrected connector pin assignments and added output voltage curve	DA
February 2007	Lever length options; connector pin assignments	CA
May 2006	Model code number	BA
May 2006	Typical contact resistance to ohms	AA

Contents

Overview

Description

Danfoss has developed the JS120 to meet the harsh operating requirements of today's mobile machine market.

Developed for applications where ergonomics and system integrity are paramount, the JS120 is a minimum width, low profile joystick that provides precise fingertip control in one axis. The low profile lever makes the JS120 less susceptible to unintentional operation and the minimum under-panel footprint makes it ideal for mounting in panels and operator arm rests. The JS120 is sealed to IP 66 above panel to enable it to operate in extreme environments.

Designed for use with electronic controllers, the joystick generates analog and switched reference signals proportional to the distance and direction over which the handle is moved. The output is configured to provide signals for fault detection circuits and a center tap provides an accurate voltage reference for the lever in its released position, or a zero point for a bipolar supply voltage. Electrically independent direction switches are also available.

This publication describes the technical features and data required to specify the JS120 base for your application.

Features and options

- Long life potentiometric sensing
- Single axis
- Spring center return and end return options
- Slim profile with low operating forces
- Easy installation
- Operating life > 5 million cycles
- Output options
  - 10 to 90 % Vs
  - 25 to 75 % Vs
- IP 66 environmental sealing above panel
- Independent direction switch signals
- Width only 26.5 mm (1.04 in)
- Ergonomic design
- Choice of two lever heights

Product configuration model code

The product configuration model code specifies particular features when ordering the JS120. The model code begins with the product family name and the remaining fields are filled in to configure the product with the desired features.

Model code summary

Product configuration model code sample

A	B
JS120	0002

A—Product series

Code	Description
JS120	Series JS120 Joystick

B—Lever length and output voltage range options

Code	Description
0002	Short lever, 10 to 90% Vs output range, 5 kΩ, spring return to center
0003	Short lever, 25 to 75% Vs output range, 5 kΩ, spring return to center
0005	Long lever, 10 to 90% Vs output range, 5 kΩ, spring return to center
0006	Long lever, 25 to 75% Vs output range, 5 kΩ, spring return to center
0008	Long lever, 10 to 90% Vs output range, 5 kΩ, spring return to end
0009	Long lever, 25 to 75% Vs output range, 5 kΩ, spring return to end
0010	Short lever, 10 to 90% Vs output range, 5 kΩ, spring return to end
0011	Short lever, 25 to 75% Vs output range, 5 kΩ, spring return to end

Vs = supply voltage

Product configuration model code

Center tap

A center tap (spring return to center option) is a standard JS120 feature, where 50% of the supply voltage can be supplied to force the sensor voltage to this known reference. When the center tap is not connected there will be a center dead band (where the voltage output does not change on initial deflection).

Padding resistors

The JS120 potentiometer track has resistors placed in series with the main resistive element. These resistors are used to reduce the outputs at full mechanical deflection. This is a safety feature that the machine control system can use to determine a broken wire or short circuit to full voltage or ground. The degree to which the output is reduced can be chosen from the Code B table in *Model code summary* on page 5.

Position switches

Position switches are a standard JS120 feature. The normally open switches close at the angles specified in the table below indicating forward and reverse travel of the lever. These switches are connected independently of the proportional potentiometric elements and can be terminated by the customer to provide center on/off data to the control system.

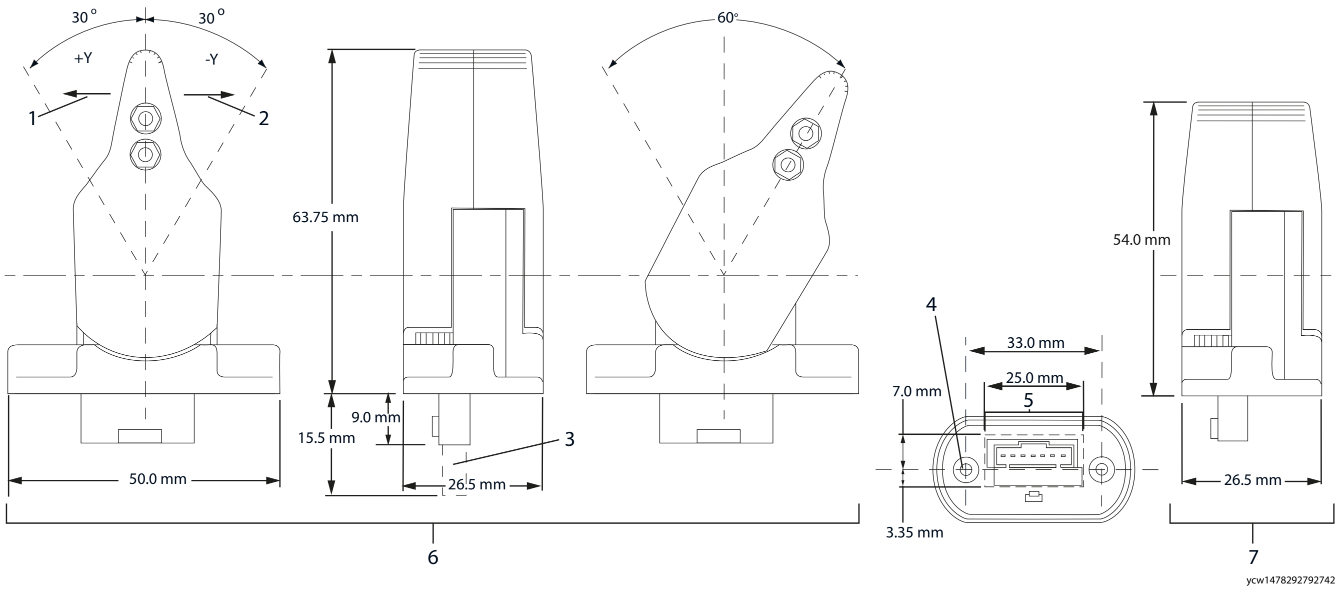
Specifications

Switch operating angle	5˚ either side of center (± 1˚ tolerance)
Maximum supply voltage—maximum Vs	< 35 Vdc
Minimum load resistance	10 kΩ
Maximum load current	2 mA resistive
Typical contact resistance	150 Ω

Product installation

Dimensions and mounting

Dimensions



1.	Forward	2.	Backward
3.	Connector	4.	Panel clearance holes 3.10 mm
5.	Panel cut out	6.	Long lever
7.	Short lever		

JS120 is designed to be fitted down into the panel, through the panel cutout. Panel seal integrity can be achieved by using sealing gasket. Mounting screws can be driven to a recommended torque of 1 N•m (9 lbf•in). The joystick is fitted with 2 x M3 inserts and the maximum screw penetration is 6 mm plus panel thickness.

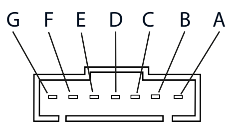
Product installation

Connector pin assignments

Connector

kwa1447351557847

Pin assignments (connector end view)



kwa1391820928784

Pinout and wiring information

Pin	JS120-0002, 0003, 0005, 0006	JS120-0008, 0009, 0010, 0011
G	Direction switch common	Direction switch common
F	Direction switch +Y (N/O)	Direction switch (N/O)
E	Direction switch -Y (N/O)	Not used
D	(-) supply (ground)	(-) supply (ground)
C	Output voltage	Output voltage
B	(+) supply (power)	(+) supply (power)
A	Center tap	Not used

Marker on underside of mating connector indicates pin G

Mating connector details

Mating connector – AMPMODU MTE series

Connector	AMP ordering number
7 pin latching male	103957-6

Mating connector assembly

Type	Danfoss ordering number
7 pin with 610 mm [24.02 in] leads	10101762

Product installation

Machine wiring guidelines

- Protect wires from mechanical abuse, run wires in flexible metal or plastic conduits.
- Use 85˚ C (185˚ F) wire with abrasion resistant insulation and 105˚ C (221˚ F) wire should be considered near hot surfaces.
- Use a wire size that is appropriate for the module connector.
- Separate high current wires such as solenoids, lights, alternators or fuel pumps from sensor and other noise-sensitive input wires.
- Run wires along the inside of, or close to, metal machine surfaces where possible, this simulates a shield which will minimize the effects of EMI/RFI radiation.
- Do not run wires near sharp metal corners, consider running wires through a grommet when rounding a corner.
- Do not run wires near hot machine members.
- Provide strain relief for all wires.
- Avoid running wires near moving or vibrating components.
- Avoid long, unsupported wire spans.
- Ground electronic modules to a dedicated conductor of sufficient size that is connected to the battery (-).
- Power the sensors and valve drive circuits by their dedicated wired power sources and ground returns.
- Twist sensor lines about one turn every 10 cm (4 in).
- Use wire harness anchors that will allow wires to float with respect to the machine rather than rigid anchors.

Caution

Unused pins on mating connectors may cause intermittent product performance or premature failure. Plug all pins on mating connectors.

Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. Improperly protected power input lines against over current conditions may cause damage to the hardware. Properly protect all power input lines against over-current conditions.

Joystick safety

Joystick dust and water protection

The joystick is sealed above the mounting surface to prevent dust and water ingress and is supplied with a sealing gasket for mounting above the panel. The effectiveness of the seal is dependent on the mounting surface being sufficiently rigid to compress the sealing gasket. The finish of the mounting surface is critical to achieving an adequate seal and rough surface finishes, paint chips, deep scratches, etc. should be avoided.

The joystick base below the mounting surface should be protected from dust and direct water spray.

Product installation

Joystick safety critical functions

For a system to operate safely it must be able to differentiate between commanded and uncommanded inputs. Take steps to detect and manage joystick and system failures that may cause an erroneous output.

For safety critical functions Danfoss recommends you use an independent momentary action system enable switch. You can incorporate this switch into the joystick as an operator presence switch or can be a separate foot or hand operated momentary switch. Disable all joystick functions that the joystick controls when this switch is released.

Ensure the control system looks for the appropriate system enable switch input before the joystick is displaced from its neutral position. Enable functions only after receiving this input.

Applications using CAN joysticks should continuously monitor for the presence of the CAN messages on periodic basis. Messages are to be checked frequently enough for the system or operator to react if the CAN messages lose priority or are no longer received.

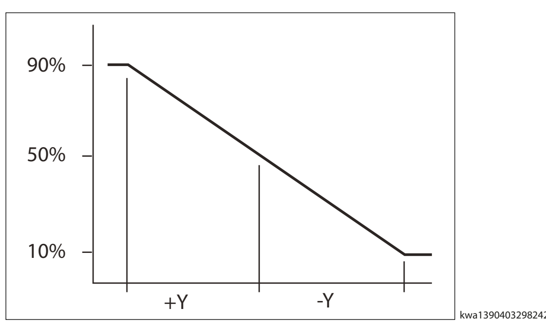
Product specifications

Electrical characteristics

Electrical characteristics

Sensor type	Potentiometric
Electrical angle of movement center return	28° ± 1°
Electrical angle of movement end return	Start 2° ± 1°, end return full angle 56° ± 1°
Total track resistance	5 kΩ (± 20%)
Maximum supply voltage (Vs)	35 Vdc
Maximum wiper current	5 mA (non-destructive)
Maximum power dissipation	0.25 W at 20°C [68°F]
Wiper circuit impedance	200 kΩ minimum
Output voltage	10 to 90% Vs 25 to 75% Vs
Resolution	Infinite
Center tap voltage (no load)	50% Vs ± 2%
Center tap angle (center return)	± 2.5° either side of center (± 1° tolerance)
Insulation resistance	> 50 MΩ at 500 Vdc
Load resistance minimum	10 kΩ
Load current maximum	2 mA resistive

Output voltage curve



Mechanical characteristics

Mechanical characteristics

Description	**Short lever**	**Long lever**
Breakout force (at lever tip)	3.1 N [0.70 lbf]	2.3 N [0.52 lbf]
Operating force (at tip, full deflection)	5.1 N [1.15 lbf]	3.4 N [0.76 lbf]
Maximum allowable force	50 N [11.24 lbf]	35 N [7.87 lbf]
Lever operating angle	30° ± 1° center return 60° ± 1° end return	
Lever action	Self centering or end return	
Expected life	> 5 million cycles	
Weight	0.045 kg [0.099 lb]	

Product specifications

Environmental parameters

Environmental parameters

Operating temperature	-25°C to 70°C [-13°F to 158°F]
Storage temperature	-40°C to 85°C [-40°F to 185°F]
Environmental sealing above the flange	IP 66 above panel, IP 40 below panel

ENGINEERING TOMORROW

Products we offer:

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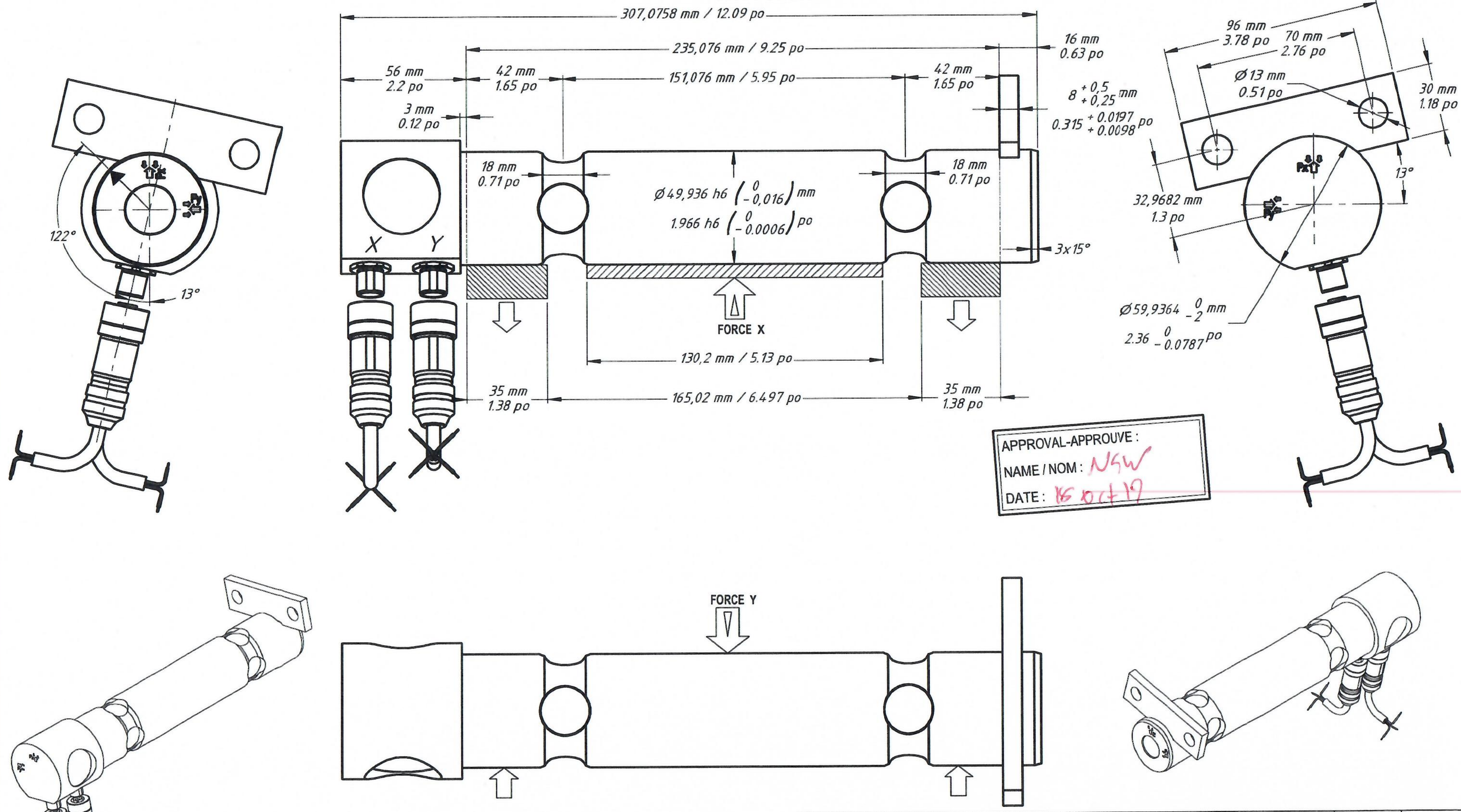
Approval drawing
Dessin d'approbation

LOAD PIN

AXE DYNAMOMÉTRIQUE

model- modèle **5000-FORC001023**

1st BCI N°(SENSY) :	20191191
Customer- Client :	HAWBOL
Rev.	18/10/2019



APPROVAL-APPROUVE :
NAME / NOM : NSW
DATE : 16 Oct 19

Ingress protection rating - Indice de protection	IP67M		Weight Poids (Tot.)		5,423 kg	11.96 lb
NOM.CAPACITY - CAPACITÉ NOM. :	20KIP	Cable - Câble 6m	Proof tested to Testé en usine à	150%	of nominal load de la charge nominale	
SENSITIVITY - SENSIBILITÉ	4-20 mA @ 14 kip	Material Matière 16%Cr - 4%Ni			Breaking load Charge à la rupture	>300%

Designer: FM

SIEMENS

Show actual product details

Data sheet 6AV2124-0GC13-0AX0

SIMATIC HMI TP700 COMFORT OUTDOOR, COMFORT PANEL, TOUCH OPERATION, 7" WIDESCREEN-TFT-DISPLAY, 16 MIL. COLORS, PROFINET INTERFACE, MPI/PROFIBUS DP INTERFACE, 12 MB USER MEMORY, WINDOWS CE 6.0, CONFIGURABLE FROM WINCC COMFORT V13 SP1, HSP

General information	
Product type designation	SIMATIC HMI TP700 Comfort Outdoor

Display	
Design of display	TFT
Screen diagonal	7 in
Display width	152.4 mm
Display height	91.4 mm
Number of colors	16 777 216
Resolution (pixels)	
• Horizontal image resolution	800 Pixel
• Vertical image resolution	480 Pixel
Backlighting	
• MTBF backlighting (at 25 °C)	50 000 h
• Backlight dimmable	Yes; LED, can be dimmed manually or automatically

Control elements	
Keyboard fonts	
• Function keys	
— Number of function keys	0

• Keys with LED	No
• System keys	No
• Numeric/alphabetical input	
— Numeric keyboard	Yes; Onscreen keyboard
— alphanumeric keyboard	Yes; Onscreen keyboard
Touch operation	
• Design as touch screen	Yes; analog, resistive
Expansions for operator control of the process	
• DP direct LEDs (LEDs as S7 output I/O)	
— F1...Fx	0
• Direct keys (keys as S7 input I/O)	
— F1...Fx	0
• Direct keys (touch buttons as S7 input I/O)	32

Installation type/mounting	
Mounting position	vertical
Mounting in portrait format possible	Yes
Mounting in landscape format possible	Yes
maximum permissible angle of inclination without external ventilation	35°

Supply voltage	
Type of supply voltage	DC
Rated value (DC)	24 V
permissible range, lower limit (DC)	19.2 V
permissible range, upper limit (DC)	28.8 V

Input current	
Current consumption (rated value)	0.7 A
Starting current inrush I^2t	0.5 $A^2 \cdot s$

Power	
Power consumption, typ.	17 W

Processor	
Processor type	X86

Memory	
Flash	Yes
RAM	Yes
Memory available for user data	12 Mbyte

Type of output	
Info LED	No
Power LED	No
Error LED	No
Acoustics	

• Buzzer	No
• Speaker	Yes

Time of day	
Clock	
• Hardware clock (real-time)	Yes
• Software clock	No
• retentive	Yes; Back-up duration typically 6 weeks
• synchronizable	Yes

Interfaces	
Number of industrial Ethernet interfaces	2
Number of RS 485 interfaces	1; RS 422/485 combined
Number of USB interfaces	2; USB 2.0
• USB Mini B	1; 5-pole
Number of 20 mA interfaces (TTY)	0
Number of RS 232 interfaces	0
Number of RS 422 interfaces	1
Number of parallel interfaces	0
Number of other interfaces	0
Number of SD card slots	2
With software interfaces	No
Industrial Ethernet	
• Industrial Ethernet status LED	2
• Number of ports of the integrated switch	2

Protocols	
PROFINET	Yes
Supports protocol for PROFINET IO	Yes
IRT	Yes; WinCC V13 SP1 HSP or higher
MRP	Yes; WinCC V13 SP1 HSP or higher
PROFIBUS	Yes
MPI	Yes
Protocols (Ethernet)	
• TCP/IP	Yes
• DHCP	Yes
• SNMP	Yes
• DCP	Yes
• LLDP	Yes
WEB characteristics	
• HTTP	Yes
• HTTPS	No
• HTML	Yes
• XML	No

• CSS	Yes
• Active X	No
• JavaScript	Yes
• Java VM	No
Further protocols	
• CAN	No
• EtherNet/IP	Yes
• MODBUS	Yes

EMC

Emission of radio interference acc. to EN 55 011	
• Limit class A, for use in industrial areas	Yes
• Limit class B, for use in residential areas	No

Degree and class of protection

IP (at the front)	IP66
Enclosure Type 4 at the front	Yes
Enclosure Type 4x at the front	Yes
IP (rear)	IP20

Standards, approvals, certificates

CE mark	Yes
cULus	Yes
RCM (formerly C-TICK)	Yes
KC approval	Yes
Marine approval	
• Germanischer Lloyd (GL)	Yes; Available soon
• American Bureau of Shipping (ABS)	Yes; Available soon
• Bureau Veritas (BV)	Yes; Available soon
• Det Norske Veritas (DNV)	Yes; Available soon
• Lloyds Register of Shipping (LRS)	Yes; Available soon
• Nippon Kaiji Kyokai (Class NK)	Yes; Available soon
• Polski Rejestr Statkow (PRS)	Yes; Available soon
• Compass working clearance	5 m
Use in hazardous areas	
• ATEX Zone 2	Yes; Available soon
• ATEX Zone 22	Yes; Available soon
• IECEx Zone 2	Yes; Available soon
• IECEx Zone 22	Yes; Available soon
• cULus Class I Zone 1	No
• cULus Class I Zone 2, Division 2	Yes; Available soon
• FM Class I Division 2	Yes; Available soon

Ambient conditions

Ambient temperature during operation	
• Operation (vertical installation)	
— For vertical installation, min.	-30 °C
— For vertical installation, max.	60 °C; (55 °C, see entry ID:64847814)
• Operation (max. tilt angle)	
— At maximum tilt angle, min.	-30 °C
— At maximum tilt angle, min.	50 °C
• Operation (vertical installation, portrait format)	
— For vertical installation, min.	-30 °C
— For vertical installation, max.	50 °C
• Operation (max. tilt angle, portrait format)	
— At maximum tilt angle, min.	-30 °C
— At maximum tilt angle, min.	45 °C
Ambient temperature during storage/transportation	
• min.	-30 °C
• max.	70 °C
Air pressure acc. to IEC 60068-2-13	
• Installation altitude above sea level, max.	3 000 m; Depending on the operating temperature
Relative humidity	
• Operation, max.	90 %; no condensation

Operating systems

proprietary	No
pre-installed operating system	
• Windows CE	Yes

Configuration

Message indicator	Yes
Alarm system (incl. buffer and acknowledgment)	Yes
Process value display (output)	Yes
Process value default (input) possible	Yes
Recipe management	Yes
Configuration software	
• STEP 7 Basic (TIA Portal)	No
• STEP 7 Professional (TIA Portal)	No
• WinCC flexible Compact	No
• WinCC flexible Standard	No
• WinCC flexible Advanced	No
• WinCC Basic (TIA Portal)	No
• WinCC Comfort (TIA Portal)	Yes; WinCC V13 SP1 Update 7 + HSP or higher
• WinCC Advanced (TIA Portal)	Yes; WinCC V13 SP1 Update 7 + HSP or higher
• WinCC Professional (TIA Portal)	Yes; WinCC V13 SP1 Update 7 + HSP or higher

Languages

Online languages	
• Number of online/runtime languages	32
Project languages	
• Languages per project	32

Functionality under WinCC (TIA Portal)	
Libraries	Yes
Applications/options	
• Web browser	Yes
• Pocket Word	Yes
• Pocket Excel	Yes
• PDF Viewer	Yes
• Media Player	Yes
• SIMATIC WinCC Sm@rtServer	Yes
• SIMATIC WinCC Audit	Yes
Number of Visual Basic Scripts	Yes
Task planner	
• time-controlled	Yes
• task-controlled	Yes
Help system	
• Number of characters per info text	70
Message system	
• Number of alarm classes	32
• Bit messages	
— Number of bit messages	4 000
• Analog messages	
— Number of analog messages	200
• S7 alarm number procedure	Yes
• System messages HMI	Yes
• System messages, other (SIMATIC S7, Sinumerik, Simotion, etc.)	Yes
• Number of characters per message	80
• Number of process values per message	8
• Acknowledgment groups	Yes
• Message indicator	Yes
• Message buffer	
— Number of entries	1 024
— Circulating buffer	Yes
— retentive	Yes
— maintenance-free	Yes
Recipe management	
• Number of recipes	300

• Data records per recipe	500
• Entries per data record	1 000
• Size of internal recipe memory	2 Mbyte
• Recipe memory expandable	Yes
Variables	
• Number of variables per device	2 048
• Number of variables per screen	400
• Limit values	Yes
• Multiplexing	Yes
• Structures	Yes
• Arrays	Yes
Images	
• Number of configurable images	500
• Permanent window/default	Yes
• Global image	Yes
• Image selection by PLC	Yes
• Image number in the PLC	Yes
Image objects	
• Number of objects per image	400
• Text fields	Yes
• I/O fields	Yes
• Graphic I/O fields (graphics list)	Yes
• Symbolic I/O fields (text list)	Yes
• Date/time fields	Yes
• Switches	Yes
• Buttons	Yes
• Graphic display	Yes
• Icons	Yes
• Geometric objects	Yes
Complex image objects	
• Number of complex objects per screen	20
• Alarm view	Yes
• Trend view	Yes
• User view	Yes
• Status/control	Yes
• Sm@rtClient view	Yes
• Recipe view	Yes
• f(x) trend view	Yes
• System diagnostics view	Yes
• Media Player	Yes
• Bar graphs	Yes

• Sliders	Yes
• Pointer instruments	Yes
• Analog/digital clock	Yes
Lists	
• Number of text lists per project	500
• Number of entries per text list	500
• Number of graphics lists per project	500
• Number of entries per graphics list	500
Archiving	
• Number of archives per device	50
• Number of entries per archive	20 000
• Message archive	Yes
• Process value archive	Yes
• Archiving methods	
— Sequential archive	Yes
— Short-term archive	Yes
• Memory location	
— Memory card	Yes
— USB memory	Yes
— Ethernet	Yes
• Data storage format	
— CSV	Yes
— TXT	Yes
— RDB	Yes
Security	
• Number of user groups	50
• Number of user rights	32
• Number of users	50
• Password export/import	Yes
• SIMATIC Logon	Yes
Logging through printer	
• Alarms	Yes
• Report (shift log)	Yes
• Hardcopy	Yes
• Electronic print to file	Yes; pdf, html
Character sets	
• Keyboard fonts	
— US English	Yes
Transfer (upload/download)	
• MPI/PROFIBUS DP	Yes
• USB	Yes

• Ethernet	Yes
• using external storage medium	Yes; Backup/restore
Process coupling	
• S7-1200	Yes
• S7-1500	Yes
• S7-200	Yes
• S7-300/400	Yes
• LOGO!	Yes
• WinAC	Yes
• SINUMERIK	Yes; with SINUMERIK option package
• SIMOTION	Yes
• Allen Bradley (EtherNet/IP)	Yes
• Allen Bradley (DF1)	Yes
• Mitsubishi (MC TCP/IP)	Yes
• Mitsubishi (FX)	Yes
• OMRON (FINS TCP)	No
• OMRON (LINK/Multilink)	Yes
• Modicon (Modbus TCP/IP)	Yes
• Modicon (Modbus)	Yes
• OPC UA Client	Yes
• OPC UA Server	Yes
Service tools/configuration aids	
• Backup/Restore manually	Yes
• Backup/Restore automatically	Yes
• Simulation	Yes
• Device switchover	Yes

Peripherals/Options

Peripherals	
• Printer	Yes
• SIMATIC HMI MM memory card: Multi Media Card	Yes
• SIMATIC HMI SD memory card: Secure Digital memory card	Yes
• SIMATIC HMI CF memory card Compact Flash Card	No
• USB memory	Yes
• SIMATIC IPC USB Flashdrive (USB stick)	Yes
• SIMATIC HMI USB stick	Yes
• Network camera	Yes

Mechanics/material

Enclosure material (front)	

• Plastic	No
• Aluminum	Yes; Powder-coated, UV resistant
• Stainless steel	No

Dimensions

Width of the housing front	214 mm
Height of housing front	158 mm
Mounting cutout, width	197 mm
Mounting cutout, height	141 mm
Overall depth	67 mm

Weights

Weight without packaging	1.5 kg
Weight incl. packaging	1.7 kg

last modified: 12/01/2016

SIEMENS

Data sheet 6ES7215-1HG40-0XB0

SIMATIC S7-1200, CPU 1215C, COMPACT CPU, DC/DC/RELAY, 2 PROFINET PORT, ONBOARD I/O: 14 DI 24V DC; 10 DO RELAY 2A, 2 AI 0-10V DC, 2 AO 0-20MA DC, POWER SUPPLY: DC 20.4 - 28.8 V DC, PROGRAM/DATA MEMORY: 125 KB

General information	
Product type designation	CPU 1215C DC/DC/Relay
Firmware version	V4.2
Engineering with	
• Programming package	STEP 7 V14 or higher

Supply voltage	
Rated value (DC)	
• 24 V DC	Yes
permissible range, lower limit (DC)	20.4 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
Load voltage L+	
• Rated value (DC)	24 V
• permissible range, lower limit (DC)	20.4 V
• permissible range, upper limit (DC)	28.8 V

Input current	
Current consumption (rated value)	500 mA; CPU only
Current consumption, max.	1 500 mA; CPU with all expansion modules

Inrush current, max.	12 A; at 28.8 V DC
I²t	0.8 A²·s
Output current	
for backplane bus (5 V DC), max.	1 600 mA; Max. 5 V DC for SM and CM
Encoder supply	
24 V encoder supply	
• 24 V	L+ minus 4 V DC min.
Power loss	
Power loss, typ.	12 W
Memory	
Work memory	
• integrated	125 kbyte
• expandable	No
Load memory	
• integrated	4 Mbyte
• Plug-in (SIMATIC Memory Card), max.	with SIMATIC memory card
Backup	
• present	Yes
• maintenance-free	Yes
• without battery	Yes
CPU processing times	
for bit operations, typ.	0.085 µs; / instruction
for word operations, typ.	1.7 µs; / instruction
for floating point arithmetic, typ.	2.3 µs; / instruction
CPU-blocks	
Number of blocks (total)	DBs, FCs, FBs, counters and timers. The maximum number of addressable blocks ranges from 1 to 65535. There is no restriction, the entire working memory can be used
OB	
• Number, max.	Limited only by RAM for code
Data areas and their retentivity	
Retentive data area (incl. timers, counters, flags), max.	10 kbyte
Flag	
• Number, max.	8 kbyte; Size of bit memory address area
Local data	
• per priority class, max.	16 kbyte; Priority class 1 (program cycle): 16 KB, priority class 2 to 26: 6 KB
Address area	
Process image	

• Inputs, adjustable	1 kbyte
• Outputs, adjustable	1 kbyte
Hardware configuration	
Number of modules per system, max.	3 comm. modules, 1 signal board, 8 signal modules
Time of day	
Clock	
• Hardware clock (real-time)	Yes
• Backup time	480 h; Typical
Digital inputs	
Number of digital inputs	14; Integrated
• of which inputs usable for technological functions	6; HSC (High Speed Counting)
Source/sink input	Yes
Number of simultaneously controllable inputs	
all mounting positions	
— up to 40 °C, max.	14
Input voltage	
• Rated value (DC)	24 V
• for signal "0"	5 V DC at 1 mA
• for signal "1"	15 V DC at 2.5 mA
Input delay (for rated value of input voltage)	
for standard inputs	
— parameterizable	Yes; 0.2 ms, 0.4 ms, 0.8 ms, 1.6 ms, 3.2 ms, 6.4 ms and 12.8 ms, selectable in groups of four
— at "0" to "1", min.	0.2 ms
— at "0" to "1", max.	12.8 ms
for interrupt inputs	
— parameterizable	Yes
for counter/technological functions	
— parameterizable	Single phase: 3 @ 100 kHz & 3 @ 30 kHz, differential: 3 @ 80 kHz & 3 @ 30 kHz
Cable length	
• shielded, max.	500 m; 50 m for technological functions
• unshielded, max.	300 m; For technological functions: No
Digital outputs	
Number of digital outputs	10; Relays
Switching capacity of the outputs	
• with resistive load, max.	2 A
• on lamp load, max.	30 W with DC, 200 W with AC
Output delay with resistive load	
• "0" to "1", max.	10 ms; max.

• "1" to "0", max.	10 ms; max.
Relay outputs	
• Number of operating cycles, max.	mechanically 10 million, at rated load voltage 100 000
Cable length	
• shielded, max.	500 m
• unshielded, max.	150 m

Analog inputs	
Number of analog inputs	2
Input ranges	
• Voltage	Yes
Input ranges (rated values), voltages	
• 0 to +10 V	Yes
• Input resistance (0 to 10 V)	≥100k ohms
Cable length	
• shielded, max.	100 m; twisted and shielded

Analog outputs	
Number of analog outputs	2
Output ranges, current	
• 0 to 20 mA	Yes

Analog value generation for the inputs	
Integration and conversion time/resolution per channel	
• Resolution with overrange (bit including sign), max.	10 bit
• Integration time, parameterizable	Yes
• Conversion time (per channel)	625 µs

Analog value generation for the outputs	
Integration and conversion time/resolution per channel	
• Resolution with overrange (bit including sign), max.	10 bit

Encoder	
Connectable encoders	
• 2-wire sensor	Yes

1. Interface	
Interface type	PROFINET
Physics	Ethernet
Isolated	Yes
automatic detection of transmission rate	Yes
Autonegotiation	Yes
Autocrossing	Yes
Interface types	

• Number of ports	2
• integrated switch	Yes
Functionality	
• PROFINET IO Controller	Yes
• PROFINET IO Device	Yes
• SIMATIC communication	Yes
• Open IE communication	Yes
• Web server	Yes
• Media redundancy	Yes; as MRP client
PROFINET IO Controller	
• Transmission rate, max.	100 Mbit/s
Services	
— PG/OP communication	Yes
— S7 routing	Yes
— Isochronous mode	No
— Open IE communication	Yes
— IRT	No
— MRP	Yes; as MRP client
— MRPD	No
— PROFIenergy	No
— Prioritized startup	Yes
— Number of IO devices with prioritized startup, max.	16
— Number of connectable IO Devices, max.	16
— Number of connectable IO Devices for RT, max.	16
— of which in line, max.	16
— Activation/deactivation of IO Devices	Yes
— Number of IO Devices that can be simultaneously activated/deactivated, max.	8
— Updating time	The minimum value of the update time also depends on the communication component set for PROFINET IO, on the number of IO devices and the quantity of configured user data.
PROFINET IO Device	
Services	
— PG/OP communication	Yes
— Isochronous mode	No
— Open IE communication	Yes
— IRT	No
— MRP	Yes; as MRP client
— MRPD	No
— PROFIenergy	Yes

— Shared device	Yes
— Number of IO Controllers with shared device, max.	2

Protocols	
Supports protocol for PROFINET IO	Yes
PROFIBUS	Yes; CM 1243-5 required
AS-Interface	Yes; CM 1243-2 required
Protocols (Ethernet)	
• TCP/IP	Yes
• DHCP	No
• SNMP	Yes
• DCP	Yes
• LLDP	Yes
Further protocols	
• MODBUS	Yes

Communication functions	
S7 communication	
• supported	Yes
• as server	Yes
• as client	Yes
• User data per job, max.	See online help (S7 communication, user data size)
Open IE communication	
• TCP/IP	Yes
— Data length, max.	8 kbyte
• ISO-on-TCP (RFC1006)	Yes
— Data length, max.	8 kbyte
• UDP	Yes
— Data length, max.	1 472 byte
Web server	
• supported	Yes
• User-defined websites	Yes
Number of connections	
• overall	16; dynamically

Test commissioning functions	
Status/control	
• Status/control variable	Yes
• Variables	Inputs/outputs, memory bits, DBs, distributed I/Os, timers, counters
Forcing	
• Forcing	Yes
Diagnostic buffer	

• present	Yes
Traces	
• Number of configurable Traces	2
• Memory size per trace, max.	512 kbyte

Interrupts/diagnostics/status information

Diagnostics indication LED	
• RUN/STOP LED	Yes
• ERROR LED	Yes
• MAINT LED	Yes

Integrated Functions

Number of counters	6
Counting frequency (counter) max.	100 kHz
Frequency meter	Yes
controlled positioning	Yes
Number of position-controlled positioning axes, max.	8
Number of positioning axes via pulse-direction interface	Up to 4 with SB 1222
PID controller	Yes
Number of alarm inputs	4

Potential separation

Potential separation digital inputs	
• Potential separation digital inputs	500V AC for 1 minute
• between the channels, in groups of	1
Potential separation digital outputs	
• Potential separation digital outputs	Relays
• between the channels	No
• between the channels, in groups of	2

EMC

Interference immunity against discharge of static electricity	
• Interference immunity against discharge of static electricity acc. to IEC 61000-4-2	Yes
— Test voltage at air discharge	8 kV
— Test voltage at contact discharge	6 kV
Interference immunity to cable-borne interference	
• Interference immunity on supply lines acc. to IEC 61000-4-4	Yes
• Interference immunity on signal cables acc. to IEC 61000-4-4	Yes
Interference immunity against voltage surge	
• on the supply lines acc. to IEC 61000-4-5	Yes
Interference immunity against conducted variable disturbance induced by high-frequency fields	

• Interference immunity against high-frequency radiation acc. to IEC 61000-4-6	Yes
Emission of radio interference acc. to EN 55 011	
• Limit class A, for use in industrial areas	Yes; Group 1
• Limit class B, for use in residential areas	Yes; When appropriate measures are used to ensure compliance with the limits for Class B according to EN 55011

Degree and class of protection

Degree of protection acc. to EN 60529	
• IP20	Yes

Standards, approvals, certificates

CE mark	Yes
UL approval	Yes
cULus	Yes
FM approval	Yes
RCM (formerly C-TICK)	Yes
KC approval	Yes
Marine approval	Yes

Ambient conditions

Free fall	
• Fall height, max.	0.3 m; five times, in product package
Ambient temperature during operation	
• min.	-20 °C
• max.	60 °C; Number of simultaneously activated inputs or outputs 7 or 5 (no adjacent points) at 60 °C horizontal or 50 °C vertical, 14 or 10 at 55 °C horizontal or 45 °C vertical
• horizontal installation, min.	-20 °C
• horizontal installation, max.	60 °C
• vertical installation, min.	-20 °C
• vertical installation, max.	50 °C
Ambient temperature during storage/transportation	
• min.	-40 °C
• max.	70 °C
Air pressure acc. to IEC 60068-2-13	
• Operation, min.	795 hPa
• Operation, max.	1 080 hPa
• Storage/transport, min.	660 hPa
• Storage/transport, max.	1 080 hPa
• permissible operating height	-1000 to 2000 m
Relative humidity	
• Operation, max.	95 %; no condensation
Vibrations	
• Vibrations	2 g (m/s²) wall mounting, 1 g (m/s²) DIN rail

• Operation, tested according to IEC 60068-2-6	Yes
Shock test	
• tested according to IEC 60068-2-27	Yes; IEC 68, Part 2-27 half-sine: strength of the shock 15 g (peak value), duration 11 ms
Extended ambient conditions	
Pollutant concentrations	
— SO2 at RH < 60% without condensation	S02: < 0.5 ppm; H2S: < 0.1 ppm; RH < 60% condensation-free

Configuration

Programming	
Programming language	
— LAD	Yes
— FBD	Yes
— SCL	Yes
Know-how protection	
• User program protection/password protection	Yes
• Copy protection	Yes
• Block protection	Yes
Access protection	
• Protection level: Write protection	Yes
• Protection level: Read/write protection	Yes
• Protection level: Complete protection	Yes
Cycle time monitoring	
• adjustable	Yes

Dimensions

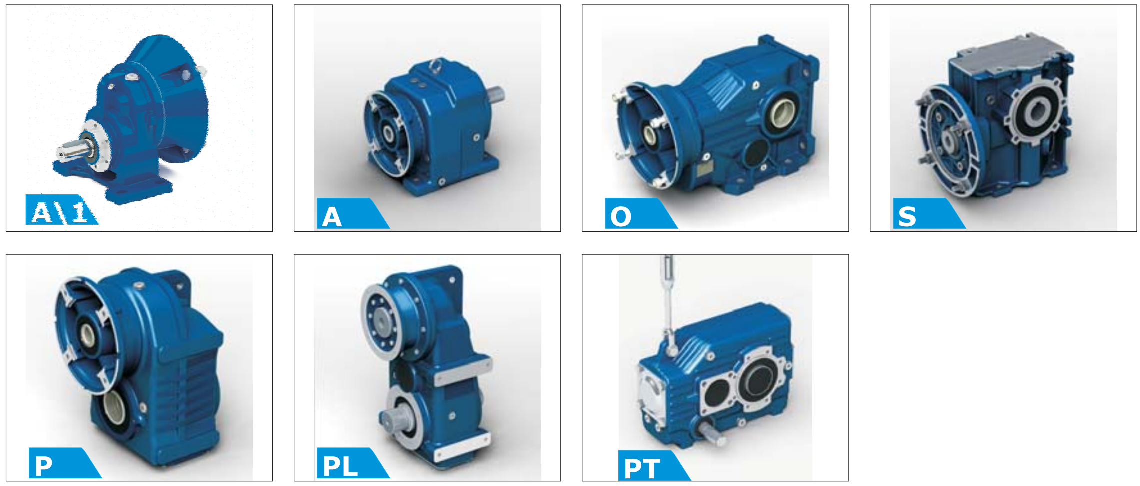
Width	130 mm
Height	100 mm
Depth	75 mm

Weights

Weight, approx.	585 g

last modified: 06/10/2017

Installation and Maintenance



HIGH TECH line Motion

STANDARD line Basic

EMPOWERING YOUR IDEAS

MT 01 I GB D

STM

Installation and Maintenance

ATEX
INCLUDED

TRASMISSIONI MECCANICHE
STM
RIDUTTORI

INDICE / *INDEX* / INHALTSVERZEICHNIS

SAFETY

SUPPLY

STOCK

INDICE / *INDEX* / INHALTSVERZEICHNIS

0. INFORMAZIONI GENERALI

0.0 GENERALITA' (VALIDITA', CAMPO APPLICAZIONE STATO REVISIONE E ERRATA CORRIGE)

LE INFORMAZIONI CONTENUTE SONO DA APPLICARSI AI PRODOTTI STANDARD E SPECIALI.
TENERE SEMPRE UNA COPIA DEL PRESENTE MANUALE A BORDO MACCHINA.

QUALORA NON FOSTE IN POSSESSO DEL DOCUMENTO RICHIEDERE UNA COPIA ALL'UFFICIO COMMERCIALE STM S.P.A PRIMA DELLA MESSA IN SERVIZIO DELLA MACCHINA.

Le informazioni relative alla Errata Corrige e al codice catalogo sono riportate in fondo al presente documento.

0. GENERAL INFORMATION

0.0 GENERAL (VALIDITY, SCOPE, REVISION AND ERRATA)

DATA GIVEN HEREIN APPLY TO STANDARD AND SPECIAL PRODUCTS.
ALWAYS KEEP A COPY OF THIS MANUAL WITH THE MACHINE.

IF YOU DO NOT HAVE THIS DOCUMENT, PLEASE ASK A COPY TO THE SALES DEPT. OF STM S.P.A. BEFORE MACHINE COMMISSIONING.

Information on Errata and catalogue code can be found at the end of this document.

0. ALLGEMEINE INFORMATIONEN

0.0 ALLGEMEINES (GÜLTIGKEITSBEREICH, ANWENDUNGSBEREICH, REVISION UND DRUCKFEHLERVERZEICHNIS)

DIE HIER ENTHALTENEN INFORMATIONEN BEZIEHEN SICH AUF DIE PRODUKTE IN IHREN STANDARD- UND SPEZIAL-VERSIONEN.
BEWAHREN SIE IMMER EINE KOPIE DIESES HANDBUCHS AN DER MASCHINE AUF.

SOLLTEN SIE NICHT ÜBER DIESE UNTERLAGE VERFÜGEN, BITTEN WIR SIE, EINE KOPIE BEI DER VERKAUFSABTEILUNG DER STM S.P.A ANZUFORDERN, BEVOR SIE DIE MASCHINE IN BETRIEB SETZTEN.

Die Informationen bezüglich des Druckfehlerverzeichnisses und der Katalognummer werden am Ende dieser Unterlage angegeben.

0. INFORMAZIONI GENERALI

0.1 SCOPO
Questo manuale contiene tutte le informazioni per il corretto stoccaggio, uso e manutenzione ed il rispetto di queste costituisce condizione necessaria per la garanzia di un corretto funzionamento; è consigliabile prendere coscienza dei contenuti di questo manuale e conservarne una copia in prossimità dei gruppi.

Le informazioni principali di carattere generale sono valide oltre che per i riduttori di serie anche per gli speciali.

Tutte le informazioni necessarie agli acquirenti ed ai progettisti, sono riportate nel “catalogo di vendita”.
Oltre ad adottare le regole della buona tecnica di costruzione, le informazioni devono essere lette attentamente ed applicate in modo rigoroso.

Le informazioni riguardanti il motore elettrico che si può trovare abbinato al riduttore devono essere reperite nel Manuale di uso, installazione e manutenzione del motore elettrico stesso.

La non osservanza di dette informazioni può essere causa di rischi per la salute e la sicurezza delle persone e danni economici.

Queste informazioni, realizzate dal Costruttore nella propria lingua originale (italiana), possono essere rese disponibili anche in altre lingue per soddisfare le esigenze legislative e/o commerciali.

La documentazione deve essere custodita da persona responsabile allo scopo preposta, in un luogo idoneo, affinché essa risulti sempre disponibile per la consultazione nel miglior stato di conservazione.

In caso di smarrimento o deterioramento, la documentazione sostitutiva dovrà essere richiesta direttamente al costruttore citando il codice del presente manuale.
Il manuale rispecchia lo stato dell’arte al momento dell’immissione sul mercato del riduttore.
Il costruttore si riserva comunque la facoltà di apportare modifiche, integrazioni o miglioramenti al manuale stesso, senza che ciò possa costituire motivo per ritenere la presente pubblicazione inadeguata.
Per evidenziare alcune parti di testo di rilevante importanza o per indicare alcune specifiche importanti, sono stati adottati alcuni simboli il cui significato viene a pagina 1.

0. GENERAL INFORMATION

0.1 PURPOSE
This manual gives all instructions about stocking, use and maintenance; follow these rules to ensure correct operation. It is recommended to thoroughly read this manual and keep one copy next to the units.

General information apply not only to the standard gearboxes but also to the special versions.

All purchasing and design criteria is provided in the Sales Catalogue.

Apart from adhering to established engineering practices, the information given in this manual must be carefully read and applied rigorously.

The information regarding the electric motor that can be found matching the gearbox is supplied with the owner’s manual relevant to the specific electric motor.

Failure to adhere to the information provided herein may result in risk to personal health and safety, and may incur economic damages.

This information, provided in the original language (Italian) of the Manufacturer, may also be made available in other languages to meet legal and/or commercial requirements.

The documentation must be stored by a person with the correct authority in a suitable place and must always be made available for consultation.

In case documents are lost or damaged, replacement documentation must be requested directly from the Manufacturer, quoting the code of this manual.
The manual reflects the state of the art at the time of commercialisation of the gear unit.

The Manufacturer reserves the right to modify, supplement and improve the manual, without the present publication being for that reason considered inadequate.

Particularly significant sections of the manual and important specifications are highlighted by symbols whose meaning is given on page 1.

0. ALLGEMEINE INFORMATIONEN

0.1 EINSATZZWECK
Dieses Handbuch enthält alle Informationen bezüglich einer korrekten Einlagerung, dem Einsatz und der Instandhaltung. Der Einhalt dieser Vorgaben stellt die Bedingung für die Gewährleistung eines korrekten Betriebs dar. Es wird daher empfohlen, den Inhalt dieses Handbuchs zur Kenntnis zu nehmen und eine Kopie davon in der Nähe der Aggregate aufzubewahren.
Die Hauptinformationen mit allgemeinem Charakter sind nicht nur für die serienmäßigen Getriebe sondern auch für die Spezialgetriebe gültig.
Alle Informationen, die für Käufer und Planer erforderlich sein könnten, finden Sie im "Verkaufskatalog".
Über die Erfordernis die Regeln der "guten Bautechnik" anzuwenden, müssen auch alle übermittelten Informationen aufmerksam gelesen und strikt angewandt werden.
Informationen, die sich auf den Elektromotor beziehen, der an das Getriebe gekoppelt sein könnte, müssen der Betriebs-, Installations- und Instandhaltungsanleitung des Elektromotors selbst entnommen werden.
Die Nichtbeachtung dieser Informationen kann gesundheits- und sicherheitsgefährdende Folgen haben und zu finanziellen Einbußen führen.
Diese Informationen, die vom Hersteller in der Herkunftssprache (Italienisch) erstellt wurden, stehen auch in anderen Sprachen zur Verfügung, um gesetzlichen und/oder wirtschaftlichen Anforderungen gerecht zu werden.
Diese Dokumentation muss von einer verantwortungsbewussten Person zum vorgesehenen Zweck und an einem angebrachten Ort aufbewahrt werden, damit sie immer zum Nachschlagen zur Verfügung steht und ihren einwandfreien Zustand beibehält.
Sollte diese Dokumentation verloren gehen oder beschädigt werden, muss direkt beim Händler, unter Angabe der Handbuchnummer, ein entsprechender Ersatz angefordert werden.
Dieses Handbuch spiegelt den technologischen Stand zum Zeitpunkt der Markteinführung des Getriebes wider.
Der Hersteller behält sich jedoch das Recht vor, jederzeit Änderungen, Integrationen oder Verbesserungen in das Handbuch einfügen zu können, ohne dass dadurch die vorliegende Veröffentlichung ungeeignet resultiert.
Um besonders wichtige Textteile hervorzuheben oder einige wichtige Spezifikationen zu unterstreichen, wurden Symbole verwendet, deren Bedeutung auf Seite 1 erläutert wird.

0. INFORMAZIONI GENERALI

0.2 GARANZIA
0.2.1 Condizioni di assistenza Tecnica
La garanzia del prodotto, relativa ai difetti di fabbricazione, ha la durata di 12 (dodici) mesi a partire dalla data del documento di fatturazione. Le condizioni e le modalità di garanzia alle quali riferirsi sono quelle riportate sul listino prezzi generale del prodotto. L'eventuale richiesta di preventivo di riparazione viene presa in considerazione solo per riduttori di taglia media e grande e deve essere concordata con il servizio di Assistenza Tecnica Post-vendita della STM SpA.

In merito alle modalità di reso del materiale non conforme è necessario:
1-Compilare il modulo "Assistenza Tecnica post vendita modulo di richiesta intervento del cliente" e inviarlo via fax al recapito sopra indicato;

2-Attendere fax di conferma da parte della STM SpA;
3-Inviare il prodotto in porto franco (spese di trasporto a carico del mittente) alla STM SpA, con allegato il modulo approvato dalla STM SpA stessa.
La STM SpA non si assume alcuna responsabilità per le conseguenze, a livello di sicurezza e funzionamento del sistema, che un utilizzo del prodotto non conforme a quanto specificato nel presente manuale può produrre.

0.2.2 LIMITI DELLA GARANZIA
La garanzia si limita esclusivamente alla sostituzione del componente difettoso, qualora si determina, dopo averlo visionato, un'effettiva nostra responsabilità.

La garanzia sul prodotto in ogni modo non ha più valore nel momento in cui si dovessero riscontrare delle manomissioni a qualsiasi parte o componente l'impianto.
Si escludono inoltre dalla garanzia le riparazioni conseguenti a danni causati da trascuratezza di manutenzione o da applicazioni inadeguate.

Tutte le spese di trasporto, sopralluogo, smontaggio dovute, per l'intervento di un nostro tecnico s'intendono in ogni caso a totale carico del cliente.
Per qualunque controversia l'unico foro competente è quello di Bologna

0. GENERAL INFORMATION

0.2 WARRANTY
0.2.1 Technical/After Sales Conditions
Product warranty applies to construction defects and shall last for a period of 12 months starting from the invoice date. The warranty terms and conditions to be referred to are those contained in the product general price list. Any price inquiry for product repair will be examined only for medium/big sized gearboxes and will have to be agreed with the after-sales service of STM SpA.

Regarding the procedure to return goods in non conformity with the requirements it is necessary:
1-to fill in the form''After sales /Technical assistance and customer's service request for intervention form'' and fax it to the above mentioned number.
2-to wait for the confirmation reply from STM SpA.
3-To send the product free of transportation charges (charged to the sender) to STM SpA along with the form approved by STM SpA.

STM SpA can not be held liable for any consequence, in terms of safety and system operation, which might result from improper use of the product other than that specified in this document.

0.2.2 LIMITS OF THE WARRANTY
Warranty only covers replacement of faulty component if, after inspection, fault proves to be our responsibility.

Product warranty becomes null and void whenever any system part or component has been tampered with.

Repairs for damage due to lack of maintenance or unsuitable application are further excluded.

All the expenses for transport, on-the-spot inspection and disassembly consequent to the intervention of one of our technicians are anyway completely at customer's charge.
Any controversy will be heard before Bologna Court.

0. ALLGEMEINE INFORMATIONEN

0.2 GARANTIE
0.2.1 Bedingungen des Technischen Kundendienstes
Die Produktgarantie bezieht sich auf Fabrikationsfehler und gilt für 12 Monate ab Rechnungsdatum. Die Garantiebedingungen und -modalitäten, auf die Bezug genommen wird, werden in der allgemeinen Preisliste des Produkts angegeben. Eine eventuelle Anfrage eines Kostenvor- anschlags für Reparaturen kann nur für mittelgroße/große Getriebe und nach entsprechender Absprache mit der Technischen Kundendienstabteilung der STM SpA berücksichtigt werden.
Bei Rücksendungen von sich als nicht konform erwiesenem Material ist folgendes zu beachten:
1- Das Formular "Technischer Kundendienst - Kundenformular für Eingriffsanforderung" ausgefüllen und an die darauf angegebene Adresse senden.
2- Den Eingang der Bestätigung STM SpA per Fax abwarten.
3- Das Produkt portofrei (Transportkosten gehen zu Lasten des Absenders) unter Anlage der von der STM SpA bestätigten Formulars an die STM SpA senden.
Die STM SpA übernimmt keinerlei Haftung für Folgen im Sinne der Sicherheit und Funktionsfähigkeit des Systems, die auf einen den Angaben in diesem Handbuch nicht konform erfolgenden Einsatz zurückgeführt werden können.

0.2.2 GARANTIEBESCHRÄNKUNG
Die Garantie beschränkt sich ausschließlich auf den Austausch der defekten Komponente, nachdem in Folge einer Überprüfung eine effektive diesbezügliche Verantwortung unsererseits festgestellt wurde.
Die Produktgarantie verfällt jedoch in dem Moment, in dem Handhabungen, egal an welchem Teil oder welcher Komponente der Anlage, festgestellt werden.
Von der Garantie ausgeschlossen sind darüber hinaus Reparaturen, die in Folge von Schäden erforderlich sind, die durch Nachlässigkeit in der Instandhaltung oder unangemessene Applikationen verursacht wurden.
Alle für den Transport, Inspektion und Ausbauarbeiten entstehenden Kosten für den Eingriff einer unser Techniker gehen immer und vollständig zu Lasten des Kunden.
Für Streitigkeiten ist allein das Gericht in Bologna zuständig.

0. INFORMAZIONI GENERALI

0.3 AVVERTENZE GENERALITA' SULL'USO

Prima di procedere a qualunque manutenzione SI RACCOMANDA DI TOGLIERE TENSIONE perché all'interno ci sono parti in movimento pericolosi per l'operatore.

Seguire inoltre le seguenti disposizioni:

- Consentire al solo personale autorizzato d'intervenire sull'unità.
- NON AVVIARE L'UNITA' IN AVARIA
- Prima di usare l'unità accertarsi che qualsiasi condizione pericolosa per la sicurezza sia stata opportunamente eliminata.
- Accertarsi che tutte le protezioni siano al loro posto ed i dispositivi di sicurezza siano presenti ed efficienti.
- Fare in modo che nella zona dell'operatore non siano presenti oggetti estranei. Qualunque operazione di manutenzione deve avvenire con la macchina isolata dalle reti di distribuzione dell'energia (elettrica, pneumatica, idraulica od altro).
- Quando sussiste la possibilità d'essere colpiti dalle proiezioni o dalla caduta di parti solide o simili, usare gli occhiali con paraocchi laterali, elmetti o guanti se necessari.
- Quando si opera con materiale caldo può essere richiesto l'uso di guanti od altri mezzi di protezione individuale, per evitare scottature da contatto manuale.
- Anche se l'unità non è di per sé rumorosa, può essere richiesto l'uso di protezioni contro il rumore a causa del livello di pressione sonora dell'ambiente in cui la macchina è installata.

Valori indicativi massimi 75 (dB).

Le versioni dotate di limitatore di coppia sono esclusivamente NELLE categorie 3 G e 3D, ovvero livello di protezione EPL Gc e Dc, quindi non installabili in zone diverse dalla 2 / 22.

Le versioni dotate di sistema di ventilazione sono installabili soltanto in presenza di polveri combustibili del gruppo IIIB (non conduttive) (MAI IIIC) con la limitazione di evitare l'accumulo di strati superficiali sia sulla carteratura esterna che tra girante e parte fissa. Pertanto in queste condizioni è richiesta una speciale ispezione e pulizia in modo da avere sempre superfici prive di strati di polvere combustibile. Laddove l'utilizzatore non possa garantire il suddetto requisito, il prodotto dotato di sistema di ventilazione non è installabile.

0. GENERAL INFORMATION

0.3 WARNINGS - GENERAL NOTES ON THE CORRECT USE OF THE SYSTEM

Before proceeding to any maintenance operation IT IS RECOMMENDED TO CUT OFF POWER SUPPLY because inside the system are moving parts dangerous for the operator.

Please stick to these provisions:

- *Only allow authorised personnel to work on the machine.*
- *DO NOT START THE UNIT IF FAULTY*
- *Before starting the unit, ensure that any dangerous condition has been suitably eliminated.*
- *Ensure that all protections are in place and that safety devices are available and in efficient conditions.*
- *Ensure that there are no foreign objects in the operator's area.*
Cut off any machine (power, air, water or other) supply before performing any maintenance operation.
- *If there is the risk of being hit by solid particles (or else) falling or being projected, use goggles with side shields, helmets or gloves, if necessary.*
- *When working with hot material, it could be necessary to wear gloves or any other safety gear to avoid scalds.*
- *Though the unit is not noisy in itself, it could be necessary to wear noise-proof protections due to the noise level of the room where machine is installed.*

Maximum approximate value of 75 (dB).

The versions featuring a torque limiter are exclusively IN categories 3 G and 3D, namely with EPL Gc and Dc protection level, and cannot thus be installed in areas other than 2 / 22.

The versions featuring a ventilation system can be installed only in case of IIB group combustible dusts (non conductive) (NEVER IIIC) by limiting the build-up of superficial layers both on the external casing and between the impeller and the fixed part. Hence, these conditions require special inspection and cleaning in order to ensure that surfaces are always free from combustible dust. Should the user not be able to fulfil the above-mentioned requirement, the product featuring a ventilation system cannot be installed.

0. ALLGEMEINE INFORMATIONEN

0.3 ALLGEMEINE EINSATZHINWEISE

Vor Beginn irgendwelcher Instandhaltungs-eingriffe MUSS DIE SPANNUNGS-VERSORGUNG UNTERBROCHEN WERDEN, da sich im Innenbereich für den Bediener gefährliche Teile in Bewegung befinden.
Sich darüber hinaus an folgende Anweisungen halten:

- Eingriffe an der Einheit dürfen nur dem befugten Personal erlaubt werden.
- NIE EINE SICH IM STÖRUNGSZUSTAND BEFINDLICHE EINHEIT EINSCHALTEN
- Vor Einsatz der Einheit muss man sich darüber vergewissern, dass jegliche, die Sicherheit gefährdende Bedingung in angemessener Weise beseitigt wurde.
- Sicherstellen, dass alle Schutzvorrichtungen sich an ihrem Platz befinden und dass die Sicherheitsvorrichtungen vorhanden und wirksam sind.
- Dafür sorgen, dass im Bedienerbereich keine Fremdkörper vorhanden sind. Jeglicher Instandhaltungseingriff muss an einer von den Energieversorgungsnetzen (Strom, Druckluft, Hydraulik oder anderweitige) getrennten Maschine erfolgen.
- Sollte die Möglichkeit bestehen, von herausgeschleuderten oder herunterfallenden Festkörpern oder ähnlichem getroffen werden zu können, müssen ggf. eine Brille mit seitlichem Schutz, ein Helm oder Handschuhe getragen werden.
- Bei Umgang mit heißem Material kann sich im Hinblick auf ein Verhindern von Handver-brennungen das Anlegen von Schutzhandschuhen oder anderen persönlichen Schutzkleidungsstücken als erforderlich erweisen.
- Auch wenn die Einheit sich nicht als besonders laut erweist, kann sich das Anlegen eines Ohrenschutzes gegen den im Umfeld der Maschine vorliegenden Schalldruck als erforderlich erweisen.

Max. Anhaltswerte 75 (dB).

Die mit Drehmomentbegrenzer ausgestatteten Versionen sind ausschließlich in den Kategorien 3 G und 3D, d. h. mit Schutzstufe EPL Gc und Dc erhältlich und dürfen daher nicht in anderen Bereichen als 2 / 22 installiert werden.

Die mit einem Lüftungssystem ausgestatteten Versionen können nur bei Vorhandensein von brennbaren Stäuben der Gruppe IIIB (nicht leitfähig) (NIE IIIC) installiert werden, dies mit der Einschränkung, dass die Ansammlung von Oberflächenschichten sowohl am Außengehäuse als auch zwischen dem Laufrad und dem festen Teil vermieden wird. Unter diesen Bedingungen ist daher eine spezielle Inspektion und Reinigung erforderlich, um stets von Schichten aus brennbarem Staub freie Oberflächen zu haben. Ist der Benutzer nicht in der Lage, die oben genannte Anforderung zu gewährleisten, kann das mit einer Lüftungsanlage ausgestattete Produkt nicht installiert werden.

0. INFORMAZIONI GENERALI

0.4 SPECIFICHE PRODOTTI
0.4.1 SPECIFICHE PRODOTTI NON "ATEX"

I riduttori della STM SpA sono organi meccanici destinati all'uso industriale e all'incorporazione in apparecchiature meccaniche più complesse. Dunque non vanno considerati macchine indipendente per una predeterminata applicazione ai sensi 2006/42/CE, né tantomeno dispositivi di sicurezza.

0. GENERAL INFORMATION

0.4 PRODUCT SPECIFICATIONS
0.4.1 SPECIFICATIONS OF NON-"ATEX" PRODUCTS

STM SpA gearboxes are mechanical devices for industrial use and incorporation in more complex machines. Consequently, they should not be considered neither self-standing machines for a pre-determined application according to 2006/42/CE nor safety devices.

0. ALLGEMEINE INFORMATIONEN

0.4 PRODUKTSPEZIFIKATIONEN
0.4.1 SPEZIFIKATIONEN FÜR PRODUKTE, DIE NICHT DER "ATEX"-NORM ENTSPRECHEN

Bei den Getrieben der STM SpA handelt es sich um Mechanikorgane, die für den industriellen Einsatz und einen Einbau in komplexere Einrichtungen bestimmt sind. Sie werden deshalb weder unter dem Aspekt unabhängiger, für eine bestimmte Anwendung vorgesehener Maschinen im Sinne der 2006/42/CE, noch als Sicherheitsvorrichtungen berück- sichtigt.

0.4.2 SPECIFICHE PRODOTTI "ATEX"

0.4.2.1 Campo applicabilità

La direttiva ATEX (2014/34/UE) si applica a prodotti elettrici e non elettrici destinati a essere introdotti e svolgere la loro funzione in atmosfera potenzialmente esplosiva. Le atmosfere potenzialmente esplosive vengono suddivise in gruppi e zone a seconda della probabilità di formazione. I prodotti STM sono Conformi alla seguente classificazione:

0.4.2 SPECIFICATIONS OF ATEX PRODUCTS

0.4.2.1Application field

ATEX set of provisions (2014/34/UE) is referred to electric and non-electric products which are used and run in a potentially explosive environment. The potentially explosive environments are divided into different groups and zones according to the probability of their formation. STM products are in conformity with following classification:

0.4.2 SPEZIFIKATIONEN FÜR "ATEX"-PRODUKTE

0.4.2.1 Anwendungsbereich

Die ATEX-Richtlinie (2014/34/UE) wird bei elektrischen und nicht elektrischen Produkten angewendet, die dazu bestimmt sind, in potentiell explosionsfähigen Atmosphären eingesetzt und betrieben zu werden. Die potentiell explosionsfähigen Atmosphären werden in Abhängigkeit der Wahrscheinlichkeit in Gruppen und Zonen unterteilt. Die STM-Produkte entsprechen der folgenden Klassifizierung:

Type Mark - standard

Designation Type Mark	Material	Symbol Mark	Group	Category	Symbol Protection	Group Dangerous material	Temperature	Protection level EPL	Use limitation
Gb-4	GAS		II	2G	Exh	IIC	T4	Gb	-
Gb-5							T5*		
Gc-4			II	3G	Exh	IIC	T4	Gc	-
Gc-5							T5*		
Db-4	DUST		II	2D	Exh	IIIC	135 °C	Db	-
Db-5				2D			100 °C*		
Dc-4			II	3D	Exh	IIIC	135 °C	Dc	-
Dc-5							100 °C*		

(1) Classe di temperatura ATEX ottenibile a richiesta / *ATEX temperature class on request* / Auf Anfrage erhältliche ATEX-Temperaturklasse

Type Mark - with limitation

Limitation		Material	Designation Type Mark	Category	Group dangerous material	NOTE
Products Versions	*Versions with brake Z0-Z1-Z2-Z3*	—	—	—	—	All versions are excluded from certification
	Versions with compact motor **WM** 	—	—	—	—	
	WI-WMI 	GAS DUST	Gc-4 - Gc-5 Dc-4 - Dc-5	3G 3D	Standard	—
Accessory Option	**Torque limiter type: LP-LC.LF** Product R-CR-C	GAS DUST	Gc-4-x - Gc-5-x Dc-4-x - Dc-5-x	3G 3D		with limitation Use x
	Ventilation system And/Or Painting type: TYP3 - TYP4 *	GAS GAS	b_Gb-4 - b_Gb-5 b_Gc-4 - b_Gc-5	Standard	IIB	*For other type painting:Type Mark is Standard On request in available painting type for IIC: TYP3C & TYP4C
	Ventilation system	DUST DUST	b_Db-4-x - b_Db-5-x b_Dc-4-x - b_Dc-5-x		IIIB	with limitation Use x

0. INFORMAZIONI GENERALI

Nel caso di classe di temperatura T5 occorre verificare la potenza limite termico declassata (rif. normativa interna NORM_0198, visionabile sul sito web: www.stmspa.com).

I prodotti del gruppo IID (atmosfera polverosa) vengono definiti dalla massima temperatura di superficie effettiva.

La massima temperatura di superficie è determinata in normali condizioni di installazione e ambientali (–20°C e +40°C) e senza depositi di polvere sugli apparecchi.
Qualunque scostamento da queste condizioni di riferimento può influenzare notevolmente lo smaltimento del calore e quindi la temperatura.

0.4.2.2 Specifiche di sicurezza
1-tappi sfiato (ove previsti) con valvola anti-intrusione
2-assenza di superfici o parti di materiale plastico in grado di accumulare cariche elettrostatiche
3-applicazione di termometri termosensibili di tipo irreversibile
4-per installazioni in atmosfere polverose (zona 2D, Z21, Z22) il committente deve prevedere uno specifico piano di pulizia periodica delle superfici allo scopo di evitare significativi depositi (spessore max 5mm) di materiale o polvere sull'involucro del riduttore.

0.4.2.3 Limiti e condizioni di impiego

Modifiche apportate alla forma costruttiva e/o qualunque intervento (es. smontaggio, riparazione, ecc) apportato al riduttore, non preventivamente autorizzate da STM S.p.A. comportano la decadenza delle condizioni di conformità del prodotto alla direttiva ATEX 2014/34/UE .

0.5 SMALTIMENTI - IMPATTO AMBIENTALE
Particolare attenzione si deve riporre nel recupero o smaltimento dei prodotti e sottoprodotti inerenti all'uso del riduttore.

Tali precauzioni, più precisamente, riguardano:

- Lo smaltimento dell'imballaggio;
- Lo smaltimento del lubrificante e il recupero delle protezioni in plastica;
- La rottamazione del prodotto.

Occorre smaltire tali oggetti secondo le locali disposizioni di legge.
Il rifiuto di tipo urbano può essere smaltito nei cassonetti dei rifiuti o attraverso una raccolta differenziata (es. materiali di imballo).
Il rifiuto di tipo speciale deve invece essere smaltito secondo le locali disposizioni di legge. Indicativamente, rientrano in codesta fattispecie le parti del riduttore e i lubrificanti.

Prima di rottamare il riduttore occorre svuotarlo del lubrificante, tenendo presente che l'olio esausto ha un forte impatto ambientale.
Agli effetti dello smaltimento del prodotto, si considerino i seguenti materiali e sostanze contenute: ghisa, ferro (Fe), alluminio (Al), bronzo, lubrificante, gomma, plastica.

0. GENERAL INFORMATION

In case of T5 temperature class it will be necessary to verify the declassed thermal limit power (refer to internal standard NORM_0198, available on the web site: www.stmspa.com).

The products of the family IID (dust environment) are defined by the max effective surface temperature.

Max surface temperature is determined in standard installation and environmental conditions (-20°C and +40°C) and in absence of dust on product surface.
Any other condition will modify the heat dissipation and consequently the temperature..

0.4.2.2 Safety specifications
1- breather plugs (if supplied) must have a safety valve
2- absence of plastic based surfaces or material potentially attracting electrostatic charge
3- application of irreversible thermosensitive thermometers
4- for installations in dusty environments (zone 2D, Z21, Z22) the client must necessarily arrange for a regular surface cleaning plan intended to prevent significant material/dust deposit (max thickness allowed 5mm) on the gearbox housing.

0.4.2.3 Limitations and use conditions

Any modification on the gearbox mounting position or execution as well as any intervention (i.e. disassembly, repair, etc.) not previously authorized by STM S.p.A. will cancel the product conformity conditions to ATEX set of provisions 2014/34/UE.

0.5 DISPOSAL – ENVIRONMENT PROTECTION
Special attention must be paid to collection and disposal/recycling of all products and components related to the gearbox.

More in detail, such precautions deal with:

- *package recycling*
- *lubricant and plastic wrapping recycling*
- *product disposal.*

Dispose of above mentioned products according to the local prevailing law.
The standard type of waste can be put into appropriate waste containers for recycling (e.g. packaging) whereas special waste (such as gearbox parts and lubricants) must be disposed of according to the law prescriptions.

Before disposing of the gearbox, the lubricant must be drained out, keeping in mind that dirty oil is highly polluting.
As far as product disposal is concerned, please consider the following materials and elements contained: cast iron, iron (Fe), aluminium (Al), bronze, lubricant, rubber, plastic.

0. ALLGEMEINE INFORMATIONEN

Bei der Temperaturklasse T5 muss die deklassierte thermische Grenzleistung überprüft werden (Bezug auf firmeninterne NORM_0198, abrufbar aus der Website: www.stmspa.com.

Die der Gruppe IID (Atmosphäre mit staubförmiger Belastung) angehörigen Produkte werden ihrer effektiven maximalen Oberflächentemperatur gemäß definiert.
Die maximale Oberflächentemperatur wird in normalen Einbau- und Umgebungsbedingungen (-20°C und +40°C) und ohne auf den Vorrichtungen vorhandenen Staubablagerungen bestimmt.
Jegliche Abweichung von diesen Bezugsbedingungen kann sich erheblich auf die Wärmeableitung bzw. auf die Betriebstemperatur auswirken

0.4.2.2 Sicherheitsbestimmungen
1- Entlüftungsstopfen (wo vorhanden) mit Schutzventil gegen Eindringen von Fremdkörpern
2- Keine Oberflächen oder Teile aus Kunststoffen, die elektrostatische Ladungen speichern können
3- Applikation von irreversiblen Thermometern mit Wärmefühler.
4- Bei einer Installation in Atmosphären mit staubförmiger Belastung (Zone 2D, Z21, Z22) muss der Auftraggeber eine spezifischen Plan für die regelmäßige Oberflächenreinigung mit dem Ziel erstellen, dass bedeutende Material- oder Staubablagerungen (max. Stärke 5 mm) auf dem Getriebegehäuse vermieden werden.

0.4.2.3 Einsatzbedingungen und -einschränkungen
An der Bauform des Getriebes angebrachte Änderungen und/oder jegliche daran erfolgte Eingriffe (z.B. Auseinanderbau, Reparatur, usw.), die ohne eine vorausgehende Genehmigung der STM S.p.A. erfolgt sind, führen zum Verfall der Produktkonformität im Sinne der Richtlinie ATEX 2014/34/UE.

0.5 ENTSORGUNG - UMWELTBELASTUNG
Besonderes Aufmerksamkeit muss bei der Rückgewinnung oder der Entsorgung der mit dem Einsatz des Getriebes verbundenen Produkten und Unterprodukten geübt werden.

Diese Vorsichtsmaßnahmen betreffen insbesondere:
- die Verpackungsentsorgung;
- die Entsorgung des Schmiermittels und die Wiederverwertung der Kunststoffabdeckungen;
- die Verschrottung des Produkts.

Diese Materialien müssen den örtlichen Gesetzen gemäß entsorgt werden.
Der normale Stadtmüll kann in Mülltonnen oder mittels differenzierter Sammlung (Trennmüll) entsorgt werden (z.B. Verpackungsmaterial).
Der Sondermüll muss hingegen den gesetzlichen Vorschriften gemäß entsorgt werden. Unter diesen Mülltyp fallen insbesondere die Getriebeteile und die Schmiermittel.

Bevor das Getriebe verschrottet wird, muss das sich darin befindliche Schmiermittel abgelassen werden. Dabei ist zu berücksichtigen, dass das Altöl eine starke Umweltbelastung darstellt.
Unter das Argument der Produktentsorgung fallen folgende Materialien und enthaltene Stoffe: Gusseisen, Eisen (Fe), Aluminium (Al), Bronze, Schmiermittel, Gummi, Kunststoff.

0. INFORMAZIONI GENERALI

0.6 Direttive UE- marcatura CE- ISO9001

Direttiva Bassa Tensione 2014/35/UE
I motoriduttori, motorinvii angolari, motovariatori e i motori elettrici STM sono conformi alle prescrizioni della direttiva Bassa Tensione .

2014/30/UE Compatibilità elettromagnetica
I motoriduttori, motoriviiangolari, motovariatori e i motori elettrici STM sono conformi alle specifiche della direttiva di Compatibilità Elettromagnetica.

Direttiva Macchine 2006/42/CE
I motoriduttori, motoriviiangolari, motovariatori e i motori elettrici STM non sono macchine ma organi da installare o assemblare nelle macchine.

Marchio CE, dichiarazione del fabbricante e dichiarazione di conformità.

I motoriduttori, motovariatori e i motori elet- trici hanno il marchio CE.
Questo marchio indica la loro conformità alla direttiva Bassa Tensione e alla direttiva Compatibilità Elettromagnetica.
Su richiesta, STM può fornire la dichiarazione di conformità dei prodotti e la dichiarazione del fabbricante secondo la direttiva macchine.

ISO 9001
I prodotti STM sono realizzati all'interno di un sistema di qualità conforme allo standard ISO 9001. A tal fine su richiesta è possibile rilasciare copia del certificato.

0. GENERAL INFORMATION

0.6 UE Directives-CE mark-ISO 9001

Directive 2014/35/UE Low VoltageSTM
geared motors, right angle drives with motor, motovariators and electric motors meet the specification of the low voltage directive.

2014/30/UE *Electromagnetic Compatibility*
STM geared motors, right angle drives with motor, motovariators and electric motors correspond to the specifications of the EMC directive.

Machinery Directive 2006/42/CE
STM geared motors, right angle drives with motor, motovariators and electric motors are not standalone machines, they are exclusively for installation into a machine or for assembly on a machine.

CE Mark, Conformity Declarations and Manufacturer's Declaration.
STM geared motors, right angle drives with motor, motovariators and electric motors carry the CE Mark.
It indicates conformity to the low voltage directive and to electromagnetic compatibility directive.
On request STM supplies both the conformity declarations and the manufacturer's declaration according to the machine directive.

ISO 9001
STM products have been designed and manufactured according to ISO 9001 quality system standard.
On request a copy of the certification can be issued.

0. ALLGEMEINE INFORMATIONEN

0.6 UE-Richtlinien - CE-Zeichen ISO9001

Niederspannungsrichtlinie. 2014/35/UE
Die Getriebemotoren, Winkelgetriebe, Verstellgetriebe und Elektromotoren der STM entsprechen den Vorschriften der Niederspannungsrichtlinie.

2014/30/UE Elektromagnetische Verträglichkeit
Die Getriebemotoren, Winkelgetriebe, Verstellgetriebe und Elektromotoren der STM entsprechen den Vorschriften der Richtlinie zur Elektromagnetischen Verträglichkeit.

Maschinenrichtlinie 2006/42/CE
Die Getriebemotoren, Winkelgetriebe, Verstellgetriebe und Elektromotoren der STM sind keine Maschinen sondern Organe, die in Maschinen eingebaut oder an diesen montiert werden.

CE-Zeichen, Hersteller- und Konformitäts-erklärung
Die Getriebemotoren, Verstellgetriebe und Elektromotoren tragen das CE-Zeichen.

Dieses Zeichen weist auf ihre Konformität mit der Niederspannungsrichtlinie und der Richtlinie zur Elektromagnetischen Verträglichkeit hin.
Auf Anfrage kann die STM die Konformitätserklärung und die Hersteller-erklärung gemäß Maschinenrichtlinie zu den Produkten liefern.

ISO 9001
Die STM-Produkte werden in einem Qualitätssystem gemäß dem Standard ISO 9001 realisiert. Auf Anfrage kann daher eine Kopie der Zertifizierung geliefert werden.

1. NORME DI SICUREZZA

I riduttori vengono progettati, costruiti e commercializzati avvalendosi di tutte le conoscenze tecnologiche e scientifiche attualmente a disposizione. Nell'ottica di un naturale sviluppo delle conoscenze il costruttore si riserva il diritto di modificare componenti al fine di migliorarne efficienza e sicurezza. Non dovranno essere apportate modifiche da parte dell'utilizzatore che ne diminuiscano l'affidabilità variando le condizioni applicative e funzionali di contratto.

I riduttori non devono essere posti in servizio prima che la macchina in cui saranno incorporati sia stata dichiarata conforme alle disposizioni della Direttiva Macchine 2006/42/CE e successivi aggiornamenti.

Il costruttore della macchina deve inglobare le informazioni contenute nel presente manuale con quelle relative alla propria macchina. Prima di effettuare interventi occorre che il riduttore sia fermo e che siano presi tutti i provvedimenti necessari affinché non si abbiano accidentali avviamenti. Occorre prevedere una protezione delle parti rotanti (es.giunti) onde prevenire contatti accidentali.

In presenza di variazioni anomale di temperatura e/o rumorosità, non motivate da variazioni applicative, il riduttore deve essere fermato ed ispezionato per prevenire danneggiamenti più gravi.
Tutte le normative vigenti in termini di inquinamento ambientale, prevenzione e sicurezza devono essere rispettate.

STM SpA dichiara la conformità alla direttiva ATEX 2014/34/UE del solo riduttore. Per quanto attiene il suo utilizzo e incorporazione in un insieme, rimane a cura dell'assemblatore:

1- Verificare che i componenti annessi al riduttore siano normativamente adeguati;
2- Svolgere l'analisi dei rischi insorgenti dal collegamento a un motore.

Dare corso a tutte le prescrizioni contenute nel presente manuale (in caso contrario decadono le condizioni di validità della certificazione di conformità del prodotto fornita da STM SpA).

Prima di iniziare qualunque attività su riduttori operanti in ambiente con possibile presenza di atmosfera esplosiva, occorre:

1- Sospendere al riduttore l'alimentazione di energia, ponendolo in regime di «fuori servizio»
2- Accertarsi che non vi siano condizioni di instabilità dell'applicazione tali da geneare un avvio involontario o moto inaspettato degli organi meccanici.

Attuare tutte le misure di sicurezza ambientali necessarie per garantire la sicurezza dell'operatore (bonifica da gas e vapori, pulitura da polveri depositate, assenza di sorgenti esterne di innesco, &c.)

1. SAFETY RULES

Our gear units are designed, manufactured and distributed following the technological and scientific knowledge available.
In the light of future development of knowledge we reserve the right to introduce modifications to the components in order to further improve efficiency and safety.
Unauthorized modifications which may decrease reliability by changing the application conditions specified in the contract, are not allowed.

The gear units must not be put into operation until the machine in which they are to be embodied has been declared to be in conformity with the Machinery Directive 2006/42/CE and subs. rev.

The machine constructor has to complete the information concerning his machine with that contained in this manual. Before any intervention, the gear unit should be stopped and all necessary precautions should be taken to prevent the accidental start-up. A protection for moving parts (eg.: couplings), should be provided in order to avoid any possible accidental contact.

If strange changes in the temperature and/or noise are detected while running the gear unit and are not due to application variations, the gear unit should be stopped and checked to prevent more serious damages.
All regulations in force concerning environment pollution, caution and safety must be respected.

STM SpA herewith states conformity with ATEX 2014/34/UE provisions only for the gearbox. As far as its usage and incorporation in a more complex machinery is concerned, this will have to be eventually provided by the installer:

1- Always verify that components connected to the gearbox are appropriate and comply with the relevant provisions;
2-Develop the analysis of the potential risks relating to connection with a motor.

Comply with all provisions specified in this booklet (if not, the conditions of validity of the product conformity certification supplied by STM SpA will be null and void).

Before starting up any activity on gearboxes operating in potentially explosive environments you need to:

1-Disconnect the gearbox from any power source by setting it in '' out of service '' condition.
2-Make sure that an unintentional start-up or motion of the application will not take place in any case.

Carry out all the environmental safety precautions to grant the safety of the operator (degassing, dust cleaning, make sure of the absence of external elements that could trigger a fire).

1. SICHERHEITSVORSCHRIFTEN

Die Getriebe werden unter Anwendung der momentan zur Verfügung stehenden technologischen und wissenschaftlichen Kenntnisse entworfen, hergestellt und gehandelt. Im Sinne einer natürlichen Entwicklung dieser Kenntnisse behält sich der Hersteller das Recht vor, die Komponenten im Hinblick auf die Verbesserung der Leistungsfähigkeit und Sicherheit ändern zu können. Der Benutzer darf keine Änderungen vornehmen, die zu einer Minderung der Zuverlässigkeit führen und damit eine Veränderung der Anwendungs- und Funktionsbedingungen zur Folge haben.
Die Getriebe dürfen nicht in Betrieb gesetzt werden, bevor die Maschine, in die sie eingebaut werden sollen, den Voraussetzungen der Maschinenrichtlinie 2006/42/CE und späteren Aktualisierungen als konform erklärt wurde.
Der Hersteller der Maschine muss die in diesem Handbuch enthaltenen Informationen in die seine Maschine betreffenden einbeziehen. Vor dem Beginn von Eingriffen muss das Getriebe zum Stillstand gebracht werden. Darüber hinaus müssen alle Vorkehrungen getroffen werden, die erforderlich sind, dass es nicht zufällig wieder eingeschaltet werden kann. Die sich im Umdrehung befindlichen Teile (z.B. Kupplungen) müssen mit Schutzabdeckungen versehen werden, um einen zufälligen Kontakt zu vermeiden.
Sollte es zu anormalen Temperatur-schwankungen und/oder abweichenden Geräuschen kommen, die nicht durch Änderungen der Anwendung begründbar sind, muss das Getriebe gestoppt und geprüft werden, um schwerere Schäden zu vermeiden.
Alle im Sinne der Umweltbelastung, der Unfallvorsorge und Sicherheit gültigen Richtlinien müssen eingehalten werden.

STM SpA erklärt ausschließlich für das Getriebe die Konformität mit der Richtlinie ATEX 2014/34/UE. Was seinen Einsatz und sein Einfügen in eine Gesamtheit anbelangt, unterliegen dem Monteur folgende Aufgaben:

1- Überprüfen, dass die mit dem Getriebe verbundenen Komponenten den Bestimmungen gemäß geeignet sind.
2- Erstellen einer Analyse der aus dem Anschluss an einen Motor resultierenden Gefahren.
Umsetzung der in diesem Handbuch enthaltenen Vorschriften (andernfalls kommt es zum Verfall der Gültigkeitsbedingungen der von STM SpA gelieferten Konformitäts-bescheinigung).

Vor Beginn jeglicher Tätigkeit an Getrieben, die in Umgebungen eingesetzt werden, in denen die Möglichkeit einer explosionsfähigen Atmosphäre besteht, muss:
1- die Energieversorgung des Getriebes unterbrochen werden, indem man es im den Zustand "Außer Betrieb" versetzt;
2- sichergestellt werden, dass die Applikation keine Instabilität aufweist, die zu einem versehentlichen Anlauf oder einer Bewegung der mechanischen Organe führen könnten.
Alle Sicherheitsmaßnahmen für die Umgebung umsetzen, die zur Gewährleistung der Bedienersicherheit erforderlich sind (Abgas- und Dampfabzug, Beseitigung der Staubablagerungen, keine externen Auslösequellen, usw.)

2.IDENTIFICAZIONE

2.0 IDENTIFICAZIONE PRODOTTO

Le istruzioni di carattere generale riportate nel seguente manualle sono valide per tutti i riduttori riportati nella tabella seguente.
Nella tabella seguente sono indicati anche i riferimenti specifici dei prodotti/documentazione tecnica disponibile.

2. IDENTIFICATION

2.0 PRODUCT IDENTIFICATION

The general instructions given in this booklet apply to all gearboxes included in the following table.
The table below also makes specific reference to available products/technical literature.

2. KENNZEICHNUNG

2.0 PRODUKTIDENTIFIZIERUNG

Die in diesem Handbuch gegebenen Anleitungen mit allgemeinem Charakter treffen für alle Getriebe aus der nachstehenden Tabelle zu.
In dieser Tabelle werden auch die spezifischen Produktbezüge/verfügbaren Technischen Unterlagen angegeben.

Prodotto ***Product*** **Produkt**	**Descrizione Prodotto** ***Product Description*** **Produktbeschreibung**	**Lineaa Prodotto** ***Product Line/*** **Produkt-linie**	**Linea Mercato** ***Market Line*** **Markt**	**CatalogoTecnico/*Technical Catalogue*/Technischer Katalog Designazione/*Description*/ Bezeichnung DatiTecnici/*Specifications*/ TechnischeDaten Dimensioni/*Dimensions* / Baugrößen** *URL:www.stmspa.com* **Codice *Part number* Art.-Nr.**	**Sezione *Section* Abschnitt**	**Note/ *Notes/* Notizen**
A/1  A	RIDUTTORI COASSIALI *IN-LINE GEARBOXES* STIRNRADGETRIEBE	HIGH TECH LINE	Industrial	CT 17 I GB D CT 17 F E P	Sezione *Section* Abschnit B	
O 	RIDUTTORI-MOTORIDUTTORI ORTOGONALI *HELICAL BEVEL GEARBOXES AND GEARED MOTORS* KEGELRADGETRIEBE UND -GETRIEBEMOTOREN				Sezione *Section* Abschnit C	
S 	RIDUTTORI-MOTORIDUTTORI ORTOGONALI AD ASSI SGHEMBI *BEVEL HELICAL GEARBOXES WITH SKEW AXIS* SCHRÄGSTIRNRADGETRIEBE/-MOTOREN				Sezione *Section* Abschnit D	
P 	RIDUTTORI - MOTORIDUTTORI PARALLELI *PARALLEL SHAFT GEARBOXES AND GEARED MOTORS* FLACHGETRIEBE/-GETRIEBEMOTOREN				Sezione *Section* Abschnit E	
PL 					Sezione *Section* Abschnit F	
PT 	*RIDUTTORI - MOTORIDUTTORI PARALLELI* *PARALLEL SHAFT GEARBOXES AND GEARED MOTORS* FLACHGETRIEBE/-GETRIEBEMOTOREN				Sezione *Section* Abschnit G	
R 	RIDUTTORI A VITE SENZAFINE *WORM GEARBOXES* SCHNECKENGETRIEBE	STANDARD LINE	Basic	CT 16 I GB D CT 16 F E P	Sezione *Section* Abschnit B	
CR 					Sezione *Section* Abschnit B	
C 					Sezione *Section* Abschni B	
U W 	RIDUTTORI UNIVERSALI AVITE SENZA FINE *UNIVERSAL WORM GEARBOXES* UNIVERSAL-SCHNECKENGETRIEBE				Sezione *Section* Abschnit C-D	
Z 	RINVII ANGOLARI *RIGHT ANGLE DRIVES* WINKELGETRIEBE		Automation		Sezione *Section* Abschnit E	
ZL 	RINVII ANGOLARI *RIGHT ANGLE DRIVES* WINKELGETRIEBE		Basic		Sezione *Section* Abschnit F	
WM 	VARIATORI MECCANICI *MECHANICAL VARIATORS* MECHANISCHEN VERSTELLGETRIEBE				Sezione *Section* Abschnit H	
	Posizioni di montaggio *Mounting positions* Elinbaulagen				Sezione *Section* Abschnit Z	
	RIDUTTORI A DISEGNO CLIENTE *GEARBOXES TO CUSTOMER SPECS* GETRIEBE NACH KUNDENZEICHNUNG			SPECIALI NON A CATALOGO *SPECIAL UNITS NOT IN CATALOGUE* SPEZIALGETRIEBE NICHT IM KATALOG		

2.IDENTIFICAZIONE

2.1 TARGHETTA
La targhetta contiene le principali informazioni tecniche relative alle caratteristiche funzionali e costruttive ne definisce i limiti applicativi contrattuali; deve perciò essere mantenuta integra e visibile.

Qualora la targa si deteriori e/o non sia più leggibile, anche in un solo degli elementi informativi riportati, si raccomanda di richiederne un'altra al costruttore, citando i dati contenuti nel presente manuale, e provvedere alla sua sostituzione.

Tipo: identificazione riduttore
M: Posizione di montaggio
Rapporto: rapporto trasmissione
Data: data produzione
Codice: codice prodotto
OL/WO: Work order

STM RIDUTTORI	S.T.M. BOLOGNA Made in Italy
Tipo Type M	
OL WO	Data Date
Cod. Code	Rapp. Ratio

Tipo/Type	M
Rapp./Ratio	Data/Date
Cod./Code	OL/WO
S.T.M.	BOLOGNA Made in Italy

2.2 TARGHETTA ATEX

Nel caso in cui i prodotti forniti siano certificati secondo la Direttiva ATEX è fornita una ulteriore targhetta nella quale sono riportate le seguenti informazioni.

OL/WO: Work order
ATEX: Gruppo, categoria, classe di temperature o temperature superficiale massimae
P1: Potenza massima applicabile
N1: numero giri Massimo in ingresso
FT_ATEX_REV_: Riferimento documentazione interna "ATEX".

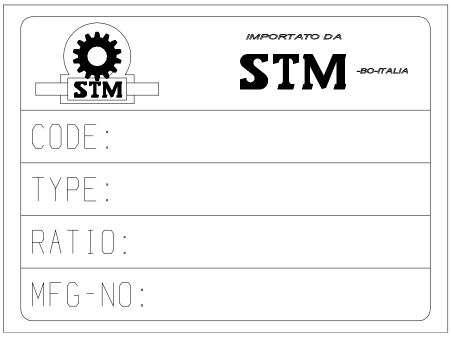
Marcatura CE
1-Limiti ambientali: temp. ambiente compresa tra –20 °C e +40°C
2-Temperatura superficiale massima: T4 per 2G e 135°C per 2D.
È possibile, a richiesta e previa verifica potenza applicabile declassata, la certificazione per la classe di temperatura T5 per 2G e 100°C per 2D

2. IDENTIFICATION

2.1 IDENTIFICATION PLATE
The identification plate features main technical details concerning its operation and construction and sets its intended application; it is thus very important to keep it in good condition and in a visible place.

Should the identification plate wear and/or become damaged so as to affect its readability or that of even one of the items of information thereon, the User must request a new nameplate from the Manufacturer, quoting the information given in this manual, and replace the old one.

Type: gearbox description
M: mounting position
Ratio: reduction ratio
Date: production date
Code: product code
OL/WO: Work order number



2.2 ATEX IDENTIFICATION PLATE

If the supplied products are certified according to ATEX Directive, a further nameplate is supplied containing the following information.

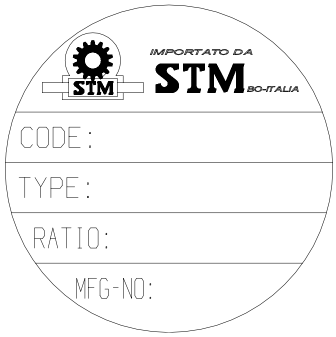
OL/WO: Work order number
ATEX: Family, type, temperature class or max surface temperature
P1: max input power allowance
N1: max input speed allowance
FT_ATEX_REV_: Reference to " ATEX " internal paperwork

CE marking
1-Environmental limits: environmental temperature between –20°C and + 40°C
2-Max surface temperature allowed: T4 for 2G and 135°C for 2D.
It is possible, upon request and verification of the declassed allowed power, to certify the temperature class T5 for 2G and 100°C for 2D.

2. KENNZEICHNUNG

2.1 TYPENSCHILD
Auf dem Schild werden die wesentlichen technischen Informationen zur den Betriebs- und Konstruktionseigenschaften gegeben, durch die die vertraglichen Anwendungsgrenzen definiert werden. Es muss daher immer leserlich und unbeschädigt sein.
Sollte sich das Schild als verschlissen erweisen und/oder die darauf angegebenen Daten, auch nur einer Information, nicht mehr leserlich sein, sollte beim Hersteller unter Angabe der in diesem Handbuch enthaltenen Daten ein neues Schild angefordert und für seinen Austausch gesorgt werden.

Typ: Getriebebezeichnung
M: Einbaulage
Übersetzung: Übersetzungsverhältnis
Datum: Produktionsdatum
Code: Artikelnummer
OL/WO: Work order



2.2 "ATEX"-TYPENSCHILD

Sollte es sich bei den gelieferten Produkten um der ATEX-Richtlinie gemäß zertifizierte Produkte handeln, wird ein weiteres Typenschild geliefert, auf dem folgende Informationen gegeben werden.

OL/WO: Work order
ATEX: Gruppe, Kategorie, Temperaturklasse oder maximale Oberflächentemperatur
P1: Max. applizierbare Leistung
N1: Max. Antriebsdrehzahl
FT_ATEX_REV_: Bezug auf firmeninterne "ATEX"-Unterlagen.

CE-Kennzeichnung
1 - Umgebungsgrenzwerte: Umgebungstemp. zwischen –20 °C und +40°C
2- Max. Oberflächentemperatur: T4 für 2G und 135°C für 2D.
Auf entsprechende Anfrage und nach Prüfung der deklassifizierten applizierbaren Leistung, kann eine Zertifizierung für die Temperarturklasse T5 für 2G und 100°C für 2D gegeben werden.

OL/WO	
CE Ex	
P1	N1
FT_ATEX_REV_	
S.T.M.	BOLOGNA Made in Italy

3. STATO DI FORNITURA

3.1 Verniciatura e protezione
I riduttori sono verniciati esternamente con smalto a polvere termoindurente blu RAL 5010, salvo disposizioni contrattuali diverse

La protezione è idonea a resistere a normali ambienti industriali anche esterni, e a consentire finiture ulteriori con vernici sintetiche.
Per maggiori informazioni relative allo stato di fornitura vedere la tabella seguente

3.1.1 Caratteristiche della Vernice

Le caratteristiche della vernice utilizzata sono le seguenti: polvere termoindurente a base di resine poliesteri, modificate con resine epossiidiche.
A richiesta è possibile fornire:
1-Ciclo di verniciatura;
2-Le caratteristiche di spessore, durezza, resistenza alla corrosione;
3-Scheda tecnica della Polvere utilizzata.

Nel caso si prevedano condizioni ambientali particolarmente aggressive occorre adottare prodotti adeguati appositi con opportuno ciclo di verniciatura. In questi casi si suggerisce di concordare il ciclo in fase di ordine.
TYP0-TYP1-TYP2-TYP3-TYP4.

ATTENZIONE
In caso di verniciatura o asportazione del prodotto antiruggine si chiede di porre attenzione alla preventiva protezione:
- Delle superfici lavorate, al fine di evitare che una eventuale verniciatura delle stesse pregiudichi il successivo accoppiamento.
-Delle tenute e più in generale di ogni parte plastica e di gomma, al fine di non variarne le caratteristiche chimico fisiche pregiudicandone così l'efficienza.
-Alla targa di identificazione per evitare la perdita di tracciabilità.
-Al tappo sfiato ed al tappo di livello olio, al fine di evitarne l'occlusione.

3. SCOPE OF THE SUPPLY

3.1 Painting and protection
The gearboxes are painted on surface with powder thermosetting blue RAL 5010 top coating, if there are not different agreements.

The protection is suitable to stand normal industrial environments, also outdoors, and allows additional synthetic paint finishes.
For further details about the supply conditions, please refer to the following table

3.1.1 Paint features

The features of the paint used are the following: thermosetting powder-coating based on polyesther resins, modified with epoxy resins.
On request , we can supply:
1-Painting cycle specs;
2-Specifications for thickness, hardness, resistance to corrosion;
3-Technical data sheet of the Powder coating used.

In case of particularly aggressive weather condition it is necessary to paint the gearboxes with a special painting cycle. We suggest you to specify your requests while ordering our products.
TYP0-TYP1-TYP2-TYP3-TYP4.

ATTENTION
If the product must be painted or cleaning off any antirust paint, protect the machined surfaces and oil seals/gaskets in order to prevent any damage. It is also necessary to protect the identification plate, the oil level plug (if fitted) and the hole in the breather plug (if fitted) against obstruction.

3. LIEFERZUSTAND

3.1 Lackierung und schutz
Die Getriebe sind außen mit wärmehärtenden blauen, RAL 5010, Lack lackiert, außer anderweitig lautende vertragliche Vereinbarungen.
Dieser Schutz ist für einen Einsatz in normalen industriellen, auch im Freien liegenden Umfeldern geeignet und erlaubt Überlack-ierungen mit Synthetiklack.
Weitere Informationen zum Lieferzustand können der folgenden Tabelle entnommen werden.
3.1.1 Eigenschaften der Lackierung
Der verwendete Lack weist folgende Eigenschaften auf: wärmehärtender Pulverlack auf Polyesterharzbasis mit Epoxidharzen modifiziert.
Auf Anfrage erhältlich:
1-Lackierungszyklus;
2-Stärke, Härte, Korrosionsfestigkeit;

3-Technisches Datenblatt des verwendeten Pulverlacks.

Bei besonders aggressiven Umweltbedingungen müssen hierfür geeignete Produkte mit den entsprechenden Lackierzyklen verwendet werden. In diesen Fällen wird vorgeschlagen, dass Sie den Zyklus in der Auftragsphase vereinbaren.
TYP0-TYP1-TYP2-TYP3-TYP4.

ACHTUNG
Sollten die Produkte lackiert werden oder Abbau des Rostschutzmittels, muss darauf geachtet werden, dass die bearbeiteten und Dichtflächen dabei geschützt werden, so dass verhindert werden kann, dass die Lackierung die chemisch-physischen Eigenschaften verändert und die Wirkung der Ölabdichtungen einschränkt. In der gleichen Weise und aus gleichem Grund müssen das Typenschild und die Öleinfüllschraube sowie die Bohrung der Entlüftungsschraube (wo vorhanden) geschützt werden.

3. STATO DI FORNITURA

3. SCOPE OF THE SUPPLY

3. LIEFERZUSTAND

OPT2 - Options - Painting and surface protection						
Serie *Series* Baureihe	Grandezza *Size* Baugröße	Verniciatura Interna *Inner painting* Innenlackierung	Verniciatura Esterna *Outer painting* Außenlackierung		Piani lavorati *Machined surfaces* Bearbeitete Flächen	Alberi *Shafts* Wellen
			Tipo e Caratteristiche vernice *Paint type and features* Lacktyp und -eigenschaften	Verniciabile *Can be painted* Kann lackiert werden		
TypSTM						
A /1	32-40-50-60-80-100	Uguale a verniciatura esterna *Same as outer painting* Wie Außenlackierung	Verniciatura a Polvere RAL 5010 *Powder coating RAL 5010* Pulverlackierung RAL 5010	Sì Dopo Grassatura e Carteggiatura e/o applicazione di un PRIMER Yes *After Degreasing and sanding and/or application of a PRIMER* Ja Nach Fettentfernung und Abschliff und/oder Auftrag eines PRIMER	Quando il materiale è la ghisa sono protetti con olio antiruggine. *When material is cast iron, they are protected with rustproof oil.* Falls aus Gusseisen mit Rostschutzöl geschützt.	Protetti con olio antiruggene. *Protected with rustproof oil.* Mit Rostschutzöl geschützt.
A	50-55-60-70-80-90-100-110 120-140					
O	63-71-80-90-100-112-125-13 2-140-150-160-170-180-190					
S	35-45					
P	63-71-90-112-125					
PL	85-95-105-115-125-135					
PT	80-100-125-132-140-150-170 190					
R	63-70-85-110-130-150-180 215-250					
CR (CRI-CRMI)	Vedere Tipo R. / *See R. type*/ Siehe G. Typ					
C (CR-CB)	70-85-110-130-150-180-215 250					
U	63-75-90-110					
W	25-30-50-63-75-90-110-130 150					
WM	63-71-80-90-100-112					
Without Paint						
A	25-35-41-45	Nessuna *None* Keine	Nessuna *None* Keine	Sì Prodotti monocomponente e bicomponente *Yes* *Monocomponent and bicomponent products* Ja Ein- und Zweikomponenten-Produkte	Nessuna *None* Keine	Protetti con olio antiruggene. *Protected with rustproof oil.* Mit Rostschutzöl geschützt.
S	25					
PL	25-45-65					
R	28-40-50					
CR (CRI-CRMI)	Vedere Tipo R. / *See R. type*/ Siehe G. Typ					
C (CR-CB)	40-50					
U	40-50					
Z	12-19-24-32-38-42-55-75					
ZL	331-332-333-334-432-433-43 4					
AS	SPECIALI A DISEGNO CLIENTE / *SPECIAL - TO CUSTOMER SPECS* / SPEZIALGETRIEBE NACH KUNDENZEICHNUNG	Specifiche cliente / *Customer specifications* / Kundenspezifikationen				

3. STATO DI FORNITURA

3.2 LUBRIFICAZIONE
Per i dati relativi allo stato di fornitura dei riduttori per quanto riguarda la lubrificazione si rimanda al paragrafo relativo alla lubrificazione.
ATTENZIONE:
Lo stato di fornitura è messo in evidenza con una targhetta adesiva posta sul riduttore.
Verificare la corrispondenza tra stato di fornitura e targhetta adesiva.

Catalogo Tecnico
CT 16..
CT 17..

URL:www.stmspa.com

3.3 CONNESSIONE MOTORE/RIDUTTORE CON GIUNTO STM/ROTEX
Qualora la connessione tra riduttore e macchina motrice sia effettuata con un giunto è necessario verificare se è necessario montare un linguetta di dimesioni a disegno STM.
La linguetta e la targhetta nella quale sono riportate le istruzioni di montaggio sono allegate ad ogni fornitura.
Qualora non fornite segnalare il problema al Nostro Ufficio Commerciale ed attenersi alle istruzioni di installazione riportate nello specifico paragrafo.

3. SCOPE OF THE SUPPLY

3.2 LUBRICATION
Please refer to the paragraph about lubrication for further details on state of supply of gearboxes as far as lubrication is concerned.
CAUTION:
Gearbox state of supply is indicated on a nameplate applied on gearbox.
Ensure that nameplate data and state of supply correspond.

Technical Catalogue
CT 16..
CT 17..

URL:www.stmspa.com

3.3 CONNECTING THE MOTOR AND GEARBOX WITH STM/ROTEX JOINT
If gearbox and driving machine are connected by means of a joint, check whether it is necessary to install a key sized as specified on STM drawing.

Key and nameplate indicating assembly instructions come with any supply.

Should they be missing, report this problem to our Sales Dept. and follow the installation instructions given in the relevant paragraph.

3. LIEFERZUSTAND

3.2. SCHMIERUNG
Die sich auf die Schmierung beziehenden Daten bezüglich dem Lieferzustand der Getriebe verweisen wir auf den Paragraph “Schmierung”.
ACHTUNG:
Der entsprechende Lieferzustand wird auf einem Aufkleber am Getriebe angegeben.
Überprüfen Sie die Übereinstimmung zwischen effektivem Lieferzustand und Aufkleber.

Technischer Katalog
CT 16..
CT 17..

URL:www.stmspa.com

3.3 VERBINDUNG ZWISCHEN MOTOR UND GETRIEBE ÜBER KUPPLUNG STM/ROTEX
Bei Verbindung zwischen Getriebe und Antriebseinheit über eine Kupplung muss überprüft werden, ob ein Federkeil gemäß STM-Maßzeichnung erforderlich ist.
Der Federkeil und das Schild, auf dem die Montageanleitung wiedergegeben wird, sind im Lieferumfang enthalten.
Sollten sie nicht angeliefert werden, muss dies unserer Verkaufsabteilung mitgeteilt werden. Für die Installation muss man sich dann an die Anleitungen im spezifischen Paragraph halten.

3. STATO DI FORNITURA

3.4 ANTIRETRO
Qualora sia presente un dispositivo antiretro una freccia ne evidenzia il senso di rotazione consentito.

3.5VERIFICHE
Compete al ricevente controllare che i dati di targa corrispondano all'ordine effettuato, che il prodotto sia integro e non abbia subito danni durante il trasporto.

Per avarie o rotture dovute a danni imputabili al trasporto, il destinatario dovrà sporgere immediata contestazione direttamente al vettore od avvisare il nostro Ufficio Commerciale.

Il materiale danneggiato non deve essere installato o messo in funzione per evitare rischi di funzionamento pericoloso.

Gli alberi recano delle protezioni di sicurezza in plastica e opportuni avvolgimenti di nastro isolante per il fissaggio della linguetta; l'estremità dell'albero e le superfici lavorate sono protette con pasta antiossidante.
Questi allestimenti non devono essere rimossi se non al momento dell'installazione.

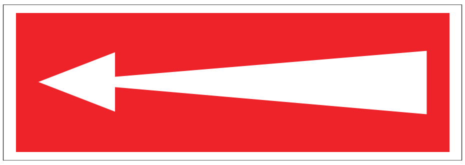
3.6 IMBALLAGGIO
Il prodotto viene consegnato imballato in contenitori di cartone, in alcuni casi avvolto o protetto con materiali di riempimento e di recupero degli spazi vuoti.
Gli imballi di peso superiore a 30 kg sono provvisti di bancale in legno, per essere facilmente movimentati tramite carrello a forche.

Le confezioni di imballaggio non devono essere sovrapposte.
Nel reimballare per qualunque motivo il prodotto, occorre utilizzare ovunque possibile l'imballo originale (del quale si consiglia la conservazione) e comunque curare particolarmente la protezione delle superfici e delle parti di accoppiamento.

Il trasporto va quindi effettuato nelle predette condizioni, e proteggendo il prodotto contro urti e altre significative sollecitazioni meccaniche, la polvere e lo sporco.

3. SCOPE OF THE SUPPLY

3.4 BACK-STOP DEVICE
In the event a back-stop device is provided, an arrow indicates its permitted direction of rotation.



3.5 INSPECTIONS
The person receiving the goods is in charge of checking that the data on the nameplate correspond to the goods ordered, that the product is complete and has not suffered damage during transportation.
The recipient shall immediately claim to the carrier any failure or faults due to transport damage or report to our Sales Department.

Any damaged material shall not be installed or operated to avoid any risk and danger.

The shafts are delivered with plastic safety protections and the keys are appropriately taped to the shafts. Shafts and machined parts are protected by oxide protectant.
These protections must not be removed unless before installation.

3.6 PACKING
The products are delivered packed in cardboard boxes, in some cases wrapped or protected with appropriate material to fill empty areas inside boxes.
Packages over Kg. 30 are set on wooden pallets and are easily handled by fork lift truck.

Do not stack packages.

Should it be necessary to pack the equipment again, do not forget to use the original packaging (that should be kept after first unpacking) and take special care to protect the surfaces and the coupling shafts.

Only transport the device if it is suitably packed and protected against shocks, dust and dirt.

3. LIEFERZUSTAND

3.4 RÜCKLAUFSPERRE
Sollte eine Rücklaufsperre vorhanden sein, wird die zulässige Drehrichtung durch einen Pfeil angegeben.

3.5 ÜBERPRÜFUNGEN
Der Empfänger muss kontrollieren, dass die auf dem Typenschild angegebenen Daten dem übermittelten Auftrag entsprechen, dass das Produkt unbeschädigt ist und während des Transports keine Schäden entstanden sind.
Im Fall von Defekten oder Schäden, die sich auf den Transport zurückführen lassen, muss der Empfänger sofort und direkt beim Frachtführer Beanstandung erstatten oder unsere Verkaufsabteilung informieren.
Beschädigtes Material darf nicht eingebaut oder in Betrieb gesetzt werden, so dass ein gefährlicher Betrieb vermieden werden kann.

Die Wellen sind mit Schutzkappen aus Kunststoff versehen und mit Isolierband umwickelt, durch das der Federkeil fixiert wird. Das Wellenende und die bearbeiteten Flächen werden mit Rostschutzpaste geschützt.
Diese Ausstattungen müssen spätestens bei der Installation entfernt werden.

3.6 VERPACKUNG
Das Produkt wird in Kartons verpackt, in einigen Fällen im eingewickelten Zustand oder durch Füllmaterial zum Ausfüllen der Freiräume geschützt geliefert.
Packungen mit einem Gewicht über 30 kg werden auf eine Holzpalette gepackt, so dass sie einfach mit einem Gabelstapler transportiert werden können.
Die Verpackungen dürfen nicht gestapelt werden.
Sollte sich ein erneutes Verpacken des Produkts aus irgendwelchen Gründen als erforderlich erweisen, sollte soweit wie möglich die Originalverpackung (die deshalb aufbewahrt werden sollte) verwendet und insbesondere auf den Schutz der Ober- und Passflächen geachtet werden.
Der Transport muss unter den angegebenen Bedingungen erfolgen. Dabei muss das Produkt vor Stössen und anderen mechanischen bedeutenden Belastungen, Staub und Schmutz geschützt werden.

4. SOLLEVAMENTO TRASPORTO

Il sollevamento ed il trasporto dell'unità devono essere eseguiti con prudenza per evitare pericolose cadute o ribaltamenti. Per il trasporto si può utilizzare un carrello a forche d'adeguata portata.

Le modalità e mezzi per la movimentazione del prodotto devono essere predisposti dall'utilizzatore nel quadro del proprio sistema di sicurezza nel luogo di lavoro e conformemente alle disposizioni prevenzionali vigenti. Compete in particolare a quegli la corrispondente valutazione dei rischi dorso-lombari incombenti sugli addetti, che può imporre mezzi meccanici di sollevamento e/o altri ausili anche per masse consistentemente inferiori ai 30Kg menzionati poco oltre.

I mezzi di sollevamento e movimentazione utilizzati devono essere scelti in relazione alle caratteristiche del prodotto ed essere conformi alle disposizioni regolamentari applicabili. Per la movimentazione del prodotto imballato è necessario prevedere idonei dispositivi di sollevamento per i colli di peso superiore ai 30 Kg, adottando in ogni caso cautele contro il verificarsi di urti sulle superfici delle parti di accoppiamento Per la movimentazione del prodotto non imballato, si può utilizzare, nei casi in cui è previsto, l'apposito golfare, ponendo mente alla sua idoneità al sollevamento del singolo prodotto e non del complesso di organi a cui esso può essere connesso. Diversamente, i prodotti non imballati, di peso superiore ai 30 Kg e sprovvisti di golfare devono essere movimentati tramite gru/paranco e imbracatura.

Nel caso di motoriduttori è consigliabile agganciare anche il motore visto che lo spostamento del centro di gravità è molto variabile con la tipologia.
Nella tabella sono riportate le masse indicative riduttori di serie privi di lubrificante (kg).

4. LIFTING AND HANDLING

The unit must be lifted and handled carefully to avoid dangerous tilting or fall of the unit. It is possible to use a fork lift truck of suitable capacity for handling the unit.

In full respect of the existing appropriate legislation, the user must use appropriate tools for correctly handling the products in accordance with his own safety system. His task is also to evaluate back-lumbar risks for the operators which eventually might imply the use of mechanical lifting devices and/or other tools for even lighter weights than Kg. 30 previously mentioned.

Lifting and handling equipment must be selected depending on the product specifications but always in full conformity with applicable safety legislation. For handling the packed product it is necessary to arrange suitable lifting equipment for packages over 30 Kg, making sure to adequately protect product surfaces and connecting parts against shocks. For handling the unpacked product, it is advisable to use the appropriate eyebolt (where provided), remembering that it is intended to lift just the product itself and not the overall machinery. While, in case of unpacked products over 30 Kg. and with no eyebolt, they must be lifted and handled through cranes/hoists and slings.

When geared motors are handled it is recommended to connect the motor on the gear unit since the centre of gravity may very much vary according to the type.
Approximate weights of standard gearboxes without lubricant (kg).

4. HEBEN UND TRANSPORT

Das Heben und das Befördern der Einheit müssen mit entsprechender Umsicht erfolgen, so dass ein mit Gefahren verbundenes Herunterfallen oder Umkippen vermieden werden können. Für den Transport kann ein Gabelstapler mit ausreichender Tragfähigkeit verwendet werden.

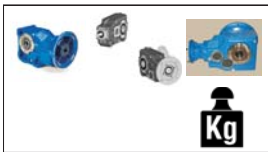
Die Verfahrensweisen und Transportmittel für die Bewegung des Produkts müssen vom Benutzer im Rahmen seines am Arbeitsplatz geltenden Sicherheitssystems und den geltenden Vorsorgerichtlinien konform ausgelegt werden. Ihnen unterliegt auch die entsprechende Bewertungspflicht der für den Oberkörperbereich der Zuständigen bestehenden Gefahren, was einen Einsatz von mechanischen Hebevorrichtungen und/oder anderen Hilfsmitteln auch im Fall von Massen, die unter den genannten 30 kg liegen erforderlich machen kann.
Die eingesetzten Hebe- und Transportmittel müssen in Abhängigkeit zu den Produkteigenschaften gewählt werden und den anwendbaren Regelvorschriften konform sein. Für das Bewegen des verpackten Produkts bzw. für Frachtstücke mit einem Gewicht über 30 kg müssen angemessene Hebemittel verwendet werden. Dazu müssen auf alle Fälle Vorsichtsmaßnahmen gegen Anstösse gegen die Passungsflächen getroffen werden. Für den Transport des unverpackten Produkts kann wo vorgesehen die entsprechende Transportöse verwendet werden. Dabei muss ihre Eignung für das Heben des Einzelprodukts abgewägt werden und nicht der Einheit, mit der es verbunden sein könnte. Unverpackte Produkte mit einem Gewicht über 30 kg und ohne Transportöse müssen dagegen mit einem Kran oder einer Hebewinde und entsprechender Hebeseile bewegt werden.

Bei Getriebemotoren wird empfohlen, auch den Motor zu verankern, da der Schwerpunkt dem Typ entsprechend stark variiert.

In der Tabelle werden die Richtgewicht der serienmäßigen Getriebe ohne Schmiermittel angegeben (kg).

	32	40	50	60	80	100
A /1	2.1	3.1	5.2	16.0	21.0	55

<table>
<tr><td></td><td>25</td><td>35</td><td>40</td><td>41</td><td>45</td><td>50</td><td>55</td><td>60</td><td>70</td><td>80</td><td>90</td><td>100</td><td>110</td><td>120</td><td>140</td></tr>
<tr><td>A /2</td><td rowspan="2">1.8</td><td>2.6</td><td rowspan="2">9.0</td><td>3.1</td><td>4.1</td><td rowspan="2">13.0</td><td rowspan="2">17.0</td><td rowspan="2">20.0</td><td rowspan="2">30.0</td><td rowspan="2">42.0</td><td rowspan="2">48.0</td><td rowspan="2">60.0</td><td rowspan="2">85.0</td><td rowspan="2">155.0</td><td rowspan="2">195.0</td></tr>
<tr><td>A /3</td><td>3.3</td><td>3.5</td><td>4.6</td></tr>
</table>

	63	71	80	90	100	112	125	132	140	150	160	170	180	190
O	10.5	18.0	20.0	44.0	32.0	68.0	56.0	70	110	120	170	180	240	250

	25	35	45
S	5.0	7.5	10.0

4. SOLLEVAMENTO TRASPORTO

4. LIFTING AND HANDLING

4. HEBEN UND TRANSPORT

 Kg	63	71	90	112	125
P	9.0	14.0	30.0	59.0	105

 Kg	25	45	65	85	95	105	115	125	135
PL	4.6	12.5	18	37	55	102	153	267	340

 Kg	80	100	125	132	140	150	170	190
PT/1	18	29	50	65	100	110	174	240
PT/2	20	32	56	70	110	120	184	250

 Kg	28	40	50	63	70	85	110	130	150	180	215	250
R	1.4	2.1	3.8	6.0	7.5	14.0	38.0	48.0	77.0	130.0	260.0	460.0

 Kg	28/ 28	28/ 40	40/ 40	28/ 50	40/ 50	28/ 63	40/ 63	28/ 70	40/ 70	50/ 70	63/ 70	40/ 85	50/ 85	63/ 85	70/ 85	50/ 110	63/ 110	70/ 110
CR (CRI-CRMI)	2.8	3.5	4.2	5.2	5.9	7.4	8.1	14.4	16.1	16.8	19.0	20.0	22.0	24.0	31.0	42.0	44.0	51.0
	85/ 110	63/ 130	70/ 130	85/ 130	85/ 150	110/ 150	85/ 180	110/ 180	130/ 180	110/ 215	130/ 250							
	56.0	54.0	61.0	66.0	95.0	115.0	148.0	168.0	178.0	298.0	508.0							

 Kg	40	50	70	85	110	130	150	180	215	250
C (CR-CB)	3.5	5.0	16.0	36.0	50.0	67.0	98.0	163.0	303.0	527.0

 Kg	40	50	63	75	90	110
U	2.1	3.5	6.0	9.0	14.0	22.0

 Kg	25	30	40	50	63	75	90	110	130	150
WI	0.7	1.2	2.3	3.5	6.2	9.0	13.0	22.0	48.0	84.0

 Kg	12	19	24	32	38	42	55	75
Z	2.5	6.0	12.0	22.0	37.0	57.0	87.0	255.0

 Kg	331	332	333	334	432	433	434
ZL	0.3	1.2	3.5	5.7	2.0	4.5	4.5

 Kg	80	90	100	112
WM	8.0	28.0	78.0	85.0

5. STOCCAGGIO

I riduttori devono essere immagazzinati in ambienti adeguatamente secchi, puliti e privi di vibrazioni. Con periodicità semestrale è bene fare compiere agli ingranaggi qualche giro onde prevenire danneggiamenti di cuscinetti e tenute. Per periodi di stoccaggio superiori ad un anno è necessario sostituire il tappo di carico con valvola di sfiato con uno chiuso e riempire i riduttori completamente d'olio.

Controllare e ripristinare ogni sei mesi il grasso nelle tenute e il protettivo sulle parti lavorate. Per ambienti aggressivi prevedere verniciature speciali, per ambienti umidi o con forti escursioni termiche pastiglie igroscopiche e, in ogni caso, verifiche più frequenti.

Nel caso di soste prolungate dopo il funzionamento, occorre adottare i provvedimenti prima citati avendo cura di ripristinare le protezioni di fornitura come indicato al punto 3; in alternativa è possibile riempire il riduttore con olio fresco del tipo impiegato.

5. STOCKING

Gear units have to be stored in adequately dry, clean and vibration free premises. We suggest to run the gears every six months to prevent bearings and seal rings damages.For storage periods longer than one year, you need to change the filler plug and the breather valve with a closed plug and fill completely the gearboxes with oil.

Check and top up grease in the seal rings and protective fluid on machined parts every six months. In case of aggressive environment, special paints are to be provided; in case of either damp environments or with great thermal excursions, frequent inspections and hygroscopic tabs will be needed.

In case of long stops after running, the above mentioned measures should be taken by restoring the supply protections as indicated at point 3; alternatively, the gear unit can be filled with fresh oil of the same type of oil used.

5. EINLAGERUNG

Die Getriebe müssen in angemessen trockenen, sauberen und schwingungsfreien Orten gelagert werden. Alle sechs Monate sollten die Zahnräder um einige Runden weitergedreht werden, um Schäden an den Lagern und Dichtungen zu vermeiden. Im Fall von Lagerzeiten, die über ein Jahr hinausgehen, muss der Einfüllverschluss mit Entlüftungsventil durch einen geschlossenen Verschluss ersetzt und das Getriebe vollständig mit Öl gefüllt werden.
Alle sechs Monate das Fett an den Dichtungen und die Schutzschmierung an den bearbeiteten Teilen kontrollieren und ggf. nachfüllen. Bei aggressiven Umgebungsbedingungen müssen Speziallackierungen, im Fall von feuchten Umgebungen oder Umfeldern mit starken Temperaturschwankungen hygroskopische Pads verwendet werden und, auf jeden Fall, häufige Kontrollen erfolgen.
Sollten nach einem Betrieb längere Stillstandzeiten vorgesehen werden, müssen die zuvor genannten Vorkehrungen getroffen und die im Lieferzustand vorhandenen Schutzbedingungen gemäß Punkt 3 wieder hergestellt werden. Als Alternative kann das Getriebe mit frischem Öl vom vorgesehenen Typ gefüllt werden.

6. INSTALLAZIONE

Le attività di installazione e messa in servizio devono essere svolte esclusivamente da personale qualificato per operazioni manutentive di tipo meccanico su apparecchiature e macchinario.
L'installazione scorretta del prodotto può pregiudicare l'incolumità delle persone esposte e può indurre danni gravi o irreparabili al prodotto e all'insieme di cui faccia parte. È necessario seguire scrupolosamente le prescrizioni che seguono.
Se prima dell'installazione si prevede un funzionamento a vuoto, occorre prestare particolare attenzione alla possibile espulsione della linguetta, con rischio di ferimento del personale e convogliamento: asportare pertanto la linguetta o predisporre adeguata protezione all'albero, stazionando in ogni caso a distanza di sicurezza dagli organi in moto e fuggendo indumenti o fogge personali adescanti il convogliamento.

Le misure di sicurezza illustrate sono solo esemplificative e hanno lo scopo di segnalare la mera circostanza di pericolo, rimanendo ogni predisposizione prevenzionale di competenza dell'utilizzatore nel quadro del proprio sistema di sicurezza nel luogo di lavoro e conformemente alle disposizioni prevenzionali vigenti.

In caso di guasto si possono raggiungere temperature elevate o si possono determinare perdite di lubrificante: analogamente, le misure prevenzionali a fronte necessarie devono essere in funzione delle caratteristiche dell'insieme di incorporazione e di quanto testé menzionato.

6.0.1 Reversibilità - Irreversibilità
Qualora fosse richiesta, nei riduttori a vite senza fine, una irreversibilità statica o dinamica è necessario ricorrere all'utilizzo di freni, poiché in quei casi la totale irreversibilità è praticamente impossibile da realizzare e mantenere nel tempo.

6.0.2 Limitatore di coppia
Il limitatore di coppia, opzionale nei riduttori a vite senza fine, non può essere considerato in alcun caso un dispositivo di sicurezza, ma solo un sistema di protezione degli organi meccanici.

6. INSTALLATION

Product mechanical maintenance or installation and start-up operations must be carried out by qualified personnel.

Incorrect installation of the product may endanger the worker's safety and cause irreparable damage to the device itself and the machine to which it is connected. Strictly follow the instructions below.

If a running test is carried out without load before installation make sure that the key does not pop out from the shaft and harm or entangle operators. Always remove the key and arrange adequate shaft protection, stay clear of the moving parts and do not wear loose-fitting clothes.

These safety precautions are mainly to be used as examples and guideline to simply warn danger circumstance. Every safety arrangement must be taken and carried out by the operator in charge according to the safety system in the working environment and in conformity with current legislation.

In the event of failure, high temperatures might be reached or lubricant may leak out. It is therefore necessary to equip the machine with all necessary preventive measures in accordance with machine operational characteristics.

6.0.1 Reversibility - Irreversibility
Should static or dynamic irreversibility be requested on worm gearboxes it is necessary to use brakes since complete irreversibility is impossible to obtain and maintain.

6.0.2 Torque limiter
The torque limiter, upon request on worm gearboxes, can not be considered a safety device in any way but only a protection device for mechanical parts/components.

6. INSTALLATION

Die Installation und die Inbetriebsetzung dürfen ausschließlich nur von für mechanische Instandhaltungsarbeiten an Geräten und Maschinen qualifiziertes Personal ausgeübt werden.
Eine falsche Installation des Produkts kann zu Verletzungen der damit/daran arbeitenden Personen führen und schwere oder irreparable Schäden am Produkt selbst und der Einheit verursachen, zu der es gehört. Nachstehende Anweisungen müssen strikt befolgt werden.
Sollte vor der Installation ein Leerbetrieb vorgesehen sein, muss besondere Aufmerksamkeit darauf gerichtet werden, dass der Federkeil herausgeschleudert werden kann, wodurch das Personal getroffen oder verletzt werden kann: Aus diesem Grund muss der Federkeil entfernt oder die Welle entsprechend geschützt werden. Auf jedem Fall muss man sich dabei in einem angemessenen Sicherheitsabstand von den sich in Bewegung befindlichen Organen aufhalten und darf keine Bekleidungsstücke oder losen persönlichen Gegenstände tragen, die in die Organe eingezogen werden könnten.
Die hier illustrierten Sicherheitsmaßnahmen sollen nur als Beispiele dienen und haben zum Ziel, auf die reell vorliegenden Gefahren hinzuweisen. Die Vorsorgemaßnahmen liegen jedoch im Zuständigkeitsbereich des Benutzers im Rahmen seines am Arbeitsplatz angewendeten und den geltenden Vorsorgerichtlinien entsprechenden Sicherheitssystems.
Bei Defekten kann es zu hohen Temperaturentwicklungen oder zu Schmiermittelleckagen kommen: Analog dazu müssen die entsprechend erforderlichen Vorsorgemaßnahmen in Abhängigkeit der Eigenschaften der Einheit und der eben genannten Faktoren getroffen werden.

6.0.1 Reversibilität - Irreversibilität
Sollte im Fall der Schneckengetriebe eine dynamische oder statische Irreversibilität gefordert werden, müssen Bremssysteme vorgesehen werden, da es in diesen Fällen praktisch unmöglich ist, die vollkommene Irreversibilität zu realisieren und über die Zeit hinweg aufrecht zu erhalten.

6.0.2 Rutschkupplung
Die bei den Schneckengetrieben als Optional erhältliche Rutschkupplung kann auf keinen Fall als Sicherheitsvorrichtung sondern nur als ein Schutzsystem für die mechanischen Organe angesehen werden.

6. INSTALLAZIONE

6.0.3 Verifica Velocità ingresso

6. INSTALLATION

6.0.3 Input speed check

6. INSTALLATION

6.0.3 Überprüfung der Antriebsdrehzahl

Riduttori *Gearboxes* Getriebe	A	O	S	P	PL	PT
n_1(rpm)	2800	2800	2800	2800	2800	2800
	1400	1400	1400	1400	1400	1400
	900	900	900	900	900	900
	500	500	500	500	500	500

Riduttori *Gearboxes* Getriebe	U - R - W	RR	CR	VM-WM	Z - ZL
n_1(rpm)	2800*	—	2800 (max)	2800 (max)	2800 (max)
	1400	1400	1400	1400	1000
	900	—	900	900	900
	500	—	500	—	500

* Nei riduttori a vite senza fine, per situazioni con velocità di ingresso particolari, attenersi alla tabella sotto riportata che evidenzia le situazioni critiche.

** As far as worm gearboxes are concerned, in cases with special input speeds, adhere to the table below that highlights any critical situations.*

* Bei den Schneckengetrieben muss man sich in Fällen mit besonderen Antriebsdrehzahlen an die Angaben in der nachstehenden Tabelle halten, die kritische Situationen berücksichtigt.

	UI - RI - WI													
	25	**28**	**30**	**40**	**50**	**63**	**70**	**75**	**85**	**90**	**110**	**130**	**150**	**180**
1500 < n_1 < 3000	OK	OK	OK	OK	OK	**Contattare il ns. servizio tecnico** ***Contact our technical dept*** **Wenden Sie sich mit unserem Technischem Service.**								
n_1 > 3000														

Velocità inferiori a 1400 min^{-1} ottenute con l'ausilio di riduzioni esterne o di azionamen- ti, sono sicuramente favorevoli al buon fun- zionamento del riduttore il quale può operare con temperature di funzionamento inferiori a vantaggio di tutto il cinematismo (in particolare nei riduttori a vite senza fine).

E' necessario però considerare che velocità molto basse non consentono un' efficace lubrificazione di tutto il gruppo, per cui tale eventualità dovrà essere segnalata per poter effettuare schermature dei cuscinetti superiori nei riduttori delle taglie maggiori o applicare sistemi di lubrificazione forzata (pompa di lubrificazione).

Speeds lower than 1400 rpm obtained by means of external reductions or drives, surely contribute to the good working of the gearbox which can operate at lower working temperatures to the advantage of the whole kinematic movement (in particular in case of the worm gearboxes).

However, please note that very low speeds do not allow efficient lubrication of the whole unit. Therefore this instance shall be specified to allow for suitable screening of the upper bearings of the gearboxes of larger sizes or for application of systems with forced lubrications (lubrication pump).

Drehzahlen unter 1400 min^{-1}, die mit Hilfe externer Reduzierungen oder Antriebe erreicht werden, sind für den guten Getriebebetrieb sicher von Vorteil, da das Getriebe unter niedrigeren Betriebstemperaturen eingesetzt werden kann, was zu Gunsten der gesamten Getriebeeinheit geht (insbesondere bei Schneckengetrieben).

Zu berücksichtigen ist jedoch, dass besonders niedrige Drehzahlen keine wirksame Schmierung der gesamten Einheit zulassen. Sollte dies eventuell erforderlich sein, muss entsprechend darauf hingewiesen werden, so dass die oberen Lager der größeren Getriebe abgeschirmt oder Zwangsschmiersysteme (Schmier- pumpe) vorgesehen werden können.

6. INSTALLAZIONE

6.1 LUOGO DI FUNZIONAMENTO
La collocazione deve consentire adeguato spazio per i successivi controlli e manutenzioni e garantire sufficiente passaggio d'aria di refrigerazione per lo smaltimento del calore. Nel caso si abbiano temperature ambientali esterne all'intervallo (0-40)°C, non considerate in fase contrattuale, contattarci.

6.2 LUOGO CHIUSO E/O POLVEROSO

E' indispensabile che nel locale in cui siano installati i riduttori esista un ricambio d'aria sufficiente in modo che l'aria stessa non venga riscaldata pregiudicando la resa termica.

La temperatura massima dell'ambiente non deve superare i 30 °C, viceversa è pregiudicata la resa termica dell'unità.
L'installazione in un ambiente molto polveroso provoca un calo di resa termica.

E' per questo che in un ambiente polveroso o saturo d'olio e' indispensabile mantenere pulito il riduttore con una pulizia regolare (vedi manutenzione).

6.3 INSTALLAZIONE IN LUOGO APERTO
In questo caso l'unità deve essere protetta dalle intemperie; prevedere quindi una tettoia, in modo che essa non risulti esposta direttamente all'acqua piovana.

6. INSTALLATION

6.1 INSTALLATION SITE
The place of installation has to foresee enough free area for periodical inspections and maintenance and secure sufficient cooling air flow for heat dispersion. In case the ambient temperature does not fall within (0-40)°C range and is different than that considered in the contract, please contact us.

6.2 ENCLOSED AND/OR DUSTY ROOM

It is indispensable that the room where the gearboxes are installed has a sufficient air circulation so that air does not reach such a temperature that would jeopardise gearbox efficiency.

Maximum allowed ambient temperature is 30 °C; above this limit, the unit efficiency is compromised.
Installing in a dusty environment leads to a drop in efficiency.

This is why it is fundamental to regularly clean the gearboxes in case of dusty environment or saturated with oil (see maintenance).

6.3 OUTDOOR INSTALLATION
In this case the unit shall be protected against weather conditions; set a roofing for this purpose, so that unit is not under the rain.

6. INSTALLATION

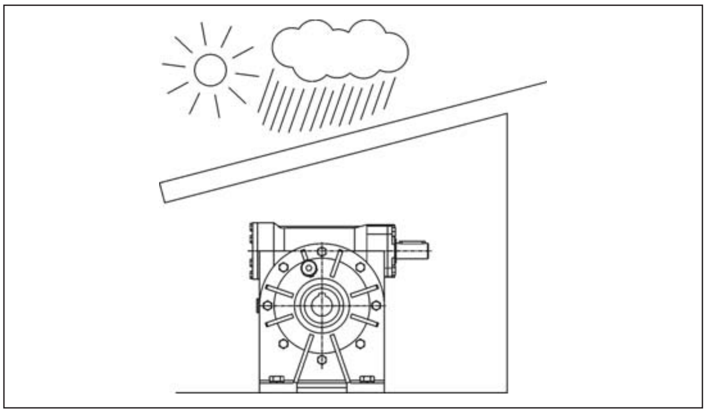
6.1 EINSATZORT
Die Anordnung muss so erfolgen, dass ein angemessener Freiraum für spätere Kontrollen und Instandhaltungseingriffe verbleibt und zum Wärmeabbau ausreichend Kühlluftzufuhr gewährleistet wird. Sollten Umgebungs-temperaturen vorliegen, die nicht innerhalb der berücksichtigten Werte (0-40)°C liegen und bei Vertragsabschluss nicht berücksichtigt wurden, setzen Sie sich bitte mit uns in Verbindung.

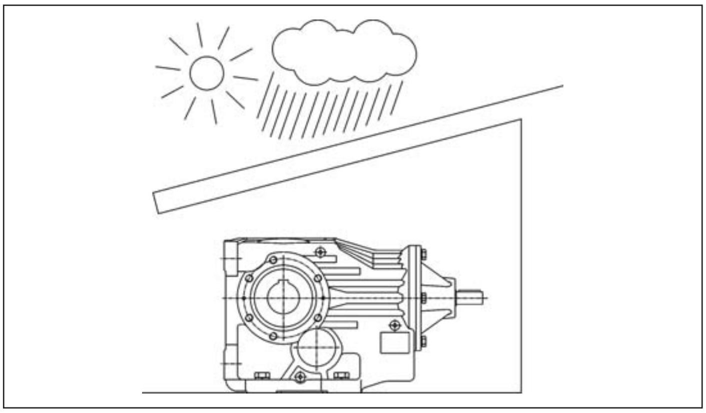
6.2 GESCHLOSSENER UND/ODER STAUBIGER INSTALLATIONSORT
Der Raum, in dem die Getriebe installiert werden, muss einen ausreichenden Luftaustausch ausweisen, so dass vermieden wird, dass sich die Luft aufheizt und so die thermische Leistung verringert.

Die max. Umgebungstemperatur darf 30 °C nicht überschreiten, andernfalls wird die thermische Leistung der Einheit negativ beeinflusst.
Die Installation in einem stark mit Staub belasteten Umfeld führt zu einer geringeren thermischen Leistung.

Daher ist es in einer staubigen oder mit Öl gesättigten Umgebung unbedingt erforderlich, das Getriebe regelmäßig zu reinigen (siehe Instandhaltung).

6.3 INSTALLATION IM FREIEN
In diesem Fall muss die Einheit vor Wettereinflüssen geschützt werden. Dazu eine Überdachung vorsehen, so dass sie dem Regen nicht direkt den Regenwasser ausgesetzt wird.





In inverno, nel caso di fermo macchina prolungata, la temperatura dell'olio diventa molto bassa e quindi aumenta di molto la sua viscosità (in fase di analisi dell'applicazione è necessario valutare la viscosità di olio necessaria e la tipologia di guarnizioni da utilizzare.

In winter, in case of long periods of inactivity, oil temperature becomes very low and thus its viscosity is remarkably increased
(when analysing the application it is necessary to evaluate necessary oil grade and the type of seal to be used.)

Im Winter, bei einem längeren Maschinenstillstand, sinkt auch die Temperatur des Öls stark ab und demzufolge seine Viskosität stark zu (in der Analysephase der Anwendung ist es daher erforderlich, die erforderliche Ölviskosität und die einzusetzenden Dichtungstypen zu bewerten).

6.4 ILLUMINAZIONE
Il luogo d'installazione della macchina deve avere un'illuminazione naturale e/o artificiale conforme alla normativa vigente, in ogni caso sufficiente a compiere eventuali operazioni di manutenzione o riparazione.

6.4 LIGHTING
The machine installation site should be naturally and/or artificially lit, as required by the prevailing standard, but in any case lit enough to allow for any maintenance or repair operations.

6.4 BELEUCHTUNG
Der Installationsort der Maschine muss der geltenden Richtlinie konform natürlich/künstlich beleuchtet werden. Die Beleuchtung muss ausreichen, um eventuelle Instandhaltungs- oder Reparaturarbeiten ausführen zu können.

6. INSTALLAZIONE

6.5 FISSAGGIO DEL GRUPPO

Il fissaggio deve essere fatto utilizzando i fori di fissaggio previsti sulle basi.
Accertarsi che il fissaggio del riduttore alla struttura portante sia stabile, in modo tale da eliminare qualsiasi vibrazione, e che esso venga effettuato su piani lavorati; utilizzare sistemi antisvitamento per le viti di serraggio.

Curare particolarmente l'allineamento del dispositivo con il motore e la macchina da comandare interponendo dove è possibile giunti elastici o autoallineanti. In caso di sovraccarichi prolungati, urti o pericoli di bloccaggio, installare salvamotori, limitatori di coppia, giunti idraulici od altri dispositivi similari.

I giunti e simili sono in generale dispositivi con contenuto di sicurezza anche agli effetti Ex, e devono essere conformi ATEX per l'ambiente di impiego o di conserva valutati all'interno dell'insieme di destinazione. Lo stesso vale per gli altri dispositivi testé menzionati).

Nel fissaggio pendolare l'albero della macchina costituisce il vincolo alla traslazione radiale e assiale del riduttore; il vincolo alla rotazione deve essere imposto utilizzando gli appositi attacchi sulla carcassa in modo che si abbia un gioco tale da consentire piccole oscillazioni evitando l'iperstaticità alla struttura.

6. INSTALLATION

6.5 FASTENING THE UNIT

Unit shall be fastened by means of the suitable securing holes located on the bases.
Make sure that the fastening of the gearbox to the load-bearing structure is steady so to be able to eliminate any possible vibration and also make sure that the fastening is done between machined surfaces. Rembember to use anti-loosening systems for the fixing bolts.

Take special care to align the device to the motor and the machinery to be driven by fitting in-between flexible or self-aligning couplings wherever possible. In the event of prolonged overloads, shocks or jamming risks, install motor cut-outs, torque limiters, hydraulic couplings or other similar devices

Couplings and similar devices generally do accomplish with Ex safety requirements and must be complying with ATEX provisions for the working and storing environment to be evaluated as a function of the final assembly. This is also true for the other mentioned devices.

In shaft mounting execution, the shaft is the constraint for radial and axial translation of the gear; rotational constraint must be realized by using the proper eyelets on the casing thus obtaining a gap allowing minor swing and avoiding making the structure hyperstatic.

6. INSTALLATION

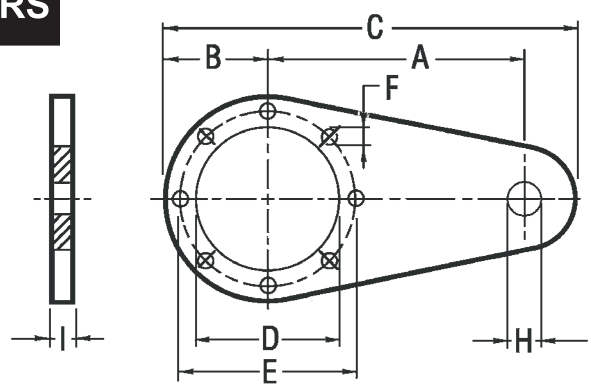
6.5 BEFESTIGUNG DES AGGREGATS

Die Befestigung muss über die an den Gestellen vorgesehenen Bohrungen erfolgen.
Sich darüber vergewissern, dass die Befestigung des Getriebes an die tragende Struktur stabil ist, so dass jegliche Schwingung beseitigt wird. Die Befestigung muss auf bearbeiteten Flächen und unter Anwendung von Lösungssicherungssystemen der Anzugs-schrauben erfolgen.
Insbesondere ist dabei die Fluchtung der Vorrichtung mit dem Motor und der zu steuernden Maschine zu beachten, dazu können, wo möglich, elastische oder selbstfluchtende Kupplungen verwendet werden. Bei länger andauernden Überlastungen, Stössen oder Klemmgefahr müssen ein Motorschutzschalter, eine Rutschkupplung, hydraulische Kupplungen oder andere ähnliche Vorrichtungen installiert werden.

Die Kupplungen und ähnliche Vorrichtungen sind im Allgemeinen Systeme die auch im Sinne der Ex den Sicherheitsbestimmungen entsprechen, sie müssen jedoch auch als Einheit mit ihrer Betriebsapplikation im Hinblick auf den Einsatz- oder Aufbewahrungsort der ATEX-Norm entsprechen. Dies gilt auch für die zuvor genannten Vorrichtungen).
Bei einer Aufsteckbefestigung stellt die Welle der Maschine die Einschränkung für die radiale und axiale Verschiebung des Getriebes dar. Die Befestigung bezüglich der Drehung muss durch den Einsatz entsprechender Anschlüsse am Gehäuse so erfolgen, das ein solches Spiel verbleibt, dass kleine Schwingungen ermöglicht und so ein hyperstatischer Zustand der Struktur vermieden werden kann.

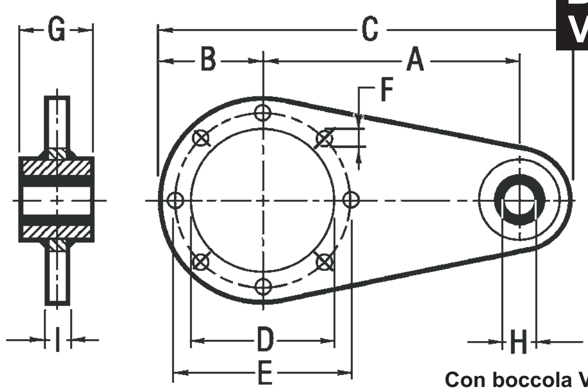


BRS



Standard

BRS VKL



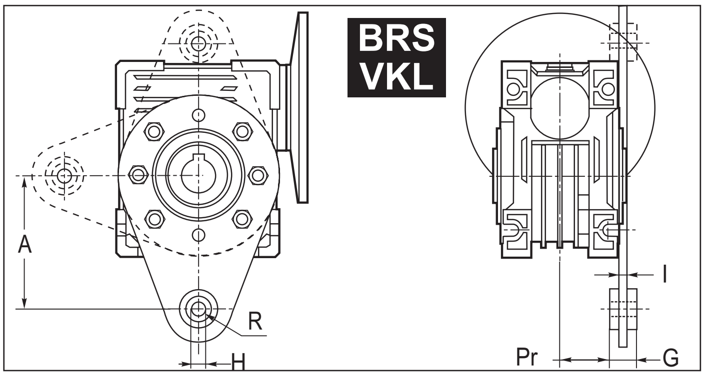
Con boccola VKL
With VKL bushing
Mit VKL-Buchse

RI - RMI	28	40	50	63	70	85	110	130	150	180	215	250
CRI - CRMI	28/28	28/40 40/40	28/50 40/50	28/63 40/63	28/70 40/70 50/70 63/70	40/85 50/85 63/85 70/85	50/110 63/110 70/110 85/110	63/130 70/130 85/130	85/150 110/150	85/180 110/180 130/180	110/215	130/250
CR - CB	—	40	50	—	70	85	110	130	150	180	215	250
A	70	90	100	150	150	200	250	300	350	400	350	400
B	34,5	50	52.5	53	60	75	100	120	125	150	175	225
C	119,5	165	177.5	230	240	313	388	465	525	610	625	725
D	42,15	60	70	70	80	110	130	180	180	230	250	350
E	56	83	85	85	100	130	165	215	215	265	300	400
F	6,5	7	9	9	9	11	13	13	15	17	17	19
G		15	15	20	20	25	25	30	30	35	60	60
H	9	10	10	10	10	20	20	25	25	35	50	50
I	4	4	4	6	6	6	6	6	6	10	8	10

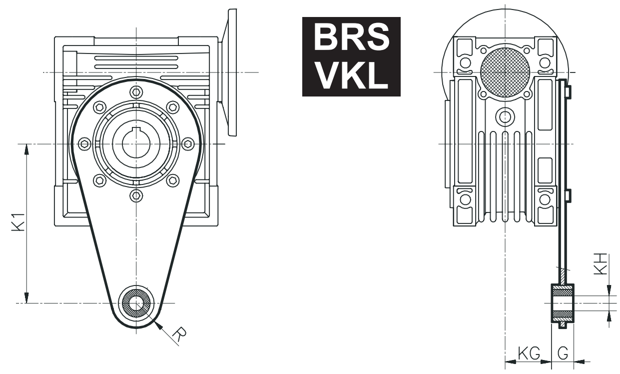
6. INSTALLAZIONE

6. INSTALLATION

6. INSTALLATION



UI - UMI	40	50	63	75	90	110
A	100	100	150	200	200	250
G	15	15	20	25	25	25
H	10	10	10	20	20	20
I	4	4	6	6	6	6
Pr	30	38	46	47.5	57.5	64.5



WI - WMI	25	30	40	50	63	75	90	110	130	150
K1	70	85	100	100	150	200	200	250	250	250
G	14	14	14	14	14	25	25	30	30	30
KG	17,5	24	31,5	38,5	49	47,5	57,5	62	69	84
KH	8	8	10	10	10	20	20	25	25	25
R	15	15	18	18	18	30	30	35	35	35

BRS_VKL 63 - 71 -90 -112

Per il fissaggio del riduttore mediante tirante, viene fornito in allegato l'apposito braccio di reazione con boccola Vulkolan di cui è possibile il montaggio nelle due posizione "A" o "B".

If the gearbox shall be shaft mounted as an extra part, a torque arm with Vulkolan bushing is also available, position "A" or "B".

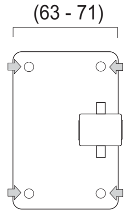
Für die Aufsteckbefestigung des Getriebes ist im Lieferumfang eine entsprechenden Drehmomentenstütze mit Vulkolan-Lagerbuchse enthalten, die sowohl in Einbaulage "A" als auch "B" montiert werden kann.

N.B.
Per il fissaggio del braccio di reazione al corpo fare riferimento alla Fig.

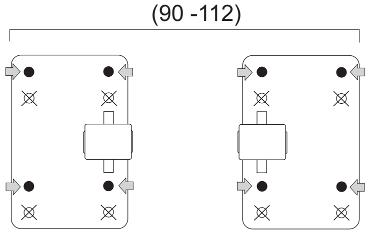
NOTE
To assemble torque arm to body, refer to fig.

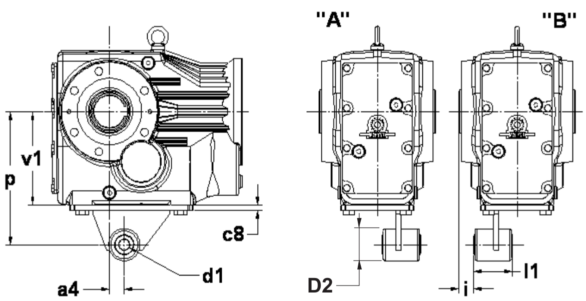
HINWEIS
Die Befestigung der Drehmomentenstütze am Getriebekörper siehe Abb.

(63 - 71)



(90 -112)





	a4	c8	D2	i	p	v1	d1	l1	viti
63	23.5	6	36	20	140	100	10 ± 0.1	34	N° 4TE M10x30 + N° 4 DADI
71	30	6	36	20	160	112	10 ± 0.1	34	N° 4TE M10x25
90	45	8	48	25	200	140	16 ± 0.1	56	N° 4TE M12x25
112	52.5	10	48	25	250	180	16 ± 0.1	56	N° 4TE M16x30

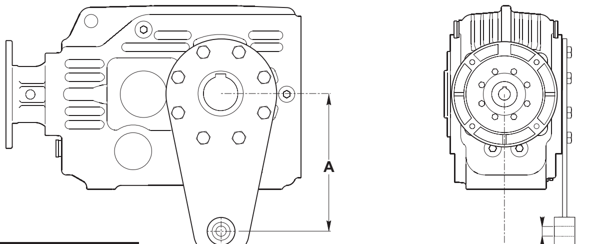
6. INSTALLAZIONE

6. INSTALLATION

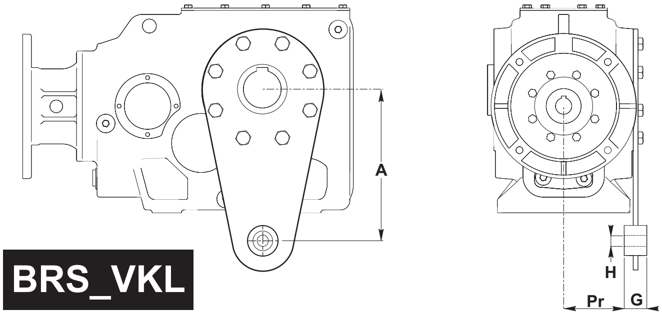
6. INSTALLATION

80 - 100 - 125 - 140 - 160 - 180

132 - 150 - 170 - 190



BRS_VKL



BRS_VKL

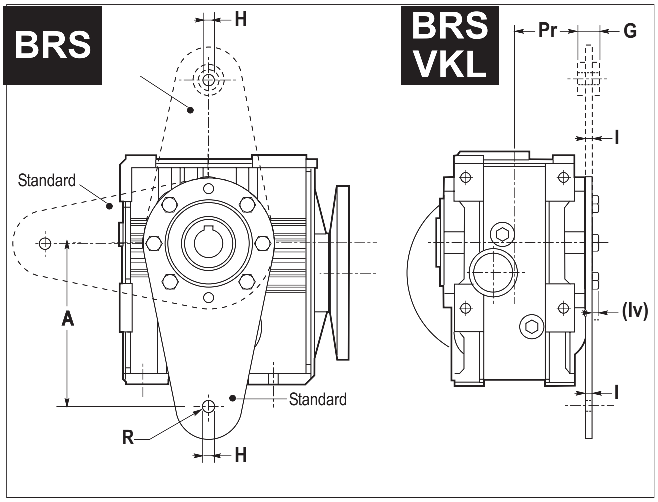
	A	G	H	Pr
80	200	25	20	49
100	200	25	20	61
125	250	30	25	69
140	300	35	35	91
160	450	35	35	132.5
180	450	35	35	152.5

	A	G	H	Pr
132	300	30	25	108
150	350	30	25	120.5
170	450	35	35	132.5
190	450	35	35	152.5

Per il fissaggio del riduttore mediante tirante, viene fornito in allegato l'apposito braccio di reazione.

If the gearbox shall be shaft mounted as an extra part, a torque arm is also available.

Für die Aufsteckbefestigung des Getriebes ist im Lieferumfang eine entsprechenden Drehmomentenstütze.



S SM	BRACCIO DI REAZIONE [T] *TORQUE ARM [T]* DREHMOMENTENSTÜTZE [T]						
	A	G	H	I	Iv	Pr	R
25	100	15	10	4	5	44.5	25
35*	150	15	10	6	5	51.0	25
45	150	20	10	6	5	58	30

* Solo Con Boccola in VKL / *With VKL bushing only* / Nur mit Buchse in VKL

AV

ANTIVIBRANTE VKL

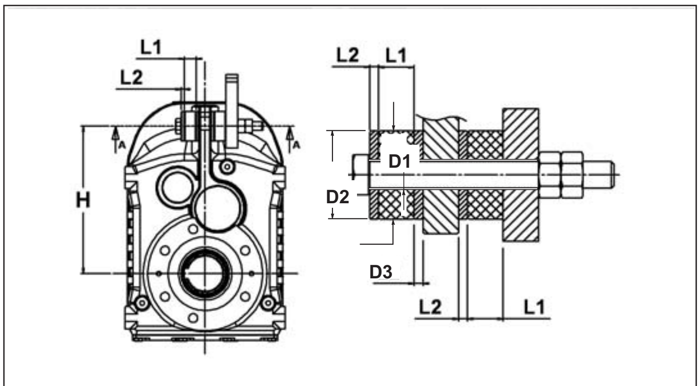
RUBBER BUFFER VKL

SCHWINGUNGSDÄMPFER VKL

Per riduttori e motoriduttori pendolari.

For shaft mounted gearboxes and geared motors.

Für Aufsteckgetriebe und -motoren.



P.P - P.F	D1	D2	D3	L1	L2	H
63	12.5	40	40	16	4	152
71	12.5	40	40	16	4	165
90	12.5	40	40	16	4	200
112	21	60	60	22	8	255
125	21	60	60	22	8	310

6. INSTALLAZIONE

6. INSTALLATION

6. INSTALLATION

AV

ANTIVIBRANTE VKL

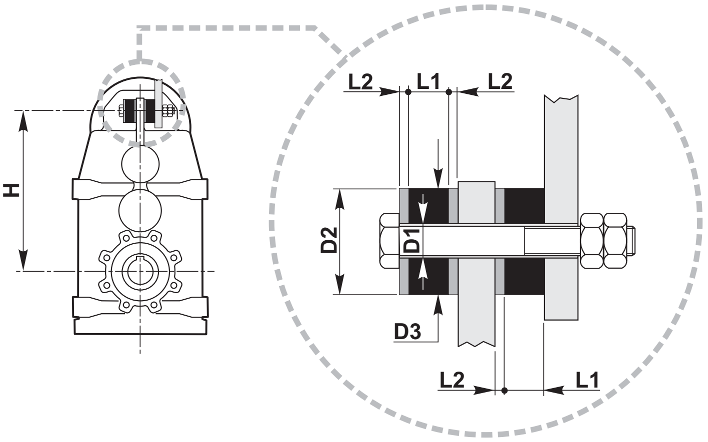
Per riduttori e motoriduttori pendolari.

RUBBER BUFFER VKL

For shaft mounted gearboxes and geared motors.

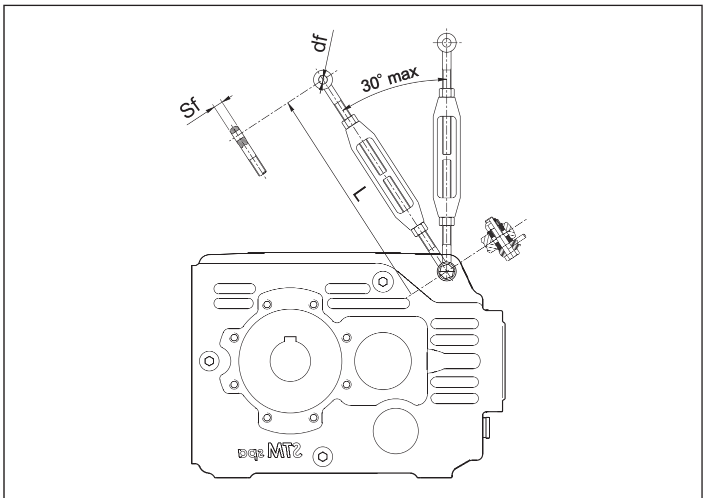
SCHWINGUNGSDÄMPFER VKL

Für Aufsteckgetriebe und -motoren.

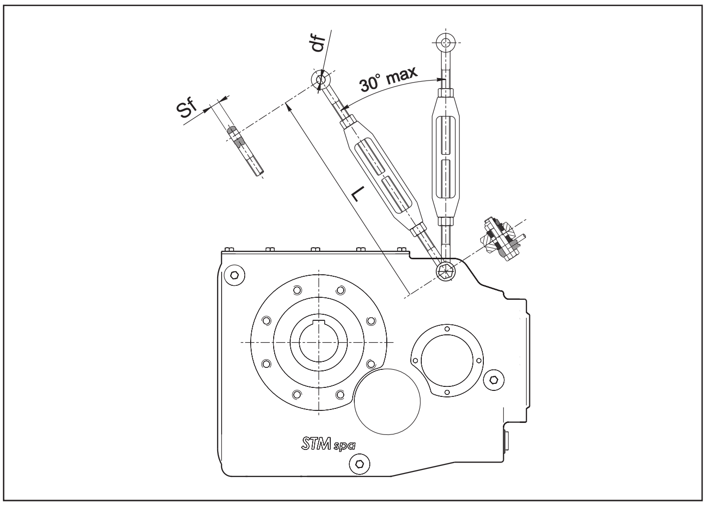


PL..	D1	D2	D3	L1	L2	H
25	12	25	25	16	4	145
45	12.5	40	40	16	4	175
65	12.5	25	25	16	4	225
85	12.5	40	40	16	4	260
95	12.5	40	40	16	4	325
105	22	60	60	22	8	375
115	22	60	60	22	8	450
125	25	70	70	25	10	550
135	32	90	90	32	12	595

TEN



80-100-125-140



132-150-170-190

	df	sf	L
80	14	10	213 - 310
100	17	12	250 - 356
125	18	14	299 - 429
132	28	18	382 - 536
140	28	18	382 - 536
150	28	20	382 - 546
170	34	22	433 - 612
190	38	27	492 - 694

6. INSTALLAZIONE

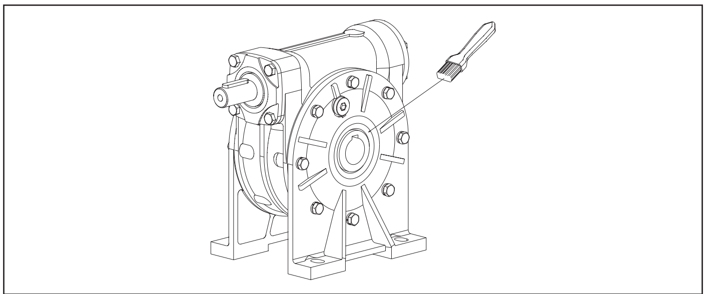
6.6 ASPETTI GENERALI DI INSTALLAZIONE
1 - Il protettivo presente sugli alberi deve essere rimosso con diluente, in ambiente sufficientemente areato evitando il contatto diretto con la pelle; non fumare durante quest'operazione.
2 - Curare l'allineamento con la macchina motrice e operatrice; è consigliabile l'uso di giunti elastici. Lavorare i fori degli elementi calettati sugli alberi nel campo di tolleranza H7 e albero ISO h6;
3 - Utilizzare i fori filettati in testa all'estremità degli alberi per il montaggio di pulegge, ruote, ecc. evitando urti che potrebbero danneggiare i cuscinetti.
4 - Qualora siano previste trasmissioni esterne ridurre al minimo gli sbalzi ed evitare i carichi radiali dovuti a giochi nulli su ingranaggi, tensioni sulle catene e tiri eccessivi sulle cinghie.
5 - Evitare vibrazioni, scegliere superfici di fissaggio sufficientemente rugose, utilizzare sistemi antiallentamento per le viti di serraggio.
6 - Verificare le velocità critiche torsionali nel caso di azionamento di ventilatori.
8 - Prevedere limitatori di momento torcente o dispositivi di sicurezza analoghi, qualora si prevedano funzionamenti con sovraccarichi.
9 - Prevedere dispositivi appositi di prevenzione e sicurezza qualora un accidentale perdita di lubrificante possa causare danni importanti.
10 - Evitare inquinamento del lubrificante dall'esterno.
11 - Proteggere le tenute da intemperie e irraggiamenti solari diretti con grasso idrorepellente.

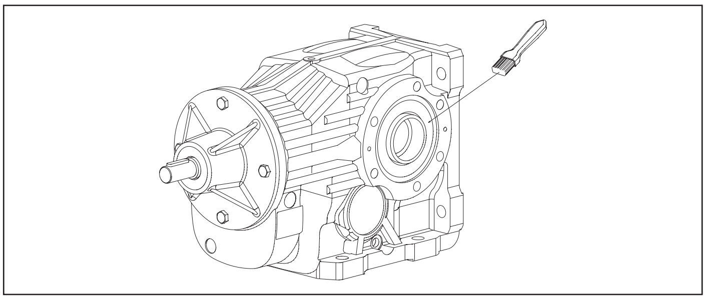
6. INSTALLATION

6.6 GENERAL INSTALLATION FEATURES
1 - Use diluent to remove protective coating on shafts in a well-aired environment, avoiding direct contact with skin. Refrain from smoking during this operation.
2 - The gear unit must be perfectly aligned with the driving and operating machine; the use of flexible couplings is recommended wherever possible. Machine the holes of components to be fitted to the gear unit shafts within a tolerance of H7 and shaft ISO h6;
3 - Use the threaded shaft end holes when fitting pulleys, couplings, etc. avoid any shocks when mounting which could damage bearings.
4 - In case of external drives, reduce overhang to a minimum and avoid radial load due to excessive tension of belt or chain pull and low clearance on teeth.
5 - Avoid vibrations; gear unit must be mounted on a sufficiently rough surface; use anti-loosening systems for retaining screws.
6 - Verify critical torsional speeds in case of fan drive gear units.
8 - Foresee torque limiters or similar safety devices in case of application with overload.
9 - Foresee protection and safety devices in case an accidental leakage of lubricant might cause major damage.
10 - Prevent lubricant from being contaminated by the outside.
11 - Protect the oil seals from direct sunbeams or bad weather by using water-repellent grease.

6. INSTALLATION

6.6 ALLGEMEINE ASPEKTE ZUR INSTALLATION
1 - Das auf den Wellen vorhandene Schutzmittel muss mit einem Verdünnungsmittel an einem ausreichend belüfteten Ort entfernt werden. Dabei ist ein direkter Hautkontakt zu vermeiden und es darf dabei nicht geraucht werden.
2 - Die Fluchtung zwischen Antriebs- und Arbeitsmaschine besonders sorgfältig vornehmen, dazu wird der Einsatz elastischer Kupplungen empfohlen. Die auf die Wellen aufgezogenen Elemente im Toleranzbereich H7 und die Welle gemäß ISO h6 bearbeiten.
3 - Für die Montage der Riemenscheiben, Räder, usw. die am Kopfende der Wellen vorgesehenen Gewindebohrungen verwenden und dabei Stöße vermeiden, die zu Lagerschäden führen könnten.
4 - Sollten externe Antriebe vorgesehenen sein, die Überstände auf ein Mindestmaß beschränken und vermeiden, dass durch zu wenig Spiel an den Zahnrädern, übermäßige Spannungen an den Ketten oder Riemen Radialkräfte erzeugt werden.
5 - Schwingungen vermeiden, ausreichend rauhe Befestigungsflächen wählen und Lösungschutzsysteme an den Anzugs-schrauben verwenden.
6 - Die kritischen Drehzahlen beim Gebläseantrieben überprüfen.
8 - Sollte ein Betrieb vorgesehen sein, bei dem es zu Überbelastungen kommen kann, sind entsprechende Drehzahlbegrenzer oder gleich-wertige Sicherheitsvorrichtungen vorzusehen.
9 - Falls eine unvorhersehbare Ölleckage schwere Schäden verursachen könnte, müssen entsprechende Vorsorge- und Schutzvorrichtungen vorgesehen werden.
10 - Eine Verschmutzung des Schmiermittels durch externe Einflüsse vermeiden.
11 - Die Dichtungen vor Schlechtwetter-einflüssen und direkten Sonneneinstrahlungen durch Auftrag von wasserabstossendem Fett schützen.





6. INSTALLAZIONE

6.7 MONTAGGIO - SMONTAGGIO ALBERO LENTO CAVO
Il montaggio dei riduttori ad albero lento cavo con linguette avviene mediante l'aiuto di tiranti ed estrattori servendosi del foro filettato in testa all'estremità d'albero.

Prima di effettuare il montaggio bisogna pulire e lubrificare le superfici di contatto, per evitare pericoli di grippaggio e per limitare l'ossidazione da contatto.

6. INSTALLATION

6.7 ASSEMBLY - DISASSEMBLY OF OUTPUT HOLLOW SHAFT
Assembly of output hollow shaft gearboxes with keys is performed by means of pullers and extractors working on the tapped hole at the shaft end.

Before assembly clean and lubricate all mating surfaces to avoid the risk of seizure and limit contact oxidation.

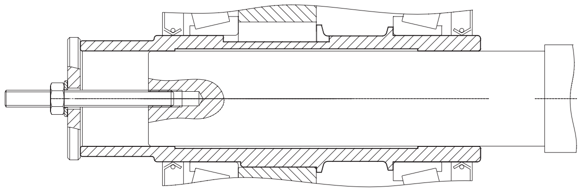
6. INSTALLATION

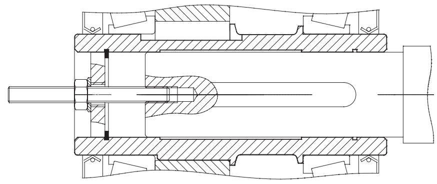
6.7 EIN- UND AUSBAU ABTRIEBSHOHLWELLE
Die Montage der Getriebe mit hohler Abtriebswelle unter Einsatz von Federkeilen erfolgt mit Hilfe von Zugstangen und Abziehern, die man in die oben am Wellenende vorgesehene Gewindebohrung einfügt.

Vor einer Montage muss man die Kontaktflächen reinigen und schmieren, um so ein Einfressen zu verhindern und die Bildung von Kontaktrost einzuschränken.

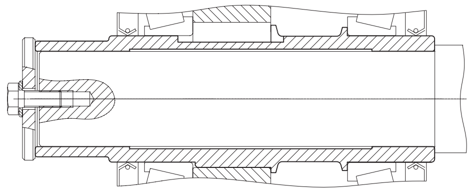
Only PLR 45-85-95

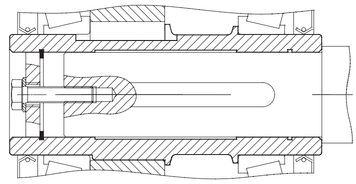
MONTAGGIO
ASSEMBLY
MONTAGE



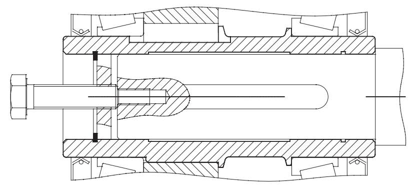


BLOCCAGGIO
FIXING
BLOCKIERUNG





SMONTAGGIO
DISASSEMBLY
AUSBAU



6. INSTALLAZIONE

6.8 MONTAGGIO - SMONTAGGIO UNITA' DI BLOCCAGGIO

Pulire accuratamente le superfici di contatto dell'albero e del mozzo.
Applicare sulle stesse una leggera pellicola d'olio.
Inserire l'unità di bloccaggio all'esterno dell'albero cavo.
Serrare le viti in modo graduale ed uniforme con sequenza continua sino a raggiungere la coppia di serraggio **Ms** indicata in tabella.
Per raggiungere la coppia di serraggio **Ms** richiesta sono necessari più serraggi delle viti.

Attenzione: non usare **bisolfuro di molibdeno** o altri grassi, causa di notevoli riduzioni del coefficiente d'attrito.

In particolare è consiglato serrare le viti secondo lo schema a croce ma qualora il numero delle viti è superiore a 12, per facilitare le operazioni di montaggio è consentito il serraggio sequenziale prestando paricolare attenzione allo schema indicato in figura.

6. INSTALLATION

6.8 ASSEMBLY - DISASSEMBLY OF BLOCK UNIT

Carefully clean the contact surfaces of the shaft and the hub.
Smear the same with a light film of oil.

Place the block unit outside the hollow shaft.

*Gradually tighten the screws in an even way, with a continuous sequence until reaching the tightening torque **Ms** indicated in table.*

*Tighten screws in steps to reach the tightening torque **Ms**.*

***Attention:** do not use **molybdenum disulphide** or other greases; it would cause big reductions of friction coefficient.*

It is recommended to tighten the screws in a cross pattern, but it is allowed to tighten screws in a sequence in case there are more than 12, to facilitate assembly operations; in this case special attention should be paid to the diagram in the figure.

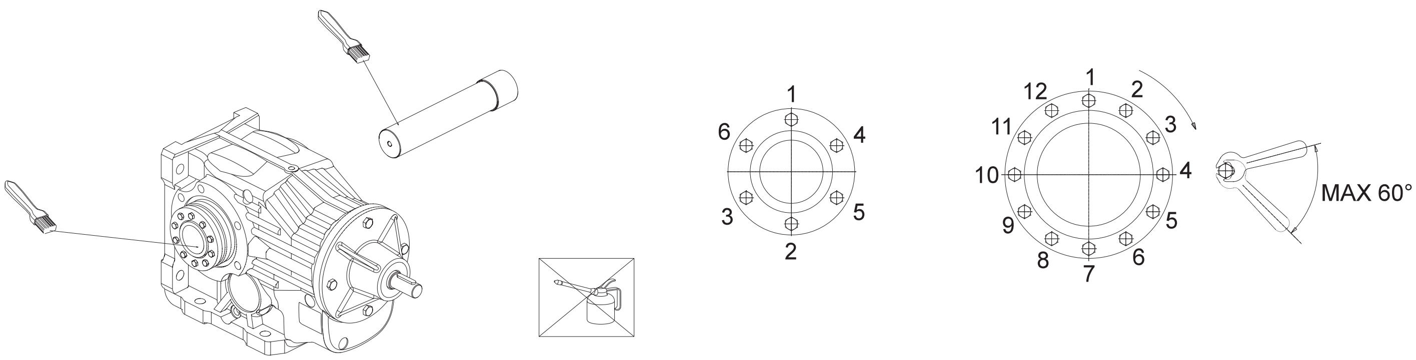
6. INSTALLATION

6.8 EIN- UND AUSBAU DER SPERREINHEIT

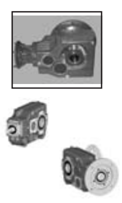
Die Kontaktflächen der Welle und der Nabe sorgfältig reinigen.
Einen leichten Ölfilm auf diesen Flächen auftragen.
Die Sperreinheit extern an der Hohlwelle anbringen.
Die Schrauben schrittweise und gleichmäßig in Dauersequenz anziehen, bis das Anzugsmoment **Ms,** das in der Tabelle angegeben wird, erreicht wurde.
Für das Erreichen des erforderlichen Anzugsmoments **Ms** müssen die Schrauben mehrfach angezogen werden.

Achtung: Kein **Molybdändisulfid** oder andere Fette verwenden, da dadurch der Reibungsbeiwerts erheblich gemindert werden würde.

Insbesondere wird empfohlen die Schrauben einem Kreuzschema gemäß anzuziehen. Sollten jedoch mehr als 12 Schrauben angezogen werden müssen, ist im Sinne einer einfacheren Montage, auch ein sequentieller Anzug zulässig, wobei besondere Aufmerksamkeit auf das abgebildete Schema gerichtet werden muss.



			63	71	80	90	100	112	125
	**O**								
	Coppia serraggio / Tightening torque / Anzugsmoment **Ms** [Nm]	DIN 931 **10.9**	12	12	12	12	12	12	12
		DIN 931 **12.9**	-	-		-		-	
	Viti di serraggio *Retaining screws* Anzugsschrauben	N° x M	5 x M6	7 x M6	7 x M6	8 x M6	8 x M6	10xM6	10xM6
	Coppia Slittamento Slipping torques Rutsch- momente T_{FU} [Nm]		570	780	780	1160	1520	2200	2500

			132		140	150		160 170	180 190
	**O**								
	Coppia serraggio / Tightening torque / Anzugsmoment **Ms** [Nm]	DIN 931 **10.9**	-	-	-	-	-	-	-
		DIN 931 **12.9**	35	35	35	35	35	71	71
	Viti di serraggio *Retaining screws* Anzugsschrauben	N° x M	7x M8	10x M8	10x M8	10x M8	12x M8	12x M10	12x M10
	Coppia Slittamento Slipping torques Rutsch- momente T_{FU} [Nm]		**ø 60** 4600	**ø 70** 8300	8300	**ø 70** 8300	**ø 80** 12000	20200	23000

			25	35	45
	**S**				
	Coppia serraggio / Tightening torque / Anzugsmoment **Ms** [Nm]	DIN 931 **10.9**	4	4	12
		DIN 931 **12.9**	-	-	-
	Viti di serraggio *Retaining screws* Anzugsschrauben	N° x M	6 x M5	7 x M5	7 x M6
	Coppia Slittamento Slipping torques Rutsch- momente T_{FU} [Nm]		170	340	780

6. INSTALLAZIONE

6. INSTALLATION

6. INSTALLATION

	**P**		**63**	**71**	**90**	**112**	**125**
	Coppia serraggio / Tightening torque / Anzugsmoment **Ms** [Nm]	DIN 931 **10.9**	12	12	12	12	12
		DIN 931 **12.9**	-	-	-	-	-
	Viti di serraggio *Retaining screws* Anzugsschrauben	N° x M	5 x M6	7 x M6	8 x M6	10xM6	10 x M6
	Coppia Slittamento Slipping torques Rutsch- momente T_{FU} [Nm]		570	780	1160	2200	2500

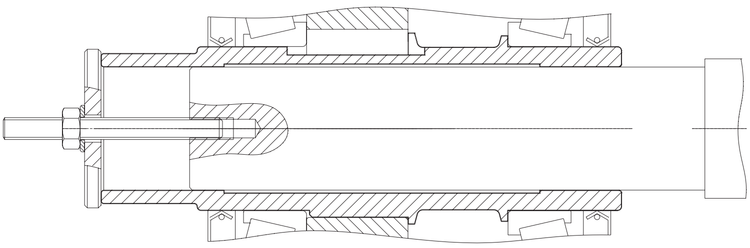
	**PL**		**25**	**45**	**65**	**85**	**95**
	Coppia serraggio / Tightening torque / Anzugsmoment **Ms** [Nm]	DIN 931 **10.9**	4	12	12	12	12
		DIN 931 **12.9**	-	-	-	-	-
	Viti di serraggio *Retaining screws* Anzugsschrauben	N° x M	6 x M5	5 x M6	7 x M6	8 x M6	10 x M6
	Coppia Slittamento Slipping torques Rutsch- momente T_{FU} [Nm]		210	570	780	1520	2500

	**PL**		**105**		**115**		**125**	**135**
	Coppia serraggio / Tightening torque / Anzugsmoment **Ms** [Nm]	DIN 931 **10.9**	-	-	-	-	-	-
		DIN 931 **12.9**	35	35	35	35	71	71
	Viti di serraggio *Retaining screws* Anzugsschrauben	N° x M	7 x M8	10 x M8	10 x M8	12 x M8	12 x M10	12 x M10
	Coppia Slittamento Slipping torques Rutsch- momente T_{FU} [Nm]		**ø 60** 4600	**ø 70** 8300	**ø 70** 8300	**ø 80** 12000	20200	23000

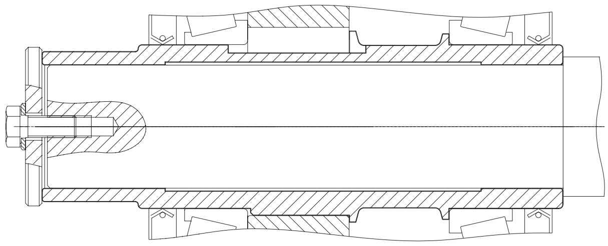
	**PT**		**80**	**100**	**125**
	Coppia serraggio / Tightening torque / Anzugsmoment **Ms** [Nm]	DIN 931 **10.9**	12	12	12
		DIN 931 **12.9**			
	Viti di serraggio *Retaining screws* Anzugsschrauben	N° x M	7 x M6	8 x M6	10xM6
	Coppia Slittamento Slipping torques Rutsch- momente T_{FU} [Nm]		780	1520	2500

	**PT**		**132**		**140**	**150**		**170**	**190**
	Coppia serraggio / Tightening torque / Anzugsmoment **Ms** [Nm]	DIN 931 **10.9**	-	-	-	-	-	-	-
		DIN 931 **12.9**	35	35	35	35	35	71	71
	Viti di serraggio *Retaining screws* Anzugsschrauben	N° x M	7 x M8	10 x M8	10x M8	10 x M8	12 x M8	12 x M10	12 x M10
	Coppia Slittamento Slipping torques Rutsch- momente T_{FU} [Nm]		**ø 60** 4600	**ø 70** 8300	8300	**ø 70** 8300	**ø 80** 12000	20200	23000

MONTAGGIO
ASSEMBLY
MONTAGE



BLOCCAGGIO
FIXING
BLOCKIERUNG



6. INSTALLAZIONE

6.9 QUICK LOCK - QL

6.9.1 - Montaggio KIT QL
A) Il KIT QUICK LOCK è composto dai seguenti componenti:
1 - Bussola;
2 - Linguetta

B) Inserire la linguetta (2) nella sede linguetta della bussola (1) e montare la bussola nell'albero cavo del riduttore.

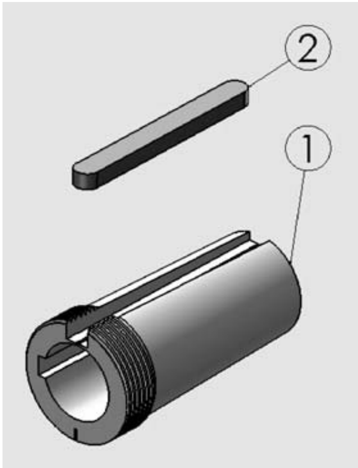
C) Per fissare la bussola (1) all'albero uscita cavo del riduttore eseguire due giri della ghiera seguendo la freccia come riportato nella targhetta.

Non avvitare mai il grano come riportato nella targhetta.

6. INSTALLATION

6.9 QUICK LOCK - QL

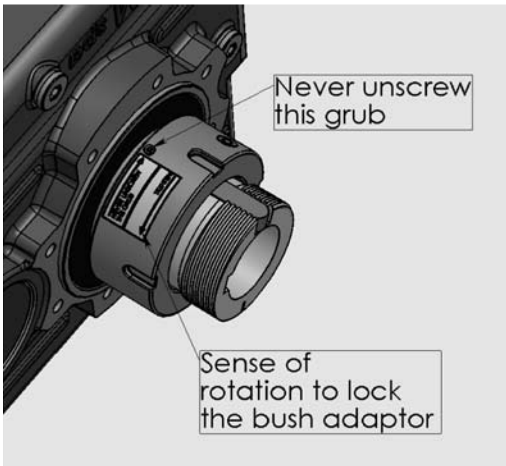
6.9.1 - ASSEMBLY KIT QL
A) The kit for QUICK LOCK device is composed by:
1 - Bush adaptor
2 - Key



B) Insert the key (2) in the keyway of the Bush Adaptor (1) and drive the Bush Adaptor in the hollow shaft of the gearbox.

C) To fit the Bush Adaptor (1) into the hollow shaft of the gearbox, tighten the nut two turns, following the arrow drawn on the sticker.

Never unscrew the grub indicated by the arrow drawn on the same sticker.



6. INSTALLATION

6.9 QUICK LOCK - QL

6.9.1 - Montage KIT QL
A) Das KIT QUICK LOCK enthält folgende Bauteile:
1 - Buchse;
2 - Passfeder

B) Die Passfeder(2) in die entsprechende Aufnahme der Buchse (1) einfügen, dann die Buchse in der Hohlwelle des Getriebes montieren.

C) Um die Buchse (1) an der Abtriebshohlwelle des Getriebes befestigen zu können, die Einstellmutter den Angaben auf dem Schild gemäß um zwei Umdrehungen in Pfeilrichtung drehen.

Den Stift nie einschrauben, siehe Schild.

6. INSTALLAZIONE

6.9 QUICK LOCK - QL

6.9.2 - Installazione del riduttore con QL

A) Montare il riduttore provvisto di Bussola nell'albero macchina.
B) Inserire il riduttore nella posizione così che la distanza "A" non risulti inferiore a 6mm e non sia maggiore del diametro dell'albero macchina.
C) girare la ghiera con l'apposita chiave (non fornita) verificando che la coppia di serraggio non superi i 70 Nm;
D) Inserire il grano con testa in bronzo ed avvitare per evitare la rotazione della ghiera.

6. INSTALLATION

6.9 QUICK LOCK - QL

6.9.2 - Installation of the gearbox with Quick Lock device

A) Insert the gearbox, with Bush Adaptor (1) into the hollow shaft , on driven machine shaft.
B) Fit the gearbox in the position desired, so that the distance "A" is not less than 6mm and not greater than the diameter of the shaft machine.
C) Tighten the nut with wrench (not provided) making sure to not exceed the torque of 70Nm
D) Fit the grub with bronze head into the nut and thigh it to avoid the rotation of the nut.

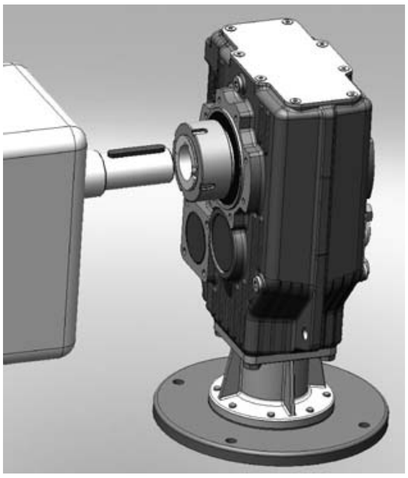
6. INSTALLATION

6.9 QUICK LOCK - QL

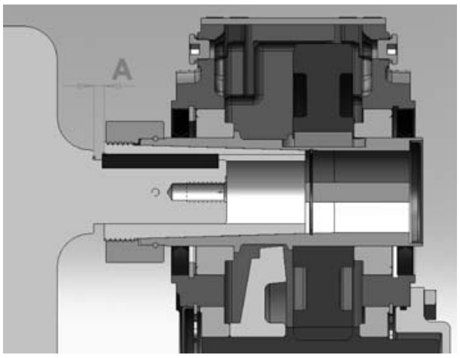
6.9.2 – Installation des Getriebes mit QL

A) Das Getriebe mit Buchse in der Maschinenwelle montieren.
B) Das Getriebe in seine Position einfügen, so dass der Abstand „A" nicht geringer als 6mm und nicht über dem Durchmesser der Maschinenwelle resultiert.
C) Die Einstellmutter mit dem entsprechenden Schlüssel (nicht im Lieferumfang enthalten) anschrauben und prüfen, dass der Anzugsmoment 70 Nm nicht überschritten wird.
D) Den Stift mit dem Bronzekopf einfügen und einschrauben, um zu verhindern, dass sich die Einstellmutter dreht.

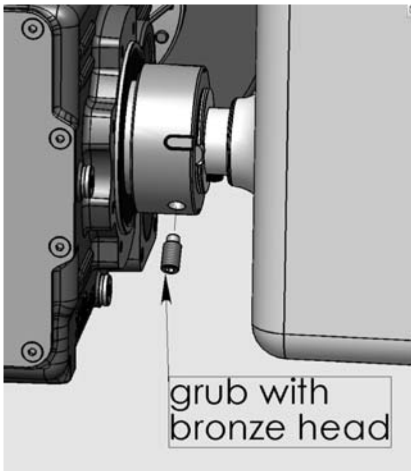
A



B



D



6.9.3 - SMONTAGGIO - Quick Lock - QL

Ripetere le stesse istruzioni elencate nel paragrafo 6.9.2 ma in senso inverso per smontare il riduttore dall'albero macchina

6.9.3 - DISASSEMBLY of Quick Lock device - QL

To repeat the same instructions 6.9.2, but in reverse, to dismount the gearbox from the shaft machine.

6.9.3 - AUSBAU - Quick Lock – QL

Für die Abnahme des Getriebes von der Maschinenwelle die im Abschnitt 6.9.2 enthaltenden Arbeitsschritte im umgekehrten Sinn wiederholen.

6. INSTALLAZIONE

6.10 CONNESSIONE MOTORE/RIDUTTORE CON GIUNTO STM/ROTEX
Qualora la connessione tra riduttore e macchina motrice sia effettuata con un giunto è necessario verificare se è necessario montare un linguetta di dimensioni a disegno STM.

La linguetta e la targhetta nella quale sono riportate le istruzioni di montaggio sono allegate ad ogni fornitura.
Qualora non fornite segnalare il problema al Nostro Ufficio Commerciale ed attenersi alla presenti istruzioni per l'istallazione del motore sul riduttore.

Nelle prossime pagine sono allegate targhette con le relative istruzioni di montaggio.

6.10.1 GIUNTO A DISEGNO "STM"

6. INSTALLATION

6.10 CONNECTING THE MOTOR AND GEARBOX WITH STM/ROTEX JOINT
If gearbox and driving machine are connected by means of a joint, check whether it is necessary to install a key sized as specified on STM drawing.

Key and nameplate indicating assembly instructions come with any supply.

Should they be missing, report this problem to our Sales Dept. and follow these instructions for installing the motor to gearbox.

The following pages show some of the nameplates bearing the installation instructions.

6.10.1 JOINT TO "STM" DRAWING

6. INSTALLATION

6.10 VERBINDUNG ZWISCHEN MOTOR UND GETRIEBE ÜBER KUPPLUNG STM/ROTEX
Bei Verbindung zwischen Getriebe und Antriebseinheit über eine Kupplung muss überprüft werden, ob die Montage einer Passfeder gemäß STM-Maßzeichnung erforderlich ist.
Der Federkeil und das Schild, auf dem die Montageanleitung wiedergegeben wird, sind im Lieferumfang enthalten.
Sollten sie nicht mitgeliefert worden sein, muss dies unserer Verkaufsabteilung mitgeteilt werden. Für die Installation des Motors am Getriebe muss man sich an die entsprechenden Anleitungen halten.
Auf den folgenden Seiten werden die Blätter mit den entsprechenden Montageanleitungen angefügt.

6.10.1 KUPPLUNG GEMÄSS "STM"-ZEICHNUNG

CODICE TARGHETTA - CODE PLATE
1080031271

1.12.4 Installazione

Prescrizioni di installazione del Motore con Riduttore.

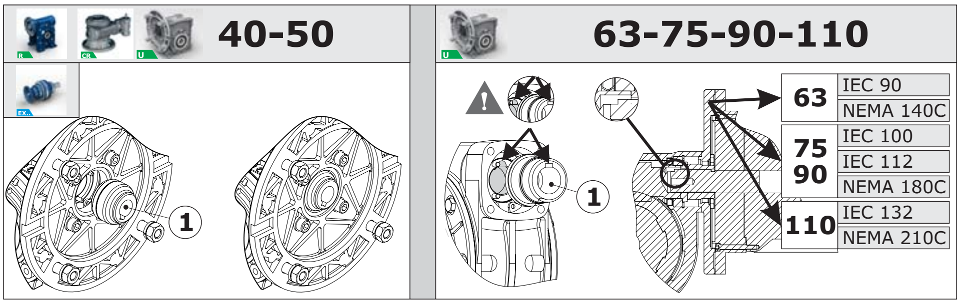
1.12.4 Installation

Instructions for installing motor on gearbox.

1.12.4 Montage

Installation des Motors mit dem Getriebe.

Giunto a disegno STM / *Coupling made to STM drawing* / Kupplung gemäß STM-Zeichnung



FASI DI INSTALLAZIONE:
A1) **UMI 40-50 - EX:**

Montare il componente 1 applicando una pressione manuale.
Eventualmente usare un piccolo martello di plastica per agevolare l'inserimento del componente.

A2)**UMI 63-75-90-110:**

A2.1 - Nei riduttori con le predisposizioni riportate in figura, prima di procedere al montaggio del componente 1, allineare la sede della linguetta presente nel componente con la corrispettiva sede presente nella vite senza fine.

A2.2 - Montare il componente 1 applicando una pressione manuale.
Eventualmente usare un piccolo martello di plastica per agevolare l'inserimento del componente.

B) Apporre un film di grasso sull'albero del motore elettrico;
C) Montare il motore elettrico sul riduttore e serrare le viti.

INSTALLATION STEPS:
A1) **UMI 40-50 - EX:**

Install part 1 by applying lightly pressure. If it would be necessary, use a small plastic hammer to facilitate the insertion of the component.

A2)**UMI 63-75-90-110:**

A2.1 - For gearboxes with arrangement shown in the figure, before starting installation of the component 1, align the key groove in this component with the corresponding groove of the worm..

A2.2 - Install part 1 by applying lightly pressure. If it would be necessary, use a small plastic hammer to facilitate the insertion of the component.

B) Apply grease on the electric motor shaft;

C) Assemble electric motor into the gearbox and tighten screws.

MONTAGESCHRITTE
A1) **UMI 40-50 - EX:**

Der Einbau der Komponente 1 erfolgt mit leichtem, manuellem Druck. Verwenden Sie gegebenenfalls einen kleinen Kunststoffhammer, um das Einsetzen des Bauteils zu erleichtern.

A2)**UMI 63-75-90-110:**

A2.1 - Bei Getrieben mit Vorbereitung, wie im Bild dargestellt, muss vor Einbau der Komponente 1 die Passfedernut entsprechend der Nut der Schneckenwelle ausgerichtet werden.

A2.2 - Der Einbau der Komponente 1 erfolgt mit leichtem, manuellem Druck. Verwenden Sie gegebenenfalls einen kleinen Kunststoffhammer, um das Einsetzten des Bauteils zu erleichtern.

B) Fetten sie die Motorwelle des Elektromotors ein;
C)Montieren sie Elektromotor am Getriebe und sichern sie die Schrauben.

FASI DI SMONTAGGIO
Prima di procedere allo smontaggio del motore assicurarsi che il motore sia assicurato ad un sistema di sollevamento tramite cinghia onde prevenire danni a persone o cose.
Questo per evitare che durante lo smontaggio delle viti di serraggio tra motore e riduttore il motore posso cadere a terra.

Per ulteriori informazioni contattare il Nostro Ufficio Tecnico.

DE-INSTALLATION
Before starting de-installation, please assure that the engine is secured with a suitable hoist to prevent injury or damage. This action is necessary because, with release of the locking screws between the gearbox and engine, the engine could fall to the ground.

Contact our Technical Dept. for more information

DEMONTAGE
Bevor Sie mit der Demontage beginnen, stellen Sie bitte sicher, dass der Motor mit einem geeigneten Hebezeug vor Absturz gesichert ist, um Personen- und Sachschäden zu verhindern.Diese Maßnahme ist notwendig, da bei Lösen der Spannschrauben zwischen Getriebe und Motor der Motor zu Boden fallen könnte.

Für weitere Informationen wenden Sie sich bitte an unsere Konstruktionsabteilung.

6. INSTALLAZIONE

6.10.1 GIUNTO A DISEGNO "STM"

6. INSTALLATION

6.10.1 JOINT TO "STM" DRAWING

6. INSTALLATION

6.10.1 KUPPLUNG GEMÄSS "STM"-ZEICHNUNG

CODICE TARGHETTA - CODE PLATE 1080031031

1.12.4 Installazione

Prescrizioni di installazione del Motore con Riduttore.

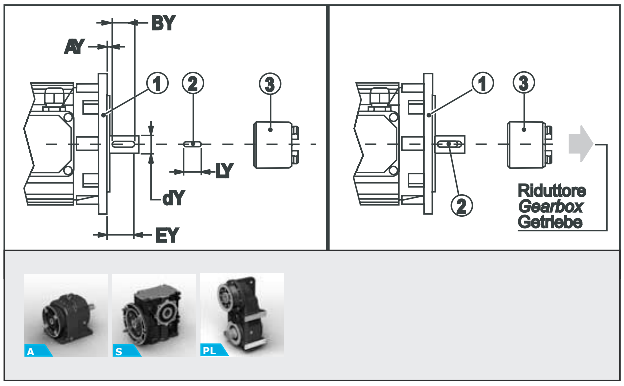
1.12.4 Installation

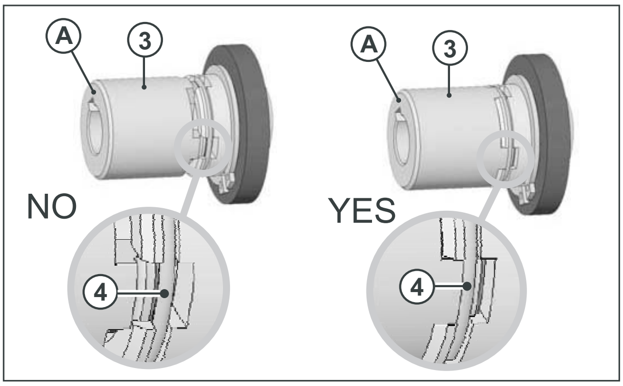
Instructions for installing motor on gearbox.

1.12.4 Montage

Installation des Motors mit dem Getriebe.

Giunto a **disegno STM** /*Coupling* ***made to STM*** *drawing*/ Kupplung gemäß **STM-Zeichnung**





A	PL	S	IEC	dY	EY	Key	BY	AY ⚠	LY
-	-	-	**71**	14	30	5 x 5	20	< 6	**16**
-	-	25	**80**	19	40	6 x 6	30	< 6	**20**
41	-	35-45	**90**	24	50	8 x 7	40	< 6	**20**
45	45	-	**100-112**	28	60	8 x 7	50	< 6	**25**
-	-	-	**132**	38	80	10 x 8	70	< 6	**30**

Linguetta con dimensione LY a disegno STM.
I riduttori nei PAM riportati in tabella sono forniti con allegato il KIT boccola + linguetta.

1) Se la quota AY misurata è minore o uguale a quella riportata in tabella si può procedere al montaggio utilizzando una linguetta di dimensioni LY;
2) Se la quota AY misurata è maggiore a quella riportata in tabella è necessario montare una linguetta di dimensione LY ridotta della differenza della quota AY misurata rispetto a quella indicata in tabella.

FASI DI INSTALLAZIONE:
A) Montare il componente 2 (linguetta) sul componente1 (motore elettrico);
B) Montare il componente 3 (giunto) sul riduttore;

C) Verificare che il giunto sia correttamente montato controllando che la molla (4) sia incastrata nella sede del giunto (3).

Pertanto si richiede di dare un paio di colpi con un martello di plastica sulla superficie "A" del componente 3 (giunto);

D) Apporre un film di grasso sull'albero del motore elettrico;
E) Montare il componente 1 (motore elettrico) sul riduttore e serrare le viti.

Tab with size LY to STM drawing.
The gearboxes in the PAMs shown on the table are Supplied with the bushing + tab kit.

1) If the measured value AY is less or equal than the value in the table, the installation will be continued by using a key with dimension LY;
2) If the resulting value AY is bigger than indicated in the table, it is necessary to use a key with dimension LY, which is reduced according to the value AY in the table.

STEP INSTALLATION
A) Assemble part 2 (key) on component 1 (electric motor);
B) Assemble component 3 (coupling) on the gearbox;
C) Verify coupling to be correctly aligned and relevant spring (4) to be inserted in the coupling seat (3)
Consequently, it is probably needed to slightly hammer the component 3 (coupling) on surface "A".

D) Apply grease on the electric motor shaft;

E) Assemble component 1 (electric motor) into the gearbox and tighten screws.

Lamelle mit Maß LY nach Zeichnung von STM. Die in der Tabelle angegebenen Getriebe in den PAM werden mit dem KIT Buchse + Lamelle geliefert.

1) Wenn der ermittelte Messwert AY kleiner oder gleich dem Wert in der Tabelle ist, kann mit der Montage, durch Verwendung einer Passfeder der Größe LY, fortgefahren werden;
2) Ist der ermittelte Wert AY größer als in der Tabelle angegeben, ist es notwendig, eine Passfeder der Größe LY zu verwenden, welche entsprechend der Maßzahl AY in der Tabelle reduziert ist.

MONTAGE
A) Montieren sie Teil 2 (Paßfeder auf Teil 1 (Elektromotor);
B) Montieren sie Teil 3 (Kupplung) am Getriebe;
C)
Überprüfen sie die korrekte Ausrichtung und ob die wichtige Feder (4)im Kupplungssitz (3) eingelegt ist.
Möglicherweise ist es erforderlich den Teil 3 (Kupplung) mit leichten Hammerschlägen auf die Oberfläche "A" aufzubringen.

D) Fetten sie die Motorwelle des Elektromotors ein;

E)Montieren sie Teil 1 (Elektromotor) am Getriebe und sichern sie die Schrauben..

FASI DI SMONTAGGIO
Prima di procedere allo smontaggio del motore assicurarsi che il motore sia assicurato ad un sistema di sollevamento tramite cinghia onde prevenire danni a persone o cose.
Questo per evitare che durante lo smontaggio delle viti di serraggio tra motore e riduttore il motore posso cadere a terra.

Per ulteriori informazioni contattare il Nostro Ufficio Tecnico.

DE-INSTALLATION
Before starting de-installation, please assure that the engine is secured with a suitable hoist to prevent injury or damage. This action is necessary because, with release of the locking screws between the gearbox and engine, the engine could fall to the ground.

Contact our Technical Dept. for more information

DEMONTAGE
Bevor Sie mit der Demontage beginnen, stellen Sie bitte sicher, dass der Motor mit einem geeigneten Hebezeug vor Absturz gesichert ist, um Personen- und Sachschäden zu verhindern.Diese Maßnahme ist notwendig, da bei Lösen der Spannschrauben zwischen Getriebe und Motor der Motor zu Boden fallen könnte.

Für weitere Informationen wenden Sie sich bitte an unsere Konstruktionsabteilung.

6. INSTALLAZIONE

6.10.2 GIUNTO TIPO "ROTEX"

6. INSTALLATION

6.10.2 "ROTEX" TYPE OF JOINT

6. INSTALLATION

6.10.2 KUPPLUNG - TYP "ROTEX"

CODICE TARGHETTA - CODE PLATE
1080031051

1.12.4 Installazione

Prescrizioni di installazione del Motore con Riduttore.

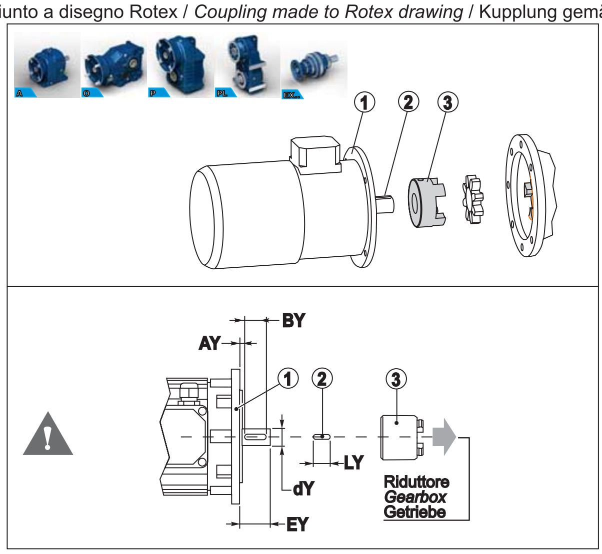
1.12.4 Installation

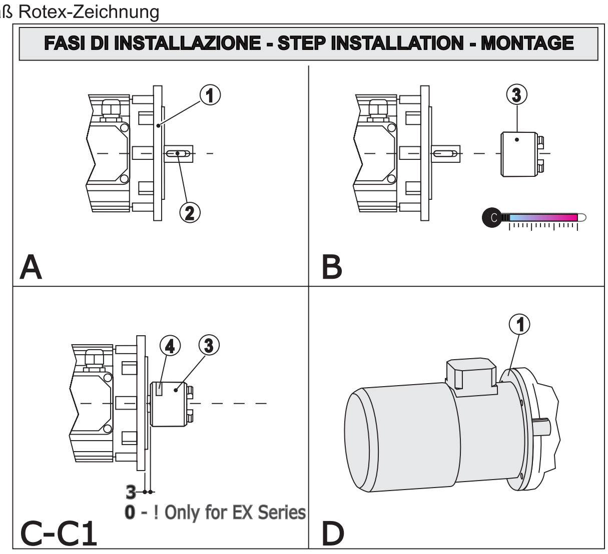
Instructions for installing motor on gearbox.

1.12.4 Montage

Installation des Motors mit dem Getriebe.

Giunto a disegno Rotex / *Coupling made to Rotex drawing* / Kupplung gemäß Rotex-Zeichnung





IEC	dY	EY	KEY	BY	AY	LY
200	55	110	16 x 10	100	< 6	45
225	60	140	18 x 11	130	< 6	55
250	65	140	18 x 11	130	< 6	63
280	75	140	20 x 12	110	< 16	60

Linguetta con dimensione LY a disegno STM.
I riduttori nei PAM riportati in tabella sono forniti con allegato il KIT boccola + linguetta.

1) Se la quota misurata AY è minore o uguale a quella riportata in tabella si può procedere al montaggio utilizzando una linguetta di dimensioni LY;
2) Se la quota misurata AY è maggiore a quella riportata in tabella è necessario montare una linguetta di dimensione LY ridotta della differenza della quota AY misurata rispetto a quella indicata in tabella.

Tab with size LY to STM drawing.
The gearboxes in the PAMs shown on the table are supplied with the bushing + tab kit.

1) If the measured value AY is less or equal than the value in the table, the installation will be continued by using a key with dimension LY;
2) If the resulting value AY is bigger than indicated in the table, it is necessary to use a key with dimension LY, which is reduced according to the value AY in the table.

Lamelle mit Maß LY nach Zeichnung von STM. Die in der Tabelle angegebenen Getriebe in den PAM werden mit dem KIT Buchse + Lamelle geliefert.

1) Wenn der ermittelte Messwert AY kleiner oder gleich dem Wert in der Tabelle ist, kann mit der Montage, durch Verwendung einer Passfeder der Größe LY, fortgefahren werden;
2) Ist der ermittelte Wert AY größer als in der Tabelle angegeben, ist es notwendig, eine Passfeder der Größe LY zu verwenden, welche entsprechend der Maßzahl AY in der Tabelle reduziert ist.

FASI DI INSTALLAZIONE:
A) Montare il componente 2 sul componente 1;

B) Preriscaldo componente 3 - Vista l'eventualità pratica di una possibile interferenza è necessario montare i semigiunti preriscaldandoli ,(max. 90°), il foro filettato in testa all'albero aiuterà il montaggio e lo smontaggio; in ogni caso evitare di battere i semigiunti onde evitare danni al motore.

C) Montare il componente 3 sul motore rispettando la quota a disegno (3mm);

! - Solo EX - la quota è (0 mm).

C1) Bloccaggio componente 3 - è comunque sempre necessario bloccare assialmente i semigiunti tramite il grano radiale presente - componente 4.
D) Montare il componente 1 sul riduttore e serrare le viti di fissaggio.

FASI DI SMONTAGGIO
Prima di procedere allo smontaggio del motore assicurarsi che il motore sia assicurato ad un sistema di sollevamento tramite cinghia onde prevenire danni a persone o cose.
Questo per evitare che durante lo smontaggio delle viti di serraggio tra motore e riduttore il motore posso cadere a terra.

Per ulteriori informazioni contattare il Nostro Ufficio Tecnico.

STEP INSTALLATION
A) Assemble part 2 on part 1.

B) Preheated part 3 - Coupling halves should be preheated before assembly (max. 90°), considering that a possible interference fit is likely; the threaded hole on shaft end will help installation and removal. At any rate, do not tap on the couplings or damage could result for motor.

C)Assemble part 3 on the electric motor regarding quote in the drawing (3mm);

! - Only for EX - the quote is (0 mm).

C1) Tighten - Part 3 - it is always necessary to tighten coupling halves axially by means of the provided radial grub screw - part 4.

D) Assemble part 1 on the gearbox and tighten the fixing screws.

DE-INSTALLATION
Before starting de-installation, please assure that the engine is secured with a suitable hoist to prevent injury or damage. This action is necessary because, with release of the locking screws between the gearbox and engine, the engine could fall to the ground.

Contact our Technical Dept. for more information

MONTAGE
A)Bauteil 2 an Bauteil 1 montieren;

B) Erarmten Bauteil 3 - Unter Berücksichtigung einer möglichen Interferenz müssen die Kupplungshälften im erwärmten Zustand (max. 90°) montiert werden. Die vordere Gewindebohrung an der Welle wird sich bei der Montage und dem Ausbau als hilfreich erweisen. Auf jeden Fall ist im Hinblick auf Schäden am Motor zu vermeiden, auf die Kupplungshälften zu schlagen.
C) Bauteil 3 am Motoren montieren - sehen Sie bitte die Abmessung in der Zeichnung (3mm);
! nur für EX - Abmessung ist (0 mm)

C1) Anziehen Bauteil 3 - es ist jedoch immer erforderlich, die Kupplungshälften axial mit Hilfe des vorhandenen radialen Stifts zu blockieren - Bauteil 4.
D) Bauteil 1 am Getriebe anbauen und Befestigungsschrauben anziehen.

DEMONTAGE
Bevor Sie mit der Demontage beginnen, stellen Sie bitte sicher, dass der Motor mit einem geeigneten Hebezeug vor Absturz gesichert ist, um Personen- und Sachschäden zu verhindern.Diese Maßnahme ist notwendig, da bei Lösen der Spannschrauben zwischen Getriebe und Motor der Motor zu Boden fallen könnte.

Für weitere Informationen wenden Sie sich bitte an unsere Konstruktionsabteilung.

6. INSTALLAZIONE

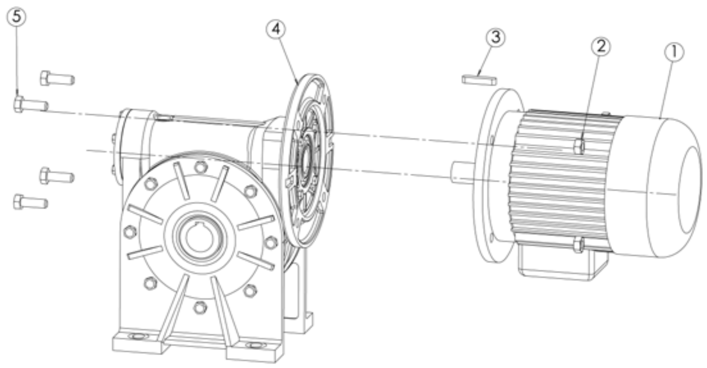
6.11 CONNESSIONE MOTORE/RIDUTTORE CON ATTACCO DIRETTO
Qualora la connessione tra riduttore e macchina motrice sia effettuata con attacco diretto attenersi alle seguenti istruzioni di montaggio.

6. INSTALLATION

6.11 CONNECTING THE MOTOR AND GEARBOX DIRECTLY
If gearbox and driving machine are connected directly, follow installation instructions below.

6. INSTALLATION

6.11 VERBINDUNG ZWISCHEN MOTOR UND GETRIEBE ÜBER DIREKTANSCHLUSS
Sollte die Verbindung zwischen Getriebe und Antriebsmaschine mittels Direktanschluss erfolgen, sind folgende Montageanleitungen zu befolgen.



ITEM	COMPONENTI / *COMPONENTS* / KOMPONENTEN
	MOTORE / *MOTOR* / MOTOR
	DADO DI FISSAGGIO / *RETAINING NUT* / KLEMMMUTTER
	LINGUETTA / *KEY* / PASSFEDER
	RIDUTTORE / *GEARBOX* / GETRIEBE
	VITE DI FISSAGGIO / *RETAINING SCREW* / BEFESTIGUNGSSCHRAUBE

CICLO DI MONTAGGIO *INSTALLATION CYCLE* MONTAGESEQUENZ	
COMPONENTI ***COMPONENTS*** **KOMPONENTEN**	**DESCRIZIONE FASE DI MONTAGGIO** ***INSTALLATION STAGE DESCRIPTION*** **BESCHREIBUNG DER MONTAGESCHRITTE**
1-3	Controllo gioco tra linguetta e sede linguetta La linguetta deve introdursi nella propria sede con una certa interferenza, usando un martello di rame ed evitando di forzare l'inserimento, al fine di evitare la formazione di bave da trafilazione o rigonfiamenti. In tali ultimi casi il montaggio è non conforme. *Check clearance between key and keyway* *Key shall be a tight fit, use a copper hammer and do not force insertion in order to avoid burrs or swelling.* *In these cases installation is non-conforming.* *Kontrolle des zwischen Passfeder und ihrer Aufnahme vorliegenden Spiels* Die Passfeder muss sich mit einem gewissen Übermaß in ihren Sitz einfügen lassen. Zum Einfügen kann ein Kupferhammer verwendet werden, dabei muss jedoch ein übermäßiges Einwirken vermieden werden, um Grate zu vermeiden, die durch Verzug oder Schwellungen entstehen können. In diesen Fällen resultiert die Montage als nicht konform.
1-2-3-4-5	Prima di procedere alla fase di montaggio del riduttore apporre un film di Pasta: **Klüberpaste® 46 MR 401** sull'albero del motore. Avvicinare il motore al riduttore impuntando l'albero dello stesso motore al foro della vite, avvedendosi che la chiavetta sia nell'esatta corrispondenza della sede relativa posta sul sopracitato foro vite. Inserire il motore assicurandosi che il tutto proceda senza interferenze. Controllare che le due flange giunte a battuta combacino perfettamente, quindi serrare stringendo viti e bulloni. Nel caso si fosse verificata qualche interferenza nell'assemblaggio è necessario togliere il motore dal riduttore e controllare sulla chiavetta dello stesso la zona che si presenta danneggiata. Quindi l'operatore valuterà il recupero con operazioni di aggiustaggio, verificando visivamente che non danneggino la funzionalità dell'albero stesso. Ripetere le operazioni fino a permettere l'assemblaggio, senza impedimento alcuno, del motore al riduttore. *Before installing the gearbox, smear a film of sealant:* ***Klüberpaste ® 46 MR 401*** *onto motor shaft.* *Move motor close to gearbox and slide motor shaft into hole, ensure that key is in the correct position with respect to keyway in the hole.* *Fit the motor ensuring that nothing jams.* *Check that the two flanges are fully home, then tighten nuts and bolts.* *In case of jamming during assembly, remove the motor from gearbox and check if there is a damaged area nearby the key. The operator will then evaluate if part can be recovered by adjusting, visually ensuring that nothing hinders shaft operation.* *Repeat the operations until completing assembly of motor to gearbox with no problems or hard spots.* Vor Beginn der Getriebemontage eine Schicht: **Klüberpaste® 46 MR 401** auf der Motorwelle auftragen. Den Motor dem Getriebe nähern und die Motorwelle in die Bohrung der Schnecke einfügen, dabei sicherstellen, dass die Passfeder sich in exakter Position in ihrem Sitz in der genannten Schneckenbohrung sitzt. Den Motor einfügen und darauf achten, dass keine Interferenzen vorliegen. Kontrollieren, dass die beiden auf Anschlag gekommenen Flanschen perfekt untereinander ausgerichtet sind, dann die Schrauben und Bolzen anziehen. Sollte man beim Zusammenfügen irgendwelche Klemmungen erfasst haben, muss der Motor vom Getriebe abgenommen und kontrolliert werden, ob die Passfeder beschädigt ist. Sollte dies der Fall sein, muss der Bediener bewerten, ob sie durch entsprechende Bearbeitungen wieder zurückgesetzt werden kann, ohne dass dabei die Funktion derWelle beeinträchtigt wird. Die Arbeitsschritte so lange wiederholen, bis der Motor sich einwandfrei mit dem Getriebe koppeln lässt.

6. INSTALLAZIONE

6.11.1 CONNESSIONE MOTORE/RIDUTTORE RMI 110 - PAM 132

Nella tabella è illustrata la targhetta allegata con le relative istruzioni di montaggio del Motore con riduttore RMI 110 PAM 132.

6. INSTALLATION

6.11.1 CONNECTING THE MOTOR/GEARBOX RMI 110 - PAM 132

The table shows the nameplate with installation instructions for coupling Motor to gearbox RMI 110 PAM 132.

6. INSTALLATION

6.11.1 VERBINDUNG ZWISCHEN MOTOR UND GETRIEBE RMI 110 - PAM 132

In der Tabelle wird die anliegende Anleitung für die Montage des Motors am Getriebe RMI 110 PAM 132 dargestellt.

STANDARD line

CODICE TARGHETTA - CODE PLATE
1080031041

1.11 Installazione

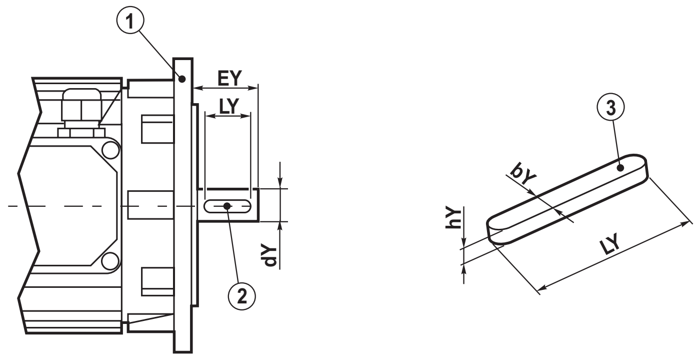
Prescrizioni di installazione del Motore con Riduttore **RMI 110 PAM 132.**

1.11 Installation

Procedure to assemble electric motor to

Getriebe**RMI110 IEC132**

Tab. 1.13



Tipo riduttore ***Gearbox type*** **Getriebe Typ**	**IEC**	**dY**	**EY**	**Key Standard (bY x hY x LY)**	**Key Fornitura STM** ***Supplied by STM*** **STM Lieferung (bY x hY x LY)**
RMI 110	**132**	38	80	10 x 8 x 70	10 x 7 x 70

Linguetta con dimensione **hY** diversa da misura unificata.
I riduttori nei PAM riportati in tabella sono forniti con allegata la linguetta con la dimensione**hY**con dimensione ridotta.

Special key having h Y dimension different from standard.
Gearboxes in the PAM versions specified in the chart are supplied with enclosed the special key having h Y reduced dimension.

Passfeder mit Massen hY nicht nach Uni norm.
Die Getriebe mit Iec wie nach Tabelle werden mit kleineren Passfedern (Mass hY) geliefert.

FASI DI INSTALLAZIONE:
A) Smontare il componente 2 (linguetta unificata) dal componente1 (motore elettrico);
B) Montare il componente 3 (linguetta fornita STM) sull'albero del motore;
C) Montare il componente 1 (motore elettrico) su riduttore.

STEP INSTALLATION
A)Disassemble the component 2 (standard key) from the component 1 (electric motor);
B)Assemble component 3 (key supplied by STM) on the motor shaft;
C) Assemble component 1 (electric motor) to the gearbox.

MONTAGE
Einbauphasen:
A)Einzelteil 2 (Passfeder nach UNI) vom Einzelteil 1(E-Motor) demontieren;
B)Einzelteil 3(STM Passfeder) auf dem Motor montieren;
C) Das Einzelteil 1 (E-Motor) auf das Getriebe montieren.

6. INSTALLAZIONE

6.12 ANTIRETRO

6.12.1
Al fine di invertire il senso di rotazione libera del riduttore dotato di dispositivo antiretro, è necessario eseguire le seguenti operazioni:

1) Abbassare il livello d'olio del riduttore.
2) Smontare il coperchio antiretro aiutandosi con un cacciavite e battendo con un martello assialmente, per rompere il film di sigillante posto sui piani di unione.
3) Ruotare di 180° rispetto ad un asse ortogonale all'asse di rotazione, la gabbia con i corpi di contatto utilizzando pinze per anelli elastici per l'estrazione.
4) Durante il montaggio ruotare il pignone/albero per facilitarne il corretto posizionamento nelle sedi; evitare urti per non danneggiare la gabbia e i corpi.
5) Pulire i piani di unione coperchio/cassa.
6) Risigillare i piani con sigillante, rimontare il coperchio e serrare le viti: attendere prima di alzare il livello olio, il tempo di polimerizzazione del sigillante usato.

6. INSTALLATION

6.12 ANTI-RUN BACK DEVICE

6.12.1
In order to reverse the free direction of rotation of a gearbox (that is equipped with an anti-run back device), it is necessary to carry out the following operations:

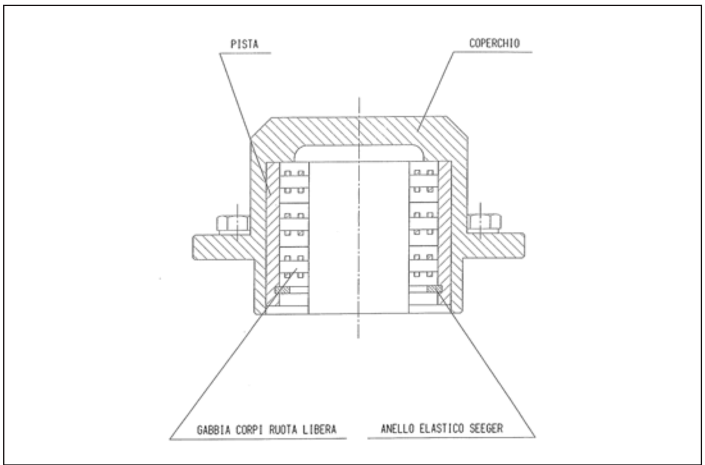
1) Reduce the oil level of the gearbox.
2) Remove the anti-run back cover using a screwdriver and axially tapping with a hammer to break the sealing film on the jointing surface.
3) Rotate of 180° (with respect to an axis at 90° to the rotation axis) the free wheel using circlip pliers to remove it.
4) During assembly, rotate the pinion/shaft to facilitate correct positioning; avoid shocks not to damage the cage and cases.
5) Clean the cover/case mating surfaces.
6) Seal once again the surfaces with sealant, re-assemble the cover and tighten the screws. Allow the sealant to polymerize before adding oil.

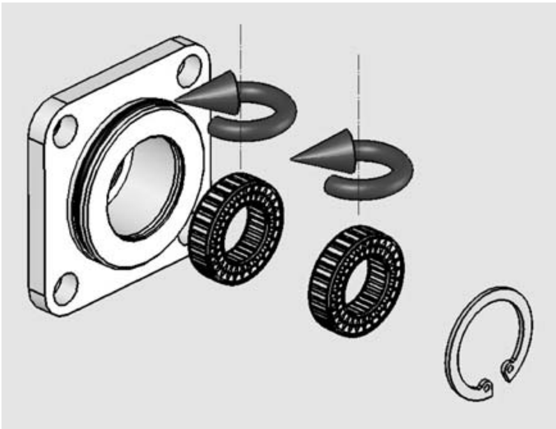
6. INSTALLATION

6.12 RÜCKLAUFSPERRE

6.12.1
Zur Umkehr der freien Umdrehungsrichtung an einem mit Rücklaufsperre ausgestattetem Getriebe sind folgende Arbeitsschritte erforderlich:

1) Den Ölfüllstand des Getriebes senken.
2) Den Deckel der Rücklaufsperre mit einem Schraubendreher und durch axial wirkendes Klopfen mit einem Hammer, durch den Versiegelungsfilm an den beiden Verbindungsflächen durchbrochen wird, lösen.
3) Den Käfig mit den Kontaktelementen um 180° zu einer zur Drehachse auf Winkel stehenden Achse drehen, dabei die Drahtsprengringe mit Hilfe einer Zange abziehen.
4) Während der Montage das Ritzel/die Welle drehen, um das korrekte Ausrichten in den Sitzen zu erleichtern. Um den Käfig und die Elemente nicht zu beschädigen, sind Stöße zu vermeiden.
5) Die Verbindungsflächen zwischen Deckel und Gehäuse reinigen.
6) Die Flächen wieder mit Siegefilm versiegeln, den Deckel erneut montieren und die Schrauben anziehen: Vor dem Anheben des Ölfüllstands die für die Polymerisierung des verwendeten Mittels erforderliche Zeit abwarten.





6. INSTALLAZIONE

6.12.2
Al fine di montare il KIT ANIRETRO è necessario eseguire le seguenti operazioni:

1) Abbassare il livello d'olio del riduttore.
2) Smontare il coperchio antiretro aiutandosi con un cacciavite e battendo con un martello assialmente, per rompere il film di sigillante posto sui piani di unione.
3) Montare il KIT ANTIRETRO.
Il kit è fonito con senso rotazione libero orario.
Qualora si voglia invertire il senso di rotazione seguire le informazioni riportate al punto 6.12.1 - punto numero 3.
4) Durante il montaggio ruotare il pignone/albero per facilitarne il corretto posizionamento nelle sedi; evitare urti per non danneggiare la gabbia e i corpi.
5) Pulire i piani di unione coperchio/cassa.
6) Risigillare i piani con sigillante, rimontare il coperchio e serrare le viti: attendere prima di alzare il livello olio, il tempo di polimerizzazione del sigillante usato.

6. INSTALLATION

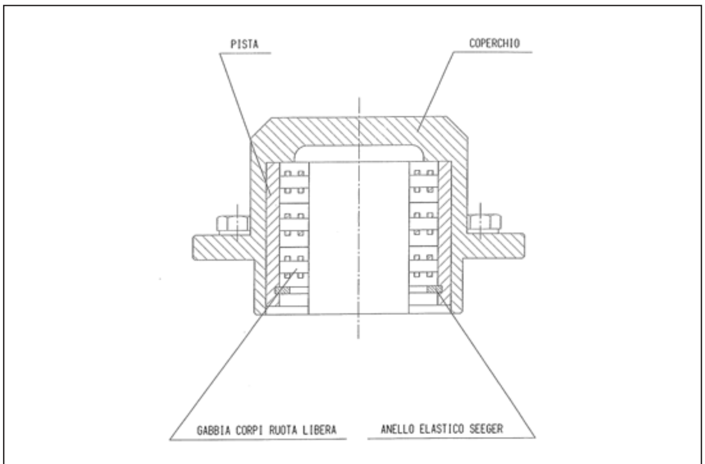
6.12.2
Install the BACK-STOP KIT as follows:

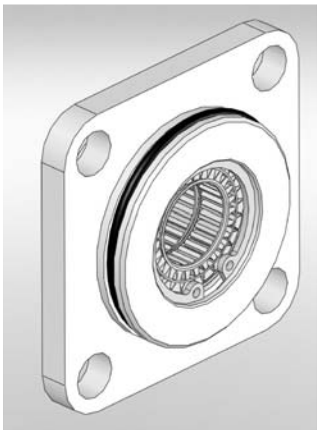
1) Reduce the oil level of the gearbox.
2) Remove the anti-run back cover using a screwdriver and axially tapping with a hammer to break the sealing film on the jointing surface.
3) Install the BACK-STOP KIT.
The kit supplied features idle clockwise direction. To reverse rotation direction follow the explanation under 6.12.1, step number 3.
4) During assembly, rotate the pinion/shaft to facilitate correct positioning; avoid shocks not to damage the cage and cases.
5) Clean the cover/case mating surfaces.
6) Seal once again the surfaces with sealant, re-assemble the cover and tighten the screws. Allow the sealant to polymerize before adding oil.

6. INSTALLATION

6.12.2
Für die Montage des KITsRÜCKLAUFSPERRE sind folgende Arbeitsschritte erforderlich:

1) Den Ölfüllstand des Getriebes senken.
2) Den Deckel der Rücklaufsperre mit einem Schraubendreher und durch axial wirkendes Klopfen mit einem Hammer, durch den Versiegelungsfilm an den beiden Verbindungsflächen durchbrochen wird, lösen.
3) Montage des KITs RÜCKLAUFSPERRE
Das Kit wirdfrei im Uhrzeigersinndrehend geliefert.
Soll der Drehsinn umgekehrt werden, müssen die Angaben im Abschnitt 6.12.1, Punkt 3, befolgt werden.
4) Während der Montage das Ritzel/die Welle drehen, um das korrekte Ausrichten in den Sitzen zu erleichtern. Um den Käfig und die Elemente nicht zu beschädigen, sind Stöße zu vermeiden.
5) Die Verbindungsflächen zwischen Deckel und Gehäuse reinigen.
6) Die Flächen wieder mit Siegefilm versiegeln, den Deckel erneut montieren und die Schrauben anziehen: Vor dem Anheben des Ölfüllstands die für die Polymerisierung des verwendeten Mittels erforderliche Zeit abwarten.





6. INSTALLAZIONE

6.13 AVVERTENZE COGENTI DI SICUREZZA

Per garantire la corretta installazione dei riduttori occorre che l'ambiente di destinazione sia preventivamente valutato in base alle prescrizioni ATEX e p.es. alle indicazioni contenute nelle norme EN1127, EN60079-10 ed EN50281 riguardanti la classificazione Ex dei luoghi e i rischi collegati. In alternativa, devono essere posti in opera modi protettivi o controllo ambientale tali da garantire analoghe condizioni microambientali nello spazio che ospita il prodotto.

1- La valutazione o gli allestimenti di cui sopra devono dare esito compatibile con il Gruppo e la Categoria ATEX dichiarati da STM SpA (II 2G/D, vedi par. 2.0) e riportati in targa. ***In assenza di verifica o con esito negativo, è vietata installazione e messa in servizio.***

2- Effettuare tutte le operazioni di messa in servizio in assenza di atmosfera potenzialmente esplosiva.

3- Pulire accuratamente le superfici lavorate (alberi, piani, flange) dai protettivi utilizzati per lo stoccaggio, da impurità e da sostanze contaminanti.
4- Durante queste operazioni evitare di il contatto diretto fra i solventi utilizzati per la pulizia e gli anelli di tenuta, per non alterarne le caratteristiche chimico-fisiche e pregiudicarne l'efficienza.

5- Evitare qualunque tipo di urto e sollecitazione meccanica in esubero dalla massima portata indicata in targa.

6- Se l'olio utilizzato per lo stoccaggio non è compatibile con il lubrificante sintetico, occorre effettuare un accurato lavaggio interno del riduttore prima di riempirlo con l'olio previsto per il funzionamento.

7- Prima di procedere al montaggio del prodotto controllare che non risultino parti danneggiate, perdite d'olio, o altri indizi di non perfetta integrità.

8 - Evitare che in condizione di funzionamento vi siano strisciamenti tra parti metalliche esterne al riduttore e lo stesso. Nel caso utilizzare elementi antifrizione non metallici conformi ad ATEX 2014/34/UE.

9 -Garantire il corretto parallelismo tra alberi uscita e gli organi di trasmissione ad esso collegati, la perpendicolarità tra piano di appoggio flangia o piedi con asse uscita.

10- Accertarsi che lo spazio libero attorno al riduttore sia sufficiente per la libera ventilazione dello stesso (carterature avvolgenti o ambienti angusti possono ostacolare l'adeguato smaltimento del calore prodotto e innalzare la temperatura superficiale oltre i valori massimi ammessi).
11 - Accertarsi che durante il funzionamento non vi siano elementi esterni che possano danneggiare le tenute striscianti del riduttore precludendone la corretta ritenuta del lubrificante.

6. INSTALLATION

6.13 SAFETY COMPULSORY WARNING

To guarantee correct gearbox installation, the working environment will have to be previously evaluated according to ATEX provisions and standards and, for example, all indications given in EN1127, EN60079-10 and EN50281 regarding Ex classification of environments and related risks. As an alternative, appropriate protections and environmental monitoring activities must be set in place so that similar microenvironmental conditions can be achieved in the area where the product operates.

1 - The evaluation or the specifications above given must be compatible with the ATEX Family and Type declared by STM SpA (II 2G/D, see par. 2.0) and mentioned on the nameplate. ***Without verification or in presence of verification with negative result, installation and operation are forbidden.***
2 - Carry out all commissioning activities in absence of potentially explosive environment.

3 - Appropriately clean all machined surfaces (shafts, surfaces, flanges, etc.) to eliminate all protective elements used for the product storage as well as dirt and polluting substances.
4 - During these activities prevent thinners from reaching the oil seals in order not to alter the product specification and impair its efficiency.

5 - Make sure not to damage the product and not to load the product more than max. admittable torque value indicated on the nameplate.

6 - In case oil used for storage is not compatible with the synthetic lubricant, it is necessary to carry out a thorough cleaning inside the gearbox prior to filling it up with oil recommended for operation.
7
 - Prior to assembling the product, it is advisable to check if any parts have been damaged, if oil leakage has taken place or if there are any other signs of failure.

8 - Make sure that during operation no metal parts external to the gearbox interfere with the gearbox. In case this happens, make sure to use non metallic anti-friction components in conformity with ATEX 2014/34/UE standard.

9 - Guarantee correct parallelism between output shafts and the transmission components connected as well as the perpendicularity between flange support surface/feet with output axis.

10 - Make sure that the area around the gearbox is enough to grant proper ventilation (enclosures, covers as well as restricted environments might easily interfere with adequate heat dissipation and consequently increase the surface temperature over the maximum allowed values)
11 - Make sure that during operation there are no external elements which might damage the seals of the gearbox so preventing the correct oil retention inside the gearbox.

6. INSTALLATION

6.13 VERBINDLICHE SICHERHEITSHINWEISE

Um eine korrekte Installation der Getriebe gewährleisten zu können, ist es erforderlich, dass der vorgesehene Installationsort zuvor in Bezug auf die ATEX-Vorschriften und auf die in den Normen EN1127, EN60079-10 und EN50281 enthaltenen Angaben zur Ex-Klassifizierung der Installationsorte und der damit verbundenen Gefahren bewertet wird. Als Alternative müssen Schutzmaßnahmen oder Umgebungskontrollvorrichtungen vorgesehen werden, die gleichwertige Mikroumweltbedingungen in dem Bereich garantieren, in denen das Produkt installiert wird.
1- Die Bewertung oder o.g. Ausstattungen müssen ein Ergebnis bringen, das mit der von STM SpA erklärten und auf dem Typenschild angegebenen ATEX-Gruppe und -Kategorie (II 2G/D, siehe Par. 2.0) kompatibel ist. **Sollte eine solche Überprüfung nicht oder mit negativem Ergebnis erfolgt sein, sind die Installation und die Inbetriebsetzung verboten.**
2- Alle Inbetriebsetzungsarbeiten dürfen nicht innerhalb einer potentiell explosionsfähigen Atmosphäre erfolgen.
3- Die für die Einlagerung aufgetragenen Schutzmittel entfernen und die bearbeiten Flächen (Wellen, Platten, Flanschen) sorgfältig reinigen, dabei den Schmutz und die Verunreinigungen entfernen.
4- Während dieser Arbeit ist ein direkter Kontakt mit den für die Reinigung verwendeten Lösungsmitteln. Ebenso sollten die Dichtringe nicht behandelt werden, um deren chemisch-physischen Eigenschaften und Wirkungsgrad aufrecht erhalten zu können.
5- Jegliche Art von Stößen und mechanischen Belastungen vermeiden, durch die es zum Überschreiten der auf dem Typenschild angegebenen maximalen Tragfähigkeit kommen würde.
6- Sollte das für die Einlagerung verwendete Öl nicht mit dem synthetischen Öl verträglich sein, muss der Innenbereich des Getriebes sorgfältig ausgewaschen werden, bevor das für den Betrieb vorgesehene Öl eingefüllt wird.

7- Vor Beginn der Montage des Produkts muss kontrolliert werden, dass keine beschädigten Teile, Ölleckagen oder andere Hinweise bezüglich einer nicht perfekten Integrität vorliegen.
8 - Vermeiden, dass es in Betriebsbedingungen zum Anschleifen externer Metallteile am Getriebe kommt. In solchen Fällen sich nicht metallische Reibschutzelemente zu verwenden, die der ATEX 2014/34/UE konform sind.

9 - Die korrekte Parallelität zwischen den Abtriebswellen und den daran angeschlossenen Antriebsorganen und das Lot zwischen Auflagefläche und Füßen mit der Abtriebsachse müssen gewährleistet sein.

10 - Sich darüber vergewissern, dass der Freiraum um das Getriebe herum für einen freie Belüftung desselben ausreicht (Abdeckungen oder enge Räume, die eine Ableitung der produzierten angemessene Wärme behindern und die zu einem Anstieg der Oberflächentemperatur über die maximal zulässigen Werte hinaus führen können).
11 - Sicherstellen, dass während des Betriebs keine externen Elemente vorhanden sind, durch die die Schleifdichtungen des Getriebes beschädigt werden könnten, da dadurch die korrekte Abdichtung gefährdet werden könnte.

6. INSTALLAZIONE

Per tutti riduttori in esecuzione "ATEX " occorre:

1- Un collegamento elettrico a terra del riduttore, oppure un montaggio metallicamente solidale con una struttura conduttrice posta elettricamente a terra.
2- Un montaggio tale da non esporre a urti/danneggiamenti l'indicatore di livello, il tappo olio e tutti gli elementi di tenuta del lubrificante (tappi di chiusura, paraolio, &c.).
3- Verificare l'assenza di correnti parassite, catodiche o altrimenti vaganti che possono interessare il riduttore. In particolare ove dovute al flusso disperso del motore elettrico accoppiato.
4- Nel caso di presenza di atmosfere in grado di reagire chimicamente con il lubrificante o i suoi vapori/nebbie e quindi formare miscele esplosive, prevedere il riempimento di lubrificante e/o i successivi controlli di livello o ispezioni varie, in aree lontane dalla zona potenzialmente esplosiva; oppure prevedere una accurata bonifica preventiva dell'ambiente.

Accoppiamento riduttore - motore elettrico:

1) Applicare uno strato di sigillante anaerobico sulla superficie del centraggio e frontale di accoppiamento delle flange.
2) Applicare pasta antigrippaggio (p. es. pasta a base di bisolfuro di molibdeno) sull'albero motore e all'interno del foro manicotto.
3) Procedere all'accoppiamento e quindi sigillare la zona di congiunzione tra motore e riduttore con adeguata pasta sigillante.

6. INSTALLATION

Each gearbox certified as ATEX must feature the following items:

1- An electrical contact to earth or a metallic assembly compatible with a conductive earth driven structure.
2- Such a type of assembly able to protect from damages the level indicator, the oil cap and all elements regarding the lubricant seals (oil seals, oil plug, etc.).
3- To verify the absence of elements such as: parasitic currents, catodical currents or any other which could affect the gearbox. Especially in areas where a leakage flux could be present caused by a coupled electrical motor.
4- In case of a chemical reaction of atmosphere against the lubricant and its vapors, in order to avoid explosive mixtures, top up and/or inspections must be carried out in very distant areas, far from those considered as potentially explosive. Any other solution should be providing accurate environment decontamination.

Gearbox – electric motor coupling:

1) Apply a layer of anaerobic sealing compound on the centering surface and side flange mating surface.
2) Apply some antiseize compound (for example compound based on molybdenum disulphide) on the motor shaft and inside the sleeve hole.
3) Connect the two components and then seal the connection parts between motor and gearbox by using appropriate sealing compound.

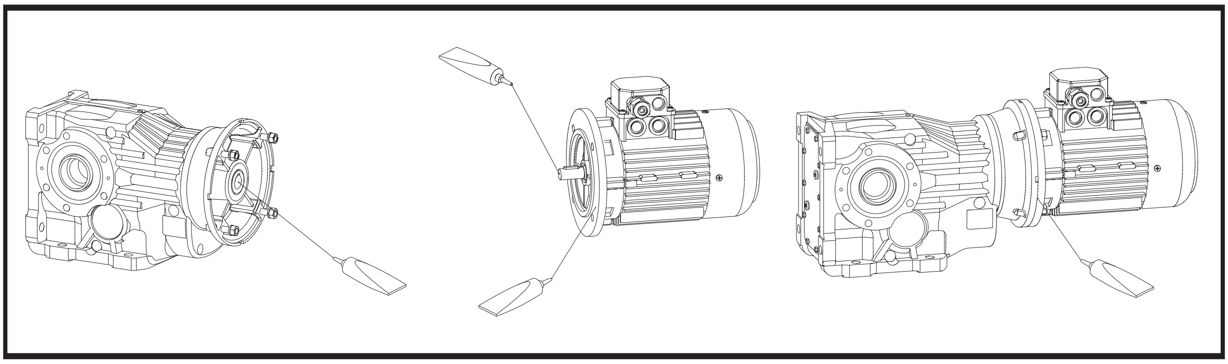
6. INSTALLATION

Bei allen Getrieben in der "ATEX-Version ist folgendes erforderlich:

1- Eine elektrische Erdung des Getriebes oder eine im metallischem Sinne feste Montage mit einer leitenden Struktur die geerdet ist.
2- Eine Montage, bei der die Ölstandanzeige, die Öleinfüllschraube und alle Schmiermittelabdichtelemente (Verschluss-stopfen, Ölabdichtungen, usw.) keinen Stössen /Beschädigungen ausgesetzt sind.
3- Überprüfen, dass kein Wirbel-, Strahl- oder anderweitig vagabundierender Strom vorliegt, der sich auf den Getriebebetrieb auswirken könnte. Insbesondere durch den Streufluss des angebauten Elektromotors.
4- Bei Vorliegen von Atmosphären, die eine chemische Reaktion mit dem Schmiermittel oder seinen Dämpfen/Nebel erzeugen und damit explosionsfähige Gemische bilden können, müssen das Einfüllen des Schmiermittels und/oder die späteren Füllstandkontrollen oder anderweitige Inspektionen in Bereichen erfolgen, die weit von den potentiell explosionsfähigen Zonen liegen. Andernfalls muss zuvor eine sorgfältige Vergütung des Umfelds erfolgen.

Passung von Getriebe und Elektromotor:

1) Eine Schicht anerobe Dichtmasse auf die Zentrierungs- und die frontale Passungsfläche der Flanschen auftragen.
2) Auf die Motorwelle und in die Bohrung der Hülse Fressschutzmittel (z.B. Paste auf Molybdändisulfidbasis) auftragen.
3) Die Passung vornehmen und den Verbindungsbereich zwischen Motor und Getriebe mit angemessener Dichtmasse versiegeln.



7. MESSA IN SERVIZIO

7.0 MODALITA' DI FUNZIONAMENTO
Caratteristiche operative: il riduttore può sopportare qualunque tipo di ciclo compatibile con una variazione dei parametri di coppia e velocità di rotazione entro i valori nominali dati a catalogo, per un fattore di servizio pari ad uno. (Per ulteriori informazioni consultare il catalogo generale STM SpA).

Avviamento/arresto: la messa in marcia e l'arresto del riduttore dipendono unicamente dalla sua alimentazione di energia; si raccomanda, ove l'applicazione possa comportare rischi elevati, di dotare la macchina di sistemi di arresto agenti sulla trasmissione, conformemente alle misure prevenzionali adottate nell'insieme meccanico di incorporazione.
Rumore aereo riduttore: il livello di pressione acustica deve mantenersi al di sotto dei valori riportati al pargrafo 0.3.1.

7. COMMISSIONING

7.0 OPERATING MODES
***Operative features**: the gearbox can tolerate any working cycle compatible with a variation of the torque/rotating speed within the rated values indicated on the catalogue according to service factor 1. (Please refer to STM SpA general catalogue for further details).*

***Start/Stop**: the start and the stop of the gearbox only depend on the power supply; it is recommended, wherever the application might imply high risks, to equip the machine with braking systems acting on the drive transmission in conformity with the preventive measures used on the mechanical combination set.*

***Gearbox air noise level**: acoustic pressure level must be below values specified in par. 0.3.1.*

7. INBETRIEBSETZUNG

7.0 BETRIEBSWEISE
Funktionseigenschaften: Das Getriebe kann,in Übereinstimmung mit einem Betriebsfaktor von eins, in jedem Zyklustyp eingesetzt werden, der mit einer Änderung der Parameter von Drehmoment und Drehzahl innerhalb der im Katalog angegebenen Nenndaten kompatibel ist. (Weitere Informationen können dem Hauptkatalog der STM SpA entnommen werden).
Start/Stopp: Die Inbetriebsetzung und der Stopp des Getriebes hängen ausschließlich von seiner Energieversorgung ab. Es wird empfohlen, dort wo es zu erheblichen Gefahren kommen kann, die Maschine mit Bremssystemen auszustatten, die auf den Antrieb wirken und die den an der mechanischen Gesamtheit der Einbaueinheit angewandten Sicherheitsvorkehrungen konform sind.
Geräuschpegel des Getriebes: Der Schalldruck muss unter den Werten liegen, die im Paragraph 0.3.1. angegeben werden.

7. MESSA IN SERVIZIO

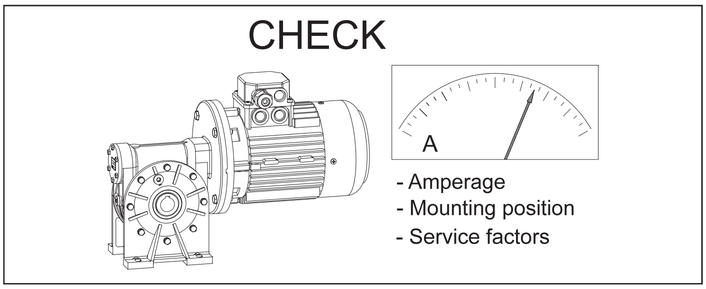
7.0 MODALITA' DI FUNZIONAMENTO
Temperatura (esterna della carcassa): deve mantenersi sempre al di sotto di 90°C, salvo contraria specifica contrattuale.
N.B.
Variatore meccanico !!!
La variazione dei giri deve essere assolutamente eseguita a motore in moto.

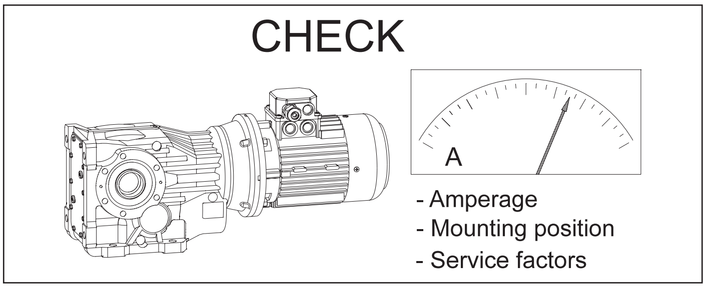
7. COMMISSIONING

7.0 OPERATING MODES
(Casing outer) Temperature: *it should always stay below 90°C, unless otherwise stated on the contract.*
N.B.
Mechanical variator!!!
Rpm variation must be performed with motor running.

7. INBETRIEBSETZUNG

7.0 BETRIEBSWEISE
Temperatur (außen am Gehäuse): Muss, anderweitige vertragliche Spezifikation ausgenommen, immer unter 90°C liegen.
HINWEIS
Mechanisches Verstellgetriebe !!!
Die Änderung der Drehzahl muss unbedingt bei laufendem Motor erfolgen.





7.1 CONTROLLO LIQUIDI/OLII

Le quantità di olio sono approssimative; per una corretta lubrificazione occorre fare riferimento al livello segnato sul riduttore.

Vedere specifico paragrafo.

7.1 FLUIDS/OIL INSPECTION

Oil quantities listed in the table are approximate; to ensure correct lubrication, please refer to the level mark on the gear unit.

See relevant paragraph.

7.1 KONTROLLE DER FLÜSSIGKEITEN/ÖLE

Bei den Ölmengenangaben handelt es sich um approximative Werte; für den Erhalt einer korrekten Schmierung muss Bezug auf den am Getriebe gekennzeichneten Füllstand genommen werden.

Siehe spezifischen Paragraph.

7.2 CONTROLLO FORMA COSTRUTTIVA/ POSIZIONE DI MONTAGGIO
Il riduttore deve essere montato nella forma costruttiva prevista in targhetta; posizioni di montaggio diverse richiedono una modifica del livello o del sistema di lubrificazione.

7.2 CHECKING THE CONSTRUCTION VERSION / MOUNTING POSITION
Do not mount the gear unit in a position different than the one specified in the rating plate; a different mounting position requires in general a modification of the level indicator or a different lubrication system.

7.2 KONTROLLE DER BAUFORM/ EINLAULAGE
Das Getriebe muss in der auf dem Typenschild vorgesehenen Einbaulage montiert werden. Abweichende Einbaulagen erfordern eine Änderung der Füllstandsanzeige oder des Schmiersystems.

7.3 CONTROLLO SENSI ROTAZIONE

Verificare prima dell'avviamento il senso di rotazione nel caso di dispositivo antiretro.

Qualora il senso di rotazione libera dell'antiretro sia errato è necessario invertirne il senso di rotazione della macchina motrice.

7.3 CHECKING THE DIRECTION OF ROTATION
Before starting, check direction of rotation if back stop device is fitted.

If back stop device free direction of rotation is incorrect, reverse driving machine direction of rotation.

7.3 KONTROLLE DER DREHRICHTUNGEN

Bei montierter Rücklaufsperre vor dem Start die Drehrichtung überprüfen.

Sollte sich die freie Drehrichtung der Rücklaufsperre als falsch erweisen, muss die Drehrichtung der Antriebseinheit invertiert werden.

7. MESSA IN SERVIZIO

7.4 VERIFICHE PRODOTTI ATEX

1. Accertarsi che durante il servizio il riduttore sia sufficientemente ventilato e che non vi siano fonti di calore nelle vicinanze;

7. COMMISSIONING

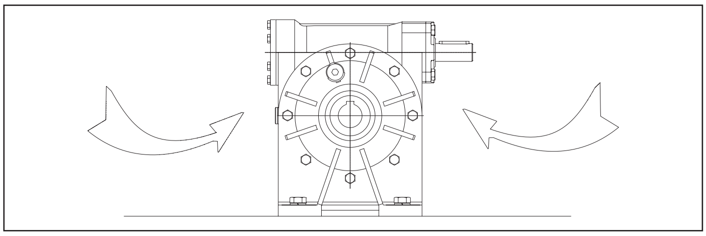
7.4 ATEX PRODUCTS INSPECTIONS

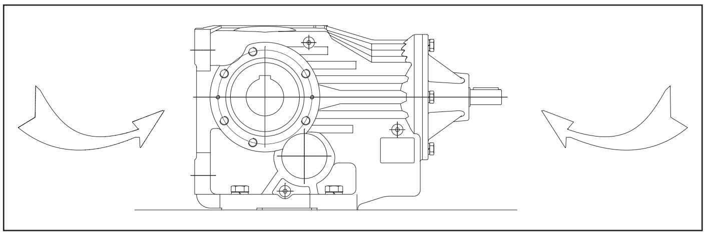
1. Make sure that during operation the gearbox is sufficiently ventilated and no heat sources are present nearby;

7. INBETRIEBSETZUNG

7.4 ÜBERPRÜFUNG DER “ATEX”-PRODUKTE

1. Sicherstellen, dass während des Betriebs das Getriebe ausreichend belüftet ist und keine Wärmequellen in der Nähe vorliegen.

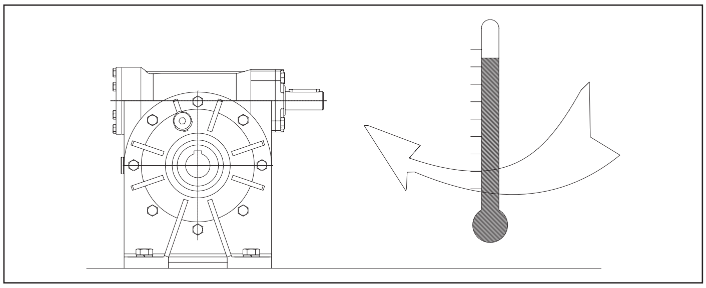


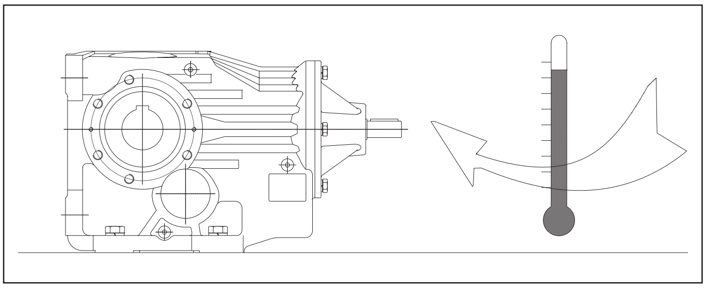


2 Accertarsi che in regime di funzionamento la temperature dell’aria di raffreddamento non superi i 40°C; in caso contrario decadono le condizioni di validità della certificazione di conformità del prodotto fornita da STM SpA .

2.Make sure that during operation the cooling air temperature does not reach 40°C or the conditions necessary for the conformity certification supplied by STM SpA would not be valid anymore.

2 Sich darüber vergewissern, dass im Betriebsdrehzahlbereich die Temperatur der Kühlluft die 40°C nicht überschreitet. Sollte dies der Fall sein, kommt es zum Verfall der von der STM SpA gelieferten Erklärung der Produktkonformität .





4. Verifica temperatura superficiale del riduttore in funzionamento:

a.Verificare nelle prime ore di funzionamento le temperatura superficiale del riduttore (si raggiunge la situazione di regime generalmente nelle prime 3 ore a pieno carico).
b.La temperatura raggiungibile dal riduttore varia in funzione del numero di giri, del rapporto di trasmissione e della forma costruttiva, attenersi alle potenze massime installabili con il relativo numero di giri del motore come indicato in targa.
c.La temperatura massima delle superfici del riduttore a pieno carico, considerando la massima temperatura ambientale ammissibile di 40°C, non deve superare nel caso di classe di temperatura T4 (o 135°C), 130 °C;
nel caso di classe di temperatura T5 (o 100°C), 93°C.

In caso di eccedimento arrestare immediatamente il funzionamento e contattare il servizio assistenza STM SpA .

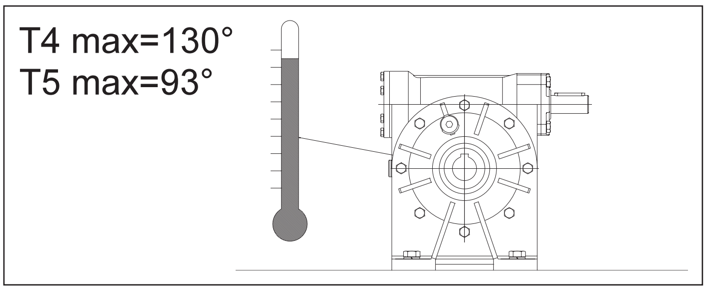
4. Verification of the temperature of the gearbox housing surface while running

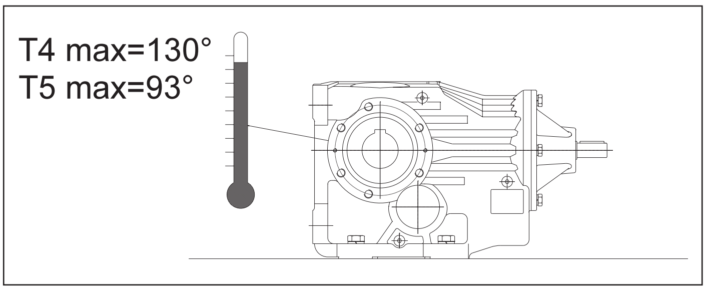
a. Verify the temperature of the gearbox housing surface during the initial running hours (the standard running conditions are normally reached after 3 hours at full load).
b.The temperature reached by the gearbox depends on the speed, reduction ratio and the assembly position. Make sure to comply with the maximum applicable power in relation with the motor speed as indicated on the nameplate.
c.The maximum temperature of the outer surfaces of the gearbox running at full load, considering the maximum environmental temperature admitted of 40°C, must not exceed 130°C in case temperature class is T4 (or 135°C) and 93°C in case temperature is T5 (or 100°C).

In case temperature is exceeded, stop immediately the system and get in touch with STM SpA.

4. Überprüfung der Oberflächentemperatur des sich im Betrieb befindlichen Getriebes:

a. In den ersten Betriebsstunden die Oberflächentemperatur des Getriebes prüfen (die Betriebstemperatur wird im Allgemeinen in den ersten 3 Stunden unter Vollast erreicht).
b. Die vom Getriebe erreichbare Temperatur variiert in Abhängigkeit der Drehzahl, des Übersetzungsverhältnisses und der Bauform. Sich an die maximalen installierbaren Leistungen mit der entsprechenden Motordrehzahl gemäß Angaben auf dem Typenschild halten.
c. Die maximale Oberflächentemperatur des Getriebes bei Vollast, unter Berücksichtigung der zulässigen Umgebungstemperatur von 40°C, darf im Fall der Temperaturklasse T4 (oder 135°C), 130 °C und im Fall der Temperaturklasse T5 (oder 100°C), 93°C nicht überschreiten.
Bei Überschreiten dieser Werte muss der Betrieb sofort gestoppt und Verbindung mit dem Kundendienst der STM SpA aufgenommen werden.





7. MESSA IN SERVIZIO

7.5 Taratura Limitatore di Coppia

Nelle tabelle seguenti sono riportate le coppie di slittamento M_{2S} in funzione del numero dei giri del dado, o della ghiera di regolazione ottenibili con la disposizione standard delle molle (par. 1.6).
Tali valori prescindono dalle prestazioni delle dentature.
Valori più elevati di M_{2S} si possono ottenere, a richiesta, con una diversa disposizione delle molle.
I valori di taratura si riferiscono ad una condizione statica(durante lo slittamento la coppia trasmessa decade considerevolmente) ed hanno un significato indicativo in quanto ottenuti per via teorica.
E' opportuno verificare periodicamente la coppia di taratura soprattutto durante la prima fase di funzionamento.

7. COMMISSIONING

7.5 Slipping Torque

In the following tables the slipping torques M_{2S} are listed according to number of turns of nut or ring nut obtainable with a standard arrangement of the springs (chapter 1.6).
Such data prescind from tothing performances.
M_{2S} higher values can eventually be obtained with a different arrangement of the springs.
Calibration values refer to a static condition (during slippage torque reports a con- siderable decrease) and are approximate being calculated on a theoric basis. It is important therefore to check the calibration torque periodically especially during first phase of running.

7. INBETRIEBSETZUNG

7.5 Rutsch-momente

In der folgenden Tabelle sind die Rutschmomente M_{2S} dargestellt, wie sie je nach Stellung der Sechskant- oder Nutmutter mit der Standardanordnung der Tellerfedern erreicht werden (siehe kapitel 1.6).
Diese Werte lassen die maximal übertragbare Leistung der Getriebe in Abhängigkeit von der Untersetzung jedoch außer acht.
Mit einer anderen Anordnung der Tellerfedern können auch größere Rutschmomente M_{2S} erreicht werden.
Die angegebenen Werte sind statische Momente (das Rutschmoment nimmt während des Schlupfvorganges ab) und sind nur als Näherungswerte zu betrachten.
Das eingestellte Rutschmoment sollte in der Einlaufphase in periodischen Abständen überprüft und gegebenenfalls korrigiert werden.

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M_{2S} (Nm)												
RI RMI	**ir**	**N. GIRI DEL DADO DI REGOLAZIONE** ***NUMBER OF TURNS OF ADJUSTEMENT RING NUT*** **DREHUNGEN DER EINSTELLMUTTER**										
		1/2	**2/3**	**1**	**1 1/3**	**1 2/3**	**2**	**2 1/3**	**2 2/3**	**3**	**3 1/3**	**3 2/3**
28	tutti i rapporti *all ratios* alle Untersetzungen	4	5.5	7.5	10	13						
40		12	16	24	31	38	46					
50		16	20	29	39	47	55	63				
63		21	27	41	55	65	79	89	101	112	124	
70		21	27	41	55	65	79	89	101	112	124	
85	7-10-15-28	60	79	113.5	148	175	210	236	265	298	323	345
	20-40-49	66	87	125	163	192.5	231	260	292	328	356	380
	56 - 100	72	95	136	178	210	253	284	319	358	388	415
110	7-10-15-28	106	141	207	271	334	392	454	516	572	630	
	20-40-49	114	152	224	293	361	423	490	557	618	680	
	56 - 100	131	174	257	336	414	486	640	709	781		
130	tutti / *all* / alle	240	310	450	590	720	850	950				
150	tutti / *all* / alle	550	730	1070	1390	1700	1990	2200				

M_{2S} (Nm)											
RI RMI Taratura maggiorata *Heavy calibration* Erhoete eichung	**CRI CRMI**	**ir**	**N. GIRI DEL DADO DI REGOLAZIONE** ***NUMBER OF TURNS OF ADJUSTEMENT RING NUT*** **DREHUNGEN DER EINSTELLMUTTER**							**ir**	**CR CB**
			1/2	**2/3**	**1**	**1 1/3**	**1 2/3**	**2**	**2 1/3**		
28	**28**	tutti i rapporti *all ratios* alle Untersetzungen	12.5	17	24						
40	**40**		40	53	77	91				tutti/*all*/alle	**40**
50	**50**		50	65	93	128					**50**
63	**63**		96	125	178	231	288				
70	**70**		96	125	178	231	288			tutti/*all*/alle	**70**
85	**85**	7-10-15-28	146	185	263	350	414	471	542	43.0 - 128.8	**85**
		20-40-49	161	204	289	385	456	518	596	167.6 - 225.4	
		56 - 100	176	223	316	420	497	566	651	286.4 - 460.0	
110	**110**	7-10-15-28	261	342	501	653	805	945		43.0 - 128.8	**110**
		20-40-49	282	369	541	705	869	1021		167.6 - 225.4	
		56 - 100	323	424	621	810	998	1172		286.4 - 460.0	
130	**130**	tutti / *all* / alle	470	620	910	1180	1450	1700	1900		
150	**150**	tutti / *all* / alle	830	110	1600	2050	2500	3000	3350		

7. MESSA IN SERVIZIO

ATTENZIONE!

Quando è richiesto il minimo errore di taratura è opportuno verificare in pratica, staticamente, che la frizione slitti effettivamente al valore desiderato è comunque consigliabile testare la coppia trasmissibile direttamente sulla macchina utilizzatrice.

7. COMMISSIONING

ATTENTION!

When minimum calibration error is required it is always advisable to actually verify, statically, that clutch slips at the required value. We suggest, however, to test the torque directly on to the machine.

7. INBETRIEBSETZUNG

ACHTUNG!

Um Abweichungen zu vermeiden, müssen die eingestellten Momente im eingebauten Zustand kontrolliert und eventuell korrigiert werden.

LF

RI RMI	ir	M_{2S} (Nm) — N. GIRI DELLA GHIERA DI REGOLAZIONE / *N. OF TURNS OF ADJUSTEMENT RING NUT* / DREHUNGEN DER EINSTELLMUTTER												
		1/4	1/2	2/3	1	1 1/3	1 2/3	2	2 1/3	2 2/3	3	3 1/3	3 2/3	4
40	tutti i rapporti *all ratios* alle Untersetzungen	15	28	36	51	64	75	86	97					
50		21	40	52	74	93	110	126	141	154	167			
63		27	51	66	93	120	140	160	175	195	210			
70		24	45	58	81	100	115	125	135	145	151	155	160	
85	7-10-15-28	50	85	115	160	200	240	280	310	340	370	395	420	
	20-40-49	60	95	120	170	220	265	300	340	370	400	430	460	
	56-70-80-100	80	100	130	190	240	290	330	370	400	440	470	500	
110	*7-10-15-28*	140	260	340	490	630	750	860	960	1060	1150	1230	1310	1390
	20-40-49	150	285	370	530	670	800	930	1040	1140	1230	1330	1410	1500
	56-70-80-100	170	330	430	600	770	930	1060	1190	1300	1415	1520	1620	1720
130	tutti / *all* / alle	244	476	625	910	1180	1438	1686	1920	2160	2390			
150	tutti / *all* / alle	550	860	1130	1660	2170	2660	3140	3600	4050	4500	4930	5370	

RI RMI Taratura maggiorata *Heavy calibration* Erhoete eichung	CRI CRMI	ir	M_{2S} (Nm) — N. GIRI DELLA GHIERA DI REGOLAZIONE / *N. OF TURNS OF ADJUSTEMENT RING NUT* / DREHUNGEN DER EINSTELLMUTTER													ir	CR CB
			1/4	1/2	2/3	1	1 1/3	1 2/3	2	2 1/3	2 2/3	3	3 1/3	3 2/3	4		
40	**40**	tutti i rapporti *all ratios* alle Untersetzungen	15	28	36	51	64	75	86	97						tutti /*all* /alle	**40**
50	**50**		21	40	52	74	93	110	126	141	154	167					**50**
63	**63**		51	100	130	190	245	295	345	385	440	480					
70	**70**		38	74	96	135	175	210	240	270	300	320	350			tutti /*all* /alle	**70**
85	**85**	7-10-15-28	100	125	160	230	300	360	410	460	510	560	600	640	680	43.0 - 128.8	**85**
		20-40-49	110	135	180	255	330	390	450	510	560	610	650	700	750	167.6 - 225.4	
		56-70-80-100	120	150	195	280	350	425	490	550	610	665	715	765	815	286.4 - 460.0	
110	**110**	7-10-15-28	190	380	500	740	930	1150	1350	1500	1700	1850	2020	2180	—	43.0 - 128.8	**110**
		20-40-49	200	400	540	780	1000	1230	1430	1620	1800	2000	2170	2360	—	167.6 - 225.4	
		56-70-80-100	220	450	600	900	1150	1380	1620	1840	2070	2300	2500	2700	—	286.4 - 460.0	
130	**130**	tutti /*all* / alle	244	476	625	910	1180	1438	1686	1920	2160	2390					
150	**150**	tutti /*all* / alle	550	860	1130	1660	2170	2660	3140	3600	4050	4500	4930	5370			

7. MESSA IN SERVIZIO

La disposizione standard delle molle garantisce una buona sensibilità di regolazione e consente di trasmettere la massima coppia nominale del riduttore.

7. COMMISSIONING

Standard arrangement of springs guarantees an acceptable setting and enables the gearbox to transmit the maximum nominal torque

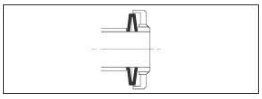
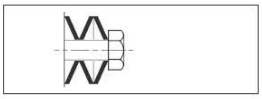
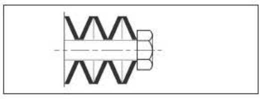
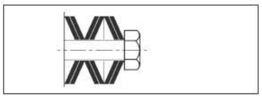
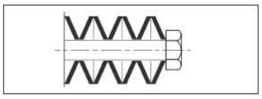
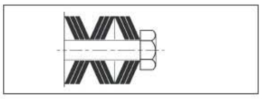
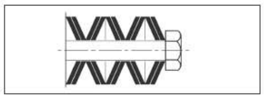
7. INBETRIEBSETZUNG

Die Standardanordnung der Tellerfedern erlaubt eine feinfühlige Einstellung des Rutschmomentes bis zum maximalen Nennmoment des Getriebes.

LP

LC

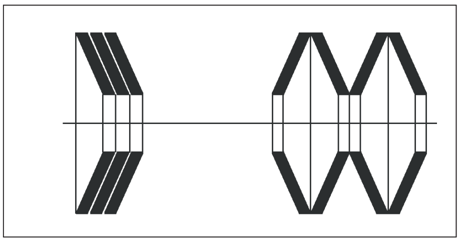
	RI- RMI	RI - RMI Taratura maggiorata *Heavy calibration* Erhoete eichung	CRI - CRMI	CR - CB
28	5 molle/*springs* 20/10.2/1.1	6 molle/*springs* 20/10.2/1.1		
40	5 molle/*springs* 23/12.2/1.5	6 molle/*springs* 23/12.2/1.5		
50	5 molle/*springs* 31.5/16.3/1.75	6 molle/*springs* 31.5/16.3/1.75		
63	7 molle/*springs* 31.5/16.3/2	6 molle/*springs* 31.5/16.3/2		—
70	7 molle/*springs* 34/16.3/2	6 molle/*springs* 34/16.3/2		
85	10 molle/*springs* 40/18.3/2	9 molle/*springs* 40/18.3/2		
110	10 molle/*springs* 45/22.4/2.5	9 molle/*springs* 45/22.4/2.5		
130	3 molle/*springs* 60/30.5/3.5	6 molle/*springs* 60/30.5/3.5		—
150	6 molle/*springs* 60/30.5/3.5	9 molle/springs 60/30.5/3.5		—

2	
3	
5	
6	
7	
9	
10	

LF

	RI- RMI	RI - RMI Taratura maggiorata *Heavy calibration* Erhoete eichung	CRI - CRMI	CR - CB
40	2 molle/*springs* 63/31/2.5			
50	2 molle/*springs* 80/41/3			
63	2 molle/*springs* 80/41/3	2 molle/*springs* 80/41/4		—
70	2 molle/*springs* 90/46/2.5	2 molle/*springs* 90/46/3.5		
85	2 molle/*springs* 100/51/3.5	2 molle/*springs* 100/51/4		
110	2 molle/*springs* 125/61/5	2 molle/*springs* 125/61/6		
130	2 molle/*springs* 125/75.5/6			—
150	2 molle/*springs* 150/81/8			—

IN PARALLELO max. coppia min. sensibilita' ***PARALLEL*** *max. torque* *min. sensitivity* **PARALLEL** max. Moment min. Empfindlichkeit	**IN SERIE** min. coppia max. sensibilita' ***SERIES*** *min. torque* *max. sensitivity* **SERIE** min. Moment max. Empfindlichkeit



Per problemi specifici è opportuno consultarci, ma a livello indicativo si può affermare che accoppiando più molle con lo stesso verso (in parallelo) si incrementa la coppia massima di slittamento raggiungibile; viceversa alternandone il posizionamento in serie si aumenta la sensibilità di taratura.

Should the user require any specific information, we suggest to contact our technical department. On a general basis, how- ever, if the springs are arranged in the same direction, a higher maximum torque of slippage can be reached; on the contrary by alternating their arrangement the calibration sensitivity is increased.

Das Rutschmoment ist umso größer, je mehr Tellerfedern parallel angeordnet sind (progressive Federkennlinie). Wird ein niedrigeres Moment oder eine erhöhte Justiergenauigkeit gewünscht, so können die Federn auch gegensinnig angeordnet werden (degressive Federkennlinie). Sollten spezifische Fragen bestehen, so empfehlen wir, unser technisches Büro zu Rate zu ziehen.

8. LUBRIFICAZIONE

ATTENZIONE:
Lo stato di fornitura è messo in evidenza con una targhetta adesiva posta sul riduttore. Verificare la corrispondenza tra stato di fornitura e targhetta adesiva.

Catalogo Tecnico
CT 16..
CT 17..

URL:www.stmspa.com

La lubrificazione dei riduttori, variatori e rinvii angolari è consentita mediante un sistema misto bagno olio e sbattimento, che garantisce normalmente la lubrificazione di tutti i componenti interni al riduttore, rinvio angolare e/o variatore.
Per quelle posizioni di montaggio caratterizzate da assi di rotazione verticali, vengono adottate particolari soluzioni al fine di garantire una buona lubrificazione anche degli organi presenti nelle posizioni più sfavorevoli.
I riduttori a vite senza fine sono caratterizzati da una elevata componente di strisciamento, variabile a seconda delle caratteristiche di dentatura dell' ingranaggio e delle velocità di rotazione del cinematismo, e per questo motivo necessitano di una accurata lubrificazione. Per questo tipo di riduttori usiamo e consigliamo oli a base sintetica, che migliorano il rendimento e possiedono una maggiore stabilità di viscosità.
E' importante che gli additivi E.P. presenti negli oli siano blandi e non agressivi nei confronti del bronzo e delle guarnizioni.
La lubrificazione a grasso è consigliata solo con grassi a base sintetica e molto fluidi (NLGI 00); vengono preferiti per esercizi con elevati urti e per funzionamenti intermittenti.

Usando il grasso anzichè l'olio, si ha un minor smaltimento del calore, una riduzione del rendimento, un incremento dell'usura e una minore lubrificazione di tutti i componenti.

8. LUBRICATION

CAUTION:
Gearbox state of supply is indicated on a nameplate applied on gearbox. Ensure that nameplate data and state of supply correspond.

Technical Catalogue
CT 16..
CT 17..

URL:www.stmspa.com

Gearboxes, variators and right angle drives lubrication is provided through a combination of oil bath and oil-splash patterns, which normally guarantees the lubrication of all internal components.

For some mounting positions, typically those featuring a vertical shaft, provisions are made to guarantee lubrication of even the least favourably located drive components.

Worm gearboxes are characterized by a high sliding velocity, which depends on teeth characteristics and input speed, and this is why they need proper lubrication.
For this kind of gearboxes STM use and suggest synthetic based oils, which increase the dynamic efficiency and guarantee longer duration and higher viscosity stability.

It is very important that E.P. additives present in lubricants are not aggressive on bronze and oil seals.
Grease lubrication is advisable only if synthetic based and fluid grease is used (NLGI 00). It is preferable to use such a lubrication when having heavy shocks and intermittent duties.

Grease used in place of oil contributes to a more difficult elimination of heat, a lower efficiency and an increase in wear and tear as well as a lower lubrication of all components.

8. SCHMIERUNG

ACHTUNG
Der entsprechende Lieferzustand wird auf einem Aufkleber am Getriebe angegeben. Überprüfen Sie die Übereinstimmung zwischen effektivem Lieferzustand und Aufkleber.

Technischer Katalog
CT 16..
CT 17..

URL:www.stmspa.com

Die Schmierung der Getriebe, Verstell- und Winkelgetriebe kann über ein kombiniertes Verfahren aus Ölbad- und -spritzschmierung erfolgen, das normalerweise die Schmierung aller Innenkomponenten der Getriebe sowie der Verstell- und Winkelgetriebe gewährleistet.
Bei Einbaulagen mit vertikal ausgerichteten Drehachsen kommen besondere Lösungen zum Einsatz, anhand derer auch an den sich in ungünstigen Lagen befindlichen Teilen eine gute Schmierung garantiert werden kann.
Die Schneckengetriebe weisen eine hohe Reibungskomponente auf, die in Abhängigkeit der Untersetzung und der Drehzahl der Getriebeeinheit variiert und deshalb einer sorgfältige Schmierung erfordern. Bei diesem Getriebetyp verwenden und empfehlen wir Öle auf synthetischer Basis, die den Wirkungsgrad steigern und im Hinblick auf die Viskosität eine höhere Stabilität aufweisen.
Wichtig ist, dass die E.P.-Additive in den Ölen mild sind und sich nicht aggressiv auf Bronze und Dichtungen auswirken.
Für die Fettschmierung ist der Einsatz von Fetten empfehlenswert, die ausschließlich auf synthetischer Basis und besonders flüssig resultieren (NLGI 00). Diese werden bei Einsätzen mit starken Schlägen und für den Aussetzbetrieb bevorzugt.
Wird Fett anstelle von Öl verwendet, wird weniger Wärme abgleitet, der Wirkungsgrad wird reduziert, der Verschleiß erhöht und die Komponenten werden weniger stark geschmiert.

8. LUBRIFICAZIONE

8.0 SCELTA TIPOLOGIA OLIO
Gli oli disponibili appartengono generalmente a tre grandi famiglie:
1) Oli minerali
2) Oli sintetici Poli-Alfa-Olefine
3) Oli sintetici Poli-Glicole

La scelta più appropriata è generalmente legata alle condizioni di impiego. riduttori non particolarmente caricati e con un ciclo di impiego discontinuo. senza escursioni termiche importanti, possono certamente essere lubrificati con olio minerale.

Nei casi di impiego gravoso, quando i riduttori saranno prevedibilmente caricati molto ed in modo continuativo, con conseguente prevedibile innalzamento della temperatura, è bene utilizzare lubrificanti sintetici tipo polialfaolefine (PAO).
Gli oli di tipo poliglicole (PG) sono da utilizzare strettamente nel caso di applicazioni con forti strisciamenti fra i contatti, ad esempio nelle viti senza fine. Debbono essere impiegati con grande attenzione poiché non sono compatibili con gli altri oli e sono invece completamente miscibili conl'acqua. Questo fenomeno è particolarmente pericoloso poiché non si nota, ma deprime velocemente le caratteristiche lubrificanti dell'olio.

Oltre a questi già menzionati, ricordiamo che esistono gli oli per l'industria alimentare. Questi trovano specifico impiego nell'industria alimentare in quanto sono prodotti speciali non nocivi alla salute. Vari produttori forniscono oli appartenenti a tutte le famiglie con caratteristiche molto simili.

Più avanti proponiamo una tabella comparativa.
TABELL 8.1

8. LUBRICATION

8.0 CORRECT OIL TYPES
Available oils are typically grouped into three major classes:
1) Mineral oils
2) Poly-Alpha-Olefin synthetic oils
3) Polyglycol synthetic oils

Oil is normally selected in accordance with environmental and operating conditions. Mineral oil is the appropriate choice for moderate load, non-continuous duty applications free from temperature extremes.

In severe applications, where gear units are to operate under heavy loads in continuous duty and high temperatures are expected, synthetic Poly-Alpha-Olefin oils (PAO) are the preferred choice.

Polyglycol oils (PG) should only be used in applications involving high sliding friction, as is the case with worm shafts. These particular oils should be used with great care, as they are not compatible with other oils, but are totally mixable with water. The oil mixed with water cannot be told from uncontaminated oil, but will degrade very rapidly.

In addition to the oils mentioned above, there are food-grade oils. These are special oils harmless to human health for use in the food industry. Oils with similar characteristics are available from a number of manufacturers.

A comparative overview table is provided in the next pages.
TABLE 8.1.

8. SCHMIERUNG

8.0 WAHL DER ÖLSORTE
Die verfügbaren Öle gehören im Allgemeinen drei großen Familien an:
1) Mineralöle
2) Polyalphaolefine-Synthetiköle
3) Polyglykol-Synthetiköle

Die angemessene Wahl ist im Allgemeinen an die Einsatzbedingungen gebunden. Getriebe, die keinen besonders schweren Belastungen ausgesetzt werden und einem unregelmäßigen Einsatzzyklus unterliegen, ohne starke thermische Schwankungen, können problemlos mit Mineralöl geschmiert werden.

Bei einem Einsatz unter harten Bedingungen, d.h. wenn die Getriebe stark und andauernd belastet werden, was einen sicheren Temperaturanstieg zur Folge hat, sollten Synthetiköle vom Typ Polyalphaolefine (PAO), verwendet werden.
Die Öle, Typ Polyglykole (PG), sind unbedingt dann einzusetzen, wenn es sich um Applikationen handelt, bei denen es zu starken Reibungen zwischen den in Kontakt stehenden Elementen kommt, z.B. bei Schnecken. Bei ihrem Einsatz ist besondere Aufmerksamkeit erforderlich, da sie nicht mit anderen Ölen kompatibel sind, sich jedoch vollständig mit Wasser vermischen lassen. Diese Tatsache erweist sich daher als besonders gefährlich, da sie sich nicht feststellen lässt, jedoch die Schmiereigenschaften des Öls bereits nach kurzer Zeit unterdrückt.

Über die bereits genannten Öle hinaus, gibt es auch Öle, die speziell für die Lebensmittelindustrie ausgelegt sind. Diese finden demzufolge in diesem Bereich ihren Einsatz, da es sich dabei um spezielle Produkte handelt, die für die Gesundheit unschädlich sind. Die den jeweiligen Familien angehörigen Ölsorten werden von verschiedenen Herstellern angeboten; sie weisen jeweils sehr ähnliche Eigenschaften auf.

Auf der folgenden Seite finden Sie eine entsprechende Vergleichstabelle.
TABELLE 8.1

8. LUBRIFICAZIONE

8. LUBRICATION

8. SCHMIERUNG

Tabella 8.1/ *Table 8.1* Tabelle 8.1

Produttore *Manufacturer* Hersteller	Oli Minerali *Mineral oils* Mineralöle			Oli Sintetici Polialfaolefine (PAO) *Poly-Alpha-Olefin synthetic oils (PAO)* Polyalphaolefine- Synthetiköle (PAO)			Oli Sintetici Poliglicoli (PG) *Polyglycol synthetic oils (PG)* Polyglykol-Synthetiköle (PG)		
	ISO VG 150	**ISO VG 220**	**ISO VG 320**	**ISO VG 150**	**ISO VG 220**	**ISO VG 320**	**ISO VG 150**	**ISO VG 220**	**ISO VG 320**
AGIP	Blasia 150	Blasia 220	Blasia 320	-	Blasia SX 220	Blasia SX 320	Blasia S 150	Blasia S 220	Blasia S 320
ARAL	Degol BG 150 Plus	Degol BG 220 Plus	Degol BG 320 Plus	Degol PAS 150	Degol PAS 220	Degol PAS 320	Degol GS 150	Degol GS 220	Degol GS 320
BP	Energol GR-XP 150	Energol GR-XP 220	Energol GR-XP 320	Enersyn EPX 150	Enersyn EPX 220	Enersyn EPX 320	Enersyn SG 150	Enersyn SG-XP 220	Enersyn SG-XP 320
CASTROL	Alpha SP 150	Alpha SP 220	AlphaSP 320	Alphasyn EP 150	Alphasyn EP 220	Alphasyn EP 320	Alphasyn PG 150	Alphasyn PG 220	Alphasyn PG 320
CHEVRON	Ultra Gear 150	Ultra Gear 220	Ultra Gear 320	Tegra Synthetic Gear 150	Tegra Synthetic Gear 220	Tegra Synthetic Gear 320	HiPerSYN 150	HiPerSYN 220	HiPerSYN 320
ESSO	Spartan EP 150	Spartan EP 220	Spartan EP 320	Spartan S EP 150	Spartan S EP 220	Spartan S EP 320	Glycolube 150	Glycolube 220	Glycolube 320
KLÜBER	Klüberoil GEM 1-150	Klüberoil GEM 1-220	Klüberoil GEM 1-320	Klübersynth EG 4-150	Klübersynth EG 4-220	Klübersynth EG 4-320	Klübersynth GH 6-150	Klübersynth GH 6-220	Klübersynth GH 6-320
MOBIL	Mobilgear XMP 150	Mobilgear XMP 220	Mobilgear XMP 320	Mobilgear SHC XMP 150	Mobilgear SHC XMP 220	Mobilgear SHC XMP 320	Glygoyle 22	Glygoyle 30	Glygoyle HE320
MOLIKOTE	L-0115	L-0122	L-0132	L-1115	L-1122	L-1132	-	-	-
OPTIMOL	Optigear BM 150	Optigear BM 220	Optigear BM 320	Optigear Synthetic A 150	Optigear Synthetic A 220	Optigear Synthetic A 320	Optiflex A 150	Optiflex A 220	Optiflex A 320
Q8	Goya 150	Goya 220	Goya 320	El Greco 150	El Greco 220	El Greco 320	Gade 150	Gade 220	Gade 320
SHELL	OMALA S2 GX 150	OMALA S2 GX 220	OMALA S2 GX 320	Omala S4 GXV 150	Omala S4 GXV 220	Omala S4 GXV 320	OMALA S4 WE 150	OMALA S4 WE 220	OMALA S4 WE 320
TEXACO	Meropa 150	Meropa 220	Meropa 320	Pinnacle EP 150	Pinnacle EP 220	Pinnacle EP 320	-	Synlube CLP 220	Synlube CLP 320
TOTAL	Carter EP 150	Carter EP 220	Carter EP 320	Carter SH 150	Carter SH 220	Carter SH 320	Carter SY 150	Carter SY 220	Carter SY 320
TRIBOL	1100/150	1100/220	1100/320	1510/150	1510/220	1510/320	800\150	800\220	800\320

Lubrificanti sintetici per uso alimentare / *Food-grade synthetic lubricants* / Synthetische Schmiermittel für den Lebensmittelbereich

AGIP				Rocol Foodlube Hi-Torque 150	—	Rocol Foodlube Hi-Torque 320			
ESSO				—	Gear Oil FM 220	—			
KLÜBER				Klüberoil 4 UH1 N 150	Klüberoil 4 UH1 N 220	Klüberoil 4 UH1 N 320			
MOBIL				DTE FM 150	DTE FM 220	DTE FM 320			
FUCHS				Cassida Fluid GL 150	Cassida Fluid GL 220	Cassida Fluid GL 320			

I riduttori, variatori e rinvii angolari STM forniti completi di lubrificante e non, possono essere utilizzati, salvo diverse indicazioni, in ambienti con temperature comprese fra 0 C° e + 50 C°. Per condizioni ambientali diverse consultare il ns. servizio tecnico.

STM gearboxes, variators and right andgle drives, supplied with oil or empty, can be used in rooms with a temperature from 0 C° and + 50 C°, unless otherwise indicated. In case of different ambient conditions, please contact our technical department.

Die mit oder ohne Schmiermittelfüllung gelieferten Getriebe, Verstell- und Winkelgetriebe der STM können, anderweitig lautende Angaben ausgenommen, in Umgebungen mit Temperaturen zwischen 0 C° und + 50 C° verwendet werden. Bei Vorliegen abweichender Umgebungstemperaturen wenden Sie sich bitte an unseren technischen Kundendienst.

8. LUBRIFICAZIONE

Il principio di funzionamento di questi variatori è quello di trasmettere la coppia attraverso ruote di frizione: ciò comporta la scelta di un particolare tipo di lubrificante, capace di migliorare il rendimento e la durata dei componenti.
La tabella è utile per la scelta dei lubrificanti da adottare nei variatori.

8. LUBRICATION

The operation principle of this variators consists of torque trasmission by friction wheels: this means to choose a particular kind of oil, able to increase dynamic efficiency and guarantee longer components duration.

The table is useful for variator lubricant selection.

8. SCHMIERUNG

Das Betriebsprinzip dieser Verstellgetriebe liegt darin den Drehmoment über Kupplungsräder zu übertragen: Diese erfordert den Einsatz eines besonderen Schmiermitteltyps, der in der Lage ist, den Wirkungsgrad und die Standzeit der Komponenten zu verbessern.
Die Tabelle dient der Wahl der bei den Verstellgetrieben erforderlichen Schmiermittel.

Tab.1.9-Produttore *Manufacturer* Hersteller	Tipi di olio raccomandati / *Recommended oils* / Empfohlene Ölsorte		
	1°	2°	3°
AGIP	TRANSMISSION V.E	A.T.F. DEXRON FLUID	-
BP	AUTRAN DX	-	-
CASTROL	TQ DEXRON II	-	-
CHEVRON	A.T.F. DEXRON	-	-
ESSO	A.T.F. DEXRON	-	-
FINA	A.T.F. DEXRON	-	-
MOBIL	A.T.F. 220	-	-
SHELL	A.T.F. DEXRON	SPIRAX S1 ATF TASA	SPIRAX S2 ATF AX
Lubrificanti sintetici per uso alimentare / *Food-grade synthetic lubricants* / Schmiermittel Synthetik für Lebensmittelbereich			
SHELL	CASSIDA FLUIDS HF32	-	-

8.2 Specifiche di sicurezza adottate per prodotti "ATEX"

1 - Tappi sfiato (ove previsti) con valvola anti-intrusione

INOIL_STD
I riduttori forniti sempre già completi di lubrificante e sono privi di tappi di servizio per il controllo della quantità di olio; verificare periodicamente che non siano visibili perdite dalle tenute striscianti e statiche del riduttore; nel caso si verificassero, fermare immediatamente l'applicazione e contattare STM SpA .

È fatto divieto di svitare il tappo olio nei modelli lubrificati a vita

OUTOIL
Per tutti gli altri riduttori il controllo del livello deve essere effettuato attraverso lo specifico tappo di servizio trasparente.

8.2 Safety features applied to "ATEX" products

1 - Breather caps (if any) fitted with safety valve

INOIL_STD
Gearboxes that are regularly supplied full of lubricant are delivered without service plugs to check oil quantity; it is necessary to periodically verify presence of oil leakages through oil seals or gaskets. In case of leakage, stop the gearbox immediately and contact STM SpA.

It is forbidden to unscrew the oil plug in the models with life lubrication.

OUTOIL
On all other gearbox types, the oil quantity check must be done through the appropriate clear oil level service plug.

8.2 Sicherheitsmaßnahmen für "ATEX"-Produkte

1 - Entlüftungsstopfen (wo vorhanden) mit Schutzventil gegen Eindringen von Fremdkörpern.

INOIL_STD
Die bereits mit Schmiermittel gefüllt gelieferten Getriebe verfügen über keine Serviceschrauben für die Kontrolle der Ölmenge. Hier muss regelmäßig geprüft werden, dass an den Schleifdichtungen und den Ölabdichtungen keine Leckagen vorliegen. Sollten solche Leckagen festgestellt werden, muss die Einheit sofort gestoppt und Kontakt mit der STM SpA aufgenommen werden

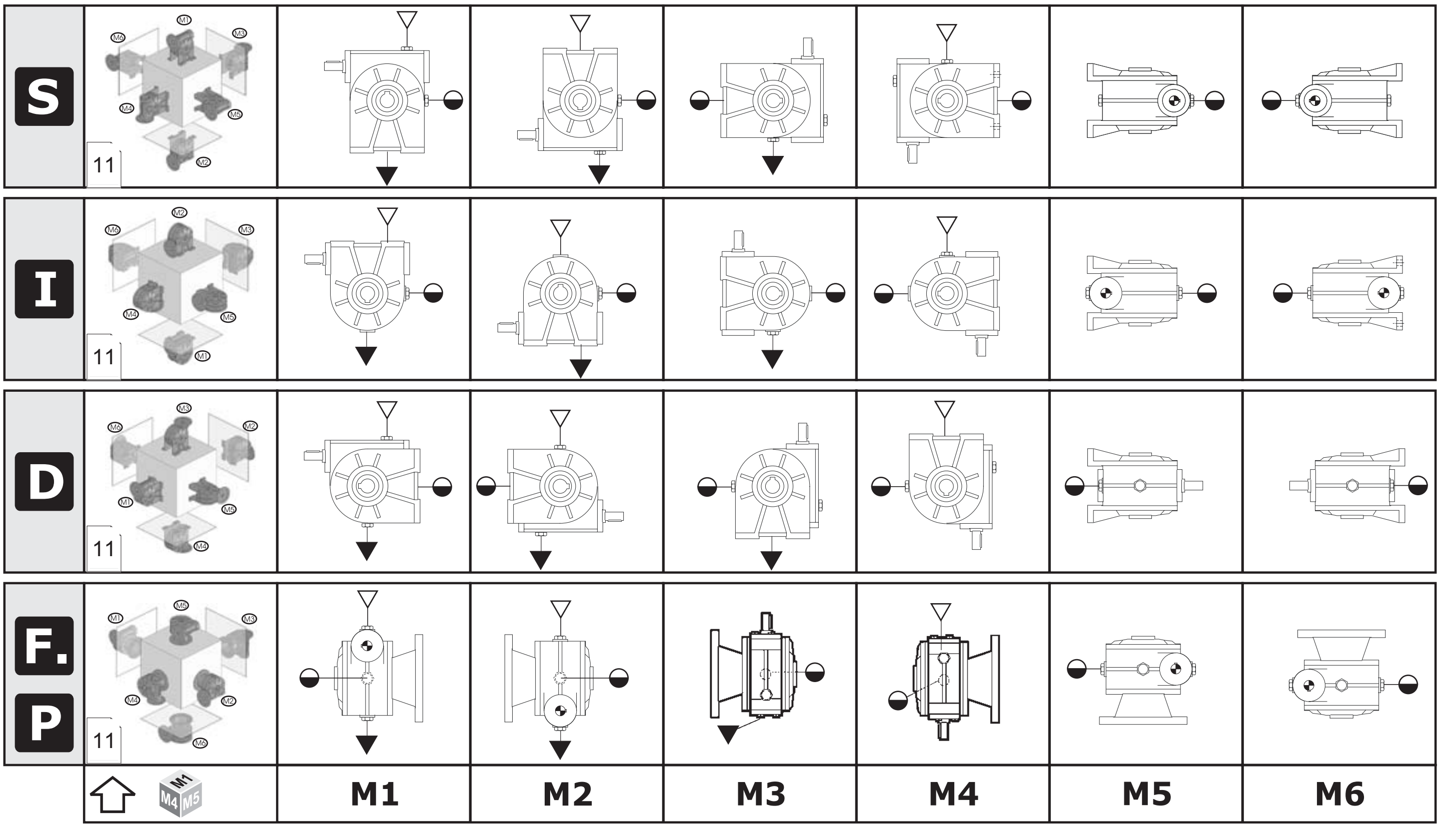
Das Ausschrauben der Ölschraube an den auf Lebensdauer geschmierten Getrieben ist verboten.

OUTOIL
Bei allen anderen Getrieben muss die Ölstandkontrolle über den spezifischen durchsichtigen Serviceverschluss erfolgen.

8. LUBRIFICAZIONE | *8. LUBRICATION* | 8. SCHMIERUNG

Posizioni di montaggio
Mounting positions
Montagepositionen

RI - RMI



▽ Carico / *Breather plug* / Nachfüllen - Entlüftung
◒ Livello / *Level plug* / Pegel
▼ Scarico / *Drain plug* / Ablassschraube

Lub

RI RMI		Quantità di lubrificante - *Lubricant Quantity* - *Schmiermittelmenge* - [Kg]						OPT1	Tappi-Plug-Stopf		
		M1	M2	M3	M4	M5	M6		N°	Diameter	Type
RI-RMI	28	0.030						INOIL_STD	1	1/8"	
RI-RMI	40	0.070							1	1/4"	
RI	50	0.170							1	1/4"	
RMI	50	0.130							1		
RI	63	0.350							1	3/8"	
RMI	63	0.240							1		
RI	70	0.430									
RMI	70	0.350							1		
RI-RMI	85	0.800 0.550 (LP-LC-LF)	0.550						1		
RI-RMI	110	2.600	2.100					OUTOIL	3	1/2"	
	130	4.100	2.900								
	150	6.000	5.000								
	180	11.00	9.000								
	215	20.00	13.00						4	1"	
	250	29.00	20.00						4		

Lub

RI-RMI 85-110-130-150-180-215-250

M1 - Durante il riempimento attenersi ai quantitativi poiché in alcuni casi il livello del lubrificante oltrepassa la spia di livello.

M2-M3-M4-M5-M6 - Quantità indicative; durante il riempimento attenersi alla spia di livello.

RI-RMI 85-110-130-150-180-215-250

M1 - During filling keep to the required quantities as in some cases the level of the lubricant exceeds the level shown by the indicator:

M2-M3-M4-M5-M6 - Indicative quantities, check the oil sight glass during filling.

RI-RMI 85-110-130-150-180-215-250

M1 - Für die Auffüllung sind die angegebenen Mengen zu beachten, da in einigen Fällen der Füllstand des Schmiermittels das Füllstands-Kontrollfenster übersteigt.

M2-M3-M4-M5-M6-Richtungsweisende Mengen, bei der Auffüllung auf das Füllstand-Kontrollfenster Bezug nehmen.

Posizioni di montaggio
Mounting positions
Montagepositionen

CRI - CRMI

Lub

		Quantità di lubrificante - *Lubricant Quantity* - *Schmiermittelmenge* - [Kg]								OPT1	Tappi-Plug-Stopf		
	Size 1	M1	M2	M3	M4	M5	M6	Size 2	M1-M2-M3 M4-M5-M6		N°	Diameter	Type
28/28	28	0.030						28	0.030	INOIL_STD	Vedere corrispettiva SIZE1 e SIZE2 facendo riferimento ai riduttori della serie R See corresponding SIZE1 and SIZE2 with reference to gear series R Siehe entsprechend SIZE 1 und SIZE 2 mit Bezug auf die Getriebe der Serie R		
28/40	28							40	0.070				
28/50	28							50	0.130				
28/63	28							63	0.240				
28/70	28							70	0.350				
40/40	40	0.070						40	0.070				
40/50	40							50	0.130				
40/63	40							63	0.240				
40/70	40							70	0.350				
40/85	40							85	0.800 0.550*				
50/70	50	CRI - 0.170 CRMI - 0.130						70	0.350				
50/85	50							85	0.800 0.550*				
50/110	50							110	2.600				
63/70	63	CRI - 0.350 CRMI - 0.240						70	0.350				
63/85	63							85	0.800 0.550*				
63/110	63							110	2.600				
63/130	63							130	4.100				
70/85	70	CRI - 0.430 CRMI - 0.350						85	0.800 0.550*				
70/110	70							110	2.600				
70/130	70							130	4.100				
85/110	85	0.800 0.550*	0.550					110	2.600	OUTOIL			
85/130	85							130	4.100				
85/150	85							150	6.000				
85/180	85							180	11.00				
110/150	110	2.600	2.100					150	6.000				
110/180	110							180	11.00				
110/215	110							215	20.00				
130/180	130	4.100	2.900					180	11.00				
130/250	130							250	29.00				

CRI CRMI

Lub

SIZE 1
RI-RMI 85-110-130

M1 - Durante il riempimento attenersi ai quantitativi poiché in alcuni casi il livello del lubrificante oltrepassa la spia di livello.

M2-M3-M4-M5-M6 - Quantità indicative; durante il riempimento attenersi alla spia di livello.

SIZE 2
Durante il riempimento attenersi ai quantitativi poiché in alcuni casi il livello del lubrificante oltrepassa la spia di livello.

SIZE 1-SIZE2
*** RI-RMI 85 -** Versioni LC-LP-LF.

SIZE 1
RI-RMI 85-110-130

M1 - During filling keep to the required quantities as in some cases the level of the lubricant exceeds the level shown by the indicator.

M2-M3-M4-M5-M6 - Indicative quantities, check the oil sight glass during filling.

SIZE 2
During filling keep to the required quantities as in some cases the level of the lubricant exceeds the level shown by the indicator.

SIZE1-SIZE2
***RI-RMI 85 -** Versions LC-LP-LF.

SIZE 1
RI-RMI 85-110-130

M1 - Für die Auffüllung sind die angegebenen Mengen zu beachten, da in einigen Fällen der Füllstand des Schmiermittels das Füllstands-Kontrollfenster übersteigt.

M2-M3-M4-M5-M6-Richtungsweisende Mengen, bei der Auffüllung auf das Füllstand-Kontrollfenster Bezug nehmen.

SIZE 2
Für die Auffüllung sind die angegebenen Mengen zu beachten, da in einigen Fällen der Füllstand des Schmiermittels das Füllstands-Kontrollfenster übersteigt.

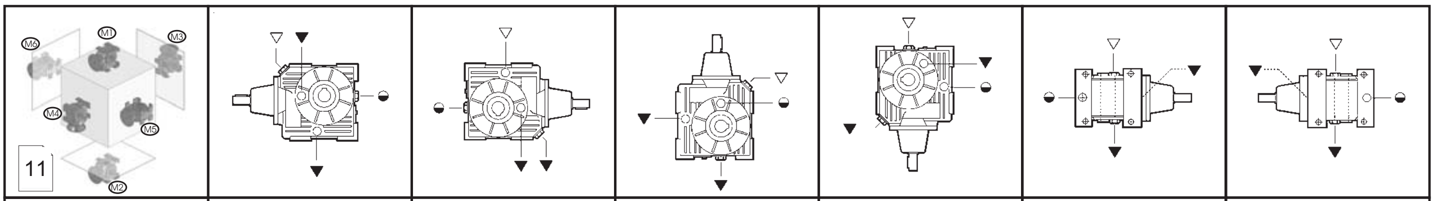
SIZE1-SIZE2
*** RI-RMI 85 -** Ausführungen LC-LP-LF.

8. LUBRIFICAZIONE
8. LUBRICATION
8. SCHMIERUNG

Posizioni di montaggio
Mounting positions
Montagepositionen

CR - CB

40 - 50 - 70 - 85 - 110



	M1	M2	M3	M4	M5	M6

▽ Carico / *Breather plug* / Nachfüllen - Entlüftung
◒ Livello / *Level plug* / Pegel
▼ Scarico / *Drain plug* / Ablassschraube

Lub		Quantità di lubrificante - *Lubricant Quantity - Schmiermittelmenge - [Kg]*						OPT1	Tappi-Plug-Stopf		
		M1	M2	M3	M4	M5	M6		N°	Diameter	Type
CR CB	40	0.260	0.260	0.260	0.260	0.260	0.260	INOIL_STD	1	1/4"	
	50	0.440	0.600	0.600	0.600	0.440	0.440		1	1/4"	
	70	0.950	1.300	1.300	1.300	0.950	0.950		1	3/8"	
	85	1.550	2.800	2.800	2.800	1.550	1.550	OUTOIL	4	3/8"	
	110	3.600	6.000	6.000	6.000	3.600	3.600		4	1/2"	

Durante il riempimento attenersi ai quantitativi poiché in alcuni casi il livello del lubrificante oltrepassa la spia di livello.

During filling keep to the required quantities as in some cases the level of the lubricant exceeds the level shown by the indicator.

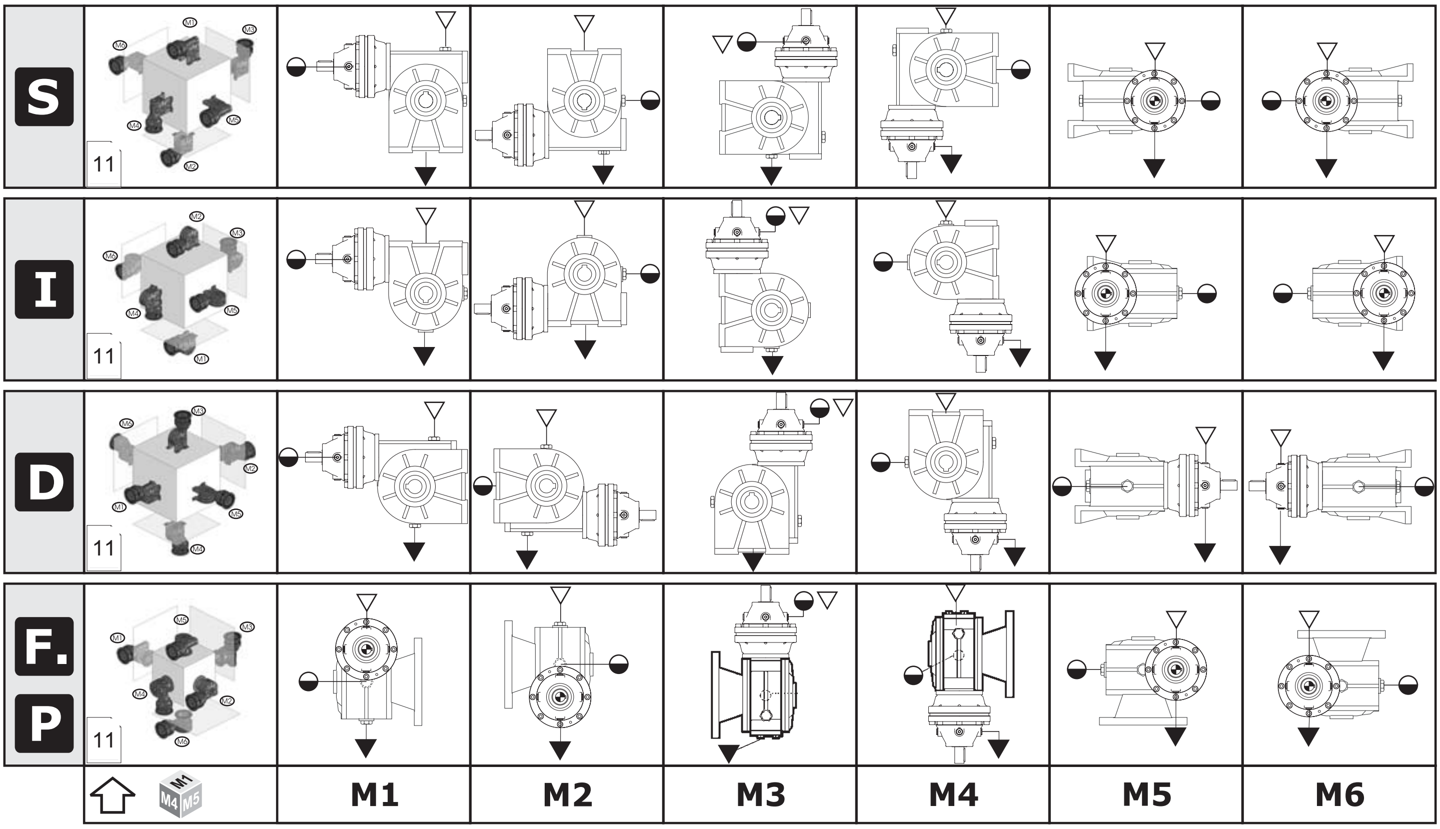
Für die Auffüllung sind die angegebenen Mengen zu beachten, da in einigen Fällen der Füllstand des Schmiermittels das Füllstands-Kontrollfenster übersteigt.

8. LUBRIFICAZIONE / *8. LUBRICATION* / 8. SCHMIERUNG

Posizioni di montaggio
Mounting positions
Montagepositionen

CR - CB

130 - 150 - 180 - 215 - 250



▽ Carico / *Breather plug* / Nachfüllen - Entlüftung
◒ Livello / *Level plug* / Pegel
▼ Scarico / *Drain plug* / Ablassschraube

Lub CR CB	Quantità di lubrificante - *Lubricant Quantity - Schmiermittelmenge - [Kg]*						OPT1	Tappi-Plug-Stopf		
	M1	M2	M3	M4	M5	M6		N°	Diameter	Type
130	5.100	3.900	5.750	3.900	3.400	3.400	OUTOIL	5-CB 7-CR	1/2" - 1/4"	
150	7.900	6.200	9.300	6.200	5.600	5.600				
180	13.20	10.70	15.85	10.70	9.850	9.850				
215	23.45	14.90	27.55	14.90	13.95	13.95		6-CB 8-CR	1" - 1/4"	
250	34.45	22.90	40.95	22.90	21.45	21.45		6-CB 8-CR	1" - 3/8"	

Lub

Quantità indicative; durante il riempimento attenersi alla spia di livello.

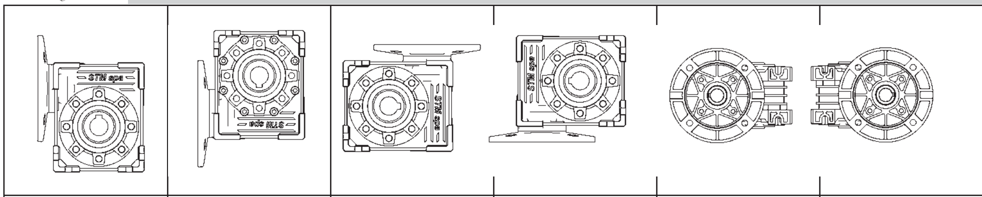
Indicative quantities, check the oil sight glass during filling.

Richtungsweisende Mengen, bei der Auffüllung auf das Füllstand-Kontrollfenster Bezug nehmen.

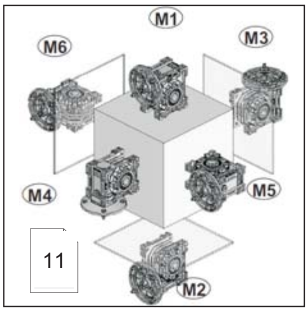
8. LUBRIFICAZIONE | *8. LUBRICATION* | 8. SCHMIERUNG

Posizioni di montaggio
Mounting positions
Montagepositionen

UI - UMI



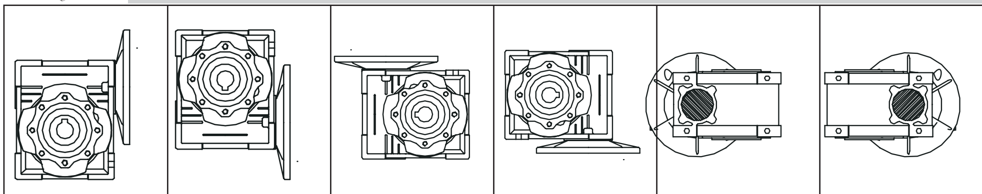
M1	M2	M3	M4	M5	M6



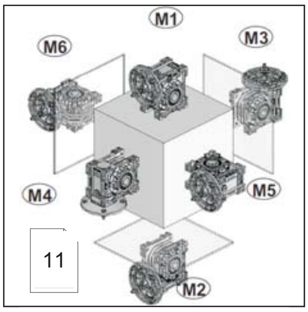
Lub		Quantità di lubrificante - *Lubricant Quantity - Schmiermittelmenge* - [Kg]						OPT1	Tappi-Plug-Stopfen		
		M1	M2	M3	M4	M5	M6		N°	Diameter	Type
UI-RMI	40	0.070						INOIL_STD	1	1/4"	
UI	50	0.170						INOIL_STD	1	1/4"	
UMI	50	0.130						INOIL_STD	1	1/4"	
UI	63	0.350						INOIL_STD	1	1/4"	
UMI	63	0.240						INOIL_STD	1	1/4"	
UI-UMI	75	0.450						INOIL_STD	1	1/4"	
UI-UMI	90	1.000	0.600					INOIL_STD	1	1/4"	
UI-UMI	110	1.600	1.300					INOIL_STD	1	3/8"	

Posizioni di montaggio
Mounting positions
Montagepositionen

WI - WMI



M1	M2	M3	M4	M5	M6



	Quantità di lubrificante - *Lubricant Quantity - Schmiermittelmenge* - [Kg]						OPT1	Tappi-Plug-Stopfen		
	M1	M2	M3	M4	M5	M6		N°	Diameter	Type
25	0.020						INOIL_STD	1	1/8"	
30	0.040						INOIL_STD	1	1/8"	
40	0.080						INOIL_STD	1	1/8"	
50	0.150						INOIL_STD	1	1/8"	
63	0.300						INOIL_STD	1	3/8"	
75	0.550						INOIL_STD	1	3/8"	
90	1.000						INOIL_STD	1	3/8"	
110	3.000	2.200	3.000	2.200	2.500	2.500	OUTOIL	3	3/8"	
130	4.500	3.300	4.500	3.300	3.500	3.500	OUTOIL	3	3/8"	
150	7.000	5.100	7.000	5.100	5.400	5.400	OUTOIL	3	3/8"	

Lub

Quantità indicative; durante il riempimento attenersi alla spia di livello.

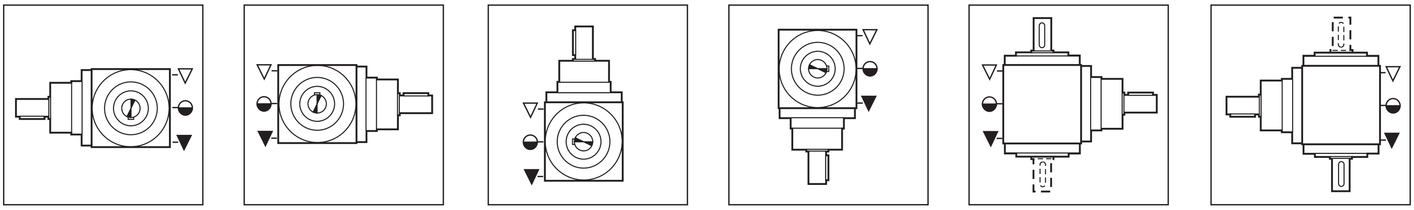
Indicative quantities, check the oil sight glass during filling.

Richtungsweisende Mengen, bei der Auffüllung auf das Füllstand-Kontrollfenster Bezug nehmen.

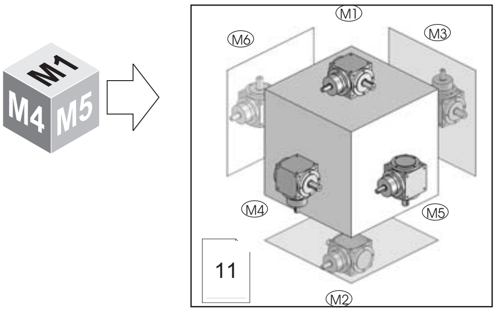
8. LUBRIFICAZIONE

8. LUBRICATION

8. SCHMIERUNG



M1 M2 M3 M4 M6 M5



▽ Carico / *Breather plug* / Nachfüllen - Entlüftung
◒ Livello / *Level plug* / Pegel
▼ Scarico / *Drain plug* / Auslauf

ZA Quantità di lubrificante - Lubricant Quantity - Schmiermittelmenge - [Kg]							
12	**19**	**24**	**32**	**38**	**42**	**55**	**75**
0.1	0.15	0.22	0.60	1.1	2.2	3.6	9.0

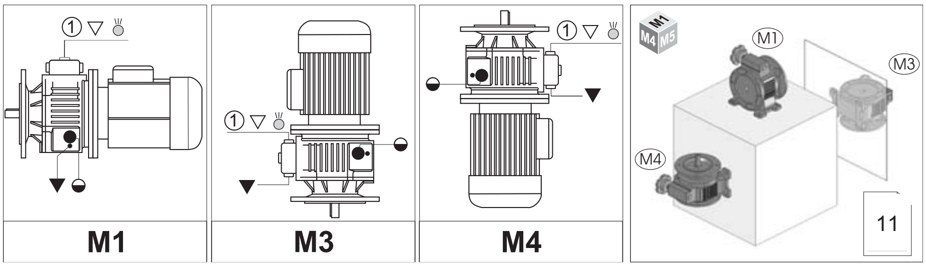
Solo per ZA.
Per Ulteriori informazioni Contattare il ns. servizio tecnico

Only ZA.
Contact our technical dept

Nur für ZA.
Weitere Informationen können Sie bei unserem Technischen Kundendienst anfordern.

Posizioni di montaggio
Mounting positions
Montagepositionen

Previous supply



M1 M3 M4

▽ Carico/*Breather plug*/Einfüll-u. Entlüftungsschraube
◒ Livello/*Level plug*/Schauglas
▼ Scarico/*Drain plug*/ Ablaßschraube
Sfiato/*Vent pung* / Entlüftungsstopfen

Lub	Quantità di lubrificante - *Lubricant Quantity - Schmiermittelmenge - [Kg]*				OPT1	Tappi-Plug-Stopf		
		M1	M3	M4		N°	Diameter	Type
WM	63	0.110	0.200	0.200	INOIL_STD	6	On request	
	71	0.180	0.400	0.300		6		
	80	0.300	0.950	0.450		6		
	90	0.650	1.200	0.900		6		
	100	1.200	2.200	2.200		6		
	112	1.200	2.200	2.200		6		

Lub

Quantità indicative; durante il riempimento attenersi alla spia di livello.

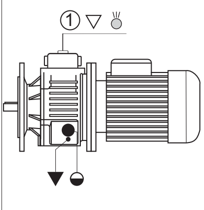
Indicative quantities, check the oil sight glass during filling.

Richtungsweisende Mengen, bei der Auffüllung auf das Füllstand-Kontrollfenster Bezug nehmen.

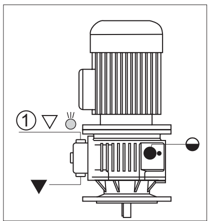
8. LUBRIFICAZIONE | *8. LUBRICATION* | 8. SCHMIERUNG

Posizioni di montaggio
Mounting positions
Montagepositionen

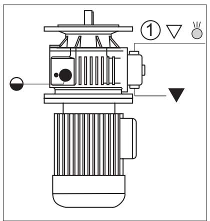
New supply



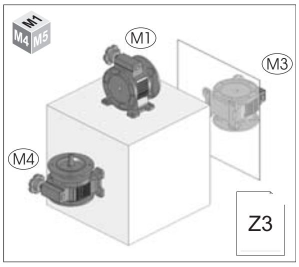
M1



M3



M4



▽ Carico/*Breather plug*/Einfüll-u. Entlüftungsschraube
◒ Livello/*Level plug*/Schauglas
▼ Scarico/*Drain plug*/ Ablaßschraube
Sfiato/*Vent pung* / Entlüftungsstopfen

Lub		Quantità di lubrificante - *Lubricant Quantity - Schmiermittelmenge - [Kg]*			OPT1	Tappi-Plug-Stopf		
		M1	M3	M4		N°	Diameter	Type
WM	63 N	0.060	0.250	0.200	INOIL_STD	6	On request	
	71 N	0.100	0.400	0.200		6		
	80 N	0.200	0.600	0.350		6		
	90 N	0.550	1.250	0.900		6		
	100 N	1.100	2.100	1.400		6		
	112 N	1.100	2.100	1.400		6		
	132 N	3.500	5.000	5.000		6		

Lub

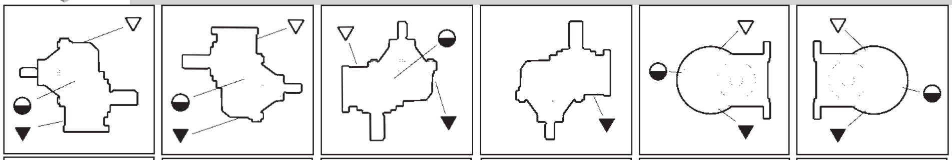
Quantità indicative; durante il riempimento attenersi alla spia di livello.

Indicative quantities, check the oil sight glass during filling.

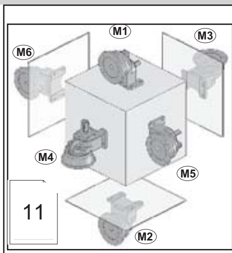
Richtungsweisende Mengen, bei der Auffüllung auf das Füllstand-Kontrollfenster Bezug nehmen.

8. LUBRIFICAZIONE
8. LUBRICATION
8. SCHMIERUNG

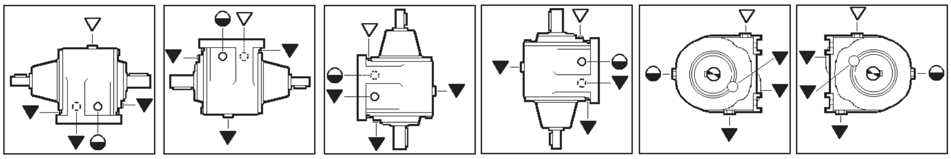
Posizioni di montaggio
Mounting positions
Montagepositionen



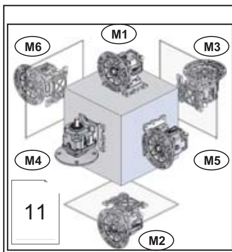
M1	M2	M3	M4	M5	M6

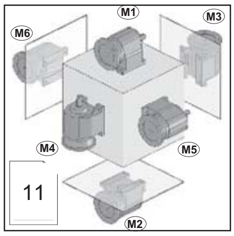


▽ Carico / *Breather plug* / Nachfüllen - Entlüftung
⊖ Livello / *Level plug* / Pegel
▼ Scarico / *Drain plug* / Auslauf



M1	M2	M3	M4	M5	M6





▽ Carico / *Breather plug* / Nachfüllen - Entlüftung
⊖ Livello / *Level plug* / Pegel
▼ Scarico / *Drain plug* / Auslauf

Lub	Quantità di lubrificante - *Lubricant Quantity - Schmiermittelmenge - [Kg]*							OPT1	Tappi-Plug-Stopfen		
			M1	M2	M3	M4	M5	M6		N°	Diameter	Type
AR AM AC	32	/1	0.100	0.100	0.100	0.100	0.100	0.100	INOIL_STD	1	1/8"	▼ ▽
	40	/1	0.160	0.270	0.180	0.270	0.160	0.160		1	1/4"	
	50	/1	0.300	0.300	0.200	0.300	0.200	0.200		1	1/4"	
	60	/1	0.470	0.640	0.570	0.750	0.570	0.570		1	3/8"	
	80	/1	1.050	1.050	1.350	1.650	1.400	1.400	OUTOIL	4	3/8"	▼ ▽
	100	/1	2.500	3.000	3.000	3.300	3.000	3.000			3/8"	

8. LUBRIFICAZIONE

8. LUBRICATION

8. SCHMIERUNG

Lub			Quantità di lubrificante - *Lubricant Quantity - Schmiermittelmenge - [Kg]*						OPT1	Tappi-Plug-Stopfen		
			M1	M2	M3	M4	M5	M6		N°	Diameter	Type
AR AM AC	25	/2 /3	0.120						INOIL_STD	1	1/8"	
	35	/2	0.150	0.200	0.200	0.200	0.150	0.150		1	1/4"	
	35	/3	0.250	0.250	0.325	0.250	0.200	0.200		1	1/4"	
	41	/2	0.290	0.290	0.240	0.300	0.200	0.200		1	1/4"	
	41	/3	0.300	0.300	0.350	0.350	0.260	0.260		1	1/4"	
	45	/2	0.350	0.350	0.400	0.400	0.350	0.350		1	1/4"	
	45	/3	0.400	0.400	0.630	0.600	0.400	0.400		1	1/4"	
	50	/2	0.800	0.900	1.250	1.450	0.900	0.950		1	1/4"	
	50	/3	0.800	0.900	1.450	1.450	0.900	0.950		1	1/4"	
	55	/2	1.600	2.000	2.500	2.700	1.600	1.600		1	1/4"	
	55	/3	1.600	2.000	2.700	2.700	1.600	1.600		1	1/4"	
	60	/2	1.550	1.550	2.400	2.700	1.600	1.750	OUTOIL	4	3/8"	
	60	/3	1.550	1.550	2.800	2.700	1.600	1.750		4	3/8"	
	70	/2	2.200	3.300	3.600	3.900	2.600	2.800		5	3/8"	
	70	/3	2.200	3.300	4.100	3.900	2.600	2.800		5	3/8"	
	80	/2	2.900	2.900	4.500	5.000	3.200	3.300		4	1/2"	
	80	/3	2.900	2.900	5.500	5.000	3.200	3.300		4	1/2"	
2-3	90	/2 /3	5.000	5.900	7.800	6.700	5.900	5.900		4	1/2"	
	100	/2 /3	5.550	5.550	9.600	9.600	5.550	5.550		4	1/2"	
	110	/2 /3	8.700	11.20	12.10	11.90	8.600	9.600		4	1/2"	
	120	/2 /3	10.00	10.00	16.50	16.50	10.00	10.00		4	1/2"	
	140	/2	16.00	19.00	21.00	25.50	16.00	19.00		7	1/2"	
	140	/3	16.00	19.00	26.00	25.50	16.00	19.00		7	1/2"	

Lub

Quantità indicative; durante il riempimento attenersi alla spia di livello.

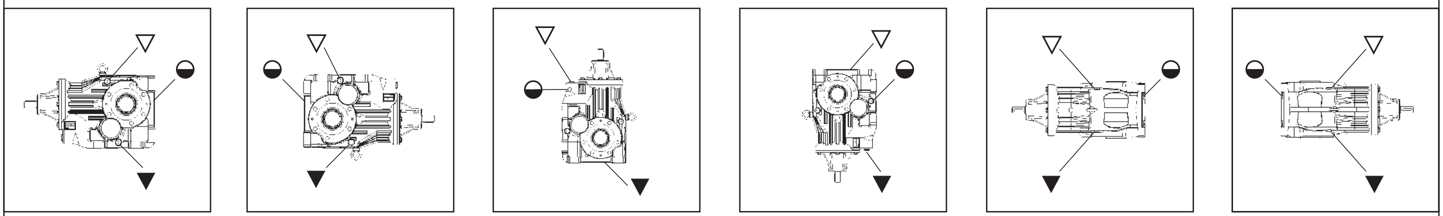
Indicative quantities, check the oil sight glass during filling.

Richtungsweisende Mengen, bei der Auffüllung auf das Füllstand-Kontrollfenster Bezug nehmen.

8. LUBRIFICAZIONE — *8. LUBRICATION* — 8. SCHMIERUNG

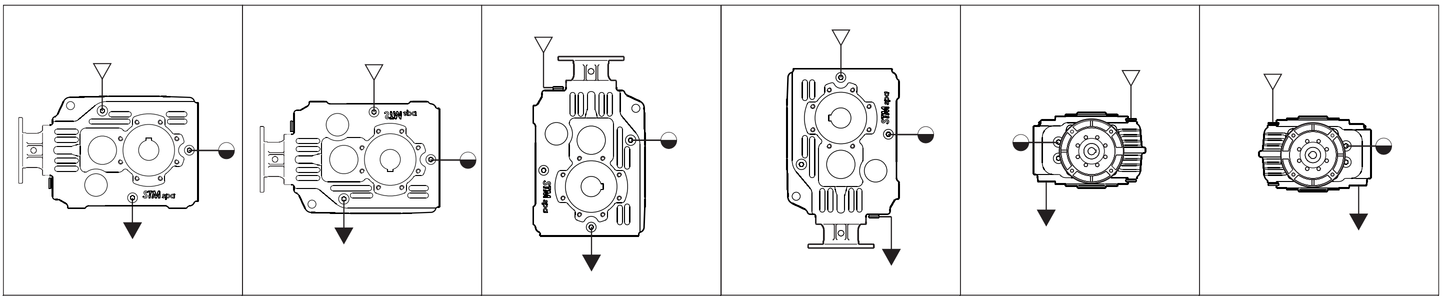
Posizioni di montaggio
Mounting positions
Montagepositionen

63 - 71 -90 -112



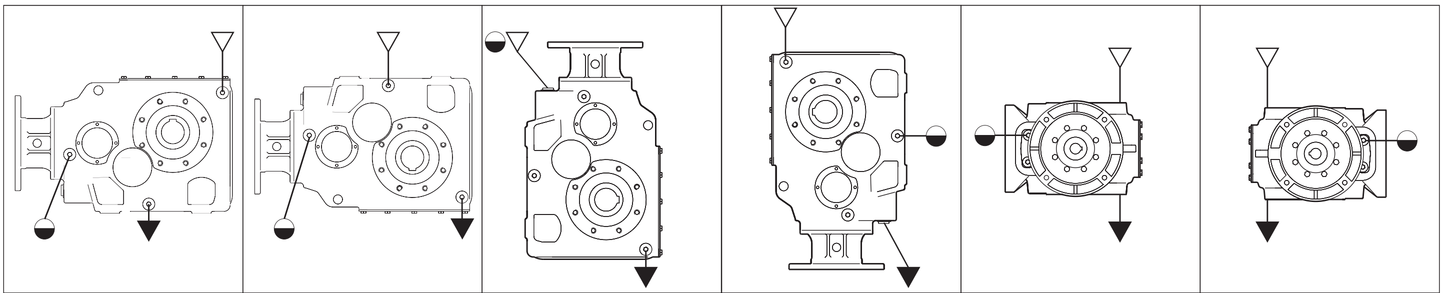
M1	M2	M3	M4	M5	M6

80 - 100 - 125 - 140 - 160 - 180

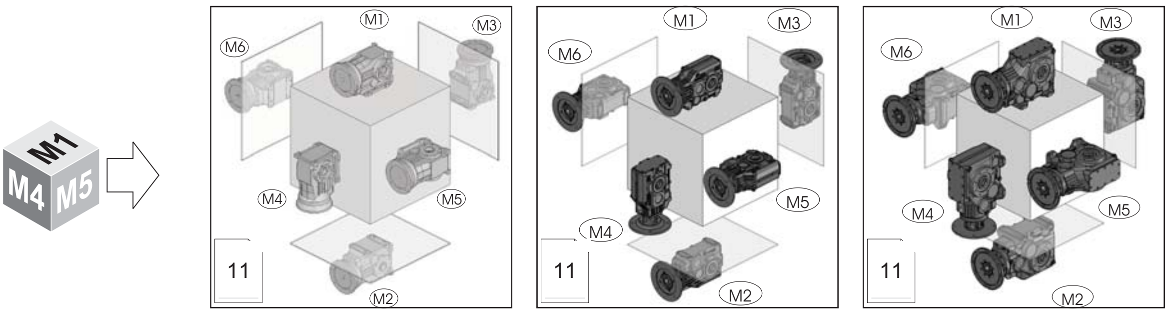


M1	M2	M3	M4	M5	M6

132 - 150 - 170 - 190



M1	M2	M3	M4	M5	M6



▽ Carico / *Breather plug* / Nachfüllen - Entlüftung
◒ Livello / *Level plug* / Pegel
▼ Scarico / *Drain plug* / Auslauf

8. LUBRIFICAZIONE

8. LUBRICATION

8. SCHMIERUNG

Lub			Quantità di lubrificante - *Lubricant Quantity - Schmiermittelmenge - [Kg]*						OPT1	Tappi-Plug-Stopfen		
			M1	M2	M3	M4	M5	M6		N°	Diameter	Type
OR OM OC	63	WITH ANTIRUN BACK DEVICE	1.260	1.260	1.260	1.260	1.260	1.260	INOIL_STD	1	1/4"	
		WITHOUT ANTIRUN BACK DEVICE	1.300	1.300	1.300	1.300	1.300	1.300				
	71	WITH ANTIRUN BACK DEVICE	1.350	1.250	1.850	1.550	1.700	1.700		1	1/4"	
		WITHOUT ANTIRUN BACK DEVICE	1.350	1.250	1.950	1.550	1.700	1.700				
	80	—	1.000	1.000	1.400	1.200	1.300	1.300	OUTOIL	8	1/4"	
	90	WITH ANTIRUN BACK DEVICE	2.700	2.700	3.600	2.700	2.700	2.700		7	1/4"	
		WITHOUT ANTIRUN BACK DEVICE	3.000	3.000	3.850	3.000	3.000	3.000				
	100	—	2.200	2.200	2.500	2.500	2.600	2.600		8	1/4"	
	112	WITH ANTIRUN BACK DEVICE	5.000	5.000	7.500	5.000	5.000	5.000		7	1/4"	
		WITHOUT ANTIRUN BACK DEVICE	5.500	5.500	8.200	5.500	5.500	5.500				
	125	—	4.000	4.000	4.400	4.400	4.500	4.500		8	3/8"	
	132	—	8.000	8.000	14.00	7.500	11.00	11.00		8	1/2"	
	140	—	9.100	9.100	10.20	10.50	13.30	13.30		8	1/2"	
	150	—	11.00	11.00	21.00	12.00	16.50	16.50		8	1/2"	
	160	—	12.00	14.00	17.00	13.00	18.00	18.00		8	1/2"	
	170	—	17.00	17.00	33.00	17.00	24.50	24.50		8	1/2"	
	180	—	16.50	18.00	22.50	17.00	24.50	24.50		8	1/2"	
	190	—	23.00	25.00	43.80	25.00	33.00	33.00		8	1/2"	

Lub

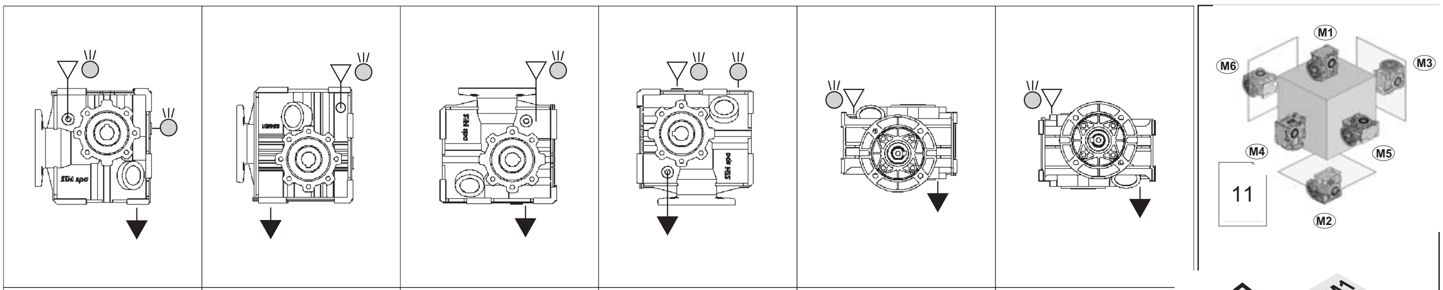
Quantità indicative; durante il riempimento attenersi alla spia di livello.

Indicative quantities, check the oil sight glass during filling.

Richtungsweisende Mengen, bei der Auffüllung auf das Füllstand-Kontrollfenster Bezug nehmen.

8. LUBRIFICAZIONE | *8. LUBRICATION* | 8. SCHMIERUNG

Posizioni di montaggio
Mounting positions
Montagepositionen

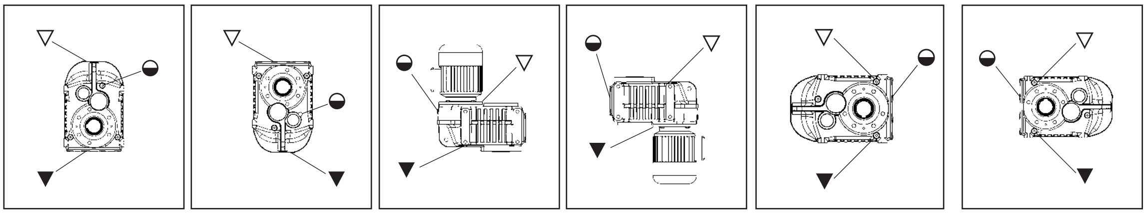


M1	M2	M3	M4	M5	M6

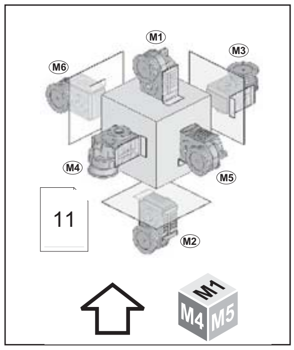
- ▽ Carico / *Breather plug* / Einfüll-u. Entlüftungsschraube
- Livello / *Level plug* / Schauglas
- ▼ Scarico / *Drain plug* / Ablaßschraube
- Sfiato / *Vent pung* / Entlüftungsstopfen

Lub			Quantità di lubrificante - *Lubricant Quantity - Schmiermittelmenge - [Kg]*						OPT1	Tappi-Plug-Stopfen		
			M1	M2	M3	M4	M5	M6		N°	Diameter	Type
SM	25		0.300	0.480	0.480	0.480	0.480	0.480	INOIL_STD	2	1/8"	
	35		0.400	0.580	0.580	0.580	0.580	0.580		2	1/8"	
	45		0.500	0.850	0.800	0.800	0.800	0.800		3	1/4"	

Posizioni di montaggio
Mounting positions
Montagepositionen



M1	M2	M3	M4	M5	M6



- ▽ Carico / *Breather plug* / Einfüll-u. Entlüftungsschraube
- Livello / *Level plug* / Schauglas
- ▼ Scarico / *Drain plug* / Ablaßschraube

Lub			Quantità di lubrificante - *Lubricant Quantity - Schmiermittelmenge - [Kg]*						OPT1	Tappi-Plug-Stopfen		
			M1	M2	M3	M4	M5	M6		N°	Diameter	Type
PR PM PC	63		1.250	0.900	1.300	1.150	0.900	0.900	INOIL_STD	1	1/4"	
	71		2.100	1.750	2.300	2.000	1.600	1.600		1	1/4"	
	90		3.300	2.800	3.800	3.700	2.650	2.650	OUTOIL	4	1/4"	
	112		7.300	7.100	8.000	7.000	6.000	6.000		4	1/4"	
	125		8.500	7.500	8.700	8.500	6.000	6.000		5	1/8"	

Lub

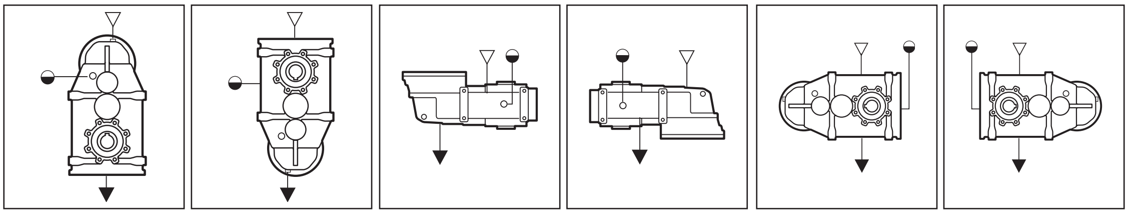
Quantità indicative; durante il riempimento attenersi alla spia di livello.

Indicative quantities, check the oil sight glass during filling.

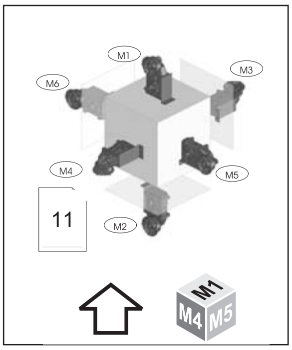
Richtungsweisende Mengen, bei der Auffüllung auf das Füllstand-Kontrollfenster Bezug nehmen.

8. LUBRIFICAZIONE | *8. LUBRICATION* | 8. SCHMIERUNG

Posizioni di montaggio
Mounting positions
Montagepositionen



M1	M2	M3	M4	M5	M6



▽ Carico / *Breather plug* / Einfüll-u. Entlüftungsschraube
◒ Livello / *Level plug* / Schauglas
▼ Scarico / *Drain plug* / Ablaßschraube

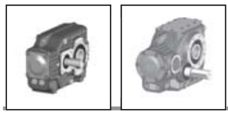
Lub	Quantità di lubrificante - *Lubricant Quantity - Schmiermittelmenge - [Kg]*							OPT1	Tappi-Plug-Stopfen		
			M1	M2	M3	M4	M5	M6		N°	Diameter	Type
PLR PLM PLC	25		0.700	0.600	0.600	0.600	0.500	0.500	INOIL_STD	1	1/4"	▼ ▽
	45		1.300	0.900	1.300	1.300	1.200	1.200		1	1/4"	
	65		1.850	1.350	1.550	1.550	1.400	1.400		1	3/8"	
	85		3.700	2.400	3.150	2.900	2.300	2.300	OUTOIL	5	3/8"	▼ ▽ ◒
	95		6.100	4.550	5.250	4.550	3.550	3.550		5	3/8"	
	105		12.00	7.200	9.200	8.500	6.600	6.600		5	1/2"	
	115		20.00	12.50	15.30	13.30	11.00	11.00		5	1/2"	
	125		31.00	19.00	24.00	22.00	16.00	16.00		5	1/2"	
	135		41.00	30.00	30.00	32.70	20.00	20.00		5	1/2"	

Lub

Quantità indicative; durante il riempimento attenersi alla spia di livello.

Indicative quantities, check the oil sight glass during filling.

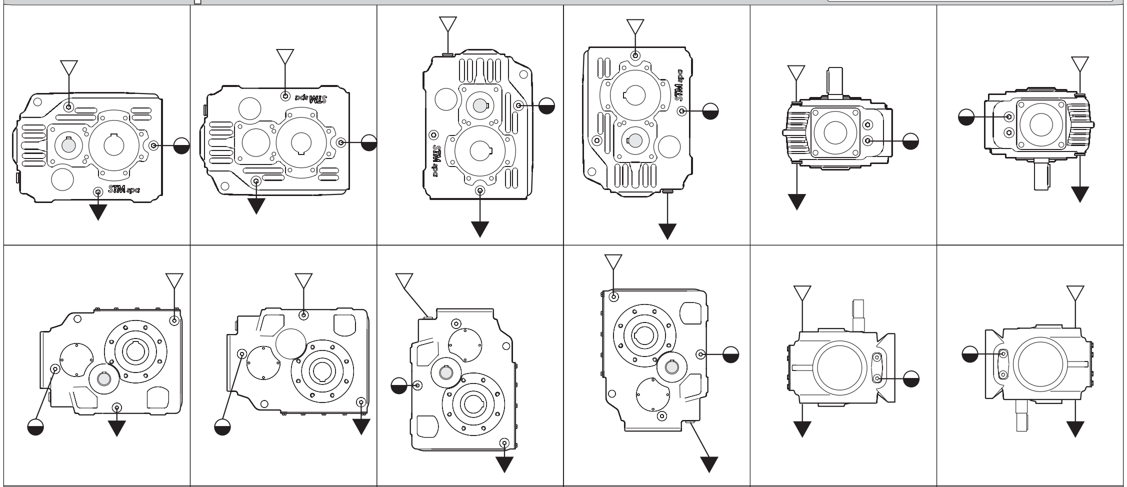
Richtungsweisende Mengen, bei der Auffüllung auf das Füllstand-Kontrollfenster Bezug nehmen.



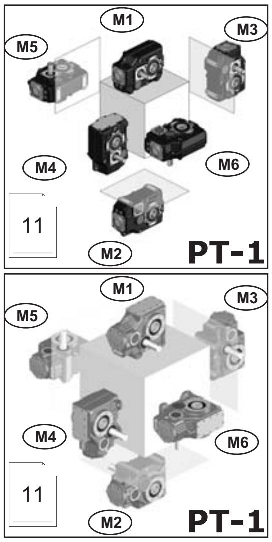
Posizioni di montaggio
Mounting positions
Montagepositionen

PT-1

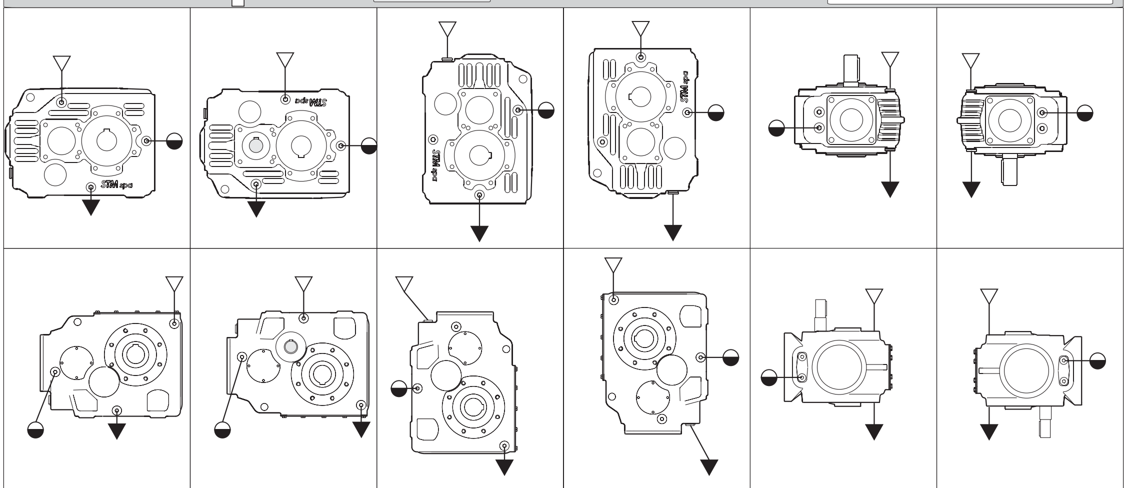
PT-1 — A | AUD | C1 — 80-100-125-140 / 132-150-170-190



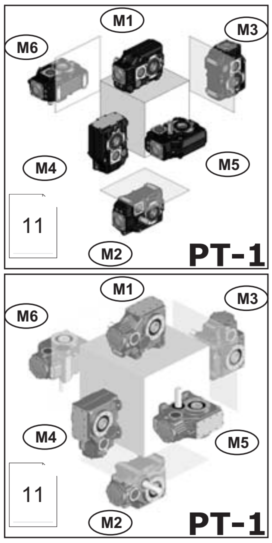
M1	M2	M3	M4	M5	M6



PT-1 — B | BUS | C2 — 80-100-125-140 / 132-150-170-190



M1	M2	M3	M4	M5	M6



▽ Carico / *Breather plug* / Nachfüllen - Entlüftung
◒ Livello / *Level plug* / Pegel
▼ Scarico / *Drain plug* / Auslauf

8. LUBRIFICAZIONE

8. LUBRICATION

8. SCHMIERUNG

Lub		Quantità di lubrificante - *Lubricant Quantity - Schmiermittelmenge - [Kg]*						OPT1	Tappi-Plug-Stopfen		
		M1	**M2**	**M3**	**M4**	**M5**	**M6**		N°	Diameter	Type
PT	**80**	**1,000**	**1,000**	**1,400**	**1,200**	**1,000**	**1,300**	**OUTOIL**	8	1/4"	
	100	**2,100**	**2,100**	**2,500**	**2,500**	**2,100**	**2,600**		8	1/4"	
	125	**4,000**	**4,000**	**4,400**	**4,400**	**4,000**	**4,500**		8	3/8"	
	132	**7.100**	**7.800**	**8.000**	**8.000**	**7.100**	**9.800**		8	1/2"	
	140	**9.000**	**9.000**	**10.00**	**10.30**	**11.00**	**13.30**		8	1/2"	
	150	**11.40**	**12.50**	**13.00**	**13.00**	**11.40**	**15.50**		8	1/2"	
	170	**16.00**	**17.50**	**18.00**	**18.00**	**16.00**	**21.00**		8	1/2"	
	190	**23.30**	**25.40**	**26.00**	**26.00**	**23.30**	**32.00**		8	1/2"	

Lub

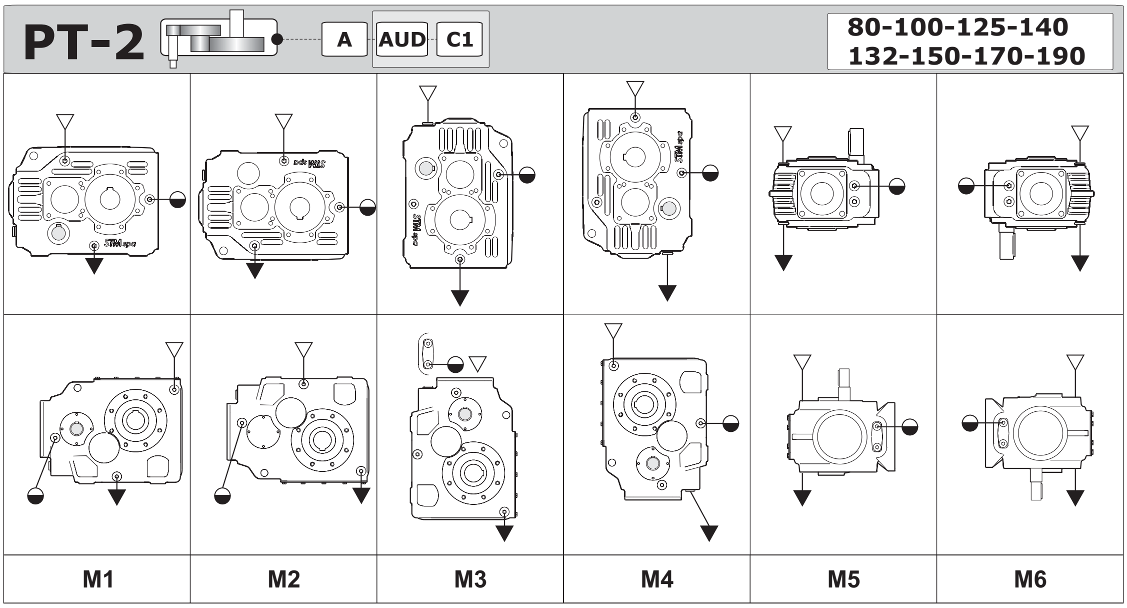
Quantità indicative; durante il riempimento attenersi alla spia di livello.

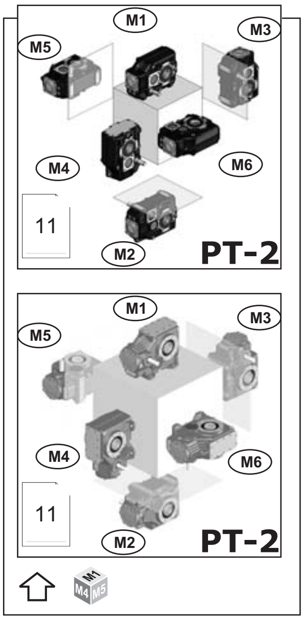
Indicative quantities, check the oil sight glass during filling.

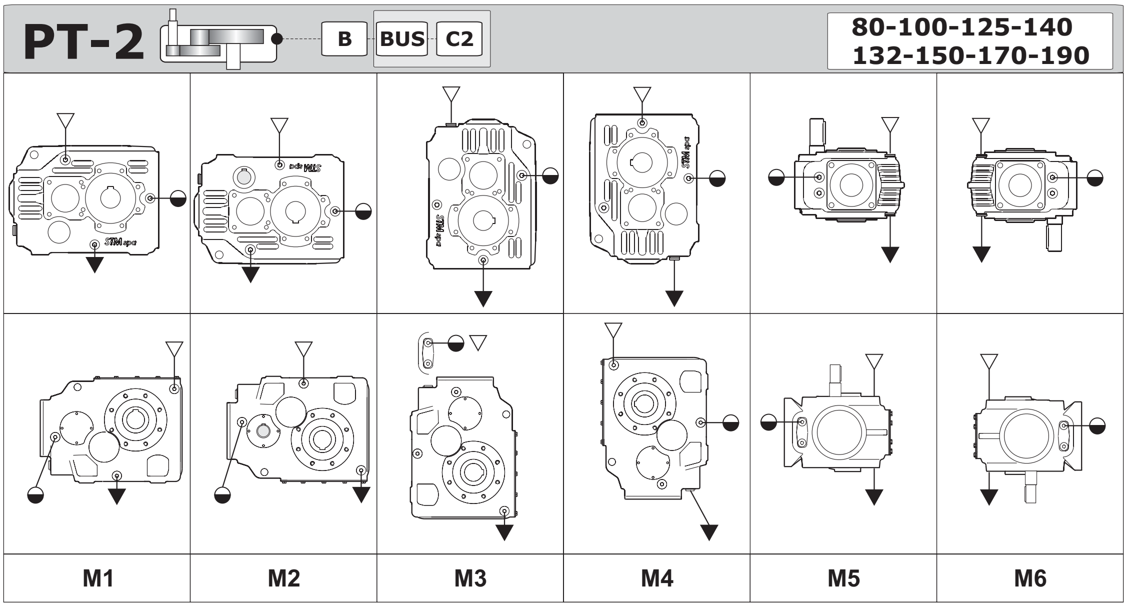
Richtungsweisende Mengen, bei der Auffüllung auf das Füllstand-Kontrollfenster Bezug nehmen.

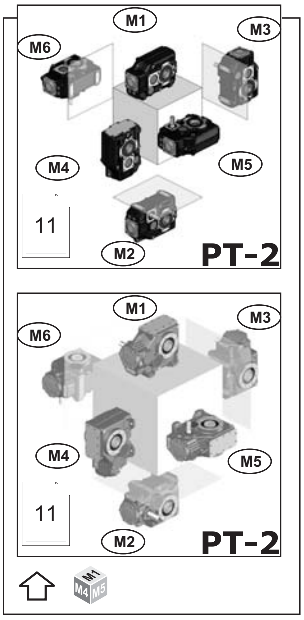
Posizioni di montaggio
Mounting positions
Montagepositionen

PT-2









▽ Carico / *Breather plug* / Nachfüllen - Entlüftung
◒ Livello / *Level plug* / Pegel
▼ Scarico / *Drain plug* / Auslauf

8. LUBRIFICAZIONE

8. LUBRICATION

8. SCHMIERUNG

Lub		Quantità di lubrificante - *Lubricant Quantity - Schmiermittelmenge - [Kg]*							OPT1		Tappi-Plug-Stopfen		
			M1	M2	M3	M4	M5	M6			N°	Diameter	Type
PT	80		1.100	1.100	1.400	1.400	1.200	1.200		OUTOIL	8	1/4"	
	100		2.200	2.200	2.500	2.500	2.600	2.600			8	1/4"	
	125		3.700	3.700	4.500	4.500	4.800	4.800			8	3/8"	
	132		7.100	7.800	12.00	8.000	9.800	9.800			8	1/2"	
	140		8.700	8.700	12.20	12.40	13.30	13.30			8	1/2"	
	150		11.40	12.50	20.00	13.00	15.50	15.50			8	1/2"	
	170		16.00	17.50	27.00	18.00	22.00	21.00			8	1/2"	
	190		23.30	25.40	40.00	26.00	32.00	32.00			8	1/2"	

Lub

Quantità indicative; durante il riempimento attenersi alla spia di livello.

Indicative quantities, check the oil sight glass during filling.

Richtungsweisende Mengen, bei der Auffüllung auf das Füllstand-Kontrollfenster Bezug nehmen.

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9. MANUTENZIONE

9.1 CONTROLLI GENERALI
Tutti i lavori devono essere eseguiti da personale adeguatamente preparato nel rispetto delle norme di sicurezza vigenti.

Il nostro servizio di assistenza è a vostra disposizione per qualsiasi esigenza.

Controllare frequentemente che non vi siano variazioni immotivate di temperatura e /o rumorosità.

La durata delle guarnizioni dipende da vari fattori fra i quali velocità, temperature ed ambiente e si può ritenere variabile fra le 4000 e 20000 h.

Ispezionare il riduttore ogni 2 anni.

Controllare il serraggio delle viti alla fine del rodaggio e successivamente ogni 2000 h.

Nel caso il riduttore sia fornito di giunto si consiglia di verificare periodicamente lo stato di usura degli elementi elastici, controllando inoltre che le condizioni di installazione non si siano modificate.

Verificare la corretta chiusura dei tappi di rabbocco e uscita lubrificante (mensilmente).

Effettuare periodicamente una accurata pulizia esterna del riduttore , per rimuovere lo sporco eventualmente depositato nel tempo e che limita la capacità di dissipazione del calore.

9. MAINTENANCE

9.1 GENERAL INSPECTIONS
All works should be carried out by adequately prepared operators and in observance of the safety rules in force.

Our assistance service is at your disposal for any need.

Check often for strange variations of temperature and/or noise.

Life of seals depends on various factors such as speed, temperature and environment, and could vary between 4000 and 20000 hours.

Inspect the gear unit every two years.

Check the screws tightening at the end of the running-in period and then every 2000h.

In case the gearbox is fitted with a coupling, we suggest to periodically check the wearing condition of the elastic components, verifying that installation conditions have not been modified as well.

Ensure (once a month) that filler and lubricant drain plugs are correctly closed.

Periodically clean the outer surfaces of the gearbox, remove the dirt that could have settled in time and that could limit heat dispersion.

9. INBETRIEBSETZUNG

9.1 ALLGEMEINE KONTROLLEN
Alle Arbeiten müssen von entsprechend geschultem Personal unter Einhaltung der geltenden Sicherheitsnormen durchgeführt werden.

Unser Kundendienst steht Ihnen für jegliche Erfordernisse gerne zur Verfügung.

Regelmäßig prüfen, dass keine unbegründeten Temperatur- und/oder Geräuschpegel-schwankungen vorliegen.

Die Lebensdauer der Dichtungen ist von verschiedenen Faktoren abhängig, wie Temperaturen und Umgebungsbedingungen, und kann zwischen 4000 und 20000 Stunden liegen.

Das Getriebe alle 2 Jahre einer Inspektion unterziehen.

Nach der Einlaufzeit, dann alle 2000 Stunden den Anzug der Schrauben kontrollieren.

Sollte das Getriebe mit Kupplung geliefert werden, wird empfohlen, den Verschleißzustand der elastischen Elemente regelmäßig zu kontrollieren. Darüber hinaus muss kontrolliert werden, dass es zu keinen Veränderungen der Installationsbedingungen gekommen ist.

Den korrekt erfolgten Verschluss der Einfüll- und Ablasschrauben des Schmiermittels überprüfen (monatlich).

Den Außenbereich des Getriebes regelmäßig reinigen und dabei den sich ggf. mit der Zeit angesetzten Schmutz entfernen, der die Wärmeableitungsleistung einschränkt.

9. MANUTENZIONE

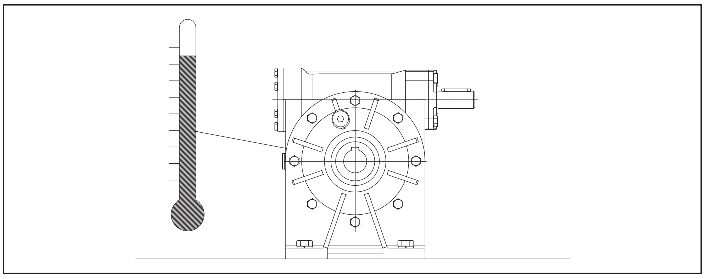
Prestare le dovute precauzioni poiché durante il normale funzionamento le superfici sono calde.

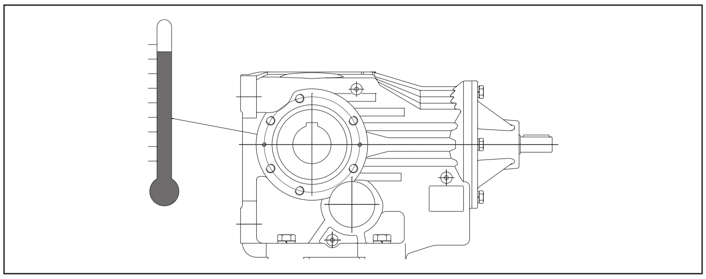
9. MAINTENANCE

During normal operation surfaces are hot: take care to avoid burns.

9. INBETRIEBSETZUNG

Angemessene Vorsicht walten lassen, da die Oberflächen während des Betriebs heiß werden.





9.2 MOMENTI DI SERRAGGIO

Momenti di serraggio consigliati (Nm) in accordo con UNI 5739 mat.8.8:

9.2 TIGHTENING TORQUES

Recommended screws tightening torques (Nm) according UNI 5739 mat.8.8.

9.2 ANZUGSMOMENTE

Empfohlene Anzugsmomente (Nm) in Übereinstimmung mit der UNI 5739 Mat. 8.8:

M6	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27	M30
10.4	24.6	50.1	84.8	135	205	283	400	532	691	1010	1370

9.3 PRESCRIZIONI ATEX

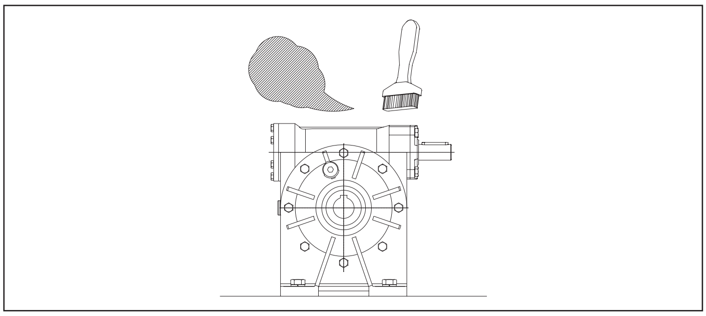
Negli ambienti polverosi prevedere un opportuno piano di pulizia periodico delle superfici esterne del riduttore atte ad evitare che lo strato depositato superi lo spessore di 5mm.

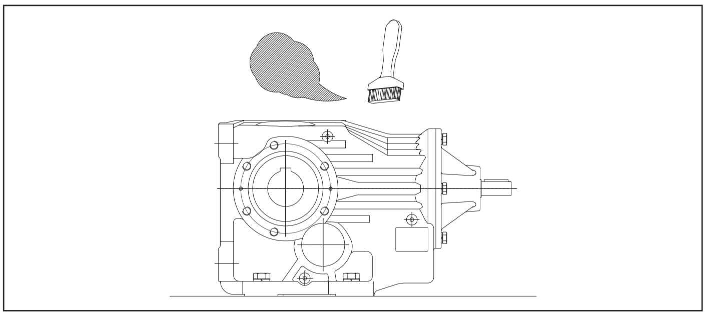
9.3 ATEX PROVISIONS

In dusty operation environments make sure to put in place an appropriate regular cleaning plan for the outer surface of the gearbox so that the layer thickness does not exceed 5mm.

9.3 ATEX-VORSCHRIFTEN

In staubhaltigen Umgebungen ist ein angemessener Plan für die regelmäßige Reinigung der Außenflächen des Getriebes zu erstellen, so dass verhindert wird, dass sich Ablagerungen mit einer Stärke von über 5 mm bilden.

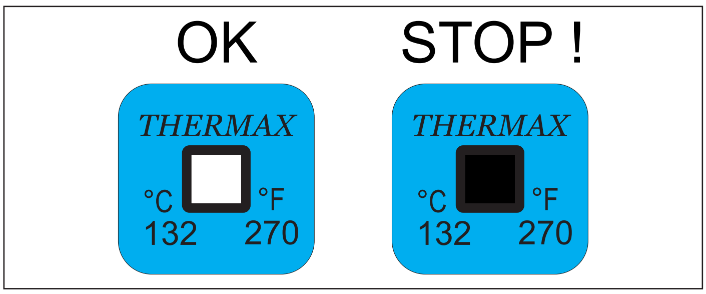


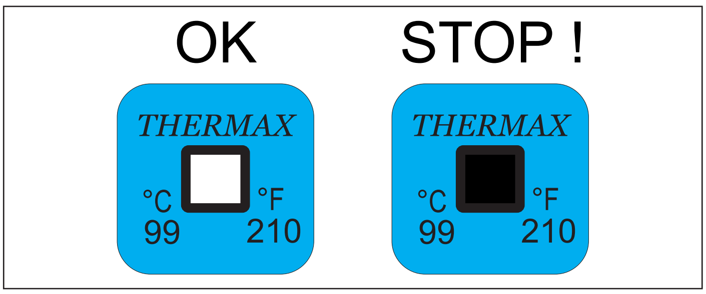


ATTENZIONE
Verificare periodicamente che l'indicatore di temperatura termosensibile (non evidenzi esposizione o trascorsa esposizione a temperatura superiore a quella indicata; in questo caso (si annerisce completamente il dischetto centrale del rilevatore) arrestare immediatamente il riduttore e contattare il servizio assistenza presso STM SpA per la risoluzione dell'anomalia e per l'invio di un nuovo indicatore termosensibile.

ATTENTION
Periodically verify that the thermosensitive temperature indicator does not show marks indicating current or past exposition to temperature higher than indicated. In this case the indicator central disc will blacken and the gearbox must be stopped immediately. After this, get in touch with STM SpA service center to solve the problem and receive a new thermosensitive indicator to replace the old one.

ACHTUNG
Regelmäßig überprüfen, dass die Temperaturanzeige mit Wärmefühler keine momentane oder vergangene Aussetzung an Temperaturen hervorhebt, die über der angegebenen liegt. In diesem Fall (die mittlere Scheibe der Instruments wird dabei vollkommen schwarz) das Getriebe sofort stoppen und sich mit dem Kundendienst der STM SpA in Verbindung setzen, um eine Abhilfe der Störung zu finden oder um sich einen neuen Wärmefühler liefern zu lassen.





9. MANUTENZIONE

Al termine di qualsiasi intervento:
1-Ripristinare l'integrità del prodotto e le predisposizioni di sicurezza;
2-Pulire accuratamente il riduttore;
3-Chiudere i tappi olio se presenti;
4-Ripristinare tutte le tenute statiche, utilizzando le appropriate sigillature;
5- Effettuare tutte le fasi previste per la messa in servizio del riduttore

9.4 CONTROLLO STATO LUBRIFICANTE

Verificare con periodicità mensile il livello dell'olio;

Sostituire l'olio esausto a riduttore ancora caldo.
Prima di sostituire il lubrificante accertarsi che il prodotto sia fermo da circa 30 minuti, periodo sufficiente affinché la temperatura dell'olio possa scendere a livelli non pericolosi per l'operatore.

Prima di introdurre olio nuovo fare fluire dell'olio dello stesso tipo per rimuovere particelle rimaste all'interno della carcassa.

L'olio nuovo va introdotto accertandosi che non vi siano impurità presenti.

Controllare mensilmente che non vi siano perdite di lubrificante.

Se il prodotto resta per lungo tempo inattivo in un ambiente con elevata percentuale di umidità (p.es. con RH oltre il 50%), riempirlo completamente di olio. Naturalmente al momento della successiva messa in funzione sarà necessario ripristinare il livello di lubrificante.

Per i riduttori e i variatori lubrificati con olio minerale, dopo le prime 500 - 1000 ore di funzionamento sostituire l'olio.

Nella tabella sottostante riportiamo gli intervalli di sostituzione del lubrificante consigliati, validi indicativamente in assenza di inquinamento esterno e di sovraccarichi. Informazioni più precise potranno ottenersi dal proprio fornitore di lubrificanti ad esempio attraverso analisi periodiche dell' olio.

9. MAINTENANCE

As soon as any intervention is over:
1- Restore product integrity and safety devices;
2- Carefully clean the gearbox;
3- Close any oil plugs;
4- Restore static sealing, using all the suitable seals;
5- Carry out all steps required for gearbox commissioning.

9.4 LUBRICANT INSPECTION

Check monthly the oil level.

Change the oil when gear unit is still in temperature.
Before replacing lubricant, always make sure that the product has not been operated for at least 30 minutes, so that the temperature has dropped to a level not dangerous for the operator.
Before filling the gear unit with new oil, first pour some oil of the same type to remove particles remained inside the casing.

Make sure the new oil is introduced when no impurities are present.

Check monthly for lubricant leakages.

If the product remains unused for a long time in a moist environment (e.g. RH above 50%), completely fill it up with oil.
Before starting it, you will obviously need to restore lubricant level first.

While gearboxes and variators lubricated with mineral oil require oil change after the first 500 - 1000 working hours.

Table for suggested oil change intervals indicatively valid in absence of pollution and overload, is reported below. More precise information can be obtained by your lubricant supplier for example through periodical analysis of the oil.

9. INBETRIEBSETZUNG

Nach jeden Eingriff:
1- Die Integrität des Produkts und seiner Sicherheitsauslegung wieder herstellen
2- Das Getriebe sorgfältig reinigen.
3- Die ggf. vorhanden Öleinfüll-/-ablassschrauben schließen.
4- Alle statischen Abdichtungen wieder herstellen und dazu die angemessenen Abdichtmittel verwenden.
5- Alle für die Inbetriebsetzung des Getriebes vorgesehenen Phasen durchführen.

9.4 KONTROLLE DES SCHMIERMITTELZUSTANDS

Monatlich den Ölfüllstand überprüfen.

Das Altöl durch frisches ersetzen, wenn das Getriebe noch warm ist.
Vor dem Schmiermittelwechsel sich darüber vergewissern, dass das Produkt seit ungefähr 30 Minuten stillsteht. Diese Zeit reicht aus, dass die Öltemperatur unter ein Niveau absinkt, das für den Bediener nicht mehr gefährlich ist.
Vor dem Einfüllen von frischem Öl, Öl von der selben Sorte durchfließen lassen, so dass die sich im Gehäuse angesammelte Teilchen herausgespült werden.

Das Frischöl nur dann einfüllen, wenn man sicher ist, dass kein Schmutz mehr vorhanden ist.

Monatlich kontrollieren, dass keine Schmiermittelleckagen vorliegen.

Wird das Produkt über längere Zeit nicht eingesetzt und befindet es sich in einer Umgebung mit hoher Feuchtigkeit (z.B. mit RH über 50%) sollte es vollkommen mit Öl gefüllt werden. Natürlich ist es in einem solchen Fall erforderlich, dass bei der darauf folgenden Inbetriebsetzung der korrekte Schmiermittelfüllstand wieder hergestellt wird.

Bei mit Mineralöl geschmierten Getrieben und Verstellgetrieben muss das Öl nach den ersten 500 - 1000 Betriebsstunden gewechselt werden.

In der nachstehenden Tabelle werden die empfohlenen Zeiten für dem Schmiermittelwechsel angegeben, bei denen es sich um Richtzeiten im Fall von keinerlei externer Verschmutzung und Überlastungen handelt. Genauere Informationen können beim Schmiermittellieferant z.B. mittels regelmäßiger Ölanalysen angefordert werden.

Frequenza cambi olio [h] / *Oil change intervals [h]* / Ölwechselfrequenz [h]

Tipo olio *Oil type* Öltyp	Temperatura olio / *Oil temperature* / Öltemperatur		
	< 60°C	80 °C	90 °C
Minerale *Mineral* Mineralöl	5000	2500	1000
Sintetico *Synthetic* Synthetiköl	20000	10000	6000

9. MANUTENZIONE

Frequenza ringrassaggio cuscinetti / grease it / Nachschmieren

Riduttori forniti con il cuscinetto schermato

Se ne consiglia il ringrasaggio indipendentemente dalle ore di esercizio effettuate, dopo almeno 2-3 anni.

Pertanto è stato predisposto un ingrassatore per provvedere all'opportuno ringrassaggio.

Le Caratteristiche tecniche generali del grasso utilizzato sono:

- Inspessente: base di Litio;
- NGLI: 2;
- Olio: minerale con adittivazione EP di viscosità minima ISO VG 160;
- Adittivi: l'olio presente nel grasso deve avere caratteristiche di adittivazione EP;

SPECIFICHE E APPROVAZIONI

ISO:**L-X-BCHB 2**
DIN 51 825: **KP2K -20**

9. MAINTENANCE

The gearboxes with a shielded bearing

It is recommended to grease it at least every 2-3 years regardless of the operating hours.

To this end it is provided with a greaser.

Following are the general technical features of the lubrication grease:

- Thickener: Lithium-based;
- NGLI: 2;
- Oil: mineral with EP additives with minimum viscosity as per ISO VG 160;
- Additives: the oil in the grease must feature EP additive;

SPECIFICATIONS AND APPROVALS

ISO:**L-X-BCHB 2**
DIN 51 825: **KP2K -20**

9. INBETRIEBSETZUNG

Getrieben mit abgeschirmtem Lager geliefert werden

Wir empfehlen, unabhängig von den erfolgten Betriebsstunden, mindests alle 2-3 Jahre ein entsprechendes Nachschmieren.

Daher wurde ein angemessener Schmiernippel für das Nachschmieren vorgesehen.

Allgemeine technische Eigenschaften des verwendeten Fetts:

- Verdickungsmittel: auf Lithiumbasis;
- NGLI: 2;
- Öl: Mineralöl mit Zusatz von EP mit Mindestviskosität gemäß ISO VG 160;
- Additive: das im Fett enthaltene Öl muss die Eigenschaften der EP Additivierung aufweisen;

SPEZIFIKATIONEN
ISO:**L-X-BCHB 2**
DIN 51 825: **KP2K -20**

10. PROSSIMITI

(Questo accessorio è disponibile per i riduttori RMI – CRMI - CB)

Caratteristiche tecniche – sensore prossimiti

10. PROXIMITY SENSOR

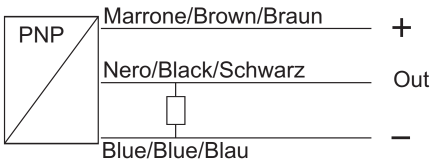
(This accessory is available for gearboxes RMI – CRMI - CB)

Specifications – Proximity sensor

10. NÄHERUNGSSENSOR

(Dieses Zubehör ist für die Getriebe RMI – CRMI - CB verfügbar)

Technische Eigenschaften – Näherungssensor



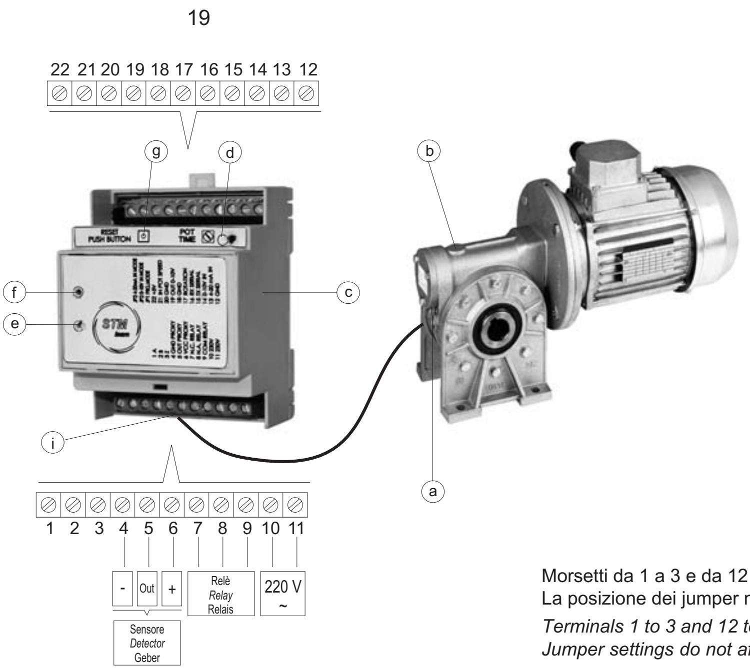
Non schermato - *Unshielded* - Nicht abgeschirmt	●
Tensione di alimentazione - *Supply voltage* - Versorgungsspannung	10..30Vdc
Ondulazioneresidua - *Ripple* - Restwelligkeit	< 10%
Correntemassima di carico - *Maximum load current* - Max. Ladestrom	200mA
Cadutaditensione - *Voltage drop* - Spannungsabfall	< 3V@200mA
Assorbimento - *Power consumption* - Aufnahme	< 10mA
Ripetibilità - *Repeatability* - Wiederholbarkeit	<2% della portata nominale/*of nominal sensing distance*/der Nennreichweite
Isteresi - *Hysteresis* - Hysterese	< 10%Sn
Frequenza di commutazione - *Switching frequency* - Schaltfrequenz	1kHz
Protezione al cortocircuito - *Short-circuit protection* - Kurzschlussfest	Sì - Yes - Ja
Led di segnalazione - *Status output led* - LED-Anzeige	Sì - Yes - Ja
Temperatura di funzionamento - *Working temperature* - Betriebstemperatur	-25+70°C
Grado di protezione - *IP rating* - Schutzart	IP67 (conconnettoremontato/*with connector mounted*/mit montiertem Stecker)
Connessione - *Connection* - Verbindung	2m Cavo - *Cable* - Kabel

Questo accessorio consiste in un'apparecchiatura elettronica studiata per la rileva- zione e la segnalazione della condizione di albero uscita fermo nei motoriduttori provvisti di limitatore di coppia.
Esso è composto da due parti: il sensore (**a**), incorporato nel riduttore (**b**) senza ulte- riori ingombri e l'unità elettronica di monito- raggio (**c**).

It consists of an electronic device designed to detect and warn about a locked output shaft in gearmotors equipped with torque limiters.

*It is mainly composed of two parts: the sensor (**a**) which is built in the gearbox (**b**) without any additional need of space and the electronic monitoring unit (**c**).*

Bei diesem Zubehör handelt es sich um eine elektronische Vorrichtung, die bei mit Rutschkupplung ausgestatteten Getriebemotoren den Zustand einer stehenden Abtriebswelle erfasst.
Sie setzt sich aus zwei Teilen zusammen: Dem Sensor (**a**), der im Getriebe (**b**) integriert ist und keinen weiteren Platz erfordert, und der elektronischen Anzeigeeinheit (**c**).



a - Rivelatore/*Detector*/Erfassungseinheit
b - Riduttore/*Gearbox*/Getriebe
c- Unità monitor/*Monitoring unit*/Bildschirm
d - Regolazione tempo di intervento/*Response time setting* / Auslösezeiteinstellung
e - Spia verde (presenza di alimentazione)/*Green LED (power on)* / Grüne Kontrollleuchte (Versorgung liegt an)
f - Spia rossa (segnalazione condizione di allerme) *Red LED (indicates an alarm condition)* Rote Kontrollleuchte (Anzeige einer Alarmbedingung)
g - Pulsante di Reset allarme/*Alarm reset button*/Reset-Taste für Alarme

i - Morsettiera/*Terminal block*/Klemmenleiste
4 - Alimentazione Negativa Sensore/*Negative Power Supply to Sensor /* Negative Sensorversorgung
5 - OUT – Sensore/*OUT - Sensor*/OUT – Sensor
6 - Alimentazione Positiva Sensore/*Positive Power Supply to Sensor /* Positive Sensorversorgung
7 - RELE' N.C./*NC RELAY*/N.C.-RELAIS
8 - RELE' N.A./*NO RELAY*/N.O.-RELAIS
9 - RELE' Comune/*Common RELAY*/Allgemeines RELAIS
10 - Alimentazione c.a. 230 V./*230 VAC power supply*/WS-Versorgung 230 V.
11 - Alimentazione c.a. 230 V./*230 VAC power supply*/WS-Versorgung 230 V.

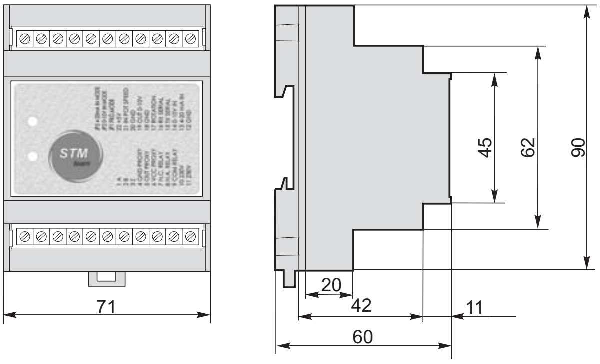
Morsetti da 1 a 3 e da 12 a 22 non sono utilizzati per la suddetta applicazione.
La posizione dei jumper non influenza la suddetta applicazione.

Terminals 1 to 3 and 12 to 22 are not used in this application.
Jumper settings do not affect this application.

Die Klemmen von 1 bis 3 und von 12 bis 22 werden in der o.g. Applikation nicht verwendet.
Die Position der Jumper hat keinen Einfluss auf die vorstehend genannte Applikation.

10. PROSSIMITI

Fig.3.3 Contenitore / *Casing* / Abb. 3.3 Gehäuse DIN H60 90x71x60



Il sensore genera un segnale elettrico digitale discontinuo con una frequenza proporzionale alla velocità di rotazione dell'albero d'uscita del riduttore; la man- canza di segnale è interpretata dall'unità elettronica come condizione di blocco, evidenziata con l'accensione di una spia luminosa rossa (f) e l'attivazione di un relè di uscita i cui contatti possono essere utiliz- zati per un segnale d'allarme, per avviare una procedura automatica di blocco del ciclo produttivo o per interrompere l'alimen- tazione al motore che aziona il riduttore entrato in blocco.

Come già accennato, il sensore genera un segnale ripetitivo di natura discontinua; ciò è da tenere in particolare considerazione in tutte le applicazioni caratterizzate da basse velocità in uscita dal riduttore in quanto l'intervallo di tempo che separa gli impulsi prodotti, può innescare il processo di riconoscimento del blocco.

Questa eventualità può essere evitata imponendo al circuito un ritardo in base alle caratteristiche della motorizzazione, al fine di coprire con un certo margine gli intervalli di ripetizione del segnale compatibilmente con la sicurezza di funzionamento dell' apparecchiatura.

La regolazione del tempo di intervento consentita dall'unità elettronica, può anche essere effettuata per imporre un ritardo alla segnalazione di blocco in casi dove brusche variazioni di velocità, di inerzia, o momentanee punte di carico determinano l'intervento del limitatore di coppia con conseguente arresto temporaneo dell'albero comandato.

Ovviamente il ritardo dovrà essere suf- ficiente a consentire il ripristino delle nor- mali condizioni di funzionamento, conside- rando che il protrarsi della condizione di blocco oltre il tempo impostato viene rile- vato e segnalato dall'unità, la quale man- tiene in memoria questo evento (anche se la rotazione dell'albero riprende) eviden- ziandolo visivamente con la spia rossa fino allo spegnimento dell' apparecchiatura dell'apparecchiatura o fino a che non si cancelli l'allarme premendo il pulsante di reset (g).

10. PROXIMITY SENSOR

The sensor generates a digital discontinuous electric signal at a frequency which is proportional to the rotational speed of the output shaft of the gearbox; every time the signal is not generated, the electronic unit activates an output relay, highlighted by means of a red led (f), that warns about the condition of locked shaft.
The contacts of the above relay may be used to activate an alarm that starts an automatic shutdown procedure or simply cuts off power to the motor which drives the locked gearbox.
As mentioned above, the sensor generates a discontinuous repetitive signal.

This is particularly important in all those applications characterized by low gearbox output speed since the time interval between the pulses generated by the detector could trigger detection of a locked shaft condition which does not actually exist.

In order to prevent this, the circuit can be programmed with a slight delay, according to motor characteristics, to compensate for the signal repetition intervals without compromising the operating safety of the equipment.

Regulation of trigger time provided by the electronic unit can also be carried out in order to set a delay to the signalling of a locked shaft condition in all those cases where, during normal operation, sudden changes of speed or inertia or when there are load peaks, could determine the intervention of the torque limiter with subsequent temporary stop of the shaft.

Such delay should obviuosly be adequately long to restore the normal operating conditions. In fact, if the shaft remains locked for longer than the set time, the condition is detected and signalled to the equipment. The limiter has actually a memory function which is used to prevent the locked shaft condition from being cancelled even if the gearbox resumes rotation and it is highlighted by means of a red led, which remains on until the equipment is powered off or the alarm reset button (g) is depressed.

10. NÄHERUNGSSENSOR

Der Sensor erzeugt ein elektrisches Rechtecksignal, das proportional zur Abtriebsdrehzahl des Getriebes steht. Das Ausbleiben des Signals wird von der elektronischen Einheit als Blockierung ausgelegt. Dieser Zustand wird durch das Aufleuchten einer roten Kontrollleuchte (f) und dem Auslösen eines Ausgangsrelais hervorgehoben, dessen Kontakte für ein Alarmsignal, für den Start eines automatischen Sperrverfahrens der Produktionszyklus oder die Unterbrechung der Versorgung an den Motor verwendet werden können, der für den Antrieb des blockierten Getriebes zuständig ist.
Wie bereits erwähnt, erzeugt der Sensor ein periodisch auftretendes Rechteckssignal. Dies muss bei allen Applikationen berücksichtigt werden, die sich durch niedrige Getriebeabtriebsdrehzahlen charakterisieren, das die zwischen den abgegeben Impulsen verstreichende Zeit zum Auslösen der Blockierungserfassung führen könnte.
Dies kann dadurch vermieden werden, dass an der Schaltung eine Verzögerung in Abhängigkeit zu den Antriebseigenschaften programmiert werden kann, so dass eine gewisse Spanne an Wiederholungsintervallen des Signals abgedeckt werden kann und gleichzeitig die Betriebssicherheit der Vorrichtung beibehalten wird.
Die Einstellung der von der elektronischen Einheit zulässigen Auslösezeit kann auch dazu verwendet werden, um der Blockierungsanzeige eine Verzögerung im Hinblick auf die Anzeige der Sperrfunktion aufzuerlegen. Dies ist insbesondere bei abrupten Drehzahländerungen und Änderungen des Trägheitsmoments oder momentanen Belastungsspitzen hilfreich, die zum Auslösen der Rutschkupplung führen, die einen momentanen Stopp der gesteuerten Welle zur Folge haben.
Natürlich muss die Ansprechverzögerung ausreichen, um ein Wiederherstellen der normalen Betriebsbedingungen zu ermöglichen. Dabei muss berücksichtigt werden, dass dann eine länger anhaltende Sperrbedingung von der Einheit erfasst und angezeigt wird. Dieses Ereignis wird von der Einheit gespeichert (auch wenn die Welle sich erneut zu drehen beginnt) und durch das Aufleuchten der roten Kontrollleuchte so lange angezeigt, bis die Vorrichtung ausgeschaltet wird oder bis der Alarm durch Drücken der Reset-Taste (g) zurückgesetzt wird.

10. PROSSIMITI

Condizioni di funzionamento:
Grado di protezione:
IP00

Temperatura di funzionamento della unità:
0° ÷ +50°C

Temperatura di stoccaggio:
-20° ÷ +70°C

Tensione di alimentazione:
230 V(±10%)

Frequenza di funzionamento:
50-60 Hz

Corrente assorbita:
200mA
(oltre i 250 l'apparecchio è protetto da fusibile autoripristinabile)

Tempo di intervento:
impostabile da 0.2 sec. a 8 sec.

Morsettiera tipo:
Phoenix contact MKDS 1,5/X
(X sta per N° di poli)

Massimo diametro filo serrabile:
Rigido 2,5 mm^2
Flessibile 1,5 mm^2

Minimo diametro filo serrabile:
0,14 mm^2

Caratteristiche contatti Relè:
Tensione applicabile 250 V
Corrente massima 5 A

Relativamente al tempo di intervento, è opportuno considerare che il minimo slittamento rilevabile con i sensori standard è di 25° quando la velocità di rotazione è tale da far rientrare il tempo impiegato per questo slittamento tra quelli possibili.
N° di giri minimo rilevabili sull'ordine di 0.2 min^{-1} dato che dipende dal modello del riduttore.

Il sensore è fornito, senza specifica richiesta, con cavo non schermato: è consigliabile quindi sostituirlo con uno schermato.
Per quanto riguarda le indicazioni sull'utilizzo del rivelatore di blocco si rimanda alle istruzioni allegate allo strumento stesso.

10. PROXIMITY SENSOR

Operating conditions:
Degree of protection:
IP00

Unit operating temperature:
0° ÷ +50°C

Storage temperature:
-20° ÷ +70°C

Voltage supply:
230V (±10%)

Operating frequency:
50-60 Hz

Current draw:
200mA
(above 250 mA, protection is ensured by a self-resetting fuse)

Response time:
0.2 sec. to 8 sec. setting range

Terminal block type:
Phoenix contact MKDS 1.5/X
(X stands for no. of poles)

Max wire diameter accepted:
Stiff 2.5 sq mm
Flexible 1.5 sq mm

Min wire diameter accepted:
0.14 sq mm

Relay contact specifications:
Input voltage 250 V
Maximum current 5 A

As regards response time, it should be noted that the minimum slip detected with standard sensors is 25° when rotational speed is such that slip time falls within allowed slip time range.
Rpm resolution from 0.2 rpm (depends on gearbox model).

Unless specified on order, sensor comes with unshielded cable; if so, replacement with a shielded cable is recommended.

For information on locked shaft detector operation, please read the instructions supplied with the detector.

10. NÄHERUNGSSENSOR

Betriebsbedingungen:
Schutzart:
IP00

Betriebstemperatur der Einheit:
0° ÷ +50°C

Einlagerungstemperatur:
-20° ÷ +70°C

Versorgungsspannung:
230 V(±10%)

Betriebsfrequenz:
50-60 Hz

Stromaufnahme:
200mA
(über 250 wird das Gerät von einer selbstrücksetzenden Sicherung geschützt)

Auslösezeit:
zwischen 0,2 Sek. bis 8 Sek. einstellbar

Klemmenbrett - Typ:
Phoenix contact MKDS 1,5/X
(X steht für die Anzahl der Pole)

Max. Durchmesser des Klemmdrahts:
Steif 2,5 mm^2
Flexibel 1,5 mm^2

Min. Durchmesser des Klemmdrahts:
0,14 mm^2

Eigenschaften der Relaiskontakte:
Applizierbare Spannung 250 V
Max. Strom 5 A

Was die Auslösezeit anbelangt sollte berücksichtigt werden, dass der erfassbare min. Schlupf 25° beträgt, wenn die Drehzahl so ausfällt, dass die für diesen Schlupf aufgewendete Zeit unter die möglichen Werte fällt.
Erfassbare min. Drehzahl liegt bei 0,2 min^{-1} und ist vom Getriebemodell abhängig.

Der Sensor wird, falls nicht anderweitig angefordert, mit ungeschirmtem Kabel geliefert: Es sollte jedoch durch ein geschirmtes Kabel ersetzt werden.
Was die Angaben bezüglich des Einsatzes der Blockierungserfassungseinheit anbelangt, verweisen wir auf die dem Gerät selbst beigelegten Anleitungen.

11. ALLEGATI

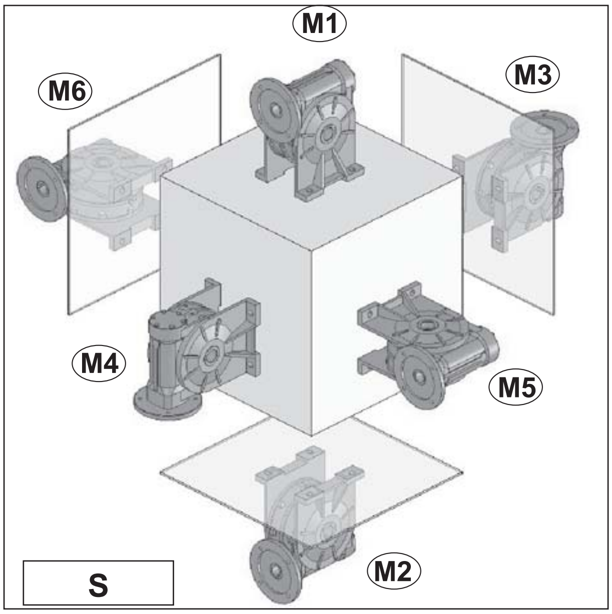
11. ATTACHMENTS

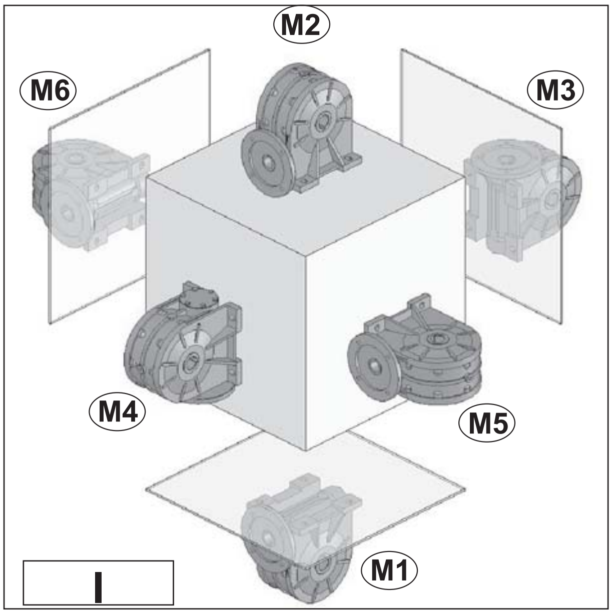
11. ANLAGEN

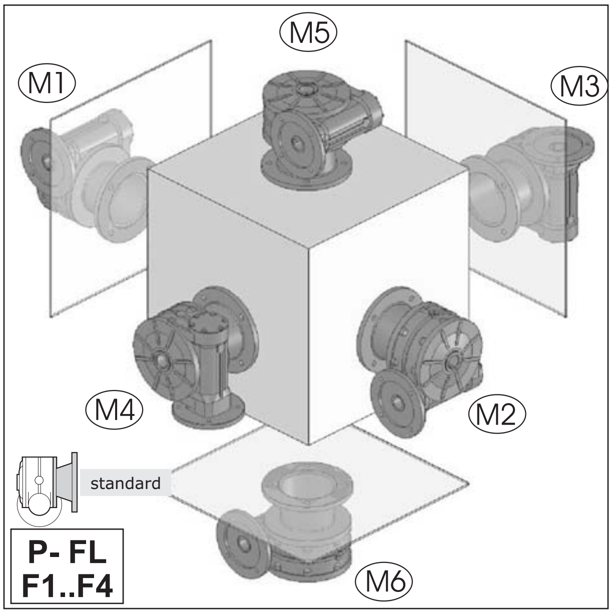
11.2 POSIZIONI DI MONTAGGIO 3D

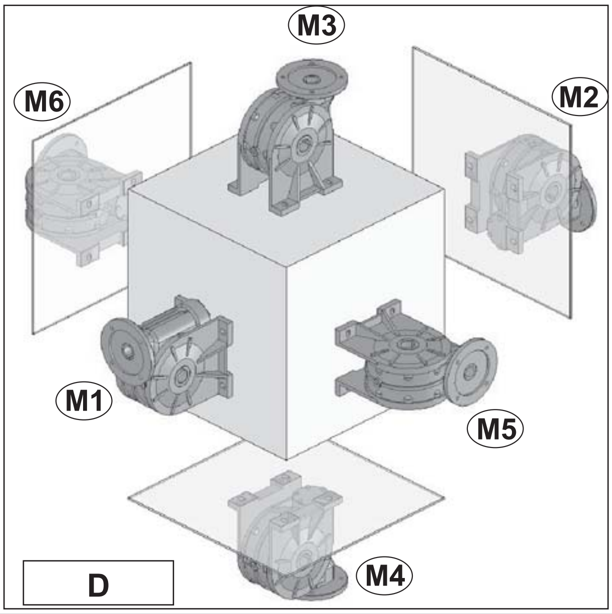
11.2 3D MOUNTING POSITIONS

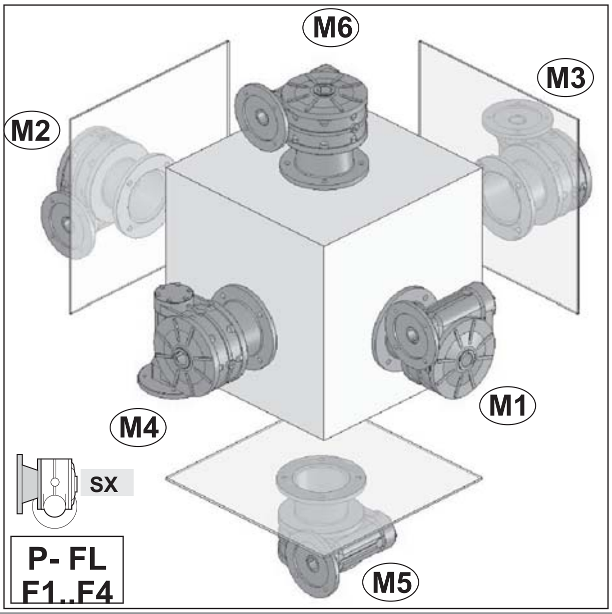
11.2 3D-EINBAULAGEN











11. ALLEGATI

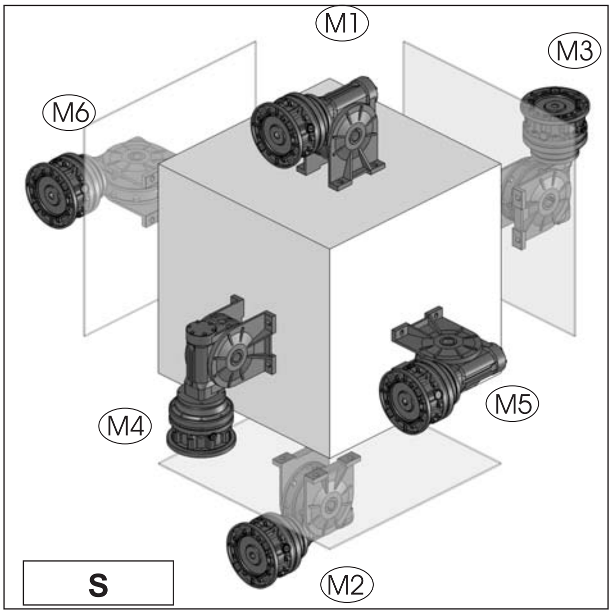
11. ATTACHMENTS

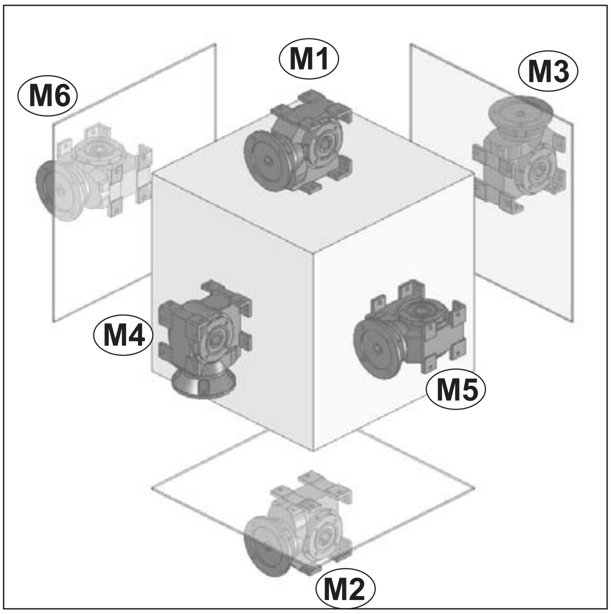
11. ANLAGEN

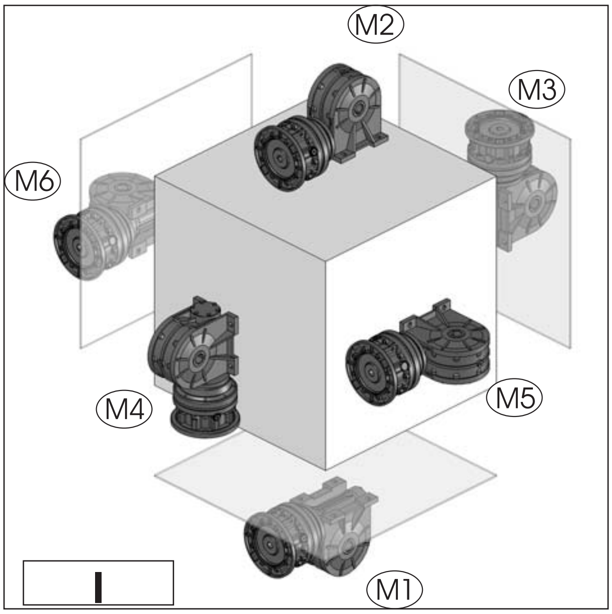
11.2 POSIZIONI DI MONTAGGIO 3D

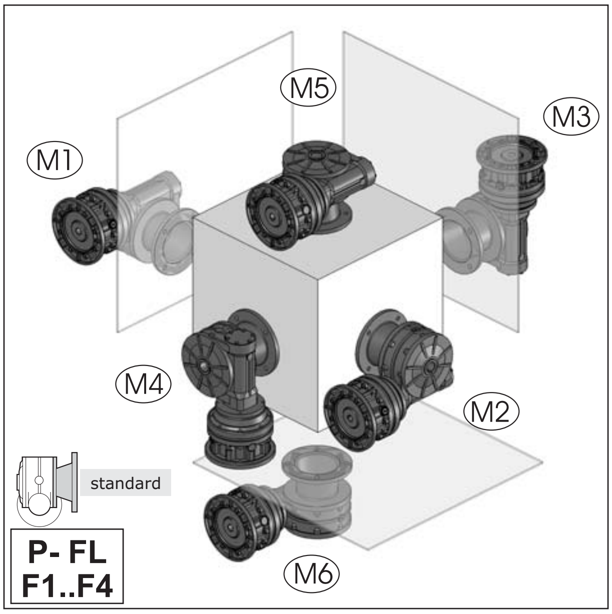
11.2 3D MOUNTING POSITIONS

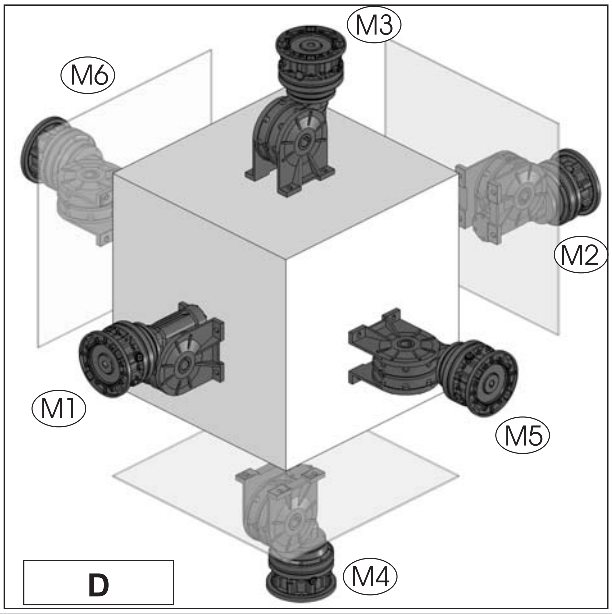
11.2 3D-EINBAULAGEN

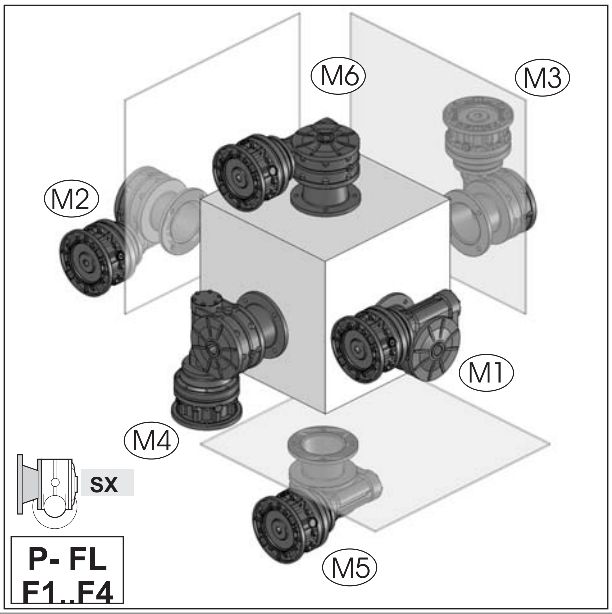












11. ALLEGATI

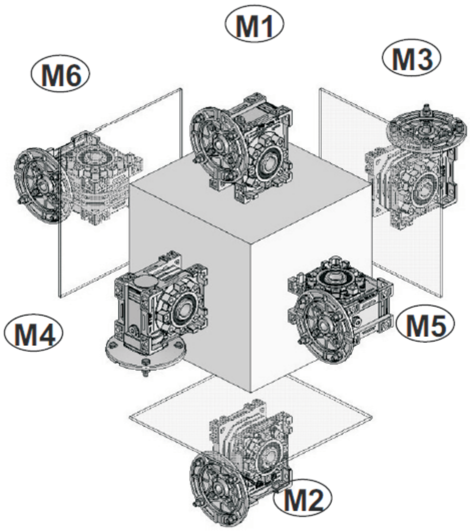
11. ATTACHMENTS

11. ANLAGEN

11.2 POSIZIONI DI MONTAGGIO 3D

11.2 3D MOUNTING POSITIONS

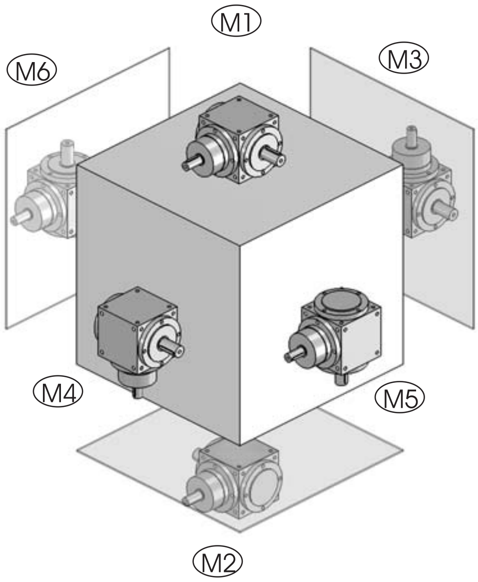
11.2 3D-EINBAULAGEN



11.2 POSIZIONI DI MONTAGGIO 3D

11.2 3D MOUNTING POSITIONS

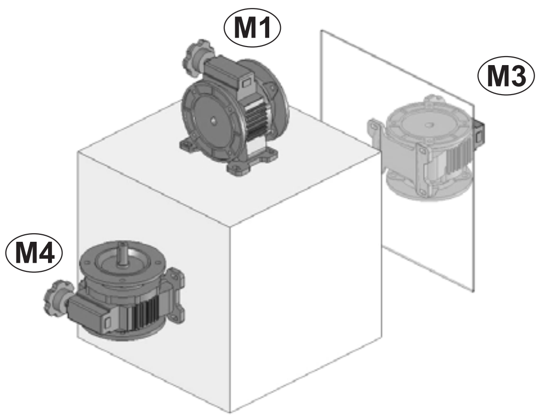
11.2 3D-EINBAULAGEN



11.2 POSIZIONI DI MONTAGGIO 3D

11.2 3D MOUNTING POSITIONS

11.2 3D-EINBAULAGEN



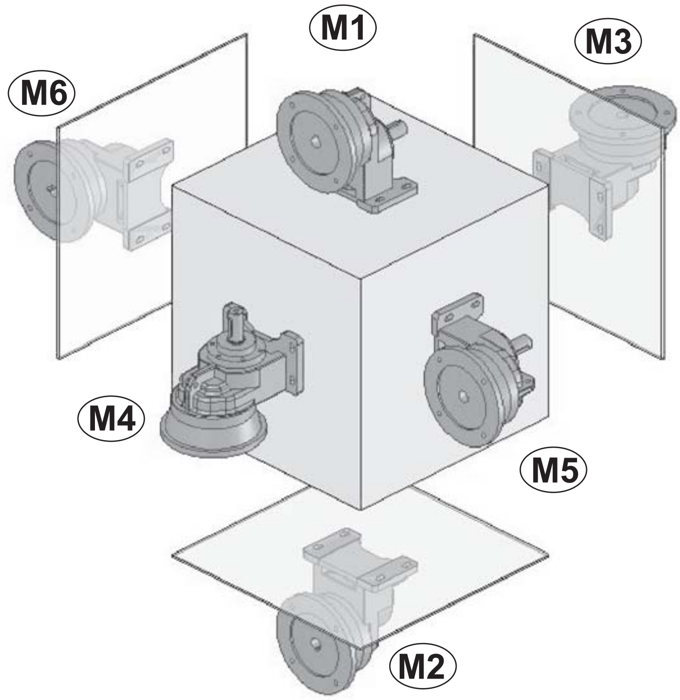
11. ALLEGATI | *11. ATTACHMENTS* | 11. ANLAGEN

11.2 POSIZIONI DI MONTAGGIO 3D | *11.2 3D MOUNTING POSITIONS* | 11.2 3D-EINBAULAGEN

1

Posizioni di montaggio
Mounting positions
Einbaulagen

AM/1 - AC/1 - AR/1



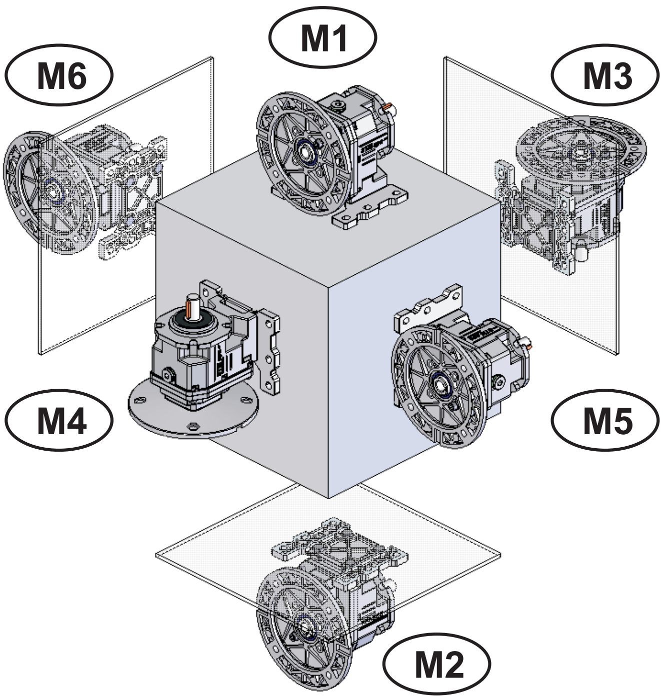
2-3

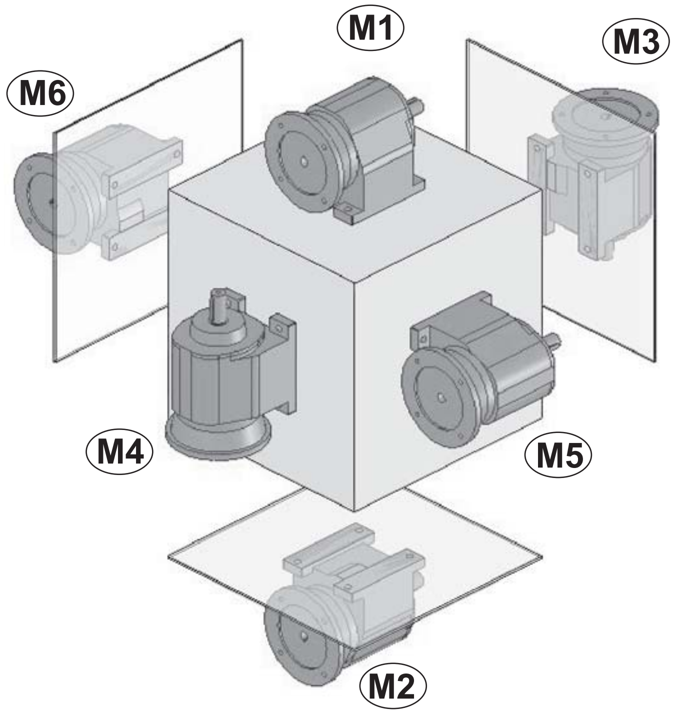
Posizioni di montaggio
Mounting positions
Einbaulagen

AM/2-3 - AC/2-3 - AR/2-3

25-35-41-45

50-55-60-70-80
90-100-120-140



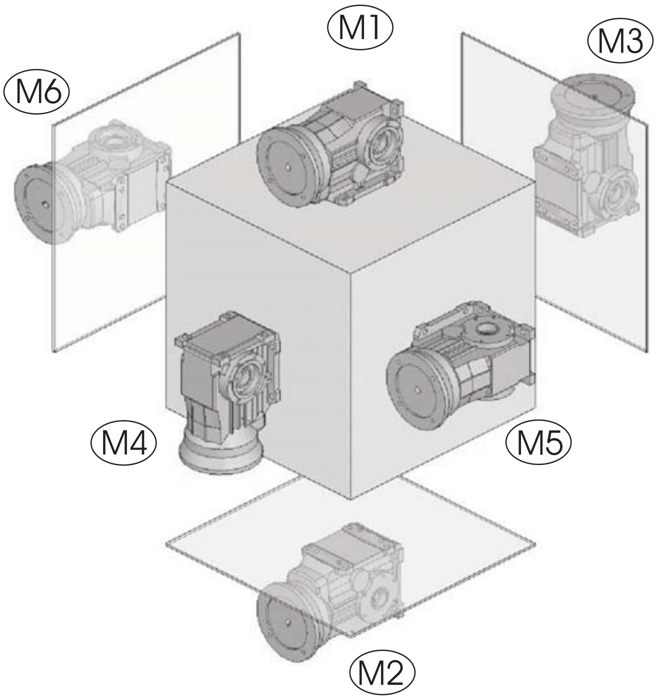


11. ALLEGATI	*11. ATTACHMENTS*	11. ANLAGEN
11.2 POSIZIONI DI MONTAGGIO 3D	*11.2 3D MOUNTING POSITIONS*	11.2 3D-EINBAULAGEN

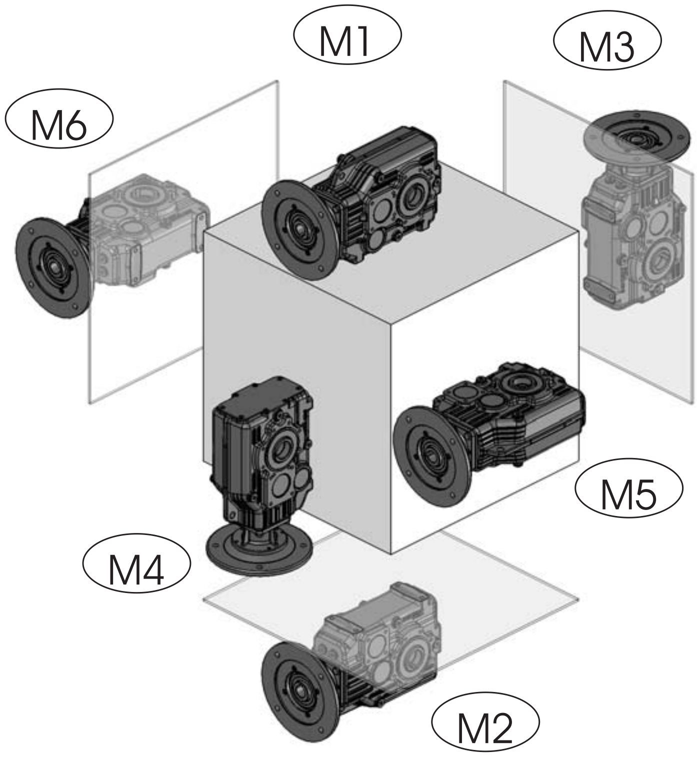
Posizioni di montaggio
Mounting positions
Einbaulagen

OM-OC-OR

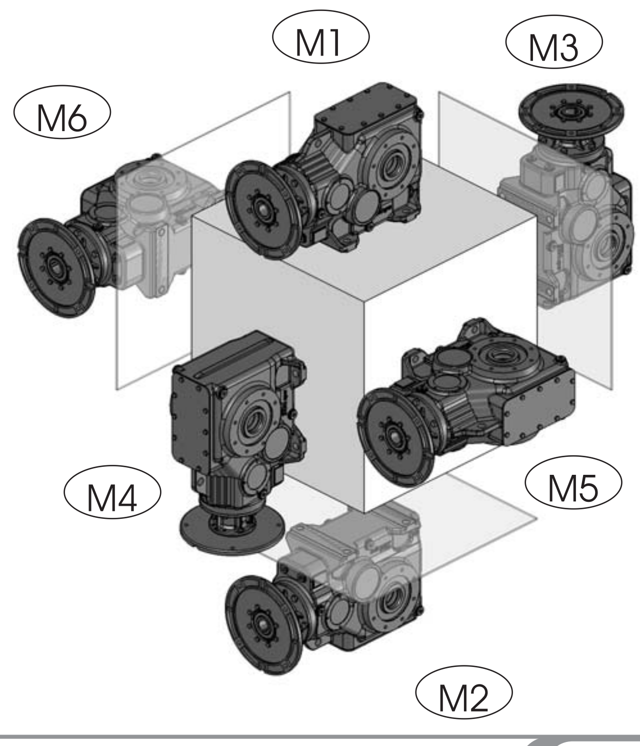
63-71-90-112



80-100-125-140-160-180



132-150-170-190



11. ALLEGATI

11. ATTACHMENTS

11. ANLAGEN

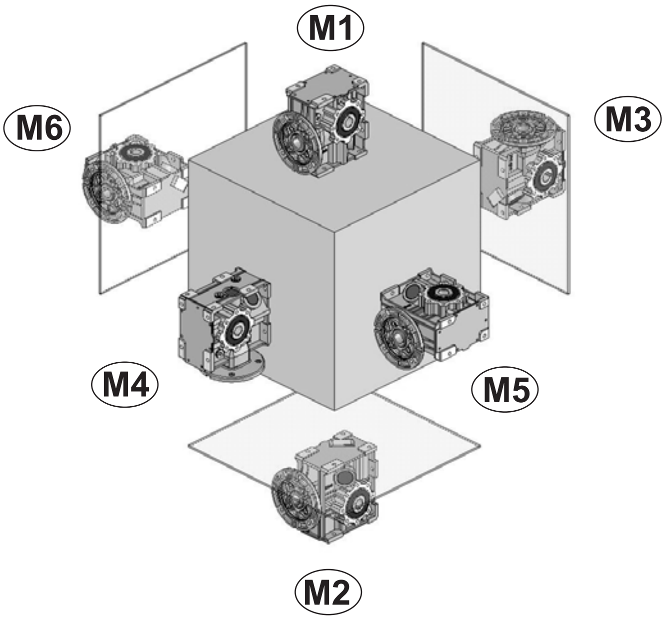
11.2 POSIZIONI DI MONTAGGIO 3D

11.2 3D MOUNTING POSITIONS

11.2 3D-EINBAULAGEN

Posizioni di montaggio
Mounting positions
Einbaulagen

SM



11. ALLEGATI

11. ATTACHMENTS

11. ANLAGEN

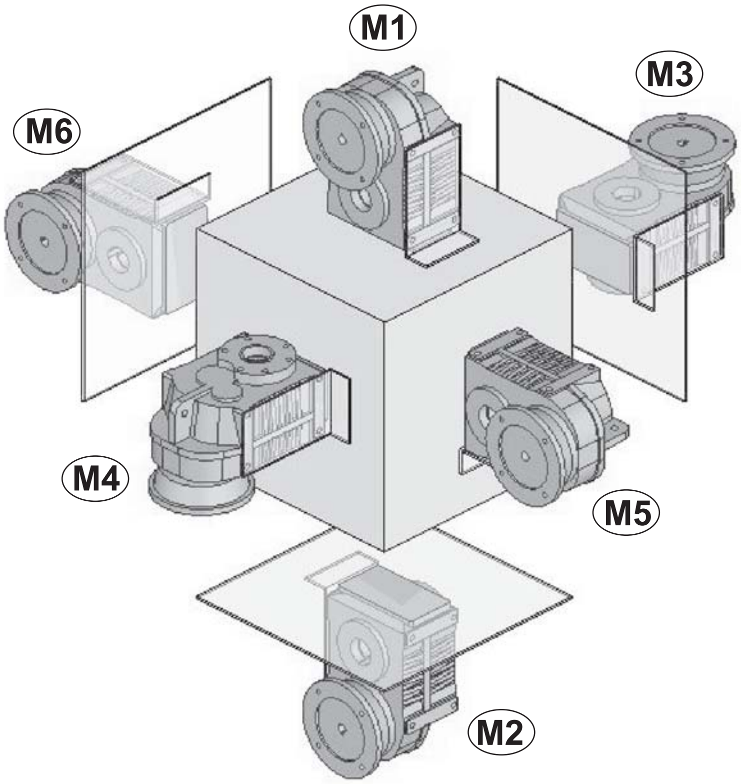
11.2 POSIZIONI DI MONTAGGIO 3D

11.2 3D MOUNTING POSITIONS

11.2 3D-EINBAULAGEN

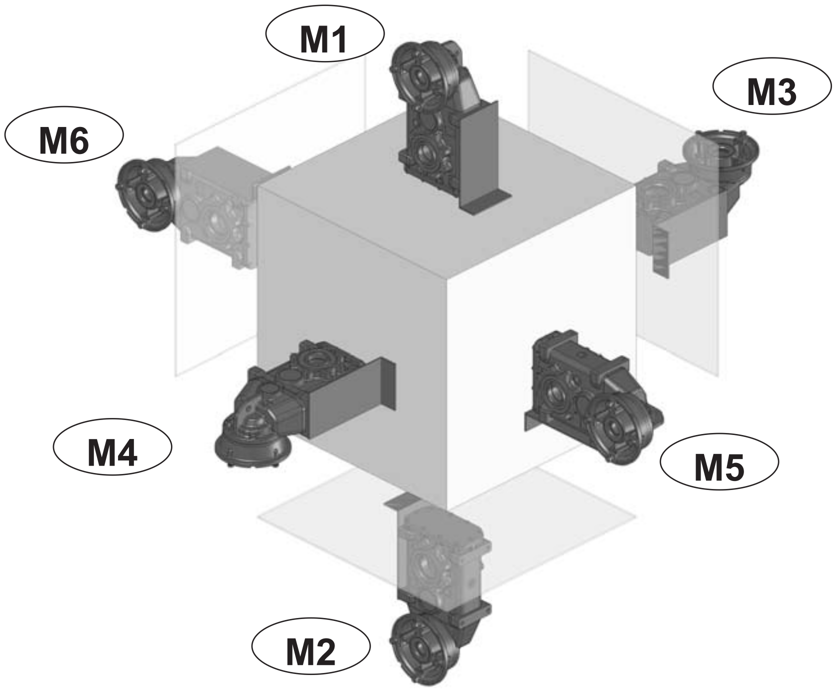
Posizioni di montaggio
Mounting positions
Einbaulagen

PM - PC - PR



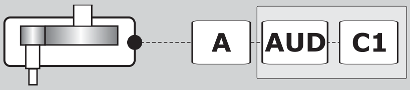
Posizioni di montaggio
Mounting positions
Einbaulagen

PLM - PLC - PLR



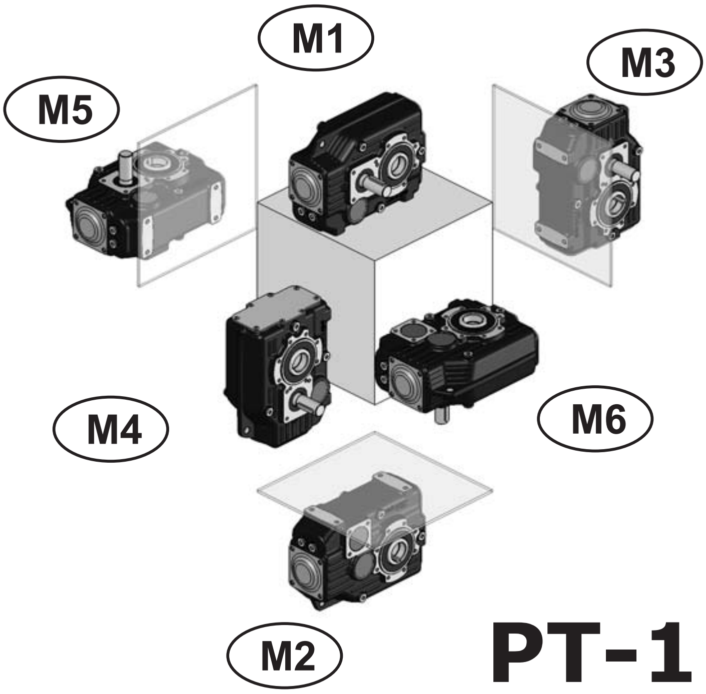
11. ALLEGATI	*11. ATTACHMENTS*	11. ANLAGEN
11.2 POSIZIONI DI MONTAGGIO 3D	*11.2 3D MOUNTING POSITIONS*	11.2 3D-EINBAULAGEN

PT-1

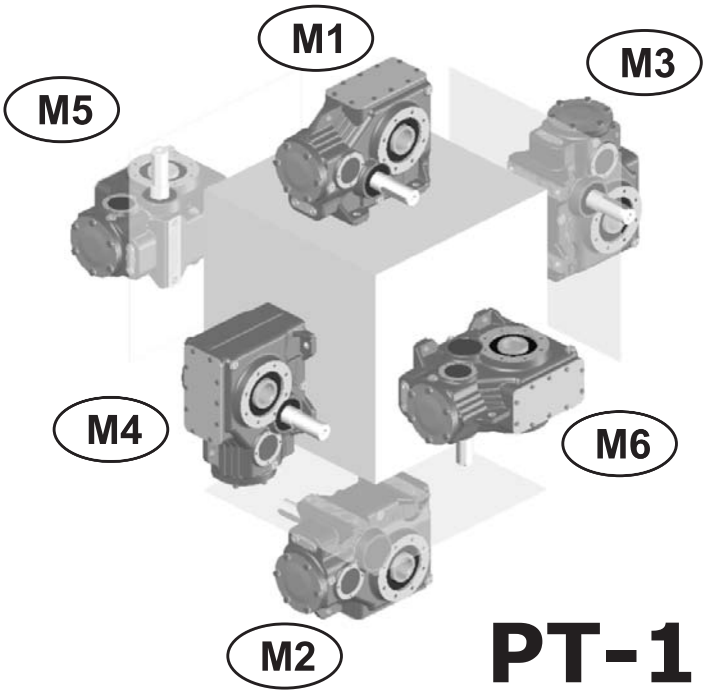


Posizioni di montaggio
Mounting positions
Einbaulagen

80-100-125-140
132-150-170-190

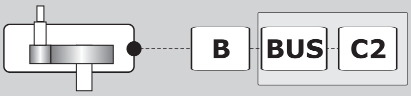


PT-1



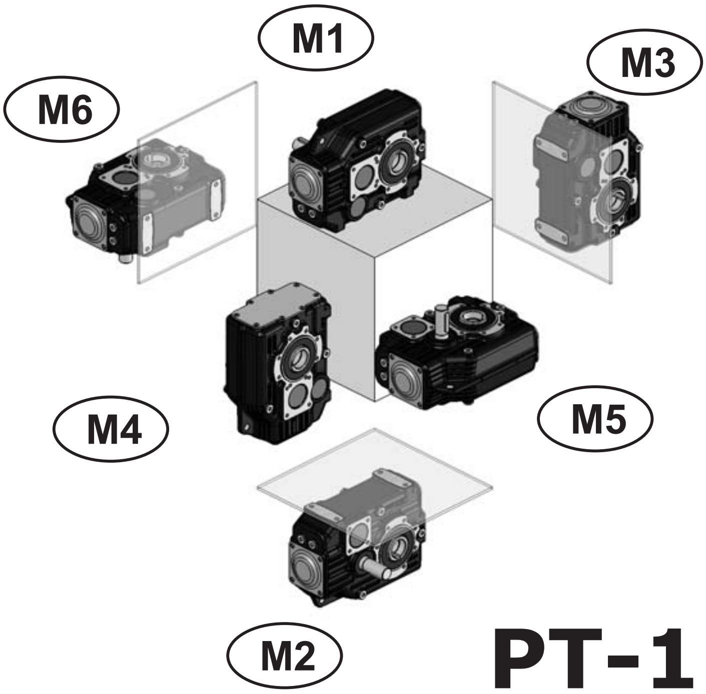
PT-1

PT-1

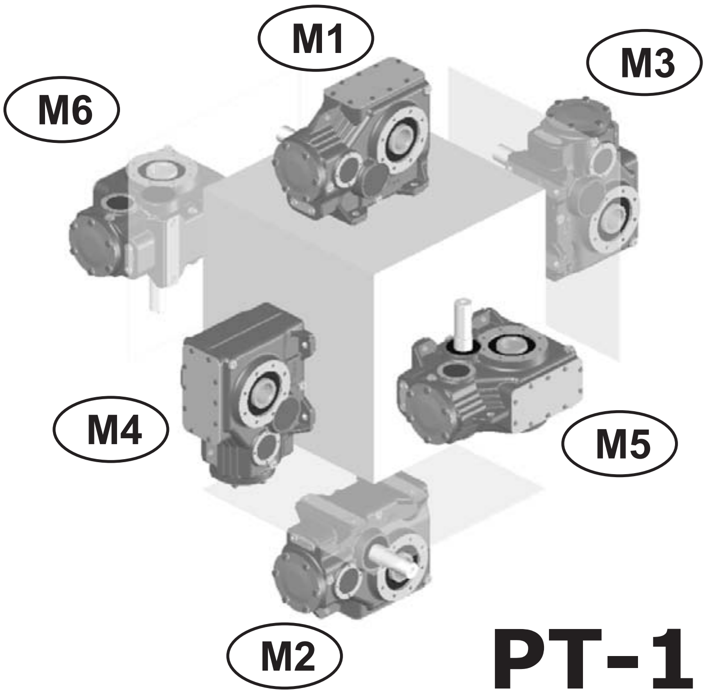


Posizioni di montaggio
Mounting positions
Einbaulagen

80-100-125-140
132-150-170-190



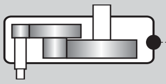
PT-1



PT-1

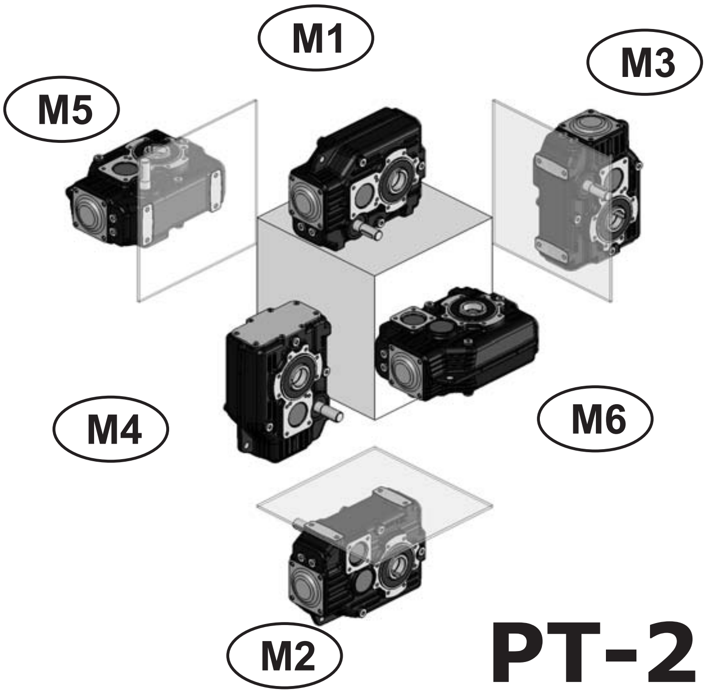
11. ALLEGATI	*11. ATTACHMENTS*	11. ANLAGEN

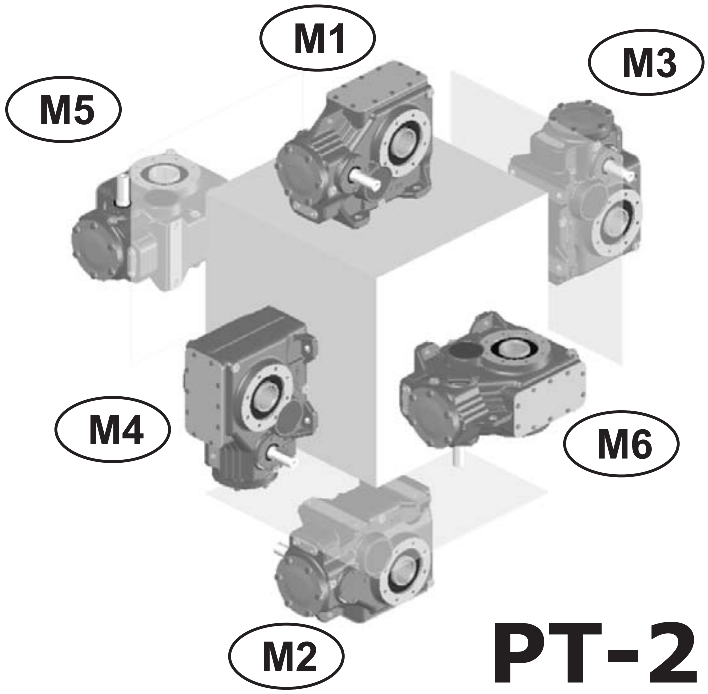
11.2 POSIZIONI DI MONTAGGIO 3D	*11.2 3D MOUNTING POSITIONS*	11.2 3D-EINBAULAGEN

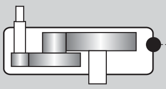
PT-2  A | AUD | C1

Posizioni di montaggio
Mounting positions
Einbaulagen

80-100-125-140
132-150-170-190

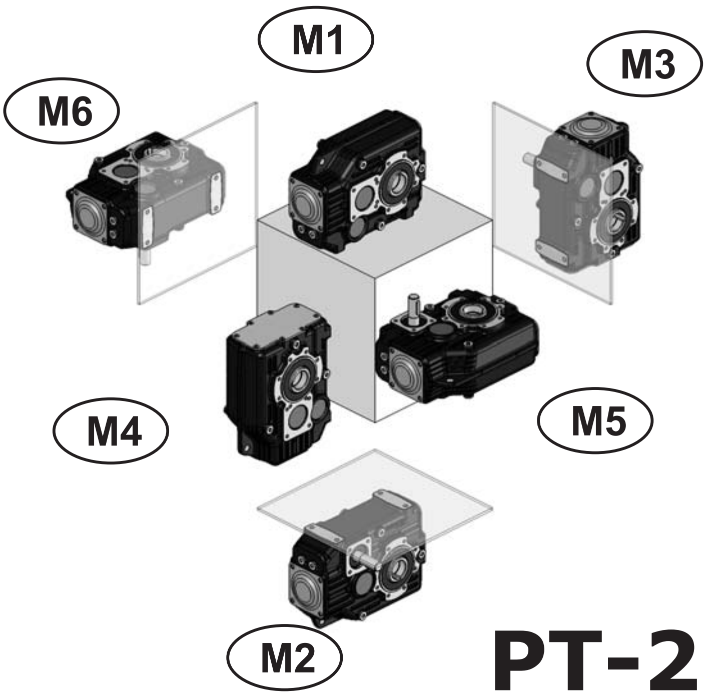


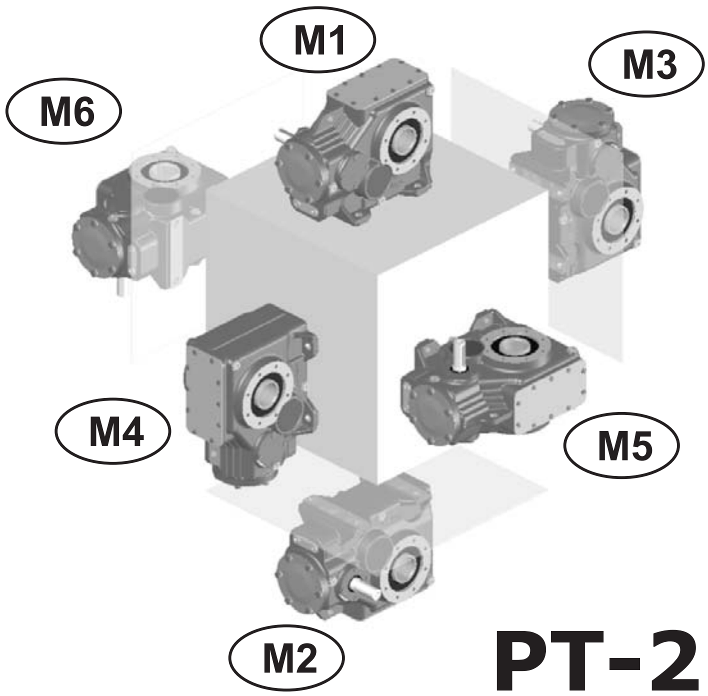


PT-2  B | BUS | C2

Posizioni di montaggio
Mounting positions
Einbaulagen

80-100-125-140
132-150-170-190





Gestione Revisioni Cataloghi STM

Managing STM Catalogue Revisions

Verwaltung Revisionen STM-Kataloge

Codice Catalogo

Catalogue Code

Katalognummer

	MT01	**I**	**GB**	**D**	**0.7_R6**	
	N° Identificativo *Identification Number* Kennummer	Identificativo Lingua - *Language* - Sprache **I** - Italiano – *Italian* - Italienisch **GB** – Inglese – *English* - Englisch **D** – Tedesco – *German* - Deutsch			Indice di Revisione *Review* Bericht	

1) Ogni catalogo STM in distribuzione e' provvisto di un codice che lo identifica che è riportato nell'ultima pagina dei cataloghi e a piè pagina di tutte le pagine del catalogo stesso.Per verificare la revisione attualmente in vostro possesso è necessario guardare l'ultima cifra che compone il codice del catalogo:

1) Each STM catalogue is identified by a code printed on the last page and reported in the page footer. The last digit in the catalogue code identifies catalogue revision.

1) Jeder, sich im Umlauf befindliche STM-Katalog ist mit einer Identifikationsnummer versehen, der auf der letzten Seite und in den Fußnoten jeder einzelnen Seite aufgeführt ist. Um zu überprüfen, über welche Revision Sie im Augenblick verfügen, müssen Sie Bezug auf die letzte Ziffer der Katalogkennnummer nehmen.

2) Il catalogo che contiene gli ultimi aggiornamenti è reperibile sul sito internet STM. Le modifiche riportate sono visibili consultando la tabella degli aggiornamenti che è allegata a questo documento. Sulle pagine che sono oggetto della modifica è riportato l'indice di revisione cambiato.

2) Latest updated catalogues are available on STM's web site. Changes are listed in the updates table attached to this document. Any pages including a change are identified by a higher revision number.

2) Der Katalog, der die letzten Aktualisierungen enthält, kann von der Internetseite der STM herunter geladen werden. Die eingefügten Neuerungen können der Tabelle der Aktualisierungen entnommen werden, die diesem Dokument anhängt. Die Seiten, die Änderungen unterlagen, sind mit der geänderten Revisionsnummer versehen.

3) Guardare con attenzione il simbolo inserito nella colonna “Classificazione Modifica”.
In questa colonna sarà inserito un simbolo che determina una classificazione delle modifiche apportate.
Questo consente di identificare con estrema rapidità l'importanza della modifica apportata;

3) Pay attention to the symbol in the “Update Classification” column.
This symbol indicates the category and significance of any changes.
This allows you to quickly identify important changes.

3) Dem in der Spalte “Änderungsklassifikation” enthaltenen Symbol ist besondere Aufmerksamkeit zuzuwenden.
In dieser Spalte wird das Symbol eingefügt, das für die Klasse der applizierten Änderungen steht. Dies ermöglicht ein schnelles Erkennen der Wichtigkeit der angesetzten Änderung.

Classificazione ***Classification*** **Klassifizierung**	**Definizione Specificante gli elementi di modifica** ***Change identifier Definition*** **Erklärende Definition der Änderungselemente**	**Simbolo Identificativo** ***Symbol*** **Identifikationssymbol**
Chiave *Key* Schlüssel	Uscita e immissione di un prodotto *Product release and marketing* Ausgabe und Einführung eines Produkts	⇆
Importante *Major* Wichtig	Modifica che influenza gli ingombri/stato fornitura/installazione del prodotto *Change affecting overall dimensions/delivery condition/product installation* Änderung, die sich auf die Abmessungen/den Lieferzustand/die Installation des Produkts auswirkt	▼
Secondaria *Minor* Zweitrangig	Modifica che riguarda traduzioni/impaginazioni/inserimento descrizioni *Change to translations/layout/captions* Änderung, die Übersetzungen/den Umbruch/das Einfügen von Beschreibungen betrifft	—

4) Qualora risultasse una diversità di quote tra disegno **2D – 3D** scaricato dal sito internet e tabella del catalogo è necessario consultare il nostro servizio tecnico.

Attenzione
Verificare la revisione in vostro possesso e la tabella degli aggiornamenti apportati nella nuova revisione.

*4) In the event the dimensions in the **2D – 3D** drawing downloaded from our site differ from those indicated in the catalogue table, contact our Engineering Dept.*

Warning
Check your catalogue revision status against the latest updates table.

4) Sollten sich zwischen den aus dem Internet herunter geladenen Maßen der Zeichnungen in **2D - 3D** und der Tabellen in diesem Katalog unterschiedliche Maße ergeben, setzen Sie sich bitte mit unserem Technischen Kundendienst in Verbindung.

Achtung
Überprüfen Sie die Revision, die sich in Ihren Händen befindet, und die Tabelle der in der neuen Revision eingefügten Aktualisierung.

☞				Aggiornamenti apportati Updates made			
Codice Code	Indice Revisione *Revision Index – Updates* **OLD**	Sezione N° *Section N°*	Pagina *Page* OLD	Descrizione Description	Indice Revisione *Revision Index – Updates* ***NEW***	Pagina *Page* **NEW**	Classificazione Modifica *Update classification*
MT 01 I GB D	0.0	2	12	Aggiunto il Prodotto WM	0.1	12	
MT 01 I GB D	0.0	3	15	Specifiche Verniciatura WM	0.1	15	
MT 01 I GB D	0.0	3	16	Targhetta Allegata di Fornitura WM	0.1	16	
MT 01 I GB D	0.0	4	19	Pesi WM	0.1	19	
MT 01 I GB D	0.1	8	52	Aggiunta Quantità olio AM41	0.2	52	
MT 01 I GB D	0.1	4	18	Aggiunto peso riduttore A 41	0.2	18	
MT 01 I GB D	0.1	6	30	inserite Coppie Slittamento Calettatori dei Riduttori	0.2	30	
MT 01 I GB D	0.2	8	52	Aggiunta Quantità olio AM45	0.3	52	
MT 01 I GB D	0.2	4	18	Aggiunto peso riduttore A 45	0.3	18	
MT 01 I GB D	0.2	3	15	Specifiche Verniciatura O 132-150-170-190	0.3	15	
MT 01 I GB D	0.2	4	18	Aggiunti Pesi riduttori O - 132-150-170-190	0.3	18	
MT 01 I GB D	0.2	8	53-54	Aggiunte Quantità Olioi riduttori O - 132-150-170-190	0.3	53-54	
MT 01 I GB D	0.2	8	54	Quantità olio OM 90 senza antiretro: M3: old 3.900 - New 3.850.	0.3	54	
MT 01 I GB D	0.2	6	25	Braccio reazione O 132-150-170-190	0.3	25	
MT 01 I GB D	0.2	6	26	Braccio Reazione O: Aggiunta quota "D2"	0.3	26	
MT 01 I GB D	0.2	6	30	Inserita tabella delle coppie Slittamento Calettatori O 132-150-170-190	0.3	30	
MT 01 I GB D	0.3	2	12	Aggiunto il Prodotto WI	0.4	12	
MT 01 I GB D	0.3	2	13	Targhetta Identificazione Prodotto WI	0.4	13	
MT 01 I GB D	0.3	3	15	Specifiche Verniciatura WM	0.4	15	
MT 01 I GB D	0.3	4	19	Peso WI	0.4	19	
MT 01 I GB D	0.3	6	22	Velocità albero ingresso WI	0.4	22	
MT 01 I GB D	0.3	6	25	Braccio Reazione WI	0.4	25	
MT 01 I GB D	0.4	2	12	Aggiunto il Prodotto PT	0.5	12	
MT 01 I GB D	0.4	3	15	Specifiche Verniciatura PT	0.5	15	
MT 01 I GB D	0.4	3	15	Specifiche Verniciatura PL 105-115-125-135-145-155	0.5	15	
MT 01 I GB D	0.4	3	16	Targhetta Identificazione olio VM-WM	0.5	16	
MT 01 I GB D	0.4	4	19	Aggiunti Pesi PT	0.5	19	
MT 01 I GB D	0.4	4	19	Aggiunti Tabella Peso PL 105-115-125-135-145-155	0.5	19	
MT 01 I GB D	0.4	6	22	Aggiunte Velocità ingresso PT/1 e PT/2 123-150-170-190	0.5	22	
MT 01 I GB D	0.4	6	27	Aggiunte Quote Antivibrante PL 105-115-125	0.5	27	
MT 01 I GB D	0.4	6	30-31	Aggiunte Coppie Slittamento riduttori PT/1 e PT/2 132-150-170-190.	0.5	30-31	
MT 01 I GB D	0.4	6	30-31	Aggiunte Coppie Slittamento riduttori PL 105-115-125-135	0.5	30-31	
MT 01 I GB D	0.4	8	New 58-59	Aggiunte Posizioni Montaggio riduttori PT/1 e PT/2 132-150-170-190.	0.5	New 58-59	
MT 01 I GB D	0.4	8	57	Aggiunte Posizioni Montaggio PL 105-115-125-135	0.5	57	
MT 01 I GB D	0.4	8	43-45 -46	Shell ha cambiato Designazione ai seguenti lubrificanti: Shell Tivela in Shell OMALA S4 WE; Shell OMALA in Shell OMALA S2 G; Shell DONAX TM in Shell SPIRAX S1 ATF TASA; Shell DONAX TA in Shell SPIRAX S2 ATF D2	0.5	43-45 -46	
MT 01 I GB D	0.4	8	da 45- a 59	Aggiunta Nota Livello olio.	0.5	da 45- a 59	
MT 01 I GB D	0.4	11	79-80	Aggiunte Posizioni Montaggio 3D riduttori PT/1 e PT/2 132-150-170-190.	0.5	79-80	
MT 01 I GB D	0.4	11	83-84	Aggiunta Rete Vendita	0.5	83-84	
MT 01 I GB D	0.6		15	Stato verniciatura A55-70-140	0.7	15	
MT 01 I GB D	0.6		18	Aggiunti i pesi dei riduttori A55-70-140	0.7	18	
MT 01 I GB D	0.6		56	Aggiunti lqua Ntitativi olio dei riduttori A55-70-140	0.7	56	

MT01 IGB D 0.7_R7 01/19

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Installation and Maintenance

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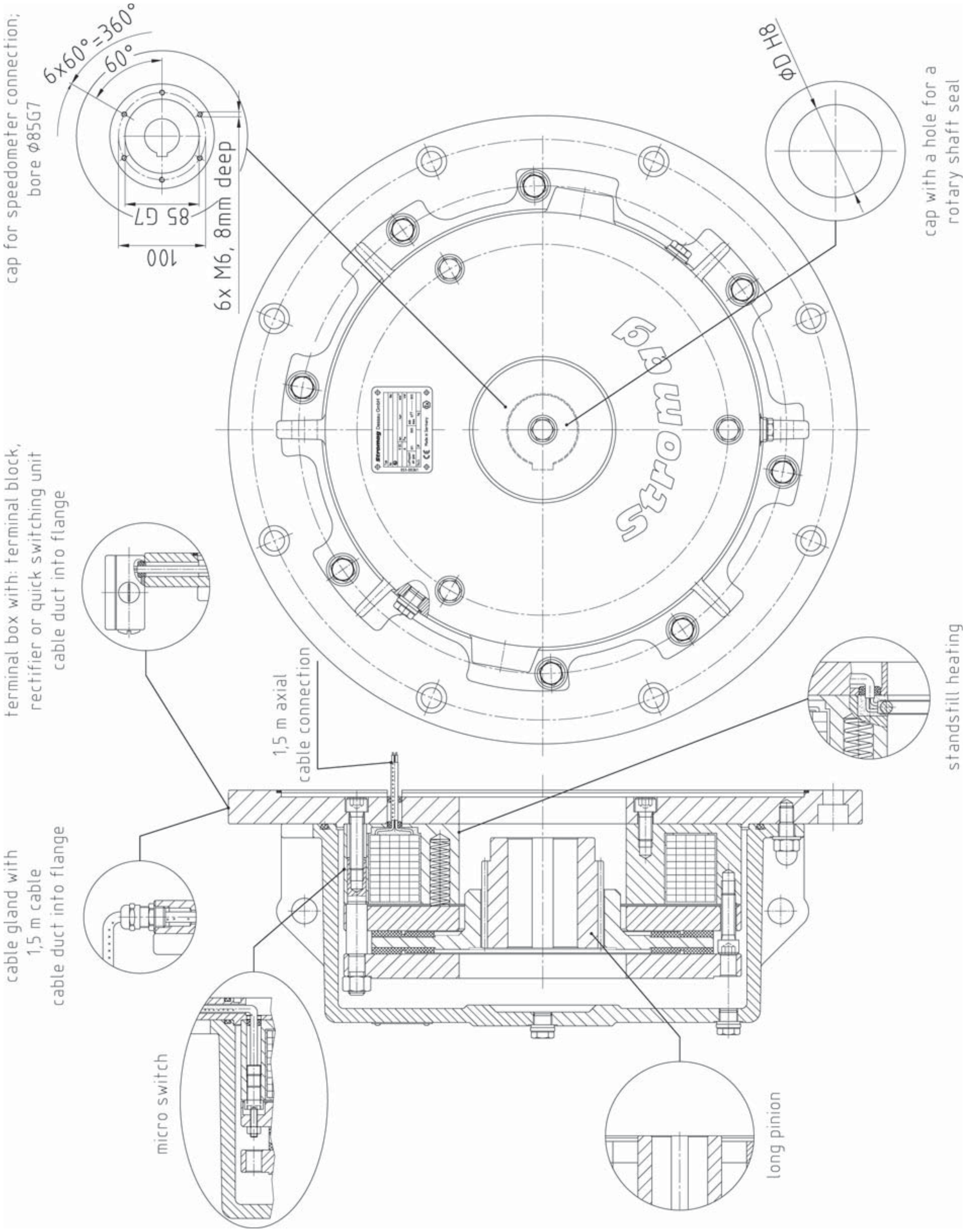
12 Appendix

12.1 Variants (optional)



12.2 List of dimensions

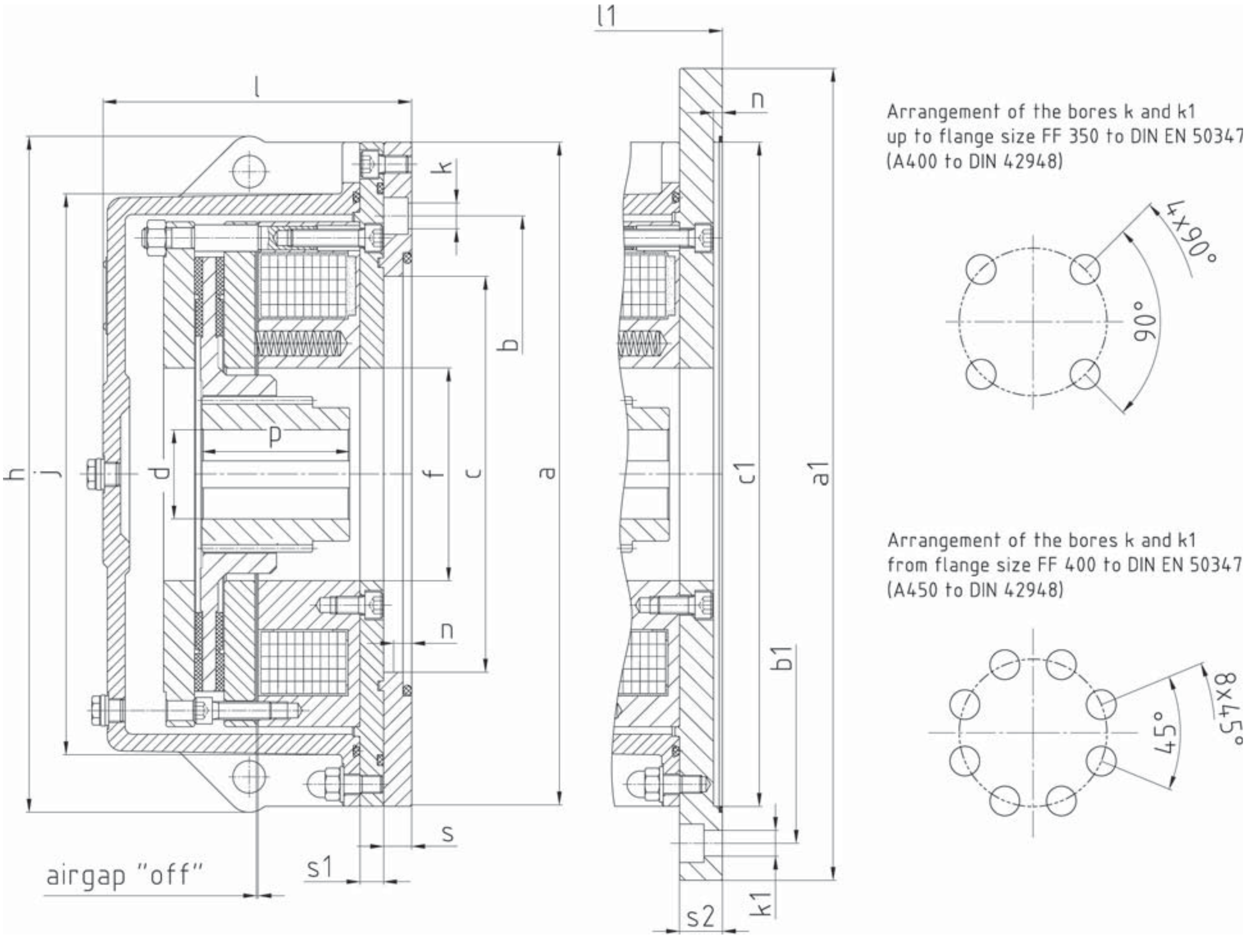


Table 4: *technichal data*

size 4BZFM	M_{SN} Nm	$M_{\ddot{U}}$ Nm	n_0 min^{-1}	n_{zn} min^{-1}	U_n* VDC	P_k W	airgap min/max	W kJ	P_{vn} kW	J kgm^2	m kg
6,3	63	69	6000	3300	110	110	0,4/1,2	80	0,16	0,0012	23
10	100	110	6000	3000	110	122	0,4/1,2	100	0,21	0,0019	32
16	160	175	6000	2700	110	142	0,4/1,2	120	0,26	0,0026	40
25	250	275	5500	2100	110	164	0,4/1,2	150	0,31	0,0050	56
40	400	440	4700	1800	110	214	0,4/1,5	220	0,38	0,0133	73
63	630	690	4000	1500	110	249	0,4/1,8	300	0,46	0,0271	107
100	1000	1100	3600	1300	110	332	0,5/2,1	350	0,57	0,0366	138
160	1600	1750	3200	1100	110	403	0,5/2,4	400	0,70	0,0600	205
250	2500	2750	2800	1000	110	530	0,5/2,8	590	0,85	0,1266	275
400	4000	4400	2400	1000	110	675	0,5/2,8	698	0,85	0,2670	380
630	6300	6930	2200	800	110	698	0,5/2,8	776	0,90	0,4700	506
1000	10000	11000	2000	700	110	827	0,6/3,0	844	0,95	0,7777	636

* other voltages on request

M_{SN}	:	switchable nominal torque at $1m/s$ frictional speed to DIN VDE 0580 (applies to dry operation with an oil- and grease-free friction lining after running-in)
$M_{\ddot{U}}$	:	transmissible static nominal torque without slip, to DIN VDE 0580 (applies to dry operation with an oil- and grease-free friction lining after running-in)
n_0	:	maximum idling speed
n_{zn}	:	admissible switching speed
P_k	:	excitation output at 20°C
P_{vn}	:	nominal braking capacity (S4-40 % I.O.)
W	:	switch work per switching operation for $z = 1 - 5h^{-1}$
J	:	mass moment of inertia of rotating parts
m	:	weight
mode of operation	:	S1, S2, S4-40 % I.O.
thermal class	:	155 (F) in accordance with DIN VDE 0580
AC-control	:	via rectifier

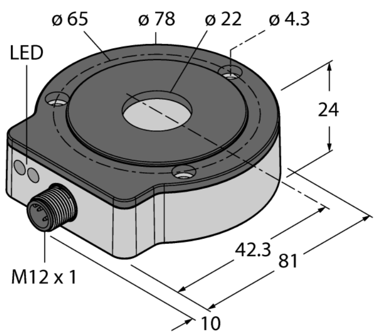
Table 5: *table of dimensions (all dimensions in mm)*

size 4BZFM	6.3	10	16	25	40	63	100	160	250	400	630	1000
a	250	250	—	300	350	400	450	550	550	—	—	—
$a1$	300	300	300	350	400	450	550	660	660	660	800	800
b	215	215	—	265	300	350	400	500	500	—	—	—
$b1$	265	265	265	300	350	400	500	600	600	600	740	740
c (H7)	180	180	—	230	250	300	350	450	450	—	—	—
$c1$ (H7)	230	230	230	250	300	350	450	550	550	550	680	680
d_{min}	28	28	38	38	38	48	48	60	65	90	90	100
d_{max}	40	40	55	55	60	75	75	110	125	140	160	180
f	82	86	98	104	130	149	144	190	210	210	233	275
h	252	275	296	322	376	426	458	532	574	654	737	800
j	193	214	233	256	306	356	380	450	491	559	615	690
k	13,5	13,5	—	13,5	17,5	17,5	17,5	17,5	17,5	—	—	—
$k1$	13,5	13,5	13,5	17,5	17,5	17,5	17,5	22	22	22	22	22
l	—	147	—	165	196	196	209	—	274	—	—	—
$l1$	126	141	145	165	184	184	203	232	252	305	358	381
n	6	6	6	6	6	6	6	7	6	7	7	7
p	70	70	80	80	90	100	100	130	171	205	245	245
s	—	15	—	15	22	22	19	—	29	—	—	—
$s1$	—	11	—	11	12	12	16	—	22	—	—	—
$s2$	18	20	20	26	22	22	29	24	29	30	37	33

keyways to DIN 6885/1
standard flange to DIN 42948

Contactless encoder
Ri360P0-EQR24M0-INCRX2-H1181

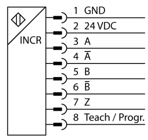
Industrial Automation

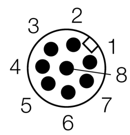


Type code	Ri360P0-EQR24M0-INCRX2-H1181
Ident no.	1590912
Max. Rotational Speed	10,000 rpm Determined with standardized construction, with a steel shaft Ø 20 mm, L = 50 mm and reducer Ø 20 mm
Starting torque shaft load (radial / axial)	not applicable, because of contactless measuring principle
Measuring range	0…360°
Repeatability	≤ 0.01 % of full scale
Linearity deviation	≤ 0.05 % f.s.
Temperature drift	≤ ± 0.003 % / K
Ambient temperature	-25…+85 °C
Operating voltage	10…30VDC
Residual ripple	≤ 10 % U_{ss}
Rated insulation voltage	≤ 0.5 kV
Short-circuit protection	yes/ cyclic
Wire breakage / Reverse polarity protection	yes/ yes (voltage supply)
Output function	8-pin, Push-Pull/HTL
Output Type	incremental
Resolution, incremental	1024
Pulse frequency max.	200 kHz
Signal level high	min. U_B - 2 V
Signal level low	max. 2.0 V
Sample rate	1000 Hz
Current consumption	< 100 mA
Dimensions	81 x 78 x 24 mm
Shaft Type	Hollow shaft
Housing material	stainless-steel/plastic
Connection	male, M12 x 1
Vibration resistance	55 Hz (1 mm)
Vibration resistance (EN 60068-2-6)	20 g; 10…3000 Hz; 50 cycles; 3 axes
Shock resistance (EN 60068-2-27)	100 g; 11 ms ½ sinus; 3 x each; 3 axes
Continuous shock resistance (EN 60068-2-29)	40 g; 6 ms ½ sinus; each 4000 x; 3 axes
IP Rating	IP68 / IP69K
MTTF	138 years acc. to SN 29500 (Ed. 99) 40 °C
Power-on indication	LED green
Measuring range display	LED, yellow, yellow flashing
Included in delivery	Adapter sleeve MT-QR24

- **Compact, rugged housing**
- **Active face, plastic PA12-GF30**
- **Housing, stainless steel V4A (1.4404)**
- **Status displayed via LED**
- **Immune to electromagnetic interference**
- **1024 pulses per revolution (default)**
- **360, 512, 1000, 1024, 2048, 2500, 3600, 4096, parametr. via Easy-Teach**
- **Free parametrization of the pulse number in the range from 1 to 5000 via PACT*ware*™**
- **Position of z-track set via Easy-Teach**
- **Burst function, absolute angular position output incrementally per Easy-Teach pulse**
- **10…30 VDC**
- **Male M12 x 1, 8-pin**
- **Push-pull A, B, Z, A (inverse), B (inverse)**

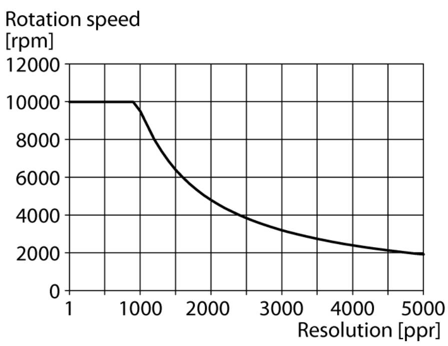
Wiring diagram





Functional principle

The measuring principle of inductive angle sensors is based on oscillation circuit coupling between the positioning element and the sensor, whereby an output signal is provided proportional to the angle of the positioning element. The rugged sensors are wear and maintenance-free, thanks to the contactless operating principle. They convince through their excellent repeatability, resolution and linearity within a broad temperature range. The innovative technology ensures a high immunity to electromagnetic DC and AC fields.



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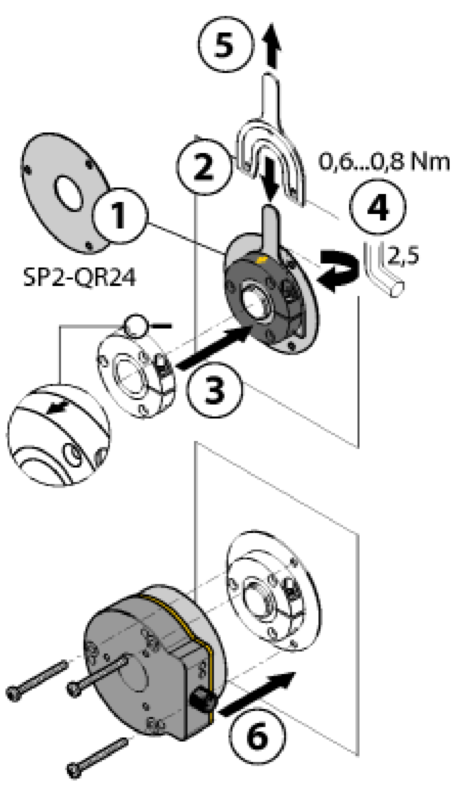
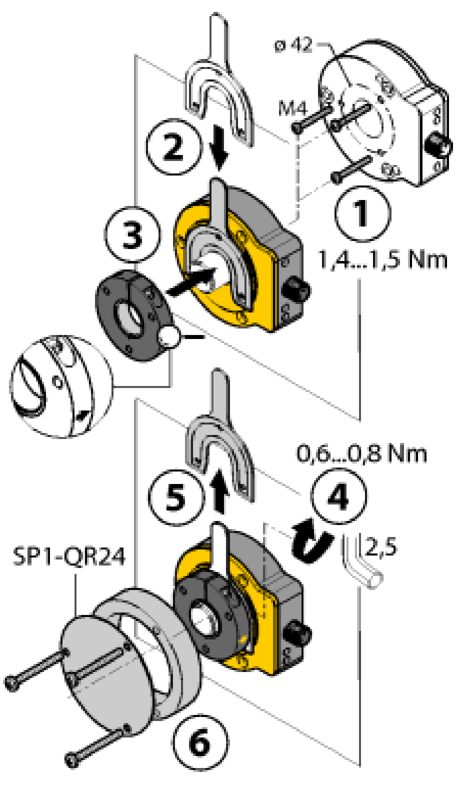
Hans Turck GmbH & Co.KG • D-45472 Mülheim an der Ruhr • Witzlebenstraße 7 • Tel. 0208 4952-0 • Fax 0208 4952-264 • more@turck.com • www.turck.com

Industrial Automation

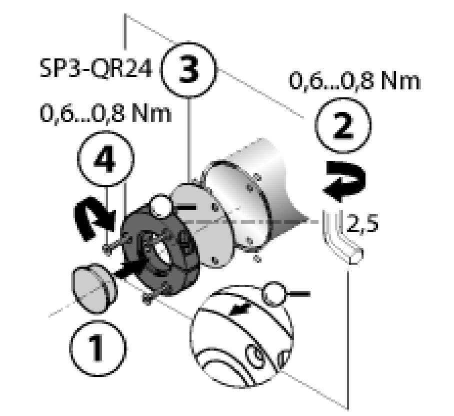
A



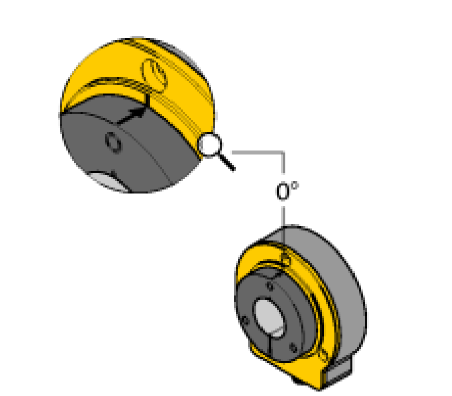
B



C



Default: 0°



Extensive range of mounting accessories for easy adaptation to many different shaft diameters. Based on the functional principle of RLC coupling, the sensor operates absolutely wear-free and is immune to magnetized metal splinters and other interference fields. Wrong installation is hardly possible.
The adjacent figure shows the two separate units, sensor and positioning element.

Mounting option A:
First, interconnect positioning element and rotatable shaft. Then place the encoder above the rotating part in such a way that you get a tight and protected unit.

Mounting option B:
Push the encoder on the back site of the shaft and fasten it to the machine. Then clamp the positioning element to the shaft with the bracket.

Mounting option C:
If the positioning element is to be screwed on a rotating machine part and not on a shaft, install first the dummy plug RA8-QR24. Then tie up the bracket. Screw on the encoder via the three bores.

The separately arranged sensor and positioning element inhibit that compensating currents or damaging mechanical loads are transmitted via the shaft to the sensor. In addition, the encoder remains tight and highly protected during its entire lifespan.
The accessories enclosed in the delivery help to mount encoder and positioning element at an optimal distance from each other. LEDs indicate the switching status. Optionally, you can use the shields which are included in the accessories to increase the allowed distance between positioning element and sensor.

Status display via LED

green steady:
Sensor is operative

yellow steady:
Positioning element has reached the end of the measuring range. This is indicated by a weaker signal.

yellow flashing:
Positioning element is outside the measuring range.

off:
Positioning element is in the measuring range

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Individual parametrization (teaching with positioning element)

Jumper between teach input Pin 8	Gnd Pin 1	Ub Pin 2	LED
2 s	z-track zero point teaching	single trigger of the burst function	status LED flashes then turns steady after 2 s
10 s	CCW rotation direction	CW rotation direction	after 10 s status LED flashes fast for 2 s
15 s	-	factory setting (z-track, CW)	after 15 s power and status LED alternate

Preset Programming Mode (teaching without positioning element)

Jumper between teach input Pin 8	Gnd Pin 1	Ub Pin 2	LED
2 s	resolution setting mode active for 10 s	resolution setting mode active for 10 s	status LED steady, flashes after 2 s as long as selection mode is active
360 pulses / 360°	start value		1 x flashing
512 pulses / 360°	press once		2 x flashing
1000 pulses / 360°	press twice		3 x flashing
1024 pulses / 360°	press three times		4 x flashing
2048 pulses / 360°	press four times		5 x flashing
2500 pulses / 360°		start value	1 x flashing
3600 pulses / 360°		press once	2 x flashing
4096 pulses / 360°		press twice	3 x flashing
5000 pulses / 360°		press three times	4 x flashing

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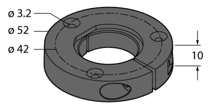
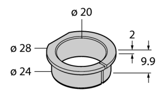
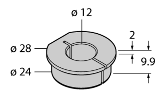
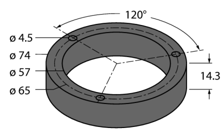
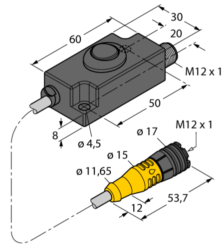
Contactless encoder
Ri360P0-EQR24M0-INCRX2-H1181

Accessories

Type code	Ident no.	Description	Design
PE1-EQR24	1590966	Positioning element without adapter sleeve	
RA1-EQR24	1593019	Stainless steel adapter sleeve, for Ø 20 mm shafts	
RA3-EQR24	1593020	Stainless steel adapter sleeve, for Ø 12 mm shafts	
M5-QR24	1590965	Plastic protecting ring, for inductive encoders Ri-QR24	
TX2-Q20L60	6967117	Teach adapter for inductive encoders with 8-pin male M12 x 1, for simple programming via Easy Teach	

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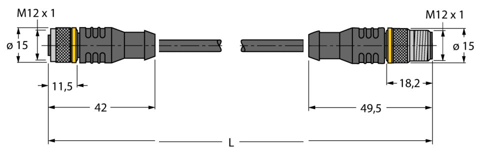
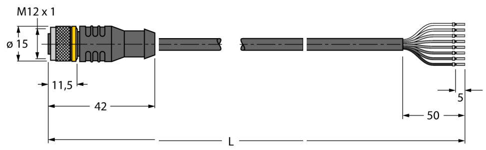
Industrial Automation

Accessories

Type code	Ident no.	Description	Design
RKC8.302T-1,5-RSC4T/ TX320	6625003	Adapter cable to connect sensor to USB-2-IOL-0002 parametrizing unit; female M12, straight, 8-pin on male M12, straigth, 3-pin; cable length: 1.5 m; sheath material: PUR, sheath color: black, cULus approved; RoHS conform; protection class IP67	
RKC8T-2/TXL	6625142	Connection cable, female M12, straight, 8-pin, cable length: 2 m, sheath material: PUR, black; cULus approval; other cable lengths and qualities available, see www.turck.com	

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Rotary Inductive Sensors, Incremental Output, QR24

Part Number	ID Number	Measuring Range	Resolution	Ambient Temperature	Operating Voltage	Output	Dimensional Drawing	Wiring Diagram
Ri360P0-QR24M0-INCRX2-H1181	M1590910	0-360°	1-5000* ppr	-40 to +185 °F (-40 to +85 °C)	15-30 VDC	Push-Pull/HTL	1	1
Ri360P0-EQR24M0-INCRX2-H1181	M1590912	0-360°	1-5000* ppr	-40 to +185 °F (-40 to +85 °C)	15-30 VDC	Push-Pull/HTL	1	1

NOTE: Incremental output QR24 sensors not to be used for speed feedback.

* Easyteach pulse rates available: 360, 512, 1000, 1024, 2048, 2500, 3600, 4096, 5000 ppr

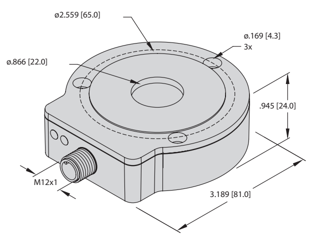
Technical Specifications:

Linearity deviation:	≤ 0.05% of full scale
Temperature drift:	≤ ±0.003% / K
Residual ripple:	≤ 10% Uss
Rated insulation voltage:	≤ 0.5 kV
Short-circuit protection:	yes
Wire-break/Rev. pol. protection:	yes/yes
Pulse frequency max.:	200 kHz
Signal level high:	min. V+ - 2V
Signal level low:	max. 2V
Sampling rate:	1000 Hz
Current consumption:	< 100 mA

Housing:	QR24
Dimensions:	81 x 78 x 24 mm
Housing material (QR24):	Metal/Plastic, ZnAlCu1/PBT-GF30-V0
Housing material (EQR24):	Stainless Steel/Plastic V4A (1.4404) PA12-GF30
Shaft type:	Hollow shaft
Electrical connection:	M12 x 1
Vibration resistance:	55 Hz (1 mm)
Shock resistance:	40 g, 6 ms (continuous)
Degree of protection:	IP68/IP69K
Power-on indication:	LED, green
Measuring range indication:	LED, yellow, yellow flashing

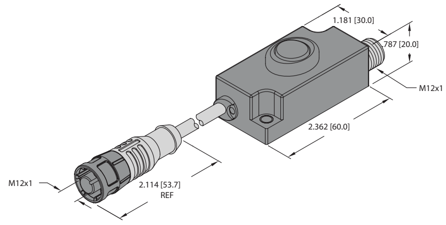
Dimensions:

1



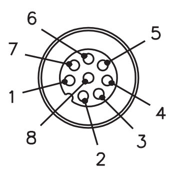
Easyteach Programming Tool:

TX2-Q20L60



Wiring Diagrams:

Diagram 1



Pinouts
1. GND(WH)
2. 24 VDC(BN)
3. A(GN)
4. $\overline{A}$(YE)
5. B(GY)
6. $\overline{B}$(PK)
7. Z(BU)
8. TEACH(RD)

Mating Cordset: **E-RKC 8T-264-***

Sample Configuration: IO-Link Master

The following components can be used for parameterization of the QR24 incremental sensor through IO-Link:

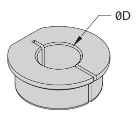
1 x IO-Link Master	USB-2-IOL-0002
1 x Connection Cable	RKC 8.302T-1.5-RSC4T/TX320

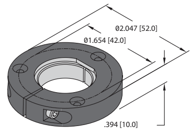
PACTware™

TURCK

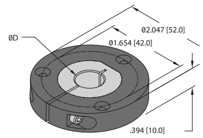
Accessories, QR24

Positioning Elements and Reducing Bushings

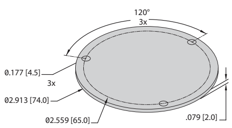
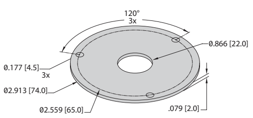
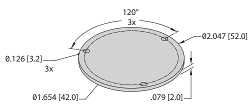
Dimension Drawing	Type	Description
	RA1-QR24 [1)] (20 mm)	Reducing bushing 20 mm
	RA2-QR24 (14 mm)	Reducing bushing 14 mm
	RA3-QR24 [1)] (12 mm)	Reducing bushing 12 mm
	RA4-QR24 [1)] (10 mm)	Reducing bushing 10 mm
	RA5-QR24 (6 mm)	Reducing bushing 6 mm
	RA6-QR24 (3/8")	Reducing bushing 3/8"
	RA7-QR24 (1/4")	Reducing bushing 1/4"
	RA8-QR24 (BP)	Blanking plug
	RA9-QR24 (1/2")	Reducing bushing 1/2"
	RA10-QR24 (5/8")	Reducing bushing 5/8"
	RA11-QR24 (3/4")	Reducing bushing 3/4"

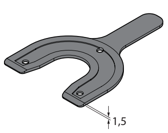
Dimension Drawing	Type	Description
	PE1-QR24 [1)]	Base unit for positioning element

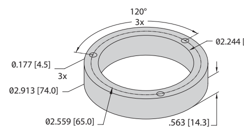
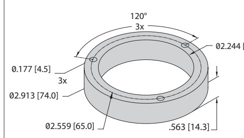
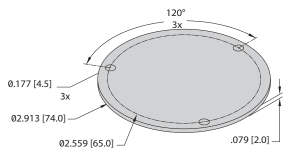
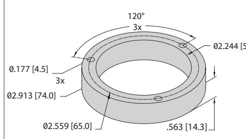
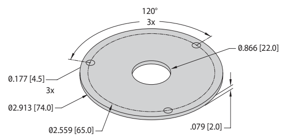
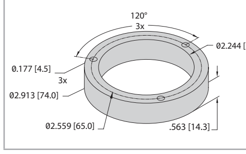
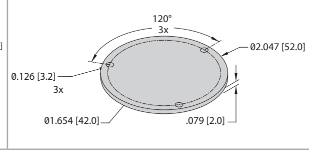
Ready-to-Install Positioning Elements

Dimension Drawing	Type	Description
	P1-Ri-QR24 [1)] (20 mm)	Positioning element with hollow shaft 20 mm
	P2-Ri-QR24 (14 mm)	Positioning element with hollow shaft 14 mm
	P3-Ri-QR24 [1)] (12 mm)	Positioning element with hollow shaft 12 mm
	P4-Ri-QR24 [1)] (10 mm)	Positioning element with hollow shaft 10 mm
	P5-Ri-QR24 (6 mm)	Positioning element with hollow shaft 6 mm
	P6-Ri-QR24 (3/8")	Positioning element with hollow shaft 3/8"
	P7-Ri-QR24 (1/4")	Positioning element with hollow shaft 1/4"
	P8-Ri-QR24 (BP)	Positioning element with blanking plug
	P9-Ri-QR24[1)] (1/2")	Positioning element with hollow shaft 1/2"
	P10-Ri-QR24[1)] (5/8")	Positioning element with hollow shaft 5/8"
	P11-Ri-QR24[1)] (3/4"	Positioning element with hollow shaft 3/4"

[1)] Items offered with stainless steel components (EQR24). Contact factory for more options.

Dimension Drawing	Type	Description
	SP1-QR24	Shield Ø 74 mm, aluminium
	SP2-QR24	Shield Ø 74 mm with bore for shaft guidance, aluminium
	SP3-QR24	Shield Ø 52 mm, aluminium

Dimension Drawing	Type	Description
	MT-QR24	Mounting aid, already included in the delivery scope of the encoder

Dimension Drawing		Type	Description
		M1-QR24[2)]	Aluminium ring
		M2-QR24	M1-QR24+SP1-QR24
		M3-QR24	M1-QR24+SP2-QR24
		M4-QR24	M1-QR24+SP3-QR24

[2)] Also offered in plastic (M5-QR24).

Rotary Position Technology – Inductive

9.0: DRAWINGS

This section contains a list of the drawings provided.

DRAWING NUMBER	TITLE
F400942	SPRE 3464 – ELEC SCRIPPS
7400371	SPRE-3464 ELECTRICAL SCHEMATIC
7400373	SPRE-3464 INTERCONNECT DIAGRAM
7400372	SPRE-3464 PANEL PAYOUT
34-00304-000	SPRE 3464 GENERAL ARRANGEMENT
34-00304-001	SPRE 3464 GENERAL ASSEMBLY
34-00304-007	ASSEMBLY – DRUM
34-00304-028	ASSEMBLY – PANELS
34-00304-031	ASSEMBLY – SCEW AND HOUSING
34-00304-032	ASSEMBLY – ENCODER AND GUARD
34-00304-033	ASSEMBLY – OPERATOR GUARD
34-00304-035	ASSEMBLY – LEVELWIND CARRIAGE
34-00304-037	ASSEMBLY - SHEAVE
34-00304-055	ASSEMBLY – SHEAVE BEARING
34-00304-056	CABLE KEEPER ASSEMBLY
34-00304-057	ASSEMBLY – SIDE PLATFORM
34-00304-058	ASSEMBLY – REAR PLATFORM
34-00304-061	ASSEMBLY – LEVELWIND GEARBOX
34-00304-070	ASSEMBLY – UPPER GUARD
34-00304-079	CABLE GUIDE FITTING ASSEMBLY
34-00304-081	DECAL LAYOUT – SPR3-3464
34-00304-082	SPRE-3464 LUBRICATION DIAGRAM
34-00304-085	ASSEMBLY – BEACON KIT
34-00304-089	ASSEMBLY – BONDING/GROUNDING KIT

SPECIFICATIONS

BARE DRUM PULL: 10000 LB @ 92 FPM [4500 KG @ 28 M/MIN]
FULL DRUM PULL: 3950 LB @ 232 FPM [1700 KG @ 74 M/MIN]
DRUM CAPACITY: 2400 METERS, 1" CABLE

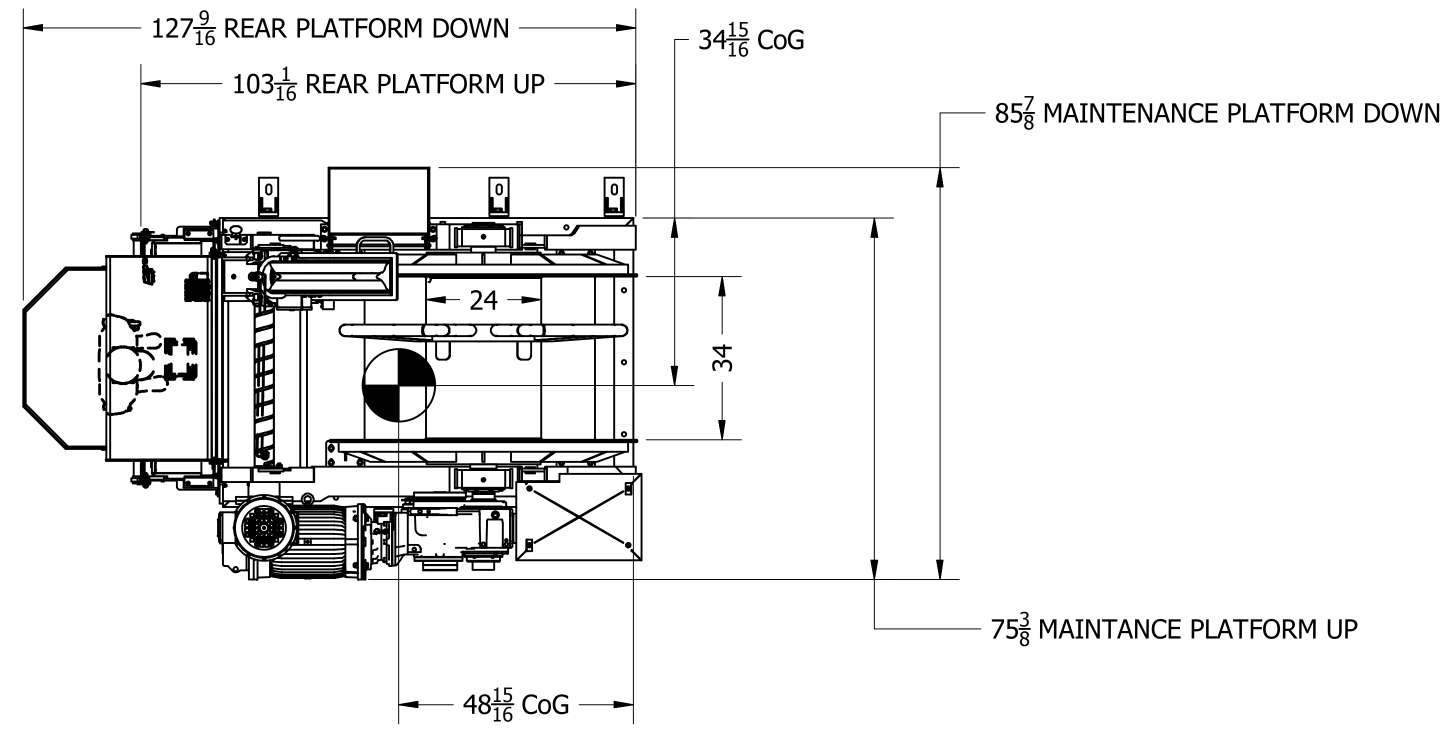
ALLOWABLE WIRE DIAMETERS: 1/4" TO 1/2"
ESTIMATED WEIGHT: 9000 LB ± 5%

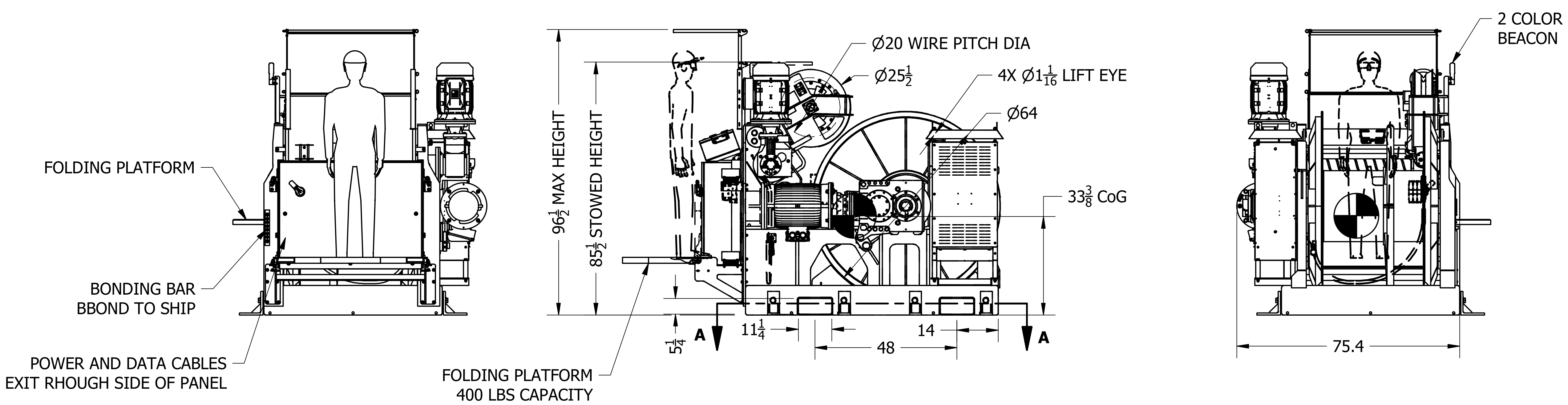
ESTIMATED WEIGHT WITHOUT CENTER FLANGE: 8600 LB ± 5%
NOTE: WEIGHTS DO NOT INCLUDE CABLE OR WIRE

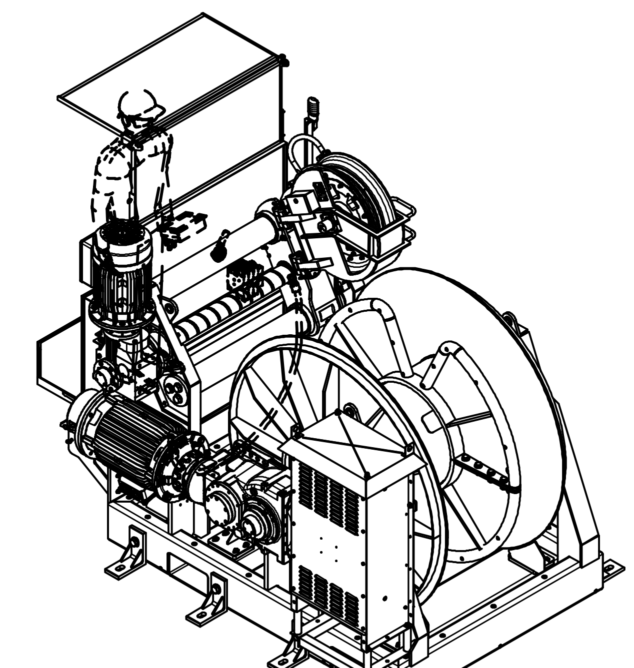
POWER SUPPLY: 480VAC/3PH/60HZ

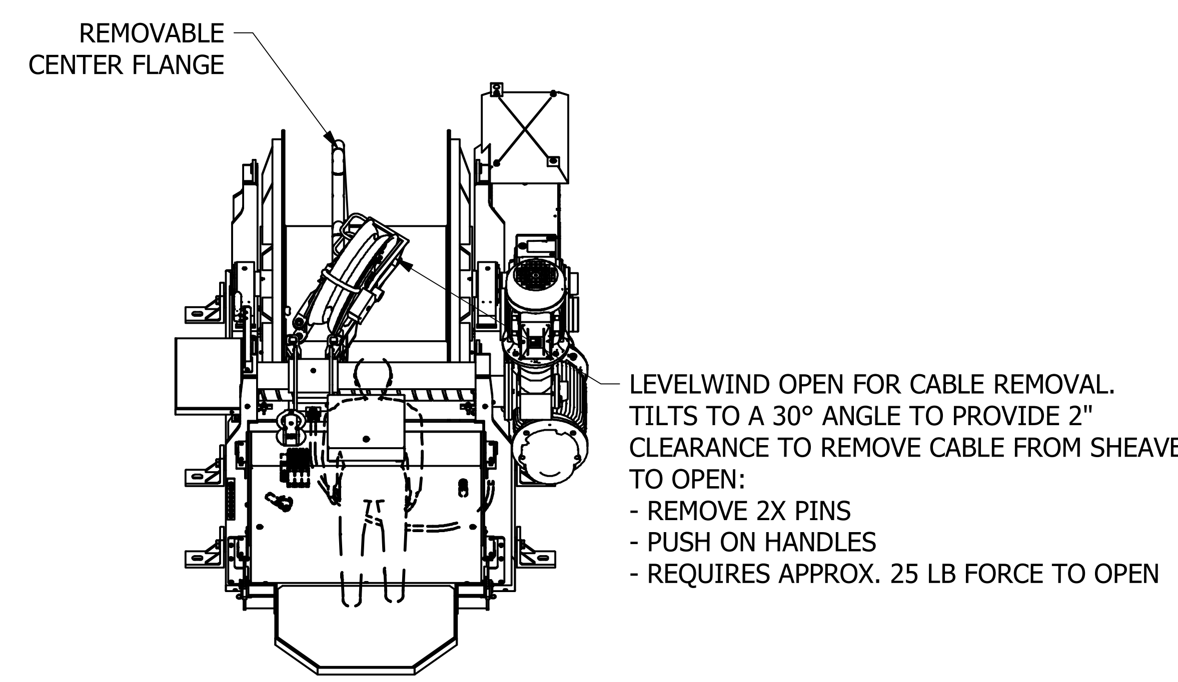
DRUM MOTOR: 40 HP
LEVELWIND MOTOR: 15 HP
LEVELWIND SPEED: 4.5-5 SEC FLANGE TO FLANGE

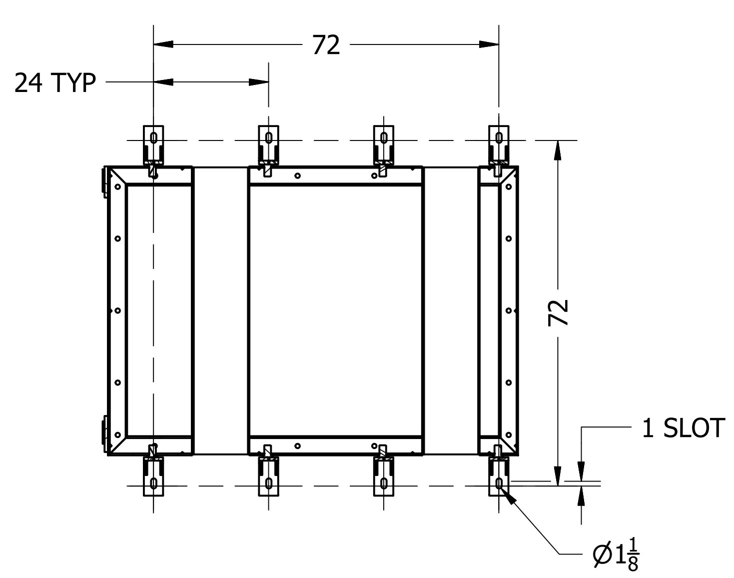
NOTE:
- DRUM CAPACITY AS 1" WIRE ONLY AS A COMPARATIVE SPECIFICATION. WINCH IS NOT DESIGNED TO BE USED WITH 1" WIRE.











SECTION A-A
FOOTPRINT
SCALE 1 / 40

REV	DATE	ECN	AMENDMENTS	BY	APPD
B	29-Feb-20	4435	AS-BUILT UPDATE	DHM	DHM
A	05-Jun-19		ADDED MOUNTING DIMENSIONS	NSW	DHM

STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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Tel: (902) 275-3591 Fax: (902) 275-5014
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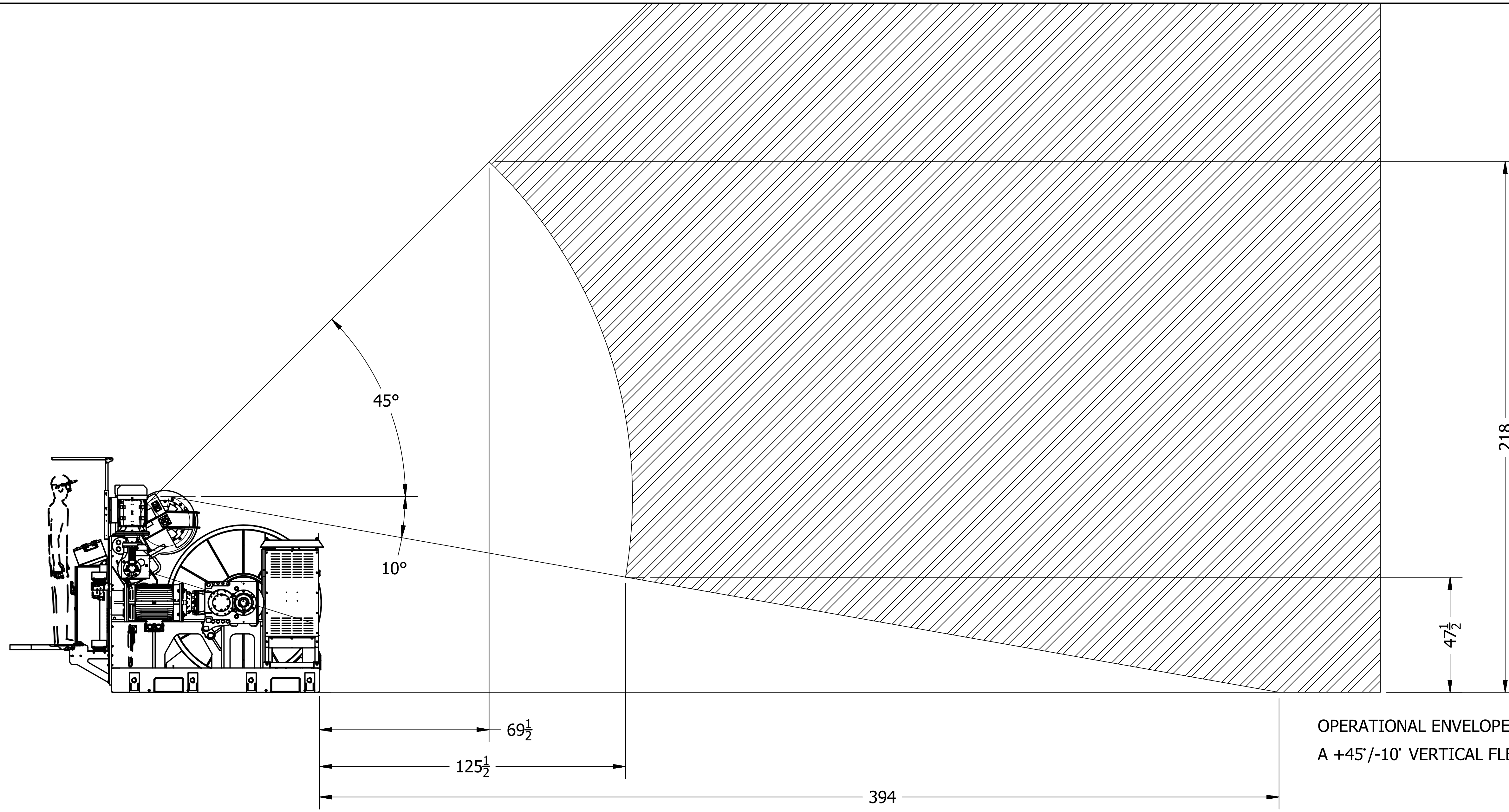
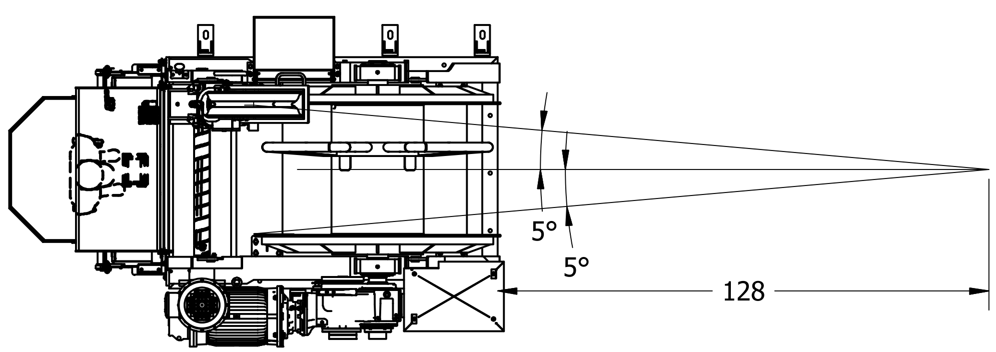
MATL CERT	TITLE: SPRE-3464 GENERAL ARRANGEMENT		
MATL TEST	NEXT ASSEMBLY: F400942	DERIVED FROM	
WELD TEST	FIRST USED ON WO: 1942	SHEET: 1	OF: 2
EST LBS	DRAWN: NSW	CHECKED: DHM	APPROVED: NSW
ACT LBS	DATE: 11-Oct-19	SCALE: 1 / 40	34-00304-000 REV B



OPERATIONAL ENVELOPE BASED OFF OF
A +45°/-10° VERTICAL FLEET ANGLE



MINIMUM HORIZONTAL WORKING DISTANCE
AT 5° FLEET ANGLE

STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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www.hawboldt.ca

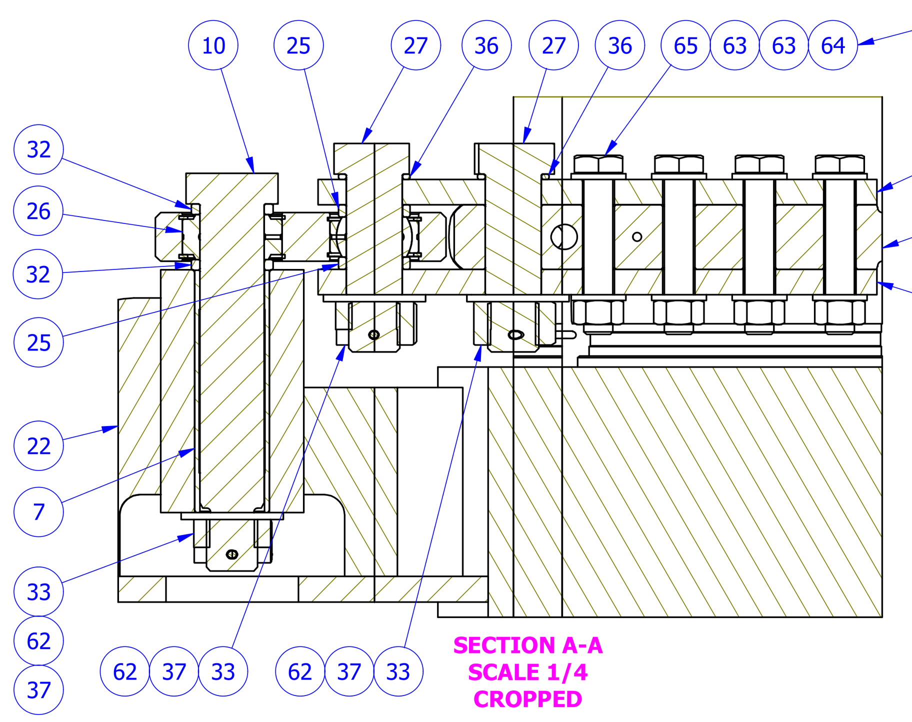
MATL CERT	TITLE SPRE-3464 GENERAL ARRANGEMENT		
MATL TEST	NEXT ASSEMBLY F400942	DERIVED FROM	
WELD TEST	FIRST USED ON WO 1942	SHEET 2	OF 2
EST LBS	DRAWN NSW · CHECKED DHM · APPROVED NSW	34-00304-000	REV B
ACT LBS	DATE 11-Oct-19 · SCALE 1 / 50		

ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	QTY
115	34-00304-876	1	ENCODER FLANGE		1
116	34-00304-877	3	ENCODER STAND-OFF		3
117	34-00304-101	1	ENCODER COVER		1
118	FI	1	CABLE GLAND - 0.375" NPT CABLE DIA .16" to .31"	Ni-Plated Brass	1
119	300464	3	SHCS M4-0.70 X 45 MM LG	SS A4	3
120	185241	6	SHCS 1/4-20NC X 1/2 LG	SS 316	6
121	5410857	1	1024PPR INCREMENTAL ENCODER	Generic	1
122	5410868	1	ENCODER COUPLING - 8MM - GFR	Nylon-MC901	1

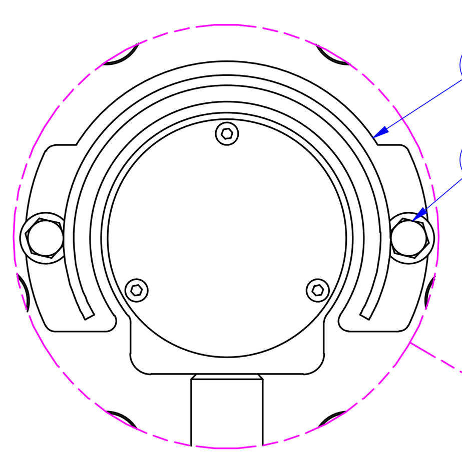
ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	QTY
77	181204		HEX NUT- 3/8-16NC	SS 316	18
78	187309		HHCS 3/8-16NC X 1 3/4 LG	SS 316	18
79	188010		HHCS 1-8NC X 2 LG	SS 316	12
80	181081		FLAT WASHER- 1	SS 316	12
81	120006	4	4 LG - 1/2 KEYSTOCK	44W	4
82	187107		HHCS 1/4-20NC X 1 1/4 LG	SS 316	10
83	255512		FLAT WASHER- M12 HARDENED	STL	4
84	281202		HHCS M12-1.75 X 35MM LG	GR8.8	4
85	5404603		OIL: VG ISO 220: SYNTHETIC		25.00 l
86	7400371		SPRE-3464 ELECTRICAL SCHEMATIC		1
87	34-00296-337		KEY		1
88	34-00304-489		LEVELWIND HOME BRACKET		1
89	34-00304-488		HOME POINTER		2
90	187104		HHCS 1/4-20NC X 3/4 LG	SS 316	6
91	5408555		SEAL, V-RING, 115 - 125 MM SHAFT		1
92	271610		HHCS 1-8NC X 2 1/2 LG	GR8	8
93	255016		HEX NUT M16-2.00	GR10.9	4
94	34-00304-084		WELDMENT - BEACON BRACKET		1
95	181073		FLAT WASHER- 5/16	SS 316	4
96	181203		HEX NUT- 5/16-18NC	SS 316	2
97	187207		HHCS 5/16-18NC X 1 1/4 LG	SS 316	2
98	255555		FLAT WASHER- M5	SS A4	2
99	307005		HEX NUT M5-0.80	SS A4	2
100	34-00304-085		ASSEMBLY - BEACON KIT		1
101	34-00296-074		WELDMENT - ENCODER GUARD		1
102	34-00304-089		ASSEMBLY - BONDING/GROUNDING KIT		1
103	194357		SFHCS - 1/2-13NC X 1-3/4 LG	SS 316	2
104	194356		SFHCS - 1/2-13NC X 1-1/2 LG	SS 316	4
105	187407		HHCS 7/16-14NC X 1 1/4 LG	SS 316	2
106	181205		HEX NUT- 7/16-14NC	SS 316	6
107	187406		HHCS 7/16-14NC X 1 LG	SS 316	4
108	181075		FLAT WASHER- 7/16	SS 316	12
109	5401903		LOCKNUT - 1/4-20NC NYLON INSERT	SS 316	8
110	194055		SFHCS - 1/4-20NC X 1 1/4 LG	SS 316	8
111	34-00304-022		BRAKE RESISTOR AND ENCLOSURE BRACKET		1
112	5410515		ENCLOSURE; 20 X 20 X 12; 316SS		1
113	34-00304-874	1	ENCODER ADAPTER PLATE		1
114	34-00304-873	1	STUB SHAFT - MOTOR ENCODER		1

ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	QTY
39	5403895		RETAINING RING, EXTERNAL; 120 MM SHAFT		2
40	5408440		O-RING, 2-167, 70 DURO		2
41	5408423		SEAL, RADIAL SHAFT, 4.625 SHAFT CRWH1		2
42	5408421		SPEEDI-SLEEVE, 4.625 SHAFT	Stainless Steel	2
43	5408560		SPEEDI-SLEEVE, 5.125 NOMINAL	Stainless Steel	2
44	5408454		BEARING, SPHERICAL ROLLER, 120X180X60		2
45	5408587		RETAINING RING, INTERNAL 100MM STL	STL	1
46	5408411		ELECTRIC MOTOR: 40 Hp		1
47	5405988		SENSOR E2A-M18KS08-WP-B2 5M	Brass	2
48	5408451		SEAL, RADIAL SHAFT, 5.125 SHAFT CRWH1		2
49	5408400		GEARBOX - BPH323 - 102.5 - IEC200	STL	1
50	5408557		ELECTRIC MOTOR, 11 kW, 160M		1
51	5400027		BEARING, FLANGE 2"	Steel, Mild	1
52	181011		FLAT WASHER- 1 HARDENED	STL	8
53	181074		FLAT WASHER- 3/8	SS 316	56
54	187307		HHCS 3/8-16NC X 1 1/4 LG	SS 316	20
55		FI	GREASE FITTING 1/8-27 NPT STRAIGHT	SS	2
56	181012		FLAT WASHER- 7/8 HARDENED	STL	4
57	271510		HHCS 7/8-9NC X 2 1/2 LG	GR8	4
58	251011		HHCS M10-1.50 X 30MM LG	GR10.9	4
59	181076		FLAT WASHER- 1/2	SS 316	30
60	181206		HEX NUT- 1/2-13NC	SS 316	10
61					1
62	181083		FLAT WASHER- 1 1/4	SS 316	3
63	255518		FLAT WASHER- M18 HARDENED	STL	16
64	255018		HEX NUT M18-2.50	GR10.9	4
65	251823		HHCS M18-2.50 X 100MM LG	GR10.9	4
66	187506		HHCS 1/2-13NC X 1 LG	SS 316	16
67	187511		HHCS 1/2-13NC X 2 1/4 LG	SS 316	4
68	181008		FLAT WASHER- 5/8 HARDENED	STL	16
69	270610		HHCS 5/8-11NC X 2 1/2 LG	GR8	8
70	180008		HEX NUT- 5/8-11NC	GR8	8
71	296010		FLAT WASHER- M10	STL	4
72	181072		FLAT WASHER- 1/4	SS 316	32
73	181202		HEX NUT- 1/4-20NC	SS 316	12
74					1
75	300555		SHCS M5-0.80 X 14 MM LG	SS A4	4
76	251618		HHCS M16-2.00 X 65MM LG	GR10.9	4

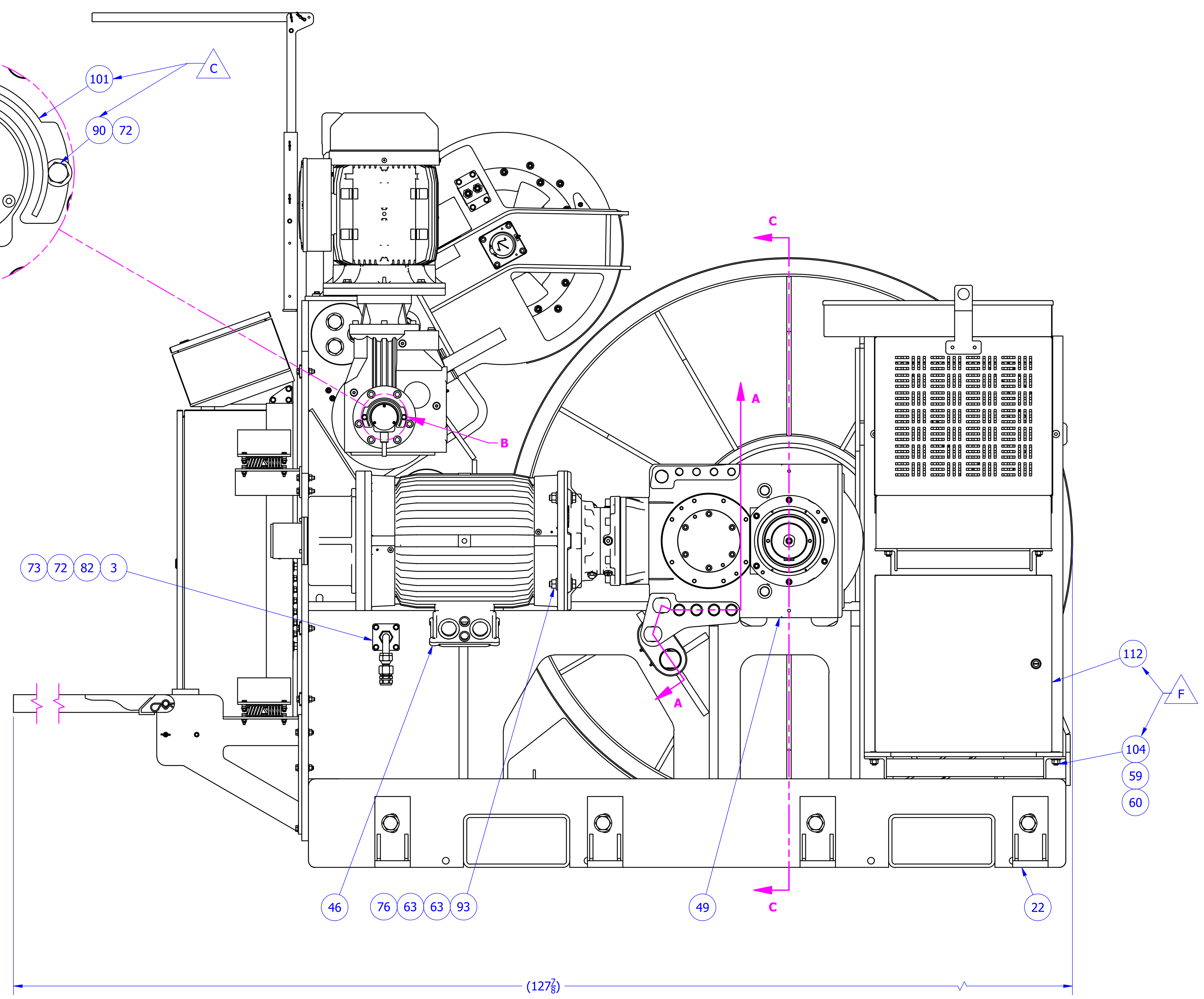
ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	QTY
1	34-00304-058		ASSEMBLY - REAR PLATFORM		1
2	34-00304-028		ASSEMBLY - PANELS		1
3	34-00304-079		CABLE GUIDE FITTING ASSEMBLY		1
4	34-00304-066		WELDMENT - REAR LEFT WIRE KEEPER		1
5	34-00304-067		WELDMENT - FRONT LEFT WIRE KEEPER		1
6	34-00304-068		WELDMENT - REAR RIGHT WIRE KEEPER		1
7	34-00304-588		TORQUE ARM PIN BUSHING		1
8	34-00304-061		ASSEMBLY - LEVELWIND GEARBOX		1
9	34-00304-057		ASSEMBLY - SIDE PLATFORM		1
10	34-00304-587		TORQUE ARM PIN		1
11	34-00304-230		PROX SENSOR BRACKET		2
12	34-00304-076		WELDMENT - PANEL BRACKET, UPPER LEFT		1
13	34-00304-007		ASSEMBLY - DRUM		1
14	34-00304-077		WELDMENT - PANEL BRACKET, UPPER RIGHT		1
15	34-00304-032		ASSEMBLY - ENCODER AND GUARD		1
16	34-00304-069		WELDMENT - FRONT RIGHT WIRE KEEPER		1
17	34-00304-276		CAP - GUIDE ROD		4
18	34-00304-031		ASSEMBLY - ACME SCREW & HOUSING		1
19	34-00304-035		ASSEMBLY - LEVELWIND CARRIAGE		1
20	34-00304-050		WELDMENT - GUIDE ROD		2
21	34-00304-033		ASSEMBLY - OPERATOR GUARD		1
22	34-00304-006		WELDMENT - BASE FRAME		1
23	34-00296-207		BEARING HOUSING		2
24	34-00296-245		GEARBOX RETAINER CAP - BPH323		1
25	34-00296-332		TORQUE ARM WASHER		2
26	34-00296-046		ASSEMBLY - TORQUE ARM		1
27	34-00296-524		TORQUE ARM PIN		2
28	34-00296-250		BEARING FIXING RING		2
29	34-00296-244		DRUM ENCODER STUB SHAFT		1
30	34-00296-345		GEARBOX BRACKET		2
31	34-00296-210		BEARING HOUSING COVER		2
32	34-00296-354		TORQUE ARM WASHER		2
33	34-00296-941		SLOTTED HEX HUT		3
34	34-00079-024		WINCH ANCHOR BRACKET		8
35	34-00207-663		SENSOR WASHER		4
36	34-00296-361		TORQUE ARM WASHER		2
37	5403217		COTTER PIN - 3/16 DIA X 2 1/2 LG	SS 316	3
38	5410491		BRAKE RESISTOR 20KW 13OHM		1

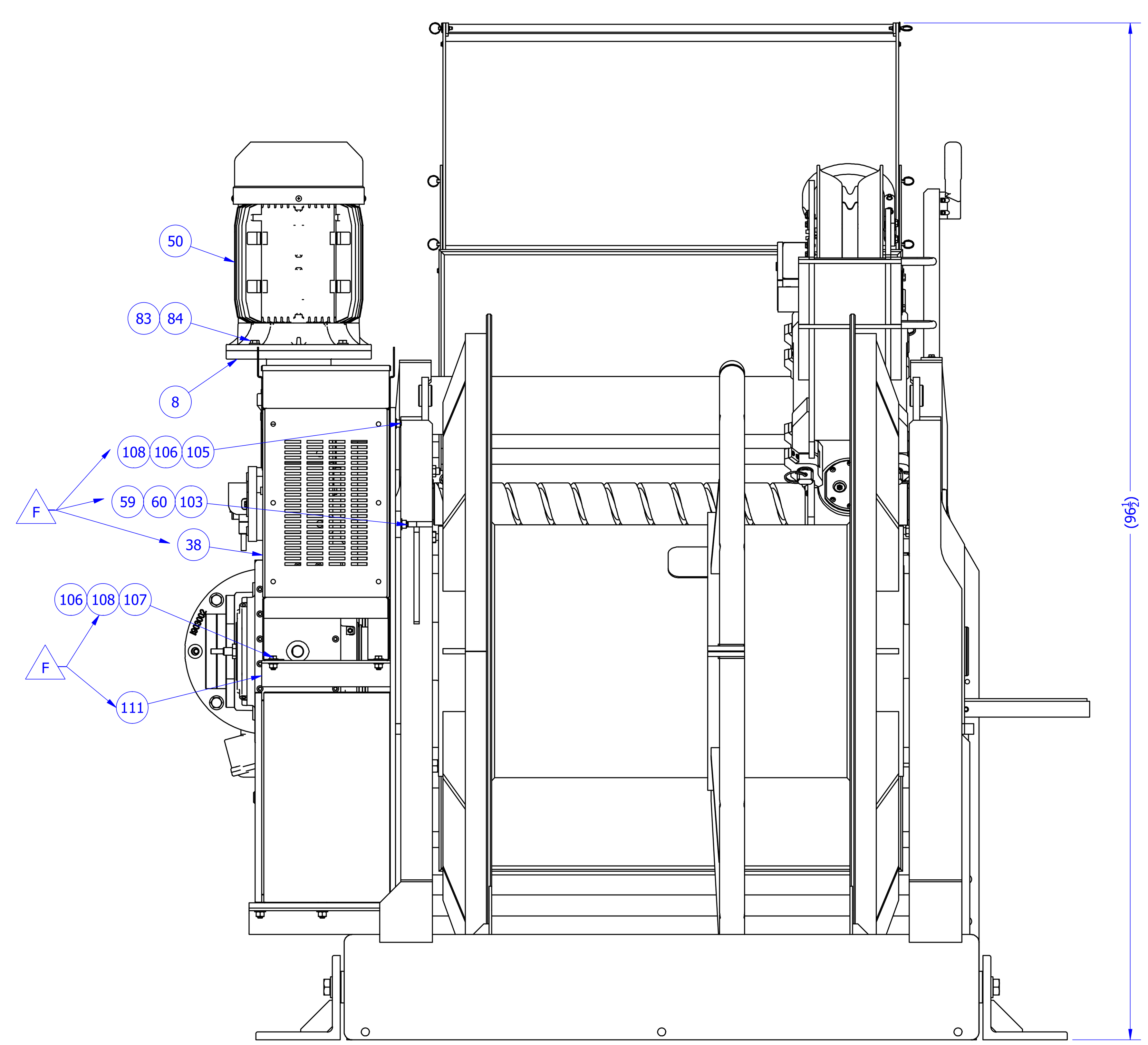


SECTION A-A
SCALE 1/4
CROPPED



DETAIL B
SCALE 1/2





REV	DATE	ECN	AMENDMENTS	BY	APPD
G	18-Mar-22	6031	ADDED ENCODER TO MOTOR, ITEMS 113-122; ADDED VIEW AD;	AHP	PMV
F	18-Aug-21	5567	ITEMS 38 AND 103-108 WERE REPLACED. ITEMS 111 AND 112 WERE ADDED. DELETED SECTION VIEW F.	AHP	PMV
E	16-Jul-21	5478	ADDED NOTE TO APPLY RTV TO GEARBOX SEAM.	PMV	CDC
D	29-Feb-20	4434	ADDED IT 109, 110, ADDED SHEET 2	DHM	DHM
C	04-Feb-20	4364	ITEMS 59- 61, 72, 90, 95 AND 96 QTY CHANGED. ITEMS 101-108 ADDED.	STC	DHM
B	06-Nov-19	7174	ADDED BEACON, ITEMS 94-100	NSW	DHM
A	22-Oct-19	4133	ITEM 86 PART# FIXED; ITEMS 88-92 ADDED	PMK	BBF

STANDARD TOLERANCE UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER ± 1/16 | 2 PLC. DECIMAL ± .01
FRACTIONAL ± 1/16 | 3 PLC. DECIMAL ± .005
ANGLES ± 1/2° | 4 PLC. DECIMAL ± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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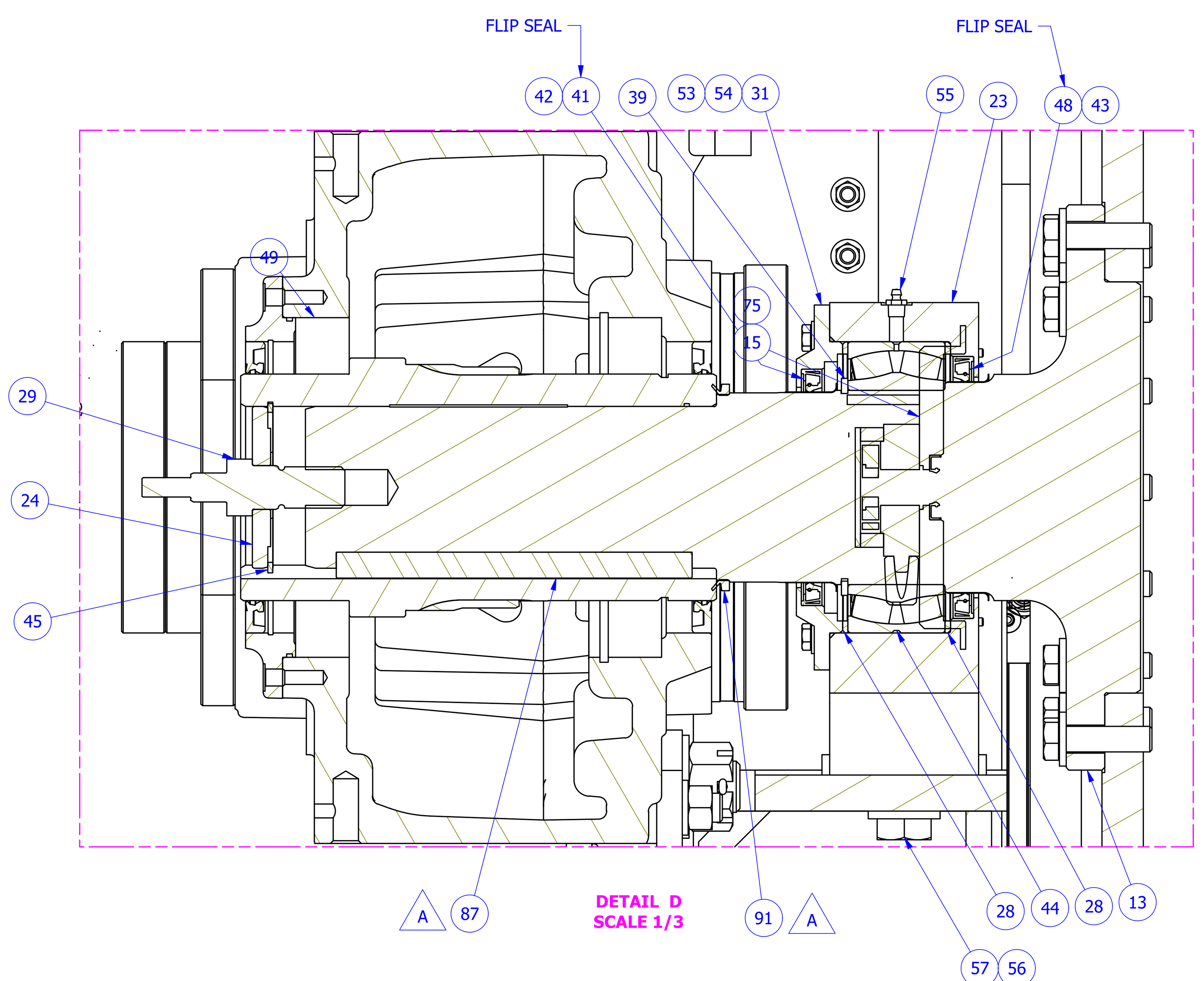
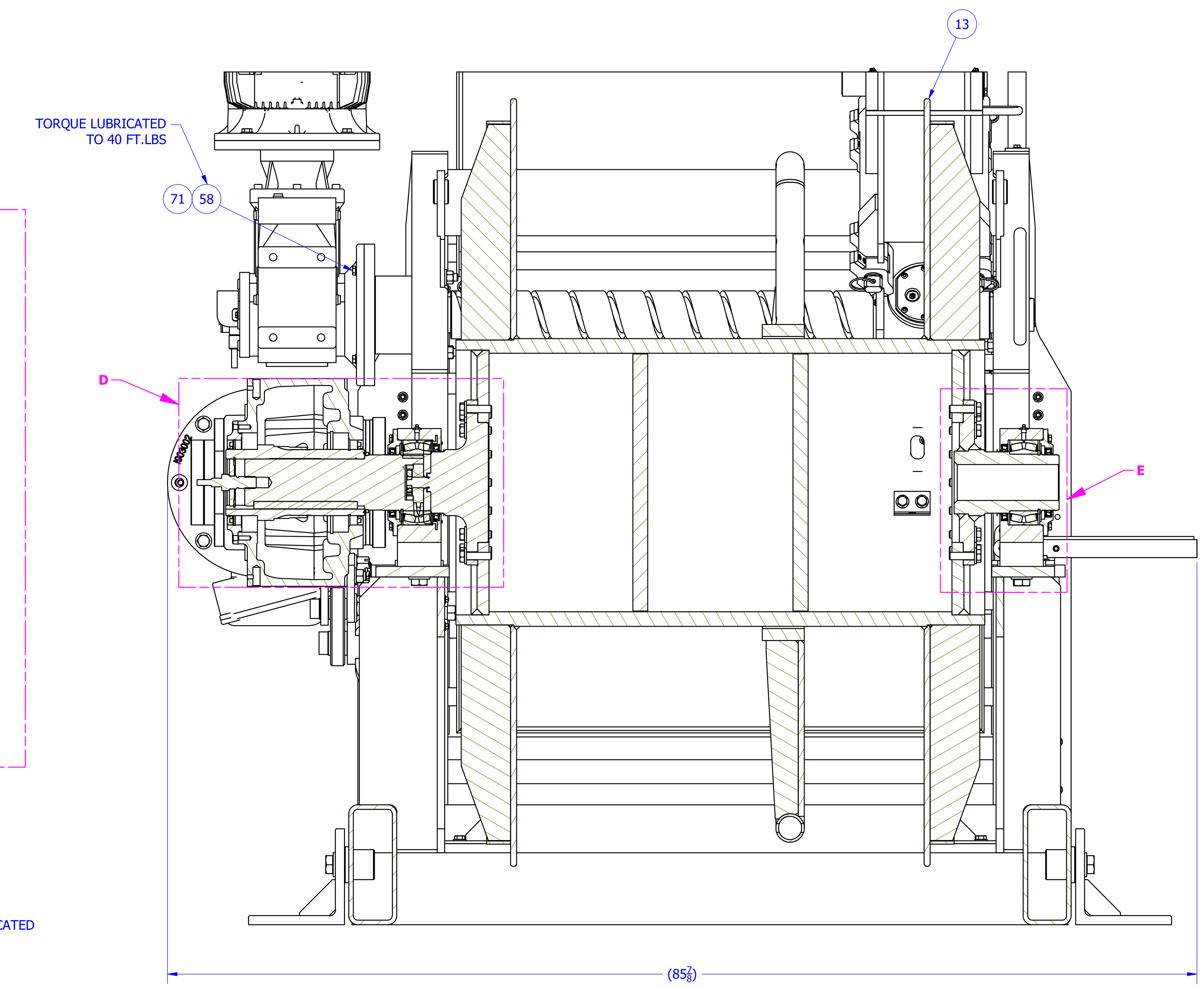
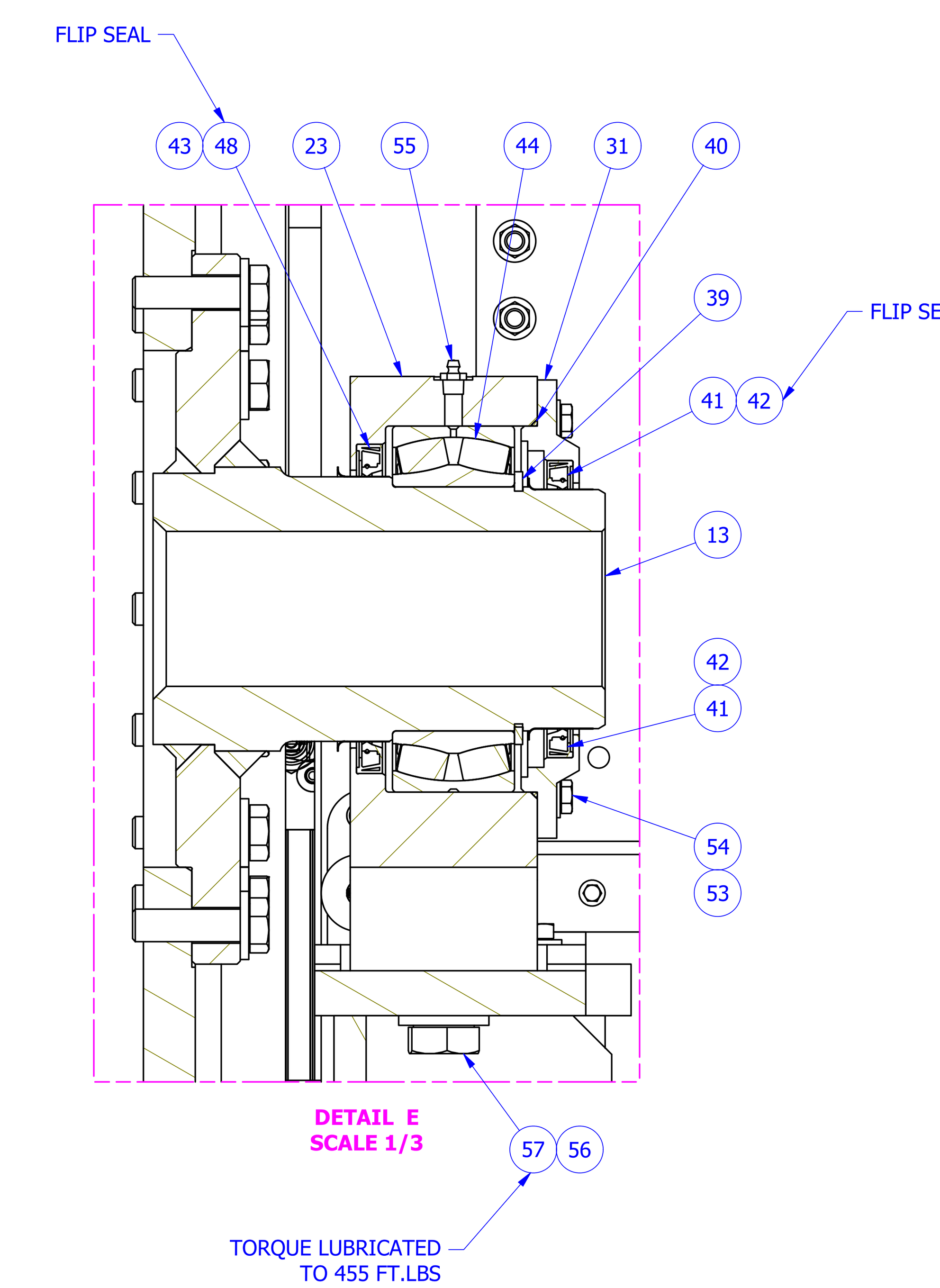
MATL CERT	TITLE SPRE-3464 GENERAL ASSEMBLY		
MATL TEST	NEXT ASSEMBLY F400942	DERIVED FROM	
WELD TEST	FIRST USED ON WO 1942	SHEET 1	OF 3
EST LBS 9892 lbmass	DRAWN CDC / CHECKED NSW / APPROVED NSW	34-00304-001	REV G
ACT LBS	DATE 10-Oct-19 / SCALE 1/10		



DETAIL D
SCALE 1/3



SECTION C-C
SCALE 1/8



DETAIL E
SCALE 1/3

STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

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WHOLE NUMBER ± 1/16	2 PLC. DECIMAL ± .01	MATL CERT	TITLE SPRE-3464 GENERAL ASSEMBLY		
FRACTIONAL ± 1/16	3 PLC. DECIMAL ± .005	MATL TEST	NEXT ASSEMBLY F400942	DERIVED FROM	
ANGLES ± 1/2°	4 PLC. DECIMAL ± .0005				
BREAK ALL SHARP CORNERS AND EDGES		WELD TEST	FIRST USED ON WO 1942	SHEET 2	OF 3
FINISH ON MACHINED SURFACES 125		EST LBS 9892 lbmass	DRAWN CDC / CHECKED NSW / APPROVED NSW	34-00304-001	REV G
		ACT LBS	DATE 10-Oct-19 / SCALE 1/8		

STANDARD TOLERANCE UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

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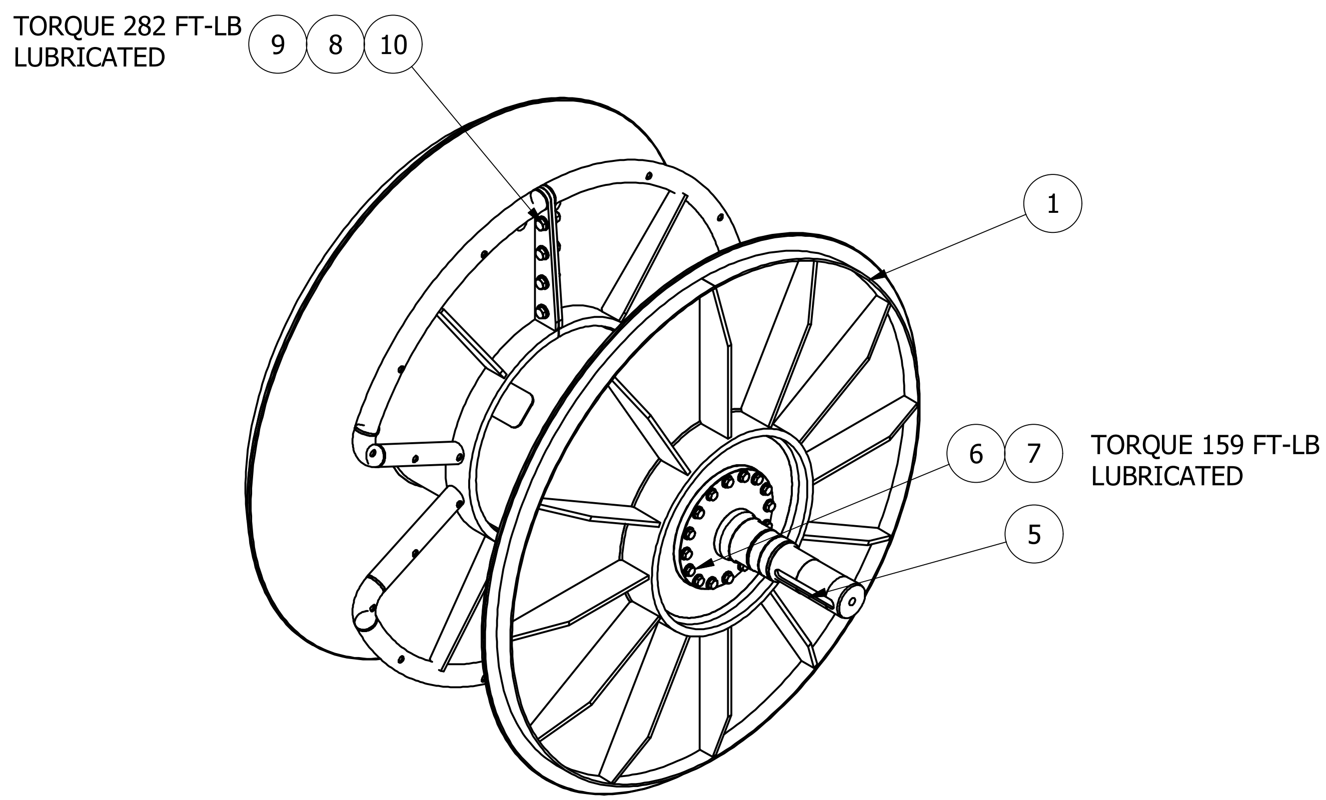
WHOLE NUMBER ± 1/16	2 PLC. DECIMAL ± .01	MATL CERT	TITLE SPRE-3464 GENERAL ASSEMBLY
FRACTIONAL ± 1/16	3 PLC. DECIMAL ± .005	MATL TEST	NEXT ASSEMBLY F400942 / DERIVED FROM
ANGLES ± 1/2°	4 PLC. DECIMAL ± .0005	WELD TEST	FIRST USED ON WO 1942 / SHEET 3 OF 3
BREAK ALL SHARP CORNERS AND EDGES		EST LBS 9892 lbmass	DRAWN CDC / CHECKED NSW / APPROVED NSW
FINISH ON MACHINED SURFACES 125		ACT LBS	DATE 10-Oct-19 / SCALE 1/10

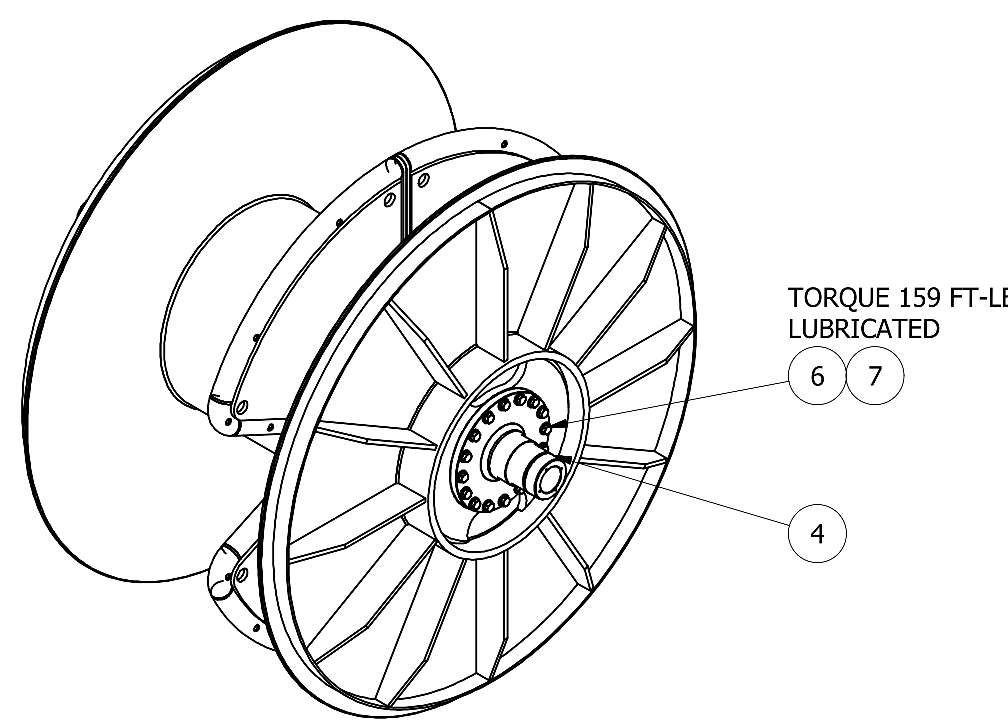
34-00304-001 REV G

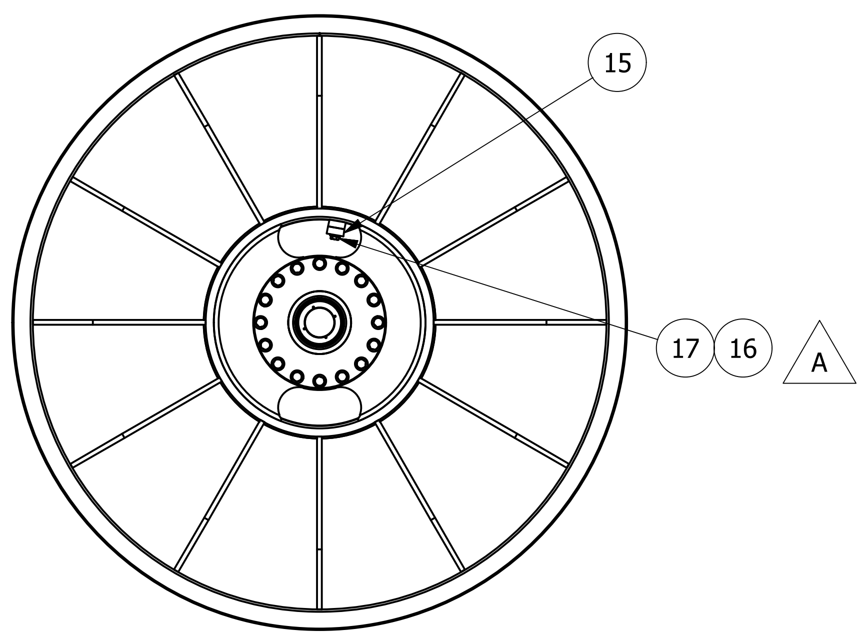
ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	34-00304-087		DRUM WELDMENT		1
2	34-00304-042		WELDMENT - INNER FLANGE BOTTOM		1
3	34-00304-049		WELDMENT - INNER FLANGE TOP		1
4	34-00296-036		WELDMENT - STUB SHAFT		1
5	34-00296-048		DRIVE SHAFT		1
6	270609		HHCS 5/8-11NC X 2 1/4 LG	GR8	32
7	181008		FLAT WASHER- 5/8 HARDENED	STL	32
8	181009		FLAT WASHER- 3/4 HARDENED	STL	16
9	180009		HEX NUT- 3/4-10NC	GR8	8
10	270709		HHCS 3/4-10NC X 2 1/4 LG	GR8	8
15	34-00304-442		CABLE CLAMP		1
16	181006		FLAT WASHER- 1/2 HARDENED	STL	2
17	270406		HHCS 1/2-13NC X 1 1/2 LG	GR8	2

B

A







STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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MATL CERT	
MATL TEST	
WELD TEST	
EST LBS	3188 lbmass
ACT LBS	

TITLE ASSEMBLY - DRUM

NEXT ASSEMBLY 34-00304-001		DERIVED FROM	
FIRST USED ON WO 1942		SHEET 1	OF 1
DRAWN NSW	CHECKED DHM	APPROVED NSW	REV B
DATE 10-Oct-19	SCALE 1 / 20	34-00304-007	

REV	DATE	ECN	AMENDMENTS	BY	APPD
B	19-Nov-19	4201	REPLACED DRUM WELDMENT WITH NEW DESIGN	NSW	DHM
A	07-Nov-19	4175	ADDED CABLE CLAMP	NSW	DHM

ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
8	187104		HHCS 1/4-20NC X 3/4 LG	SS 316	2
9	187106		HHCS 1/4-20NC X 1 LG	SS 316	6
10	194053		SFHCS - 1/4-20NC X 3/4 LG	SS 316	2
11	5406488		VIBRATION ISOLATOR		4
12	34-00304-911		CUP HOLDER - NSF		1
13	34-00304-912		STANDOFF - CUP HOLDER		2
14	187120		HHCS 1/4-20NC X 5 LG	SS 316	2
15	194054		SFHCS - 1/4-20NC X 1 LG	SS 316	8

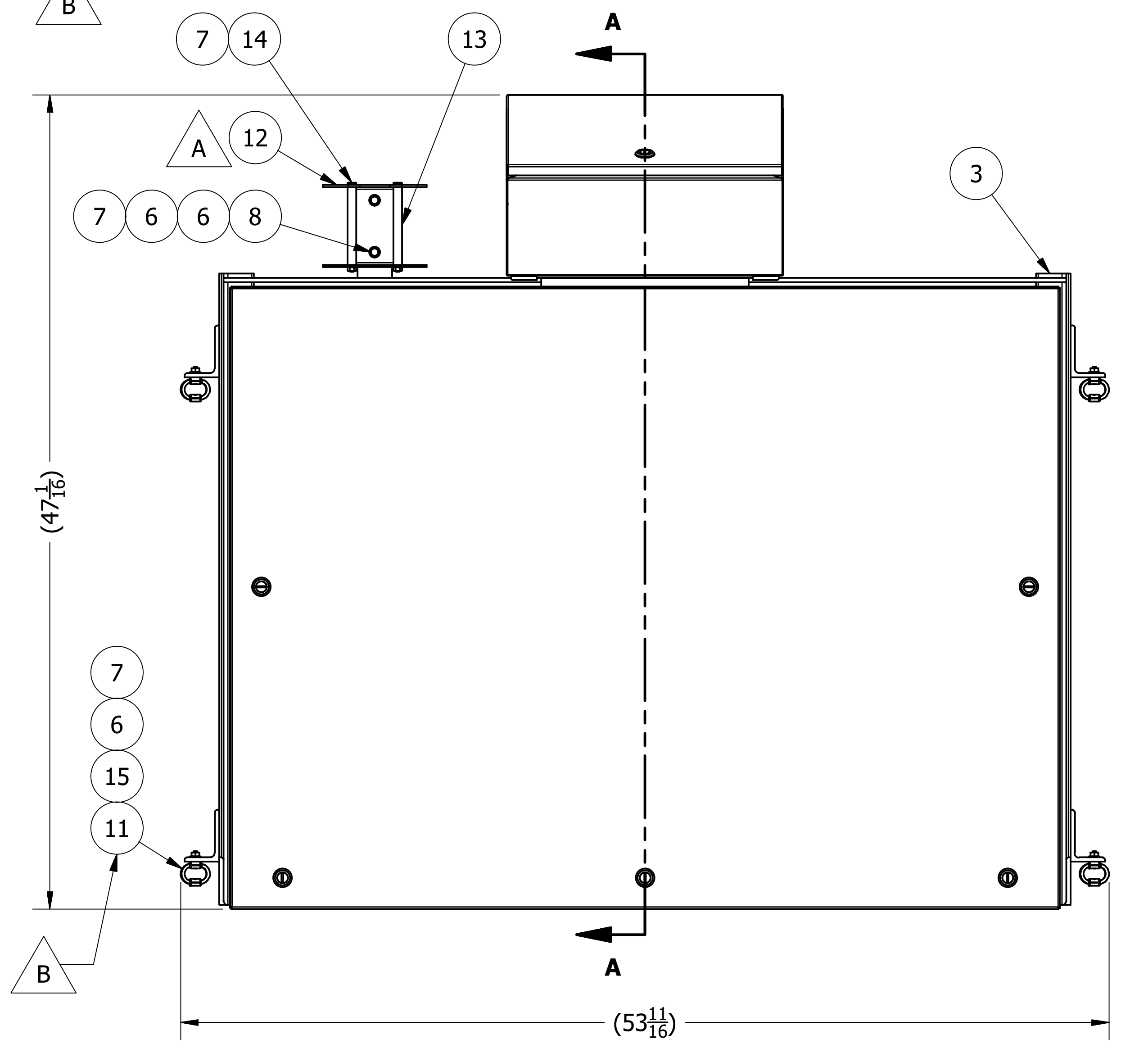
ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	5408660		ENCLOSURE, 16X12X6, 316SS	SS 316	1
2	5408659		ENCLOSURE, 48X36X12, 316SS	SS 316	1
3	34-00304-045		WELDMENT - MAIN PANEL BRACKET		1
4	34-00304-059		WELDMENT - HMI BRACKET		1
5	34-00304-364		ELECTRICAL PANEL PAD		1
6	181072		FLAT WASHER- 1/4	SS 316	24
7	181202		HEX NUT- 1/4-20NC	SS 316	18

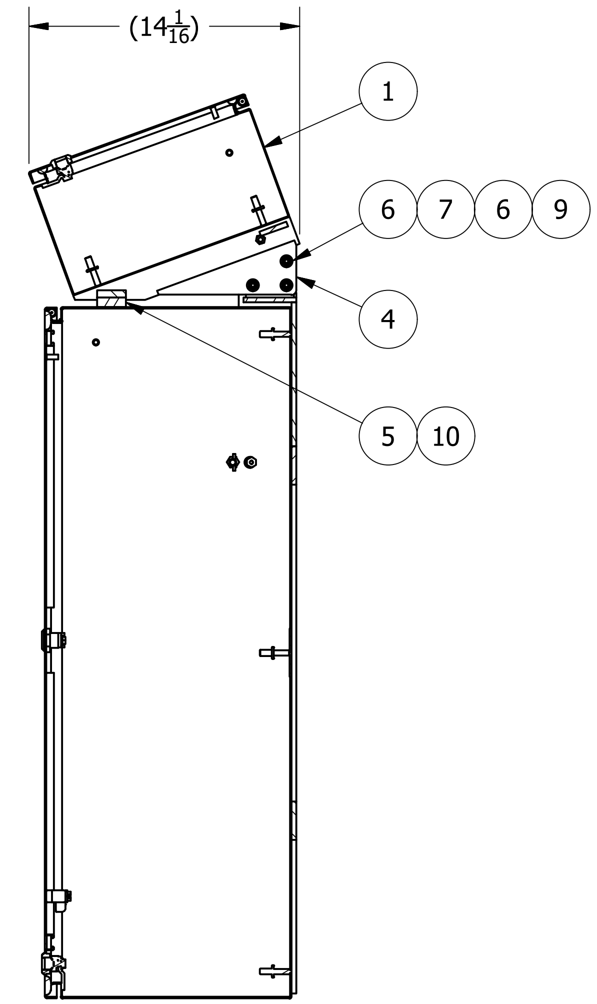
B

A

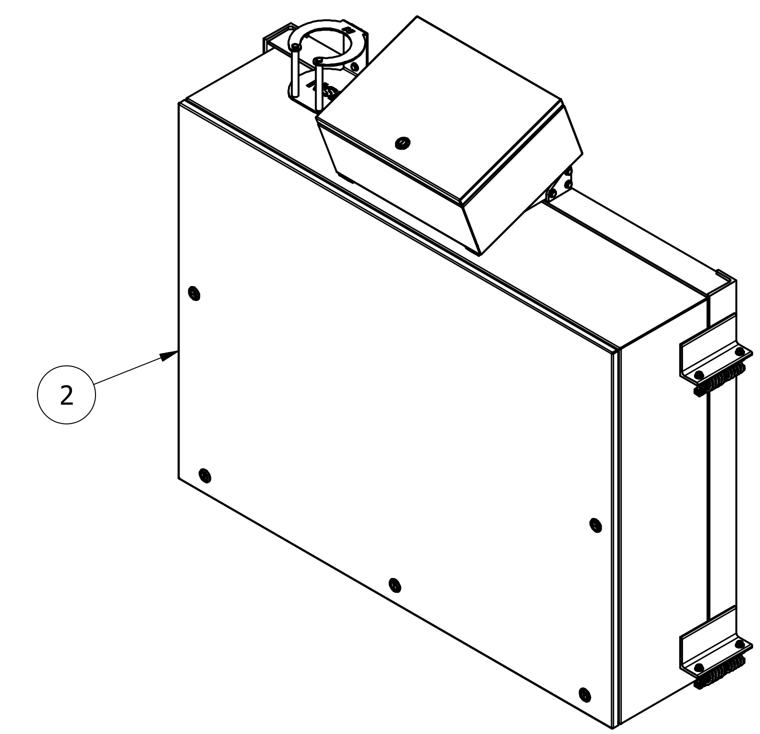
B

B





SECTION A-A
SCALE 1/10



ISO VIEW
SCALE 1/15

STANDARD TOLERANCE UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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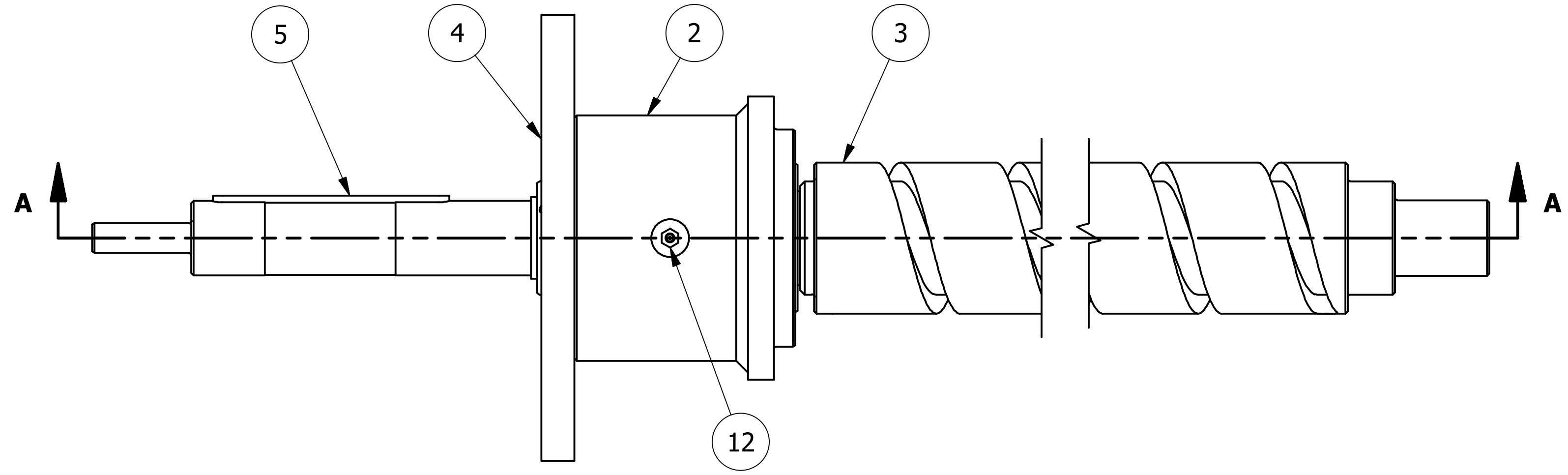
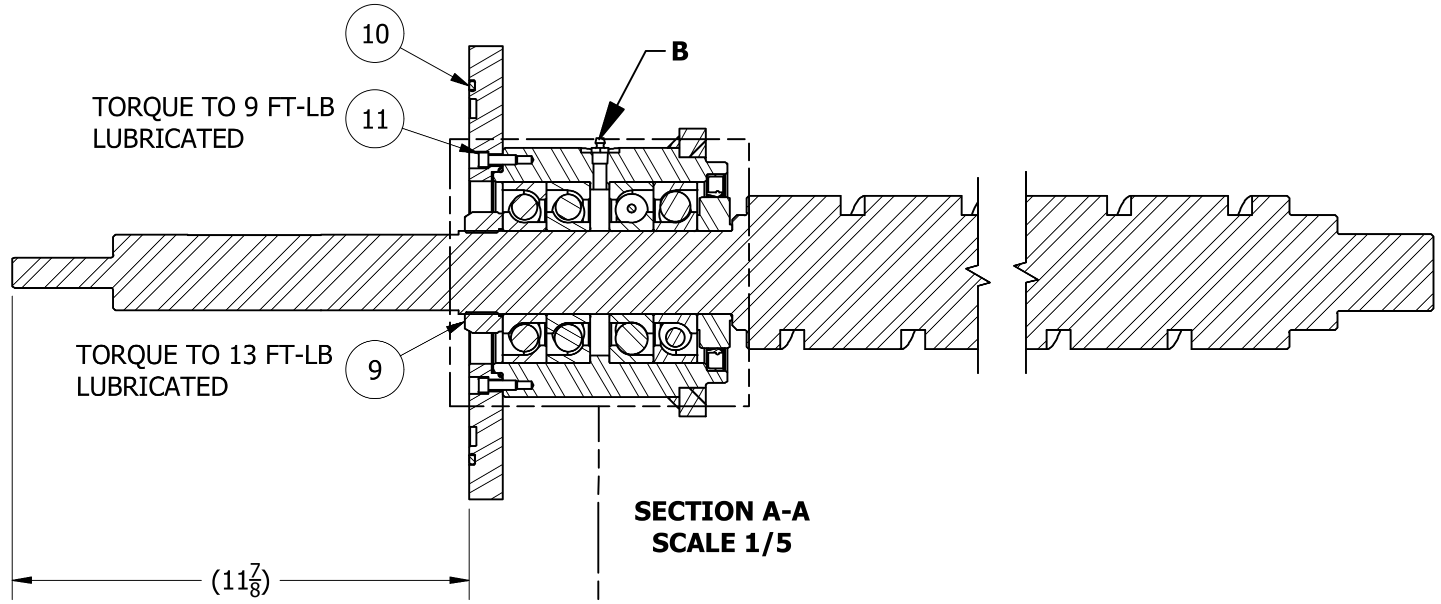
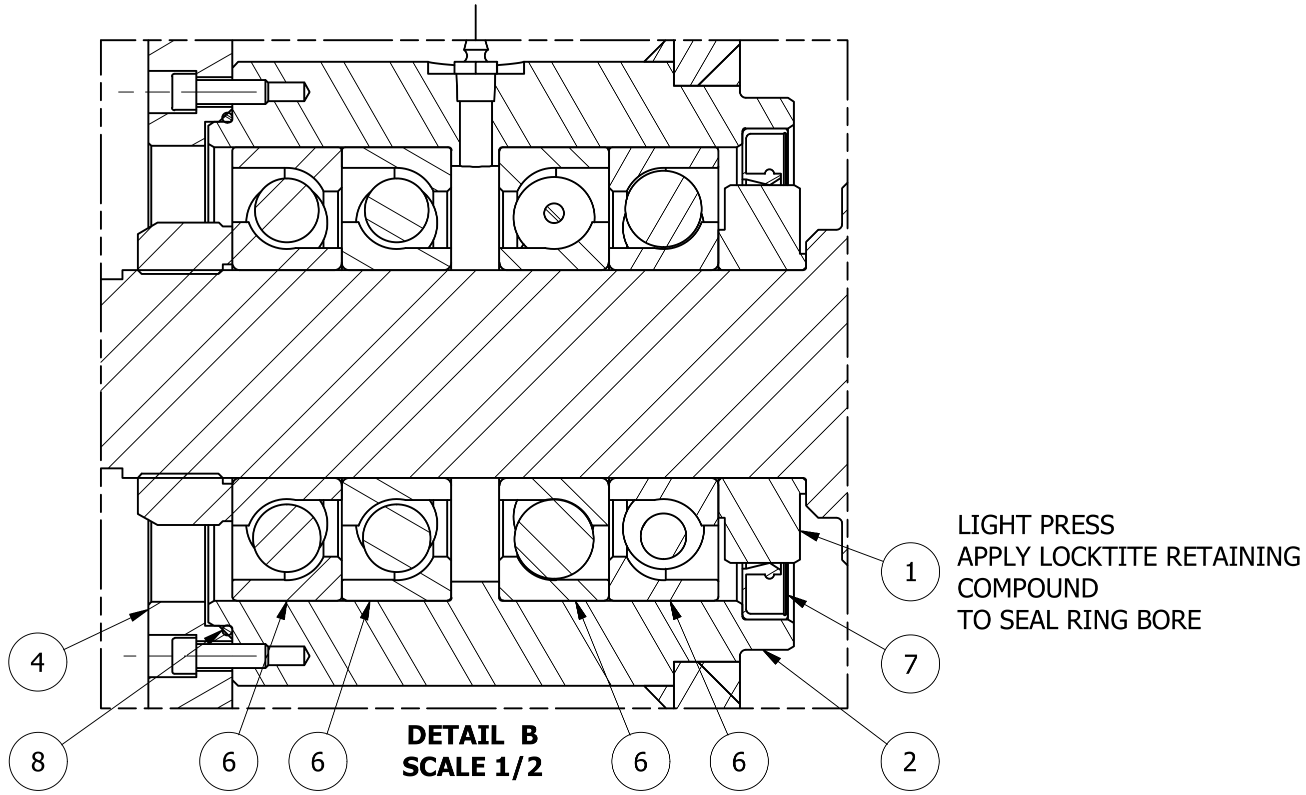
MATL CERT		TITLE	ASSEMBLY - PANELS
MATL TEST		NEXT ASSEMBLY 34-00304-001	DERIVED FROM
WELD TEST		FIRST USED ON WO 1942	SHEET 1 OF 1
EST LBS	385 lbmass	DRAWN CDC / CHECKED NSW / APPROVED NSW	34-00304-028 REV B
ACT LBS		DATE 09-Oct-19 / SCALE 1/10	

REV	DATE	ECN	AMENDMENTS	BY	APPD
B	05-Feb-20	4359	ADDED ITEM 15, ITEM 7 AND 8 QTY CHANGED AND ITEM 11 P/N CHANGE	STC	NSW
A	06-Nov-19	4169	ADDED CUP HOLDER, ITEMS 12-14	NSW	DHM





SECTION A-A
SCALE 1/5



DETAIL B
SCALE 1/2

ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	34-00170-321		SEAL RING		1
2	34-00304-054		WELDMENT - BEARING HOUSING		1
3	34-00304-156		SPOOLING SCREW		1
4	34-00304-258		ADAPTER - LEVELWIND GEARBOX		1
5	34-00304-517		KEY - ACME SCREW		1
6	5405122		BEARING, ANGULAR CONTACT 55MM	Steel	4
7	5405795		100X130X12 CRW1 R		1
8	5408517		O-RING 2-160, 70 DURO		1
9	5408661		LOCK NUT, 55MM		1
10	5402865		O-RING, 2-375, 70 DURO		1
11	199300		SHCS 1/4-20NC X 3/4 LG	STL	12
12		FI	GREASE FITTING 1/8-27 NPT STRAIGHT	SS	1

STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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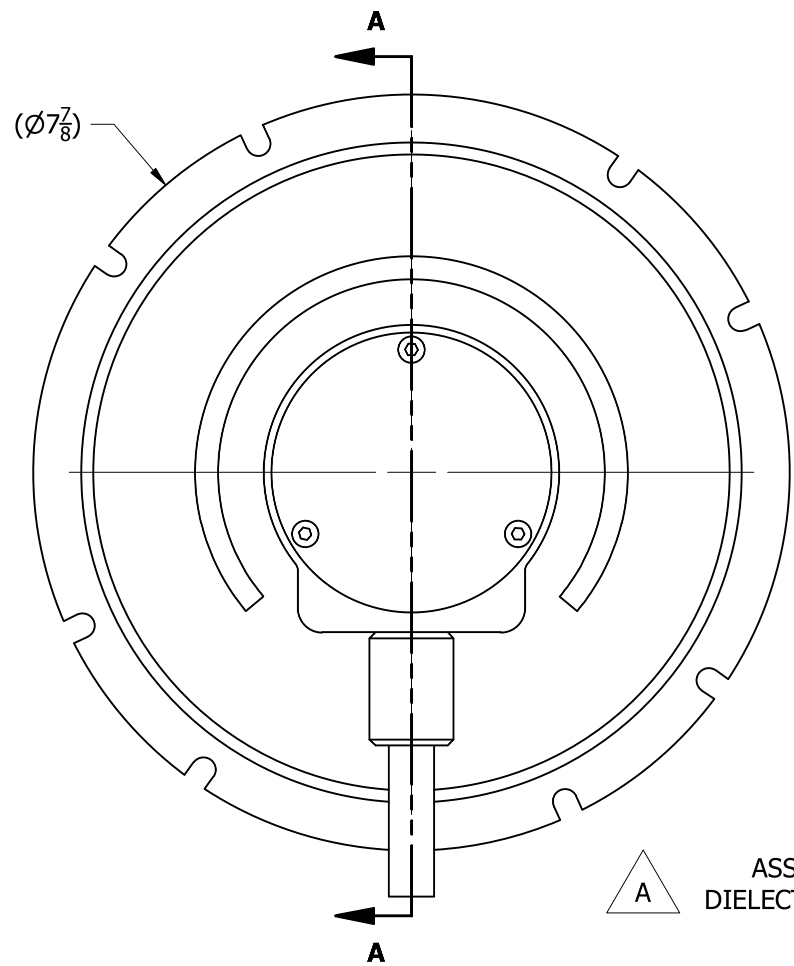
MATL CERT		TITLE	ASSEMBLY - ACME SCREW & HOUSING	
MATL TEST		NEXT ASSEMBLY	34-00304-001	DERIVED FROM 34-00202-024
WELD TEST		FIRST USED ON WO	1942	SHEET 1 OF 1
EST LBS	234 lbmass	DRAWN STC	CHECKED NSW	APPROVED NSW
ACT LBS		DATE 09-Oct-19	SCALE 1:4	

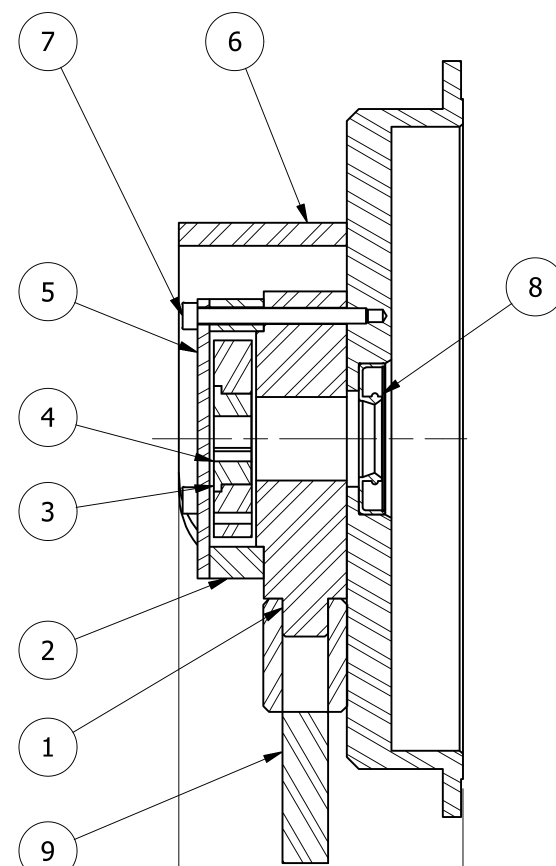
34-00304-031

REV

ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	5406446		ENCODER, INCREMENTAL	SS 316	1
2	5406447		PROTECTION RING, ENCODER ACCESSORY	Plastic	1
3	5406449		POSITIONING ELEMENT, ENCODER ACCESSORY	Plastic	1
4	5406553		ADAPTER SLEEVE, ENCODER ACCESSORY	SS 316	1
5	5406448		COVER, ENCODER ACCESSORY	SS 316	1
6	34-00296-018		WELDMENT - DRUM ENCODER MOUNT		1
7	300464		SHCS M4-0.70 X 45 MM LG	SS A4	3
8	5406547		SEAL, RADIAL SHAFT 18 X 40 X 7 MM		1
9	5406451		CABLE, ENCODER ACCESSORY		1

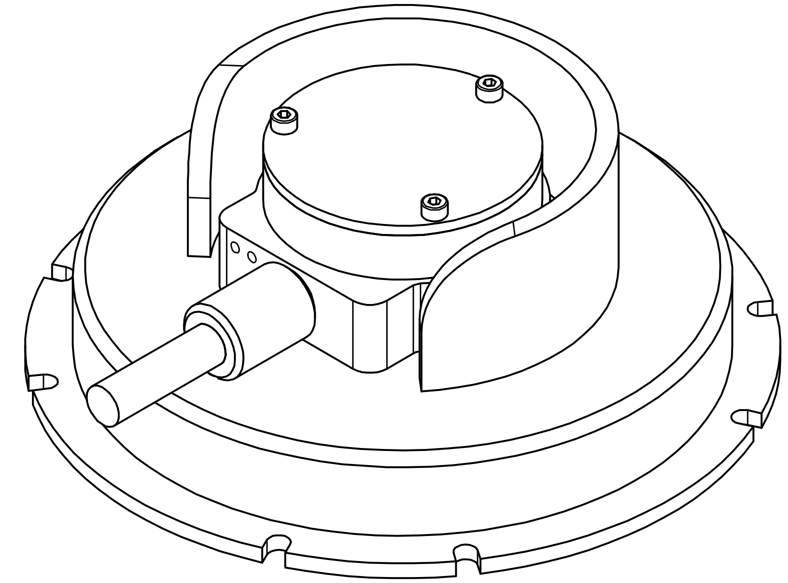


A ASSEMBLE WITH DIELECTRIC GREASE



SECTION A-A
SCALE 1 / 2

(2 15/16)



A	30-Oct-19	4160	DIELECTRIC GREASE NOTE	PMK	NSW
REV	DATE	ECN	AMENDMENTS	BY	APPD

STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

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WHOLE NUMBER ± 1/16	2 PLC. DECIMAL ± .01	MATL CERT
FRACTIONAL ± 1/16	3 PLC. DECIMAL ± .005	MATL TEST
ANGLES ± 1/2°	4 PLC. DECIMAL ± .0005	
BREAK ALL SHARP CORNERS AND EDGES		WELD TEST
FINISH ON MACHINED SURFACES 125		EST LBS 10 lbmass
		ACT LBS

TITLE ASSEMBLY - ENCODER AND GUARD

NEXT ASSEMBLY 34-00304-001

DERIVED FROM

FIRST USED ON WO 1942

SHEET 1 OF 1

DRAWN	CHECKED	APPROVED
CDC	NSW	NSW

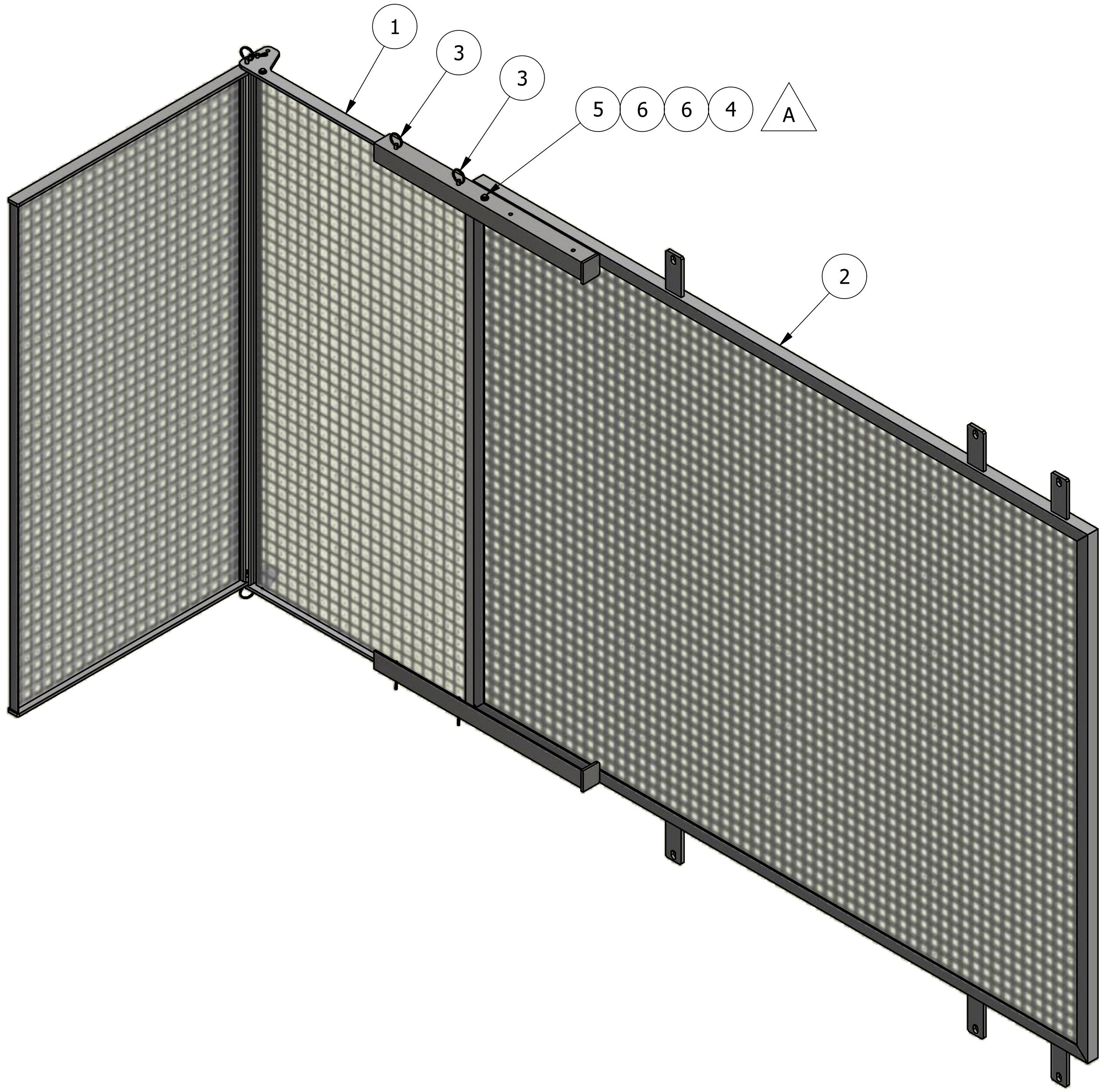
DATE 08-Oct-19

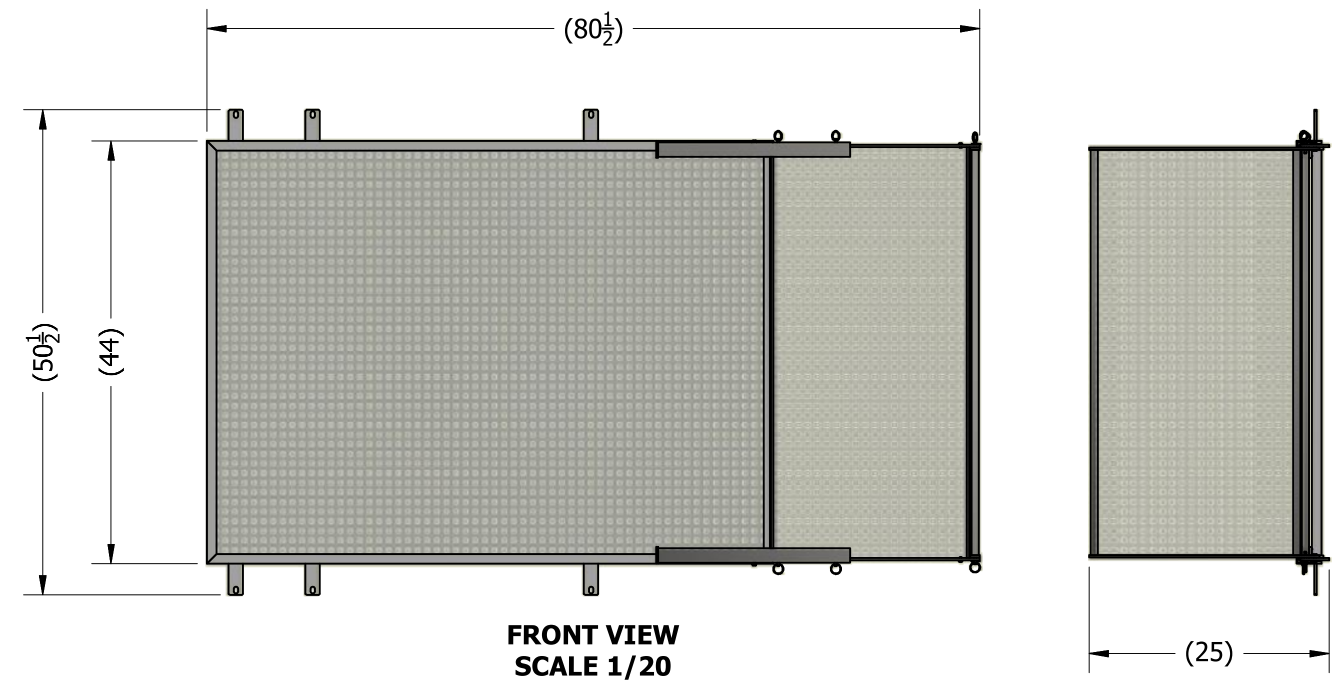
SCALE 1 / 2

34-00304-032

REV A

ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	34-00304-070		ASSEMBLY - UPPER GUARD		1
2	34-00304-073		WELDMENT - LOWER GUARD		1
3	5408630		PIN, QUICK RELEASE; 1/4" OD X 13/16" LG		4
4	5408708		LANYARD, 18-8 SS, 10" LG, LOOP-TAB		2
5	186801		MACH SCR HEX HD #10-24NC X 3/8 LG	SS 316	2
6	181192		FLAT WASHER- #10	SS 316	4





FRONT VIEW
SCALE 1/20

NOTES:

1) ATTACH LANYARD LOOP (ITEM 4) TO REMOVABLE PIN (ITEM 3) FURTHEST FROM BOLT HOLE FOR ITEM 5.

2) THREAD LANYARD THRU RING IN NEXT REMOVABLE PIN AND THEN FIX TO FRAME WITH BOLT (ITEM 5). USE MULTIPLE WASHERS SO THAT BOLT DOES NOT INTERFERE WITH THE SLIDING ACTION OF THE UPPER GUARD. ENSURE THE LANYARD WORKS WELL FOR THE PINS IN BOTH GUARD POSITIONS.

REV	DATE	ECN	AMENDMENTS	BY	APPD
A	24-Oct-19	4148	ADDED LANYARDS	PMK	BBF

STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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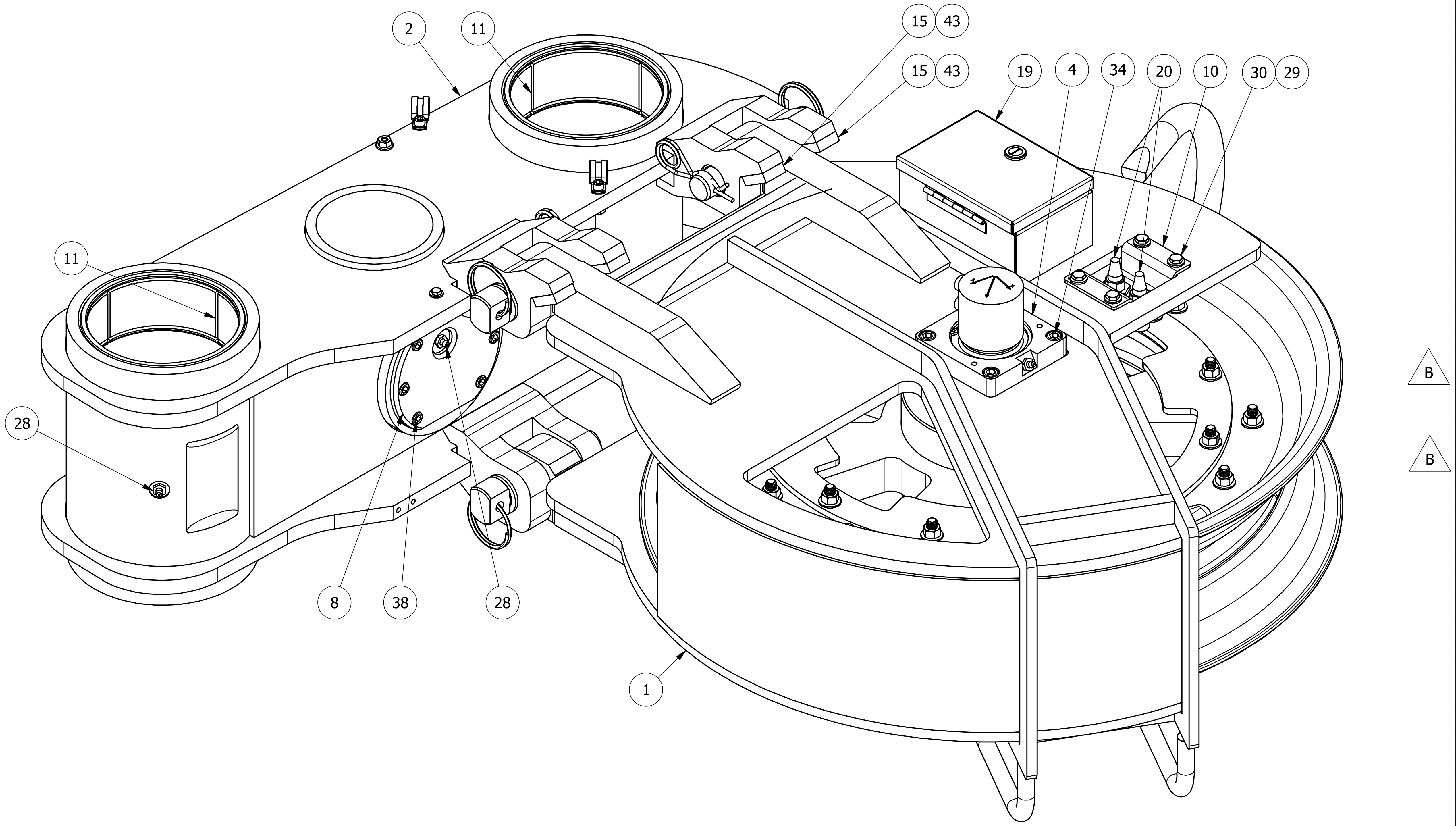
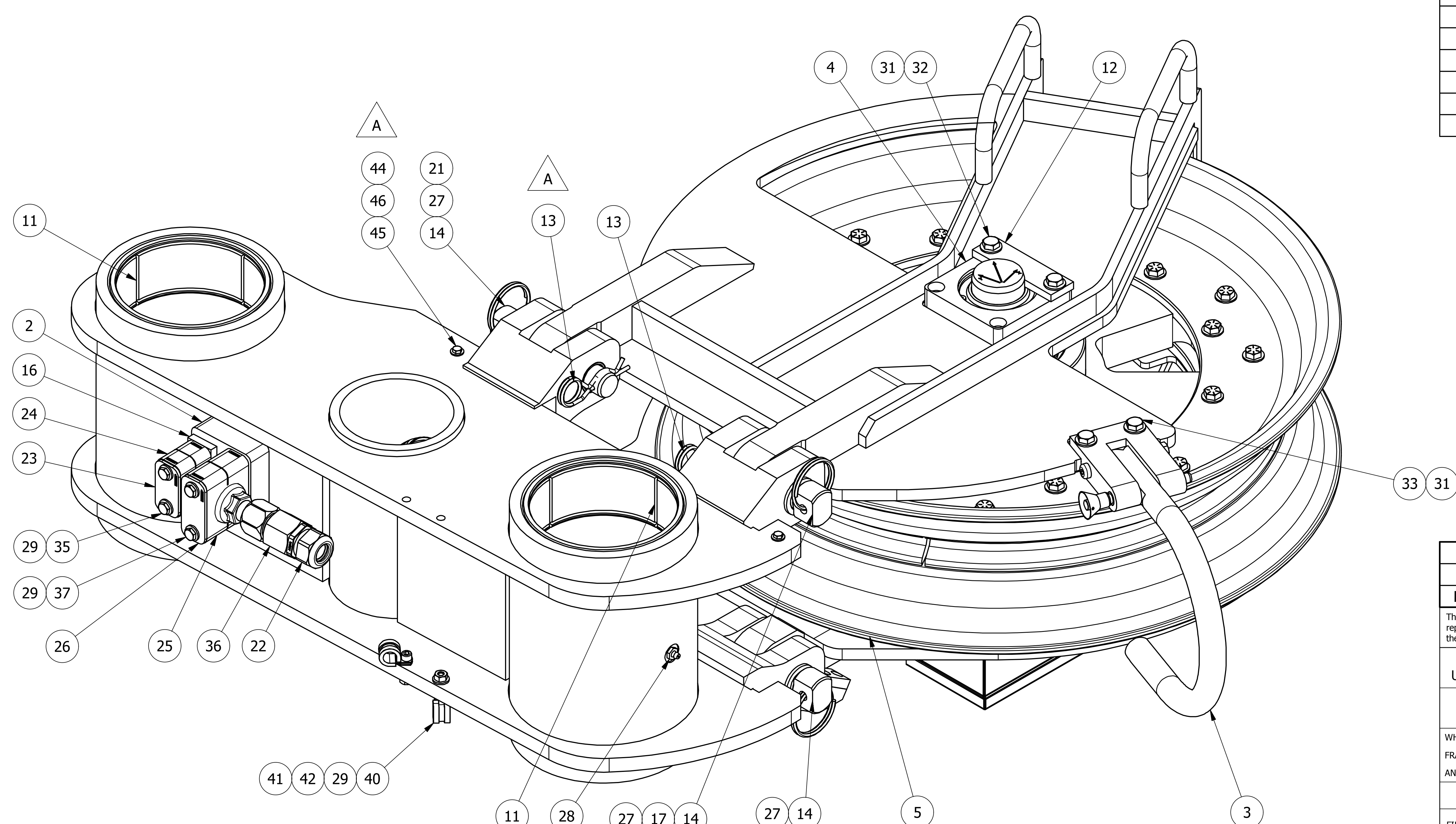
MATL CERT		TITLE	ASSEMBLY - OPERATOR GUARD
MATL TEST		NEXT ASSEMBLY 34-00304-001	DERIVED FROM
WELD TEST		FIRST USED ON WO 1942	SHEET 1 OF 1
EST LBS	128 lbmass	DRAWN STC / CHECKED NSW / APPROVED NSW	34-00304-033 REV A
ACT LBS		DATE 09-Oct-19 / SCALE 1/10	





ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	34-00304-064		SHEAVE CHEEKPLATES		1
2	34-00304-065		WELDMENT - LEVELWIND CARRIAGE		1
3	34-00304-056		CABLE KEEPER ASSEMBLY		1
4	34-00304-055		ASSEMBLY - SHEAVE BEARING		2
5	34-00304-037		ASSEMBLY - SHEAVE		1
6	34-00304-440		BLADE RETAINER		1
7	34-00304-487		BUSHING - SPOOLING KNIFE		1
8	34-00304-486		SPOOLING KNIFE COVER		1
9	34-00304-530		SHEAVE SPACER		2
10	34-00207-534		SENSOR MOUNT PLATE		1
11	34-00304-544		BUSHING - LEVELWIND CARRIAGE		4
12	34-00304-586		LOAD PIN - 14 KIP - DUAL AXIS		1
13	5408697		COTTER PIN, 18-8SS, 5/8" TO 1", W/ EYE		4
14	34-00304-396		SHEAVE HINGE PIN (SHORT)		4
15	34-00304-431		SHEAVE BUMPER PLATE		4
16	34-00296-306		SPACER - HOSE CLAMP		1
17	34-00304-591		SHEAVE HINGE PIN BUSHING, 1" LG		8
18	34-00304-900		HELICAL BLADE, 4" SCREW		1
19	5401402		6" x 4" x 3" ENCLOSURE	SS 316	1
20	5403849		SENSOR, PROXIMITY; M18		2
21	34-00304-590		SHEAVE HINGE PIN BUSHING, 1.5" LG		4
22	5408533		3/4" LIQUID TIGHT STRAIN RELIEF, NYLON		1
23	5407253		COVER PLATE - STAUFF GR. 4 - SS 316	SS 316	1
24	5403898		CLAMP, 26.9 MM TUBE OD	Polypropylene	1
25	5406788		STD. CLAMP - 1-1/4" TUBE		1
26	5406565		COVER PLATE	SS 316	1
27	5408643		SPLIT RING, 2" DIA	SS 316	4
28		FI	GREASE FITTING 1/8-27 NPT STRAIGHT	SS	3
29	181072		FLAT WASHER- 1/4	SS 316	11
30	187104		HHCS 1/4-20NC X 3/4 LG	SS 316	4
31	181074		FLAT WASHER- 3/8	SS 316	8
32	187305		HHCS 3/8-16NC X 7/8 LG	SS 316	2
33	187306		HHCS 3/8-16NC X 1 LG	SS 316	2
34	185643		SHCS 3/8-16NC X 3/4 LG	SS 316	4
35	187115		HHCS 1/4-20NC X 3 1/4 LG	SS 316	2
36	430111		CONNECTOR, 12 JICM - 12 NPTF STRT	SS 316	1
37	187114		HHCS 1/4-20NC X 3 LG	SS 316	2
38	185443		SHCS 5/16-18NC X 3/4 LG	SS 316	6
39	187302		HHCS 3/8-16NC X 1/2 LG	SS 316	4
40	5408665		LOOP CLAMP, 1/2 ID		3
41	185245		SHCS 1/4-20NC X 1 LG	SS 316	3
42	181202		HEX NUT- 1/4-20NC	SS 316	3
43	193350		SFHCS - #12-24NC X 1/2 LG	SS 316	8
44	5408698		LANYARD, 18-8SS, LOOP-TO-TAB, 14" LG		4
45	186801		MACH SCR HEX HD #10-24NC X 3/8 LG	SS 316	4
46	181192		FLAT WASHER- #10	SS 316	4

NOTES:

1) ATTACH THE LOOP END OF THE LANYARD TO THE HINGE PIN RING (ITEM 27).

2) THREAD THE LANYARD THRU THE EYE OF THE COTTER PIN (ITEM 13).

3) ATTACH THE LANYARD TAB TO THE LEVELWIND CARRIAGE WITH ITEM 45.

4) ENSURE HINGE PINS CAN BE REMOVED EASILY.

REV	DATE	ECN	AMENDMENTS	BY	APPD
B	07-Feb-20	4371	REPLACED SHEAVE PIN BUSHINGS. ITEMS 17, 21	NSW	DHM
A	23-Oct-19	4142	ADDED LANYARDS; CHANGED COTTER PIN PART NUMBERS.	PMK	BBF

STANDARD TOLERANCE UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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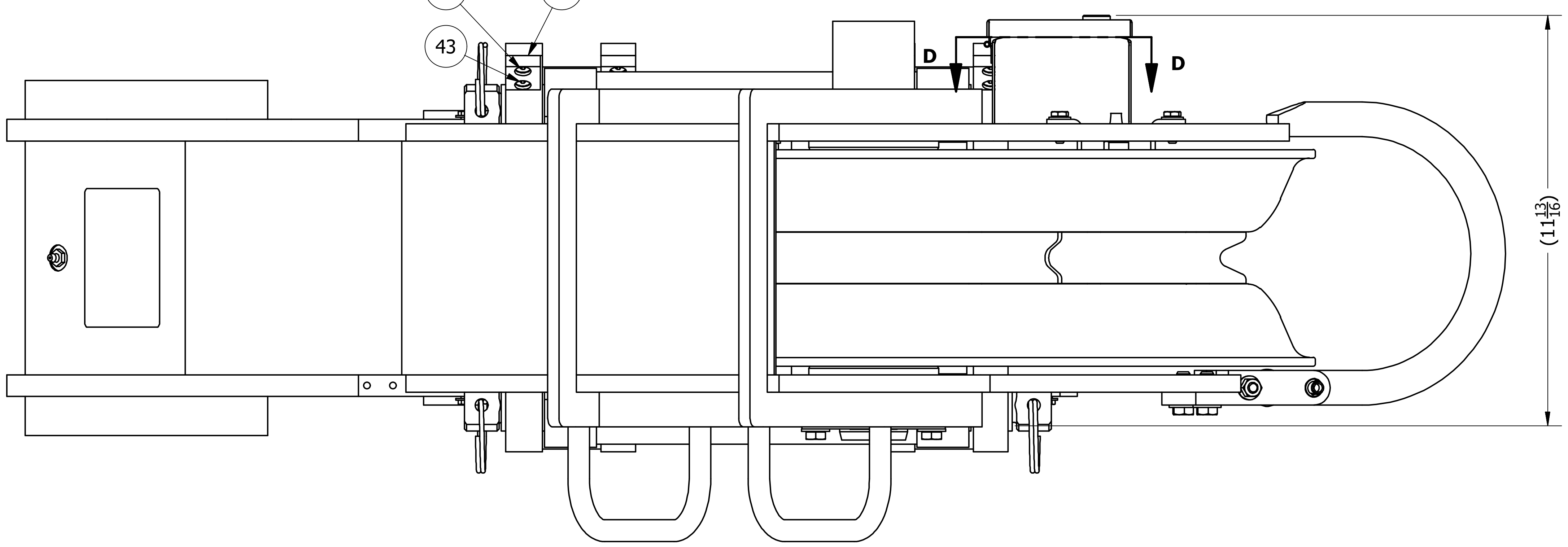
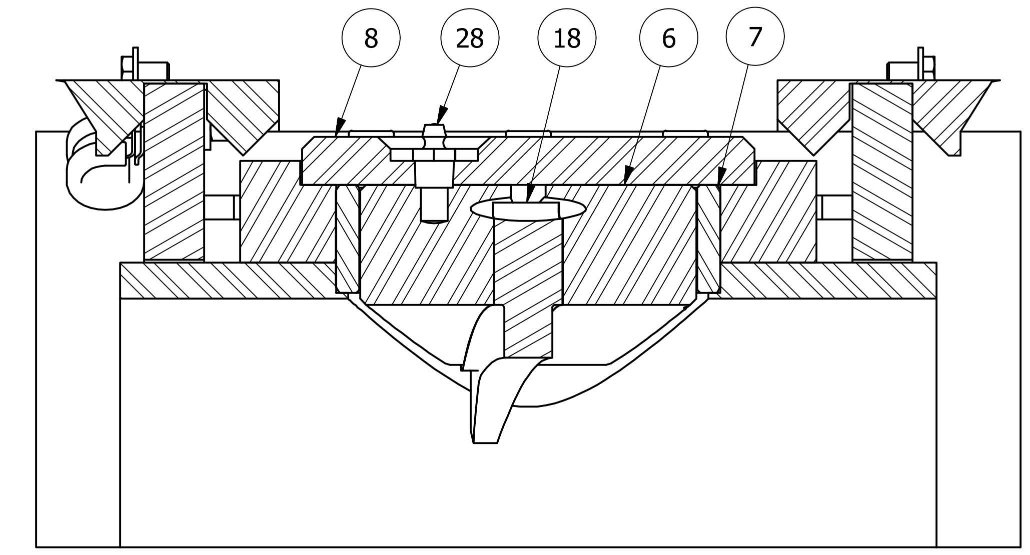
MATL CERT		TITLE	ASSEMBLY - LEVELWIND CARRIAGE
MATL TEST		NEXT ASSEMBLY	34-00304-001
DERIVED FROM			
WELD TEST		FIRST USED ON WO	1942
SHEET	1	OF	2
EST LBS	536 lbmass	DRAWN	STC
CHECKED	NSW	APPROVED	NSW
ACT LBS		DATE	10-Oct-19
SCALE	1/4		

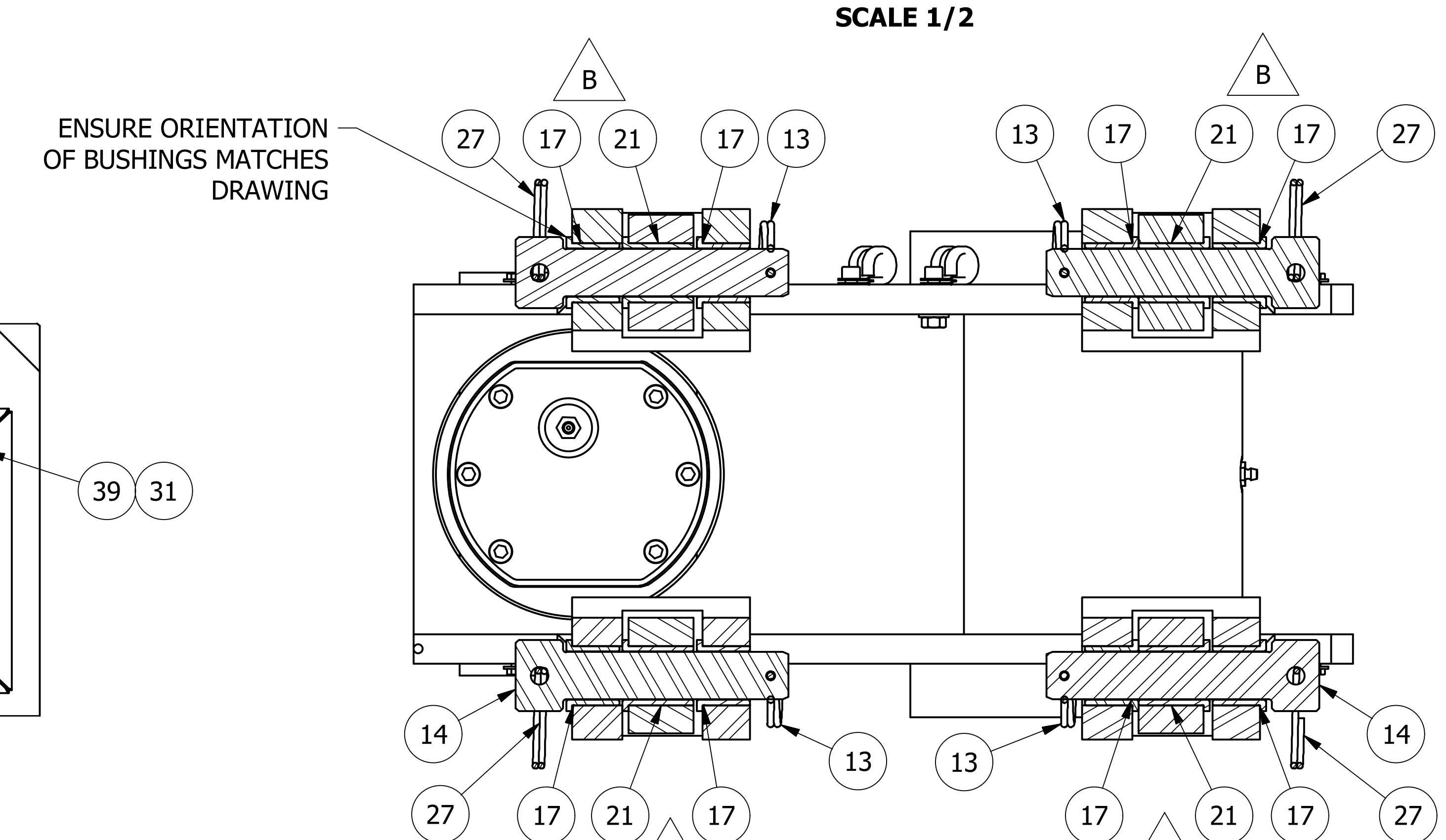
34-00304-035

REV B

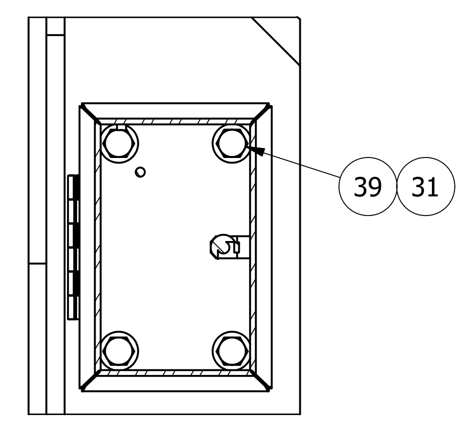




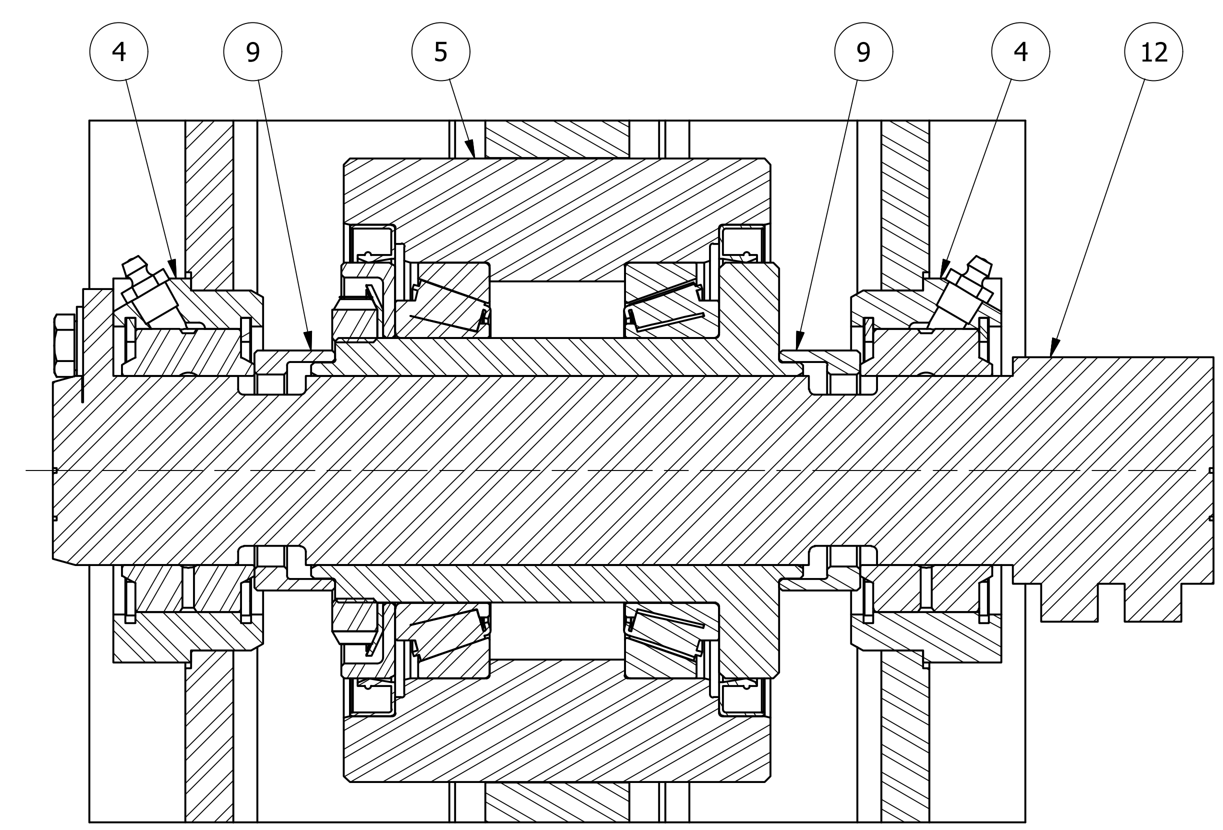
SECTION B-B
SCALE 1/2



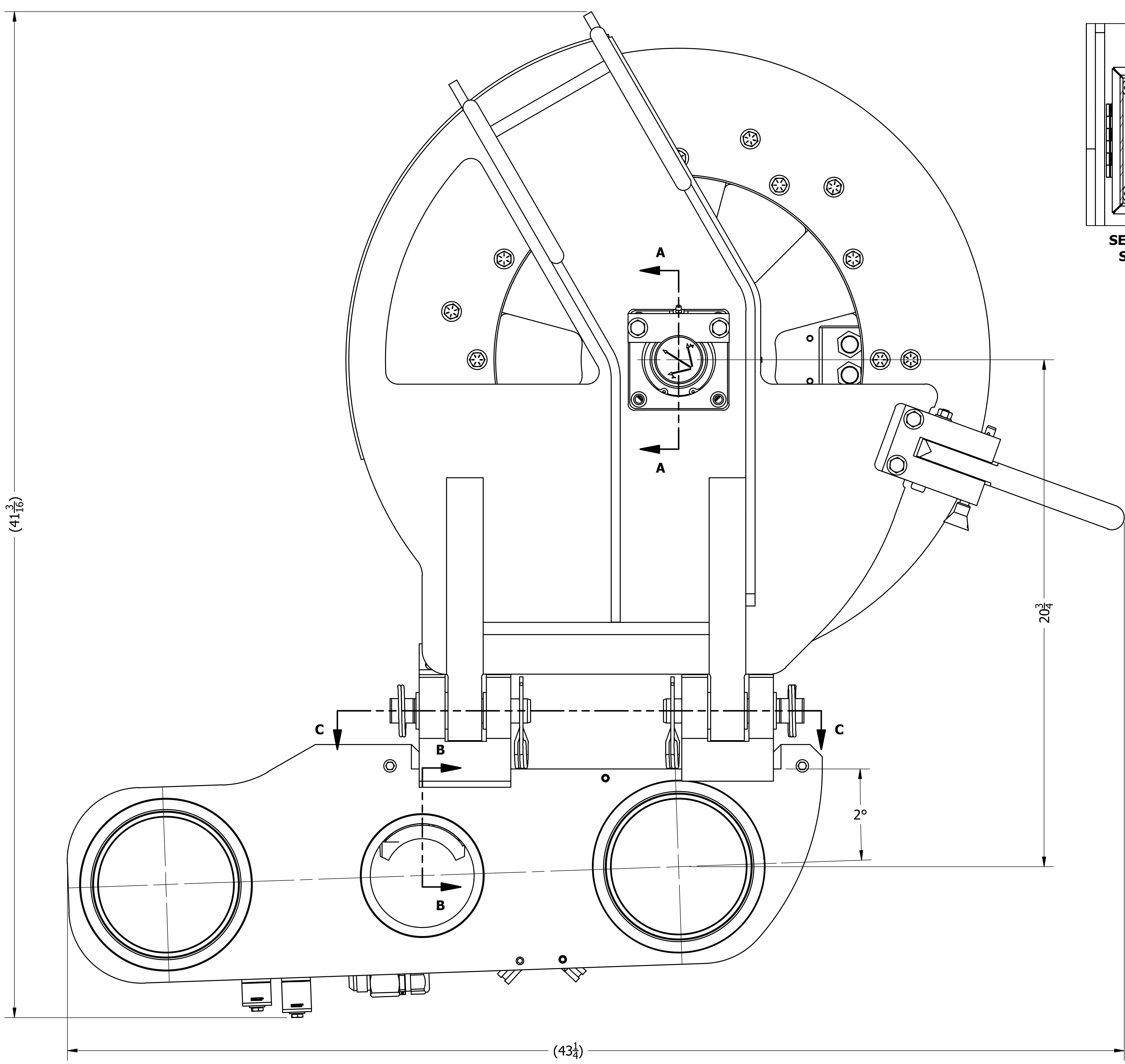
SECTION C-C
SCALE 1/4



SECTION D-D
SCALE 1/4



SECTION A-A
SCALE 1/2



STANDARD TOLERANCE UNLESS OTHERWISE SPECIFIED

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DIMENSIONS IN [ ] ARE IN MM

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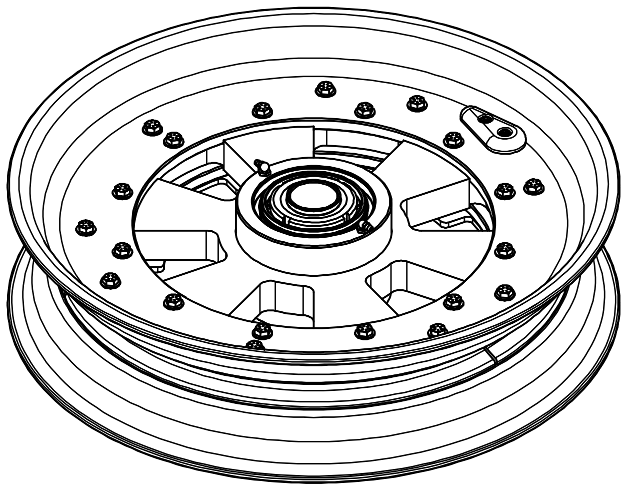
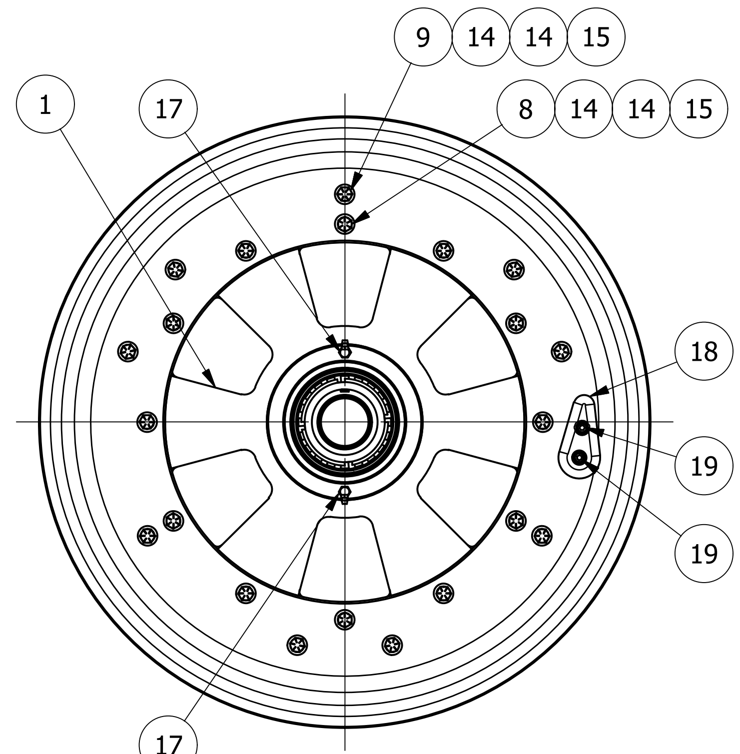
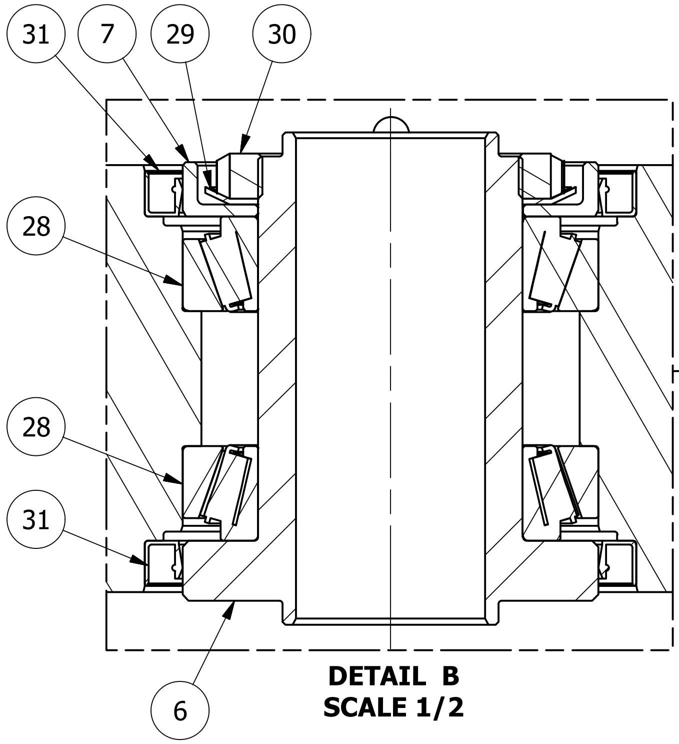
WHOLE NUMBER ± 1/16	2 PLC. DECIMAL ± .01	MATL CERT	TITLE ASSEMBLY - LEVELWIND CARRIAGE	
FRACTIONAL ± 1/16	3 PLC. DECIMAL ± .005	MATL TEST	NEXT ASSEMBLY 34-00304-001	DERIVED FROM
ANGLES ± 1/2°	4 PLC. DECIMAL ± .0005			
BREAK ALL SHARP CORNERS AND EDGES		WELD TEST	FIRST USED ON WO 1942	SHEET 2 OF 2
FINISH ON MACHINED SURFACES 125		EST LBS 536 lbmass	DRAWN STC / CHECKED NSW / APPROVED NSW	34-00304-035
		ACT LBS	DATE 10-Oct-19 / SCALE 1/4	REV B

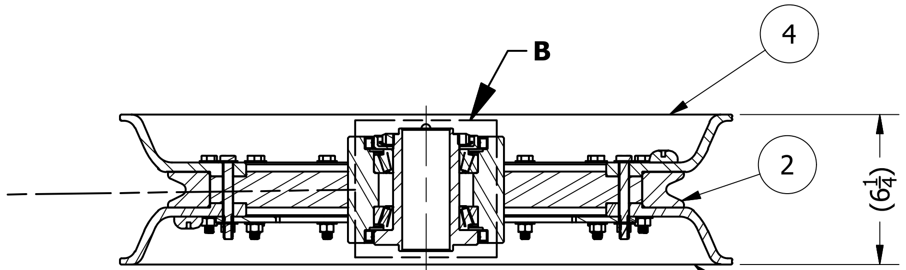
ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	34-00304-038		WELDMENT - SHEAVE HUB		1
2	34-00304-039		SHEAVE LINER - 0.322 INCH		1
4	34-00304-450		SHEAVE CHEEK PLATE		2
5	34-00304-533		SENSOR PICKUP - SHEAVE		1
6	34-00304-541		BEARING ADAPTER SLEEVE		1
7	34-00304-542		SEAL RING		1
8	5406555		HHCS - 3/8-16 X 3-1/4 LG - ULTRA COAT		12
9	5406554		HHCS - 3/8-16 X 3 LG - ULTRA COAT		9
14	5406245		FLAT WASHER- 3/8 , ULTRACOAT	GR8	42
15	5406174		HEX NUT; 3/8"-16 UNC; BRONZE		21
17		FI	GREASE FITTING 1/8-27 NPT 90 DEGREE	SS	2
18	5405222		ZINC ANODE	Zinc	2
19	185241		SHCS 1/4-20NC X 1/2 LG	SS 316	4
28	5408565		TAPERED ROLLER BRG - 70X110X25MM	Steel	2
29	5408574		SKF LOCK NUT WASHER, 70MM	Steel	1
30	5408575		SKF BEARING LOCKNUT, 70MM		1
31	5408573		SEAL, RADIAL SHAFT 110MM		2



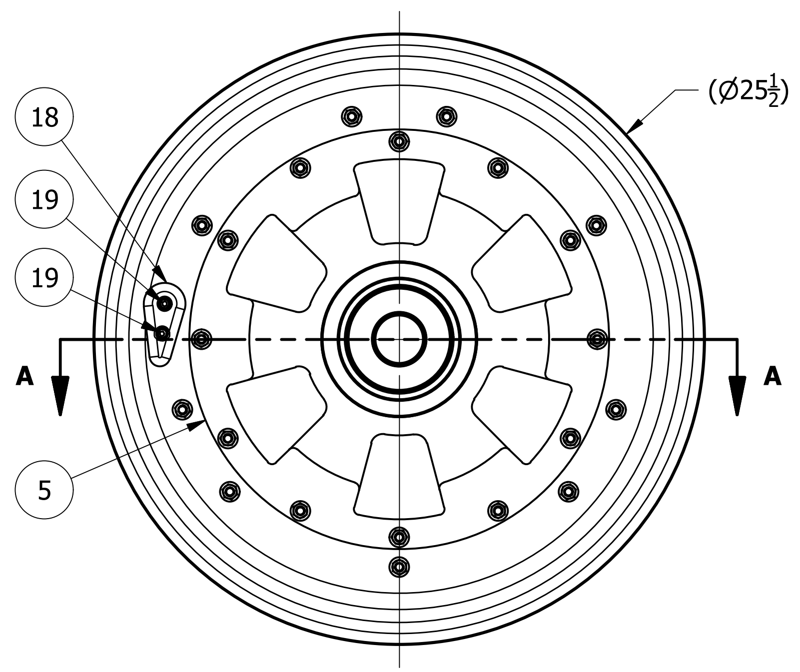




DETAIL B
SCALE 1/2



SECTION A-A
SCALE 1/8



STANDARD TOLERANCE UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

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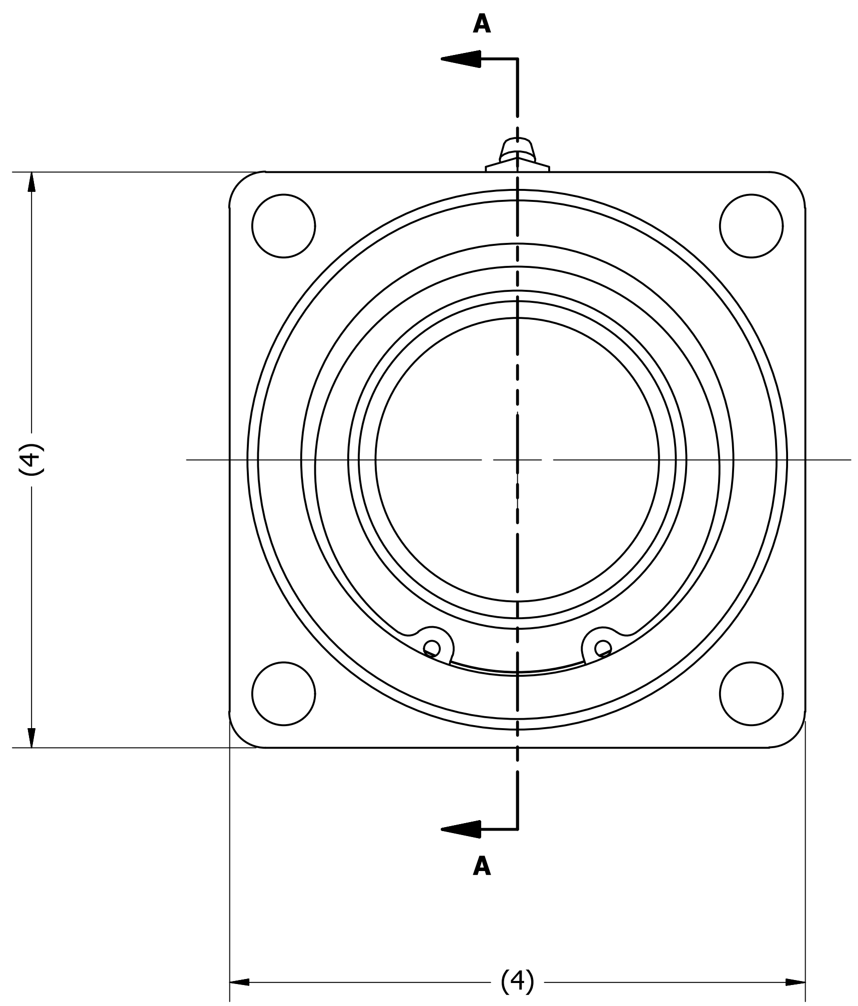
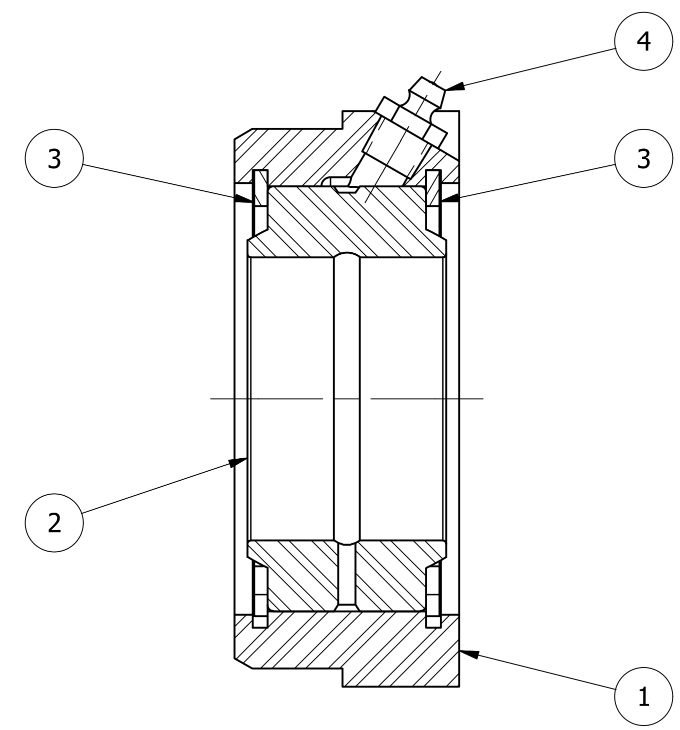
WHOLE NUMBER ± 1/16	2 PLC. DECIMAL ± .01	MATL CERT	TITLE ASSEMBLY - SHEAVE
FRACTIONAL ± 1/16	3 PLC. DECIMAL ± .005	MATL TEST	NEXT ASSEMBLY 34-00304-035
ANGLES ± 1/2°	4 PLC. DECIMAL ± .0005		DERIVED FROM

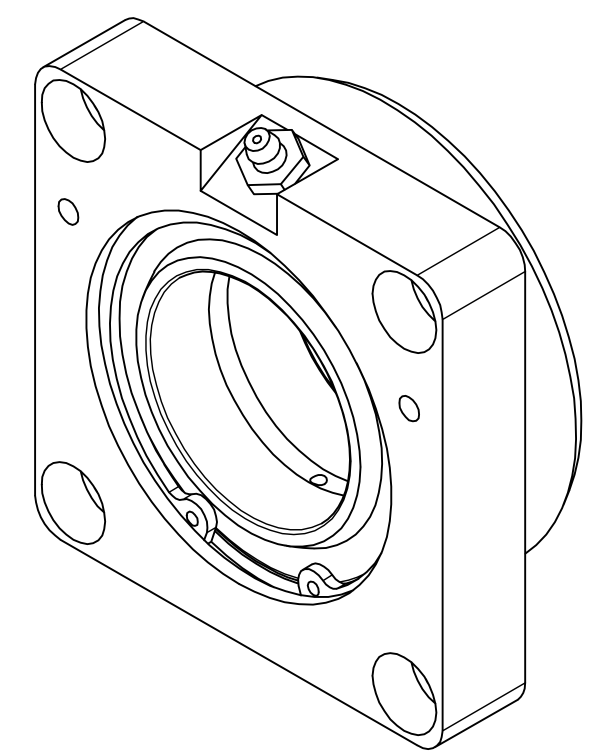
BREAK ALL SHARP CORNERS AND EDGES	WELD TEST	FIRST USED ON WO 1942		SHEET 1	OF 1
FINISH ON MACHINED SURFACES 125	EST LBS 135 lbmass	DRAWN STC	CHECKED NSW	APPROVED NSW	REV
	ACT LBS	DATE 07-Oct-19	SCALE 1/8	34-00304-037	

ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	34-00304-320		SHEAVE BEARING HOUSING		1
2	5408577		BEARING, SPHERICAL PLAIN 50MM ID	Steel	1
3	5408578		INTERNAL RETAINING RING 3 DIA	SS 15-7 PH	2
4		FI	GREASE FITTING 1/8-27 NPT STRAIGHT	SS	1





SECTION A-A
SCALE 3/4



STANDARD TOLERANCE UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

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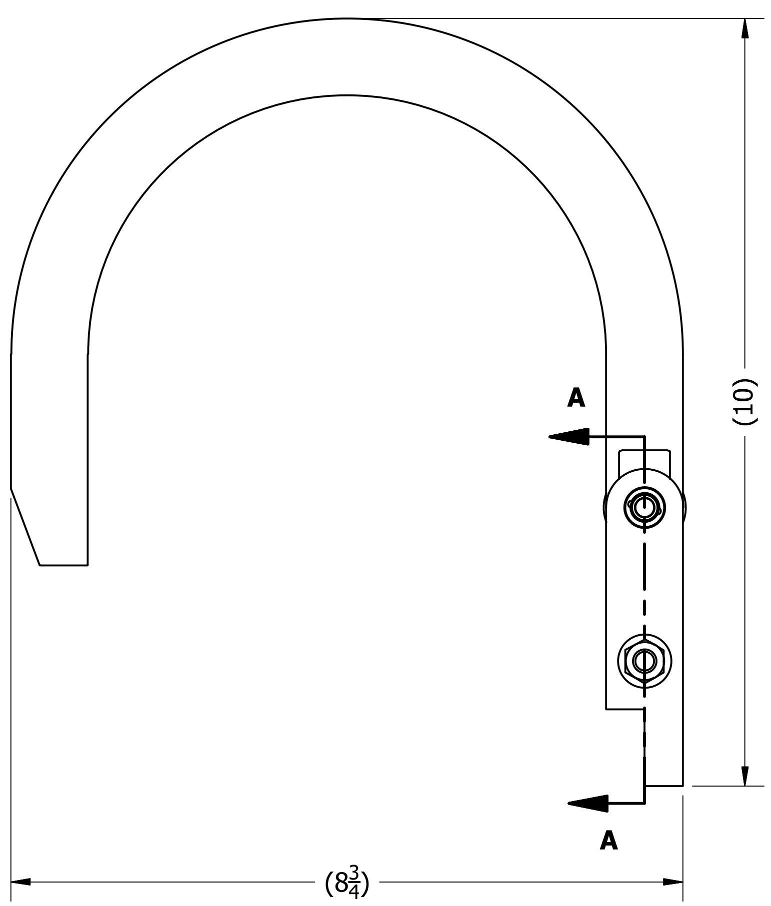
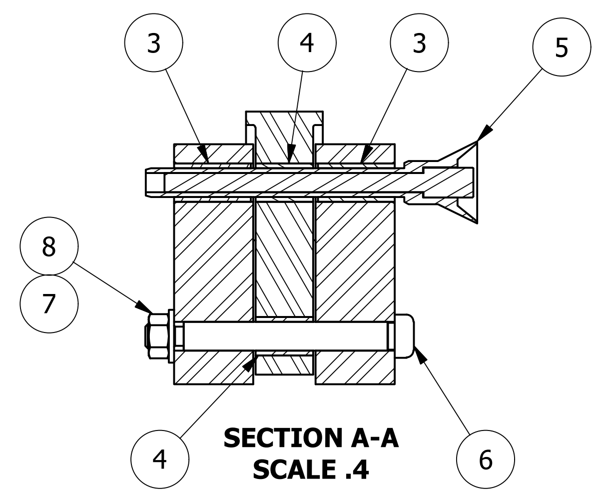
WHOLE NUMBER ± 1/16	2 PLC. DECIMAL ± .01	MATL CERT	TITLE ASSEMBLY - SHEAVE BEARING
FRACTIONAL ± 1/16	3 PLC. DECIMAL ± .005	MATL TEST	NEXT ASSEMBLY 34-00304-035
ANGLES ± 1/2°	4 PLC. DECIMAL ± .0005		DERIVED FROM
BREAK ALL SHARP CORNERS AND EDGES		WELD TEST	FIRST USED ON WO 1942
FINISH ON MACHINED SURFACES 125		EST LBS 4 lbmass	DRAWN PMK
		ACT LBS	DATE 09-Oct-19

SHEET 1	OF 1	CHECKED NSW	APPROVED NSW	SCALE 3/4	REV

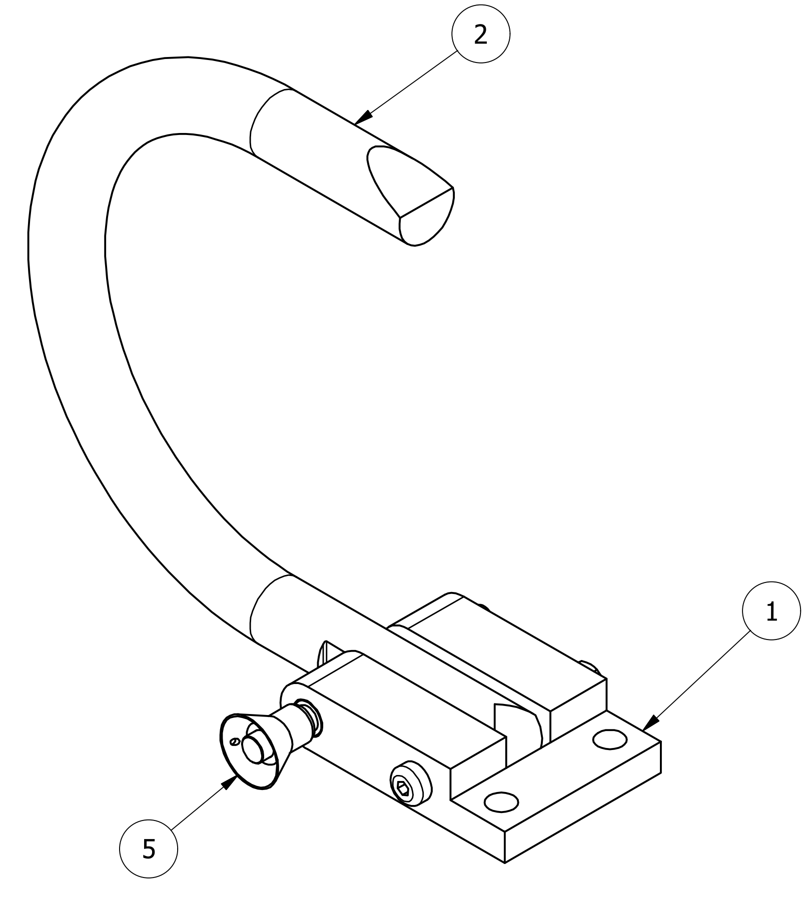
34-00304-055

ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	34-00304-480		MOUNT, CABLE KEEPER		1
2	34-00304-340		WIRE KEEPER		1
3	5406024		BUSHING, SLEEVE; 3/8 ID X 1 LG	SAE 841	2
4	5408642		SLEEVE BUSHING, 0.375" ID X .5" OD X 0.750 LG	SAE 841	2
5	5405981		PIN - QUICK RELEASE, 3/8" DIA X 3" LG	SS 17-4 PH	1
6	5406495		SKHSHS 3/8 DIA X 2-3/4 LG 5/16-18NC	SS 316	1
7	181073		FLAT WASHER- 5/16	SS 316	1
8	181203		HEX NUT- 5/16-18NC	SS 316	1





SECTION A-A
SCALE .4



STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

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WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

MATL CERT	
MATL TEST	
WELD TEST	
EST LBS	7 lbmass
ACT LBS	

TITLE	CABLE KEEPER ASSEMBLY	
NEXT ASSEMBLY	34-00304-035	DERIVED FROM
FIRST USED ON WO	1942	SHEET 1 OF 1
DRAWN NSW	CHECKED CDC	APPROVED NSW
DATE 09-Oct-19	SCALE .4	

34-00304-056

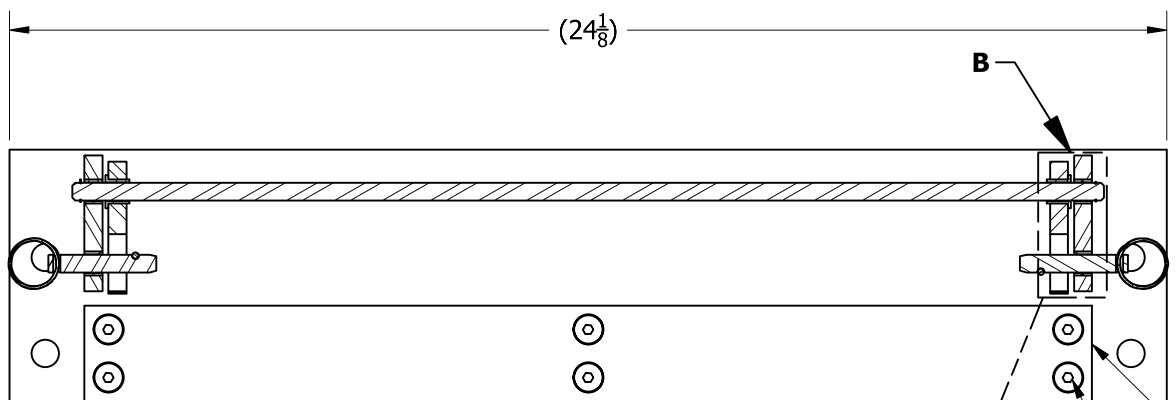
REV

NOTES:

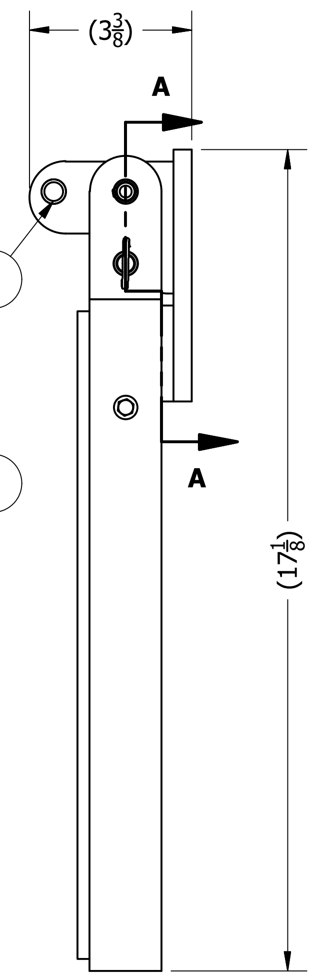
1) ATTACH LANYARD LOOP (ITEM 12) TO REMOVABLE PIN (ITEM 8).

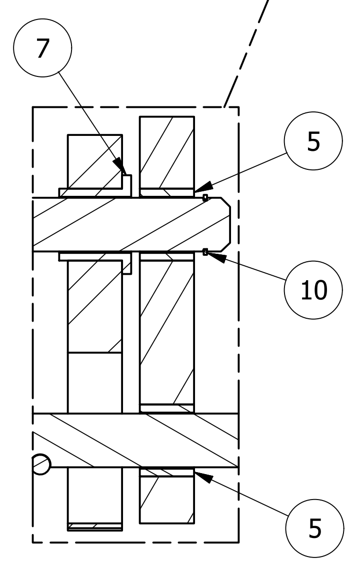
2) FIX LANYARD TAB TO FRAME WITH BOLT (ITEM 13).

ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	34-00304-052		PLATFORM FRAME		1
2	34-00304-074		PLATFORM MOUNT		1
3	34-00304-349		GRATING PANEL A		1
4	34-00304-348		HINGE PIN		1
5	34-00304-484		PLATFORM BUSHINGS		6
6	34-00304-485		BUMPER		1
7	34-00304-904		FLG SLEEVE BEARING 3/8" ID X 1/2" LG		2
8	5407212		PIN, QUICK RELEASE		2
9	5403586		GRATING FASTENER		4
10	5402822		RETAINING RING, EXTERNAL, 3/8		2
11	192740		FHCS- HEX SKT 5/16-24NF X 5/8 LG	STL	6
12	5408716		WIRE ROPE LANYARD, 18-8 SS, 6" LG		2
13	186801		MACH SCR HEX HD #10-24NC X 3/8 LG	SS 316	2
14	181192		FLAT WASHER- #10	SS 316	2

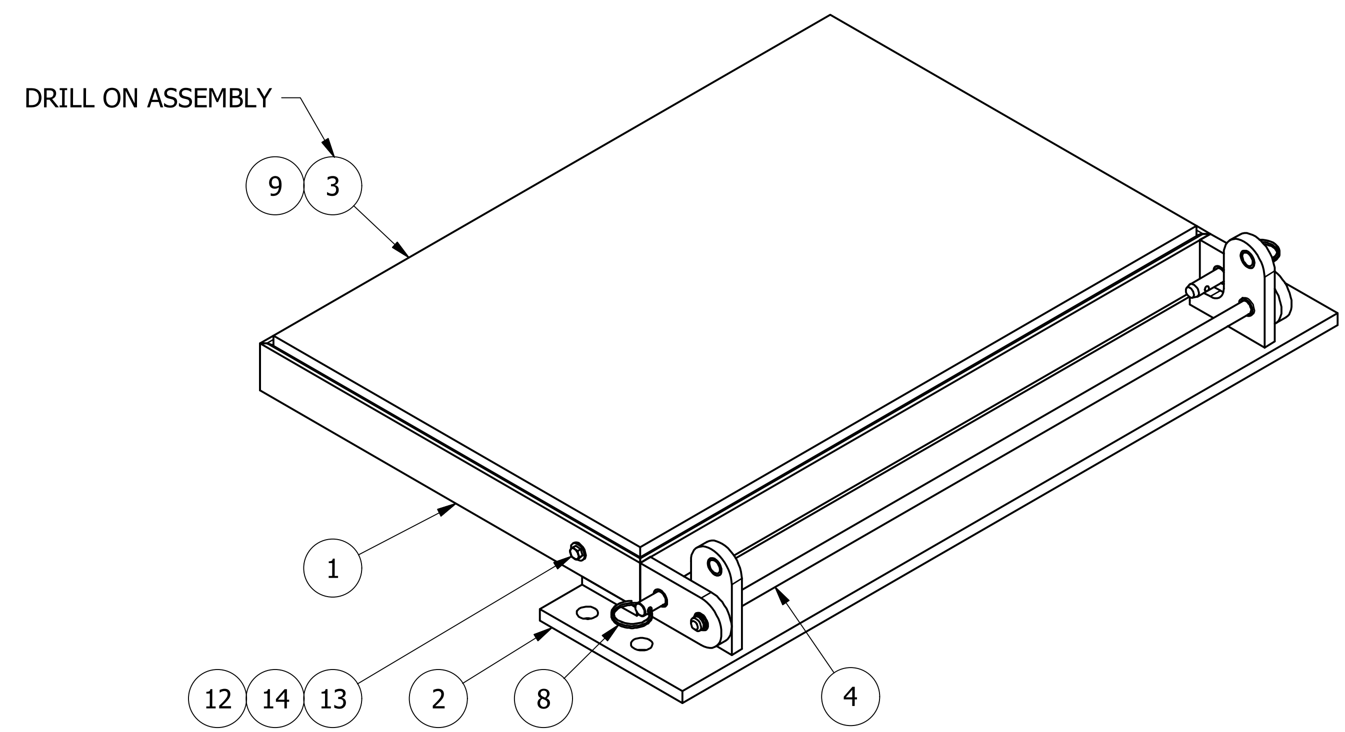


SECTION A-A
SCALE 1/4





DETAIL B
SCALE 3/4



REV	DATE	ECN	AMENDMENTS	BY	APPD
B	05-Feb-20	4361	ITEM 5 QTY CHANGE	STC	NSW
A	23-Oct-19	4143	ADDED LANYARDS	PMK	BBF

STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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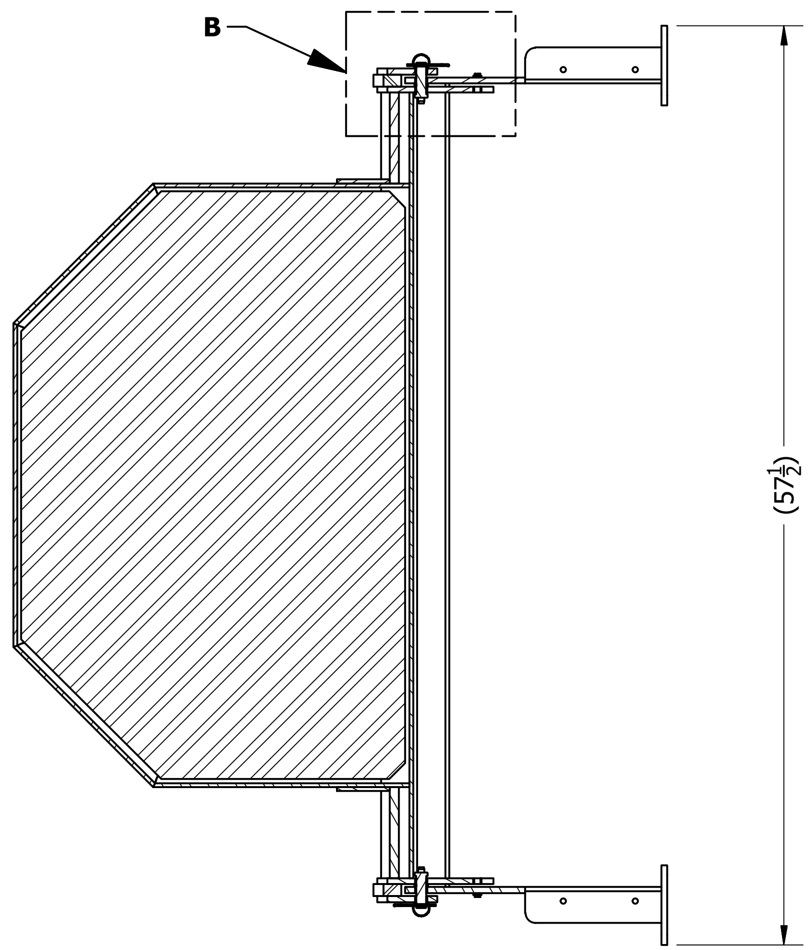
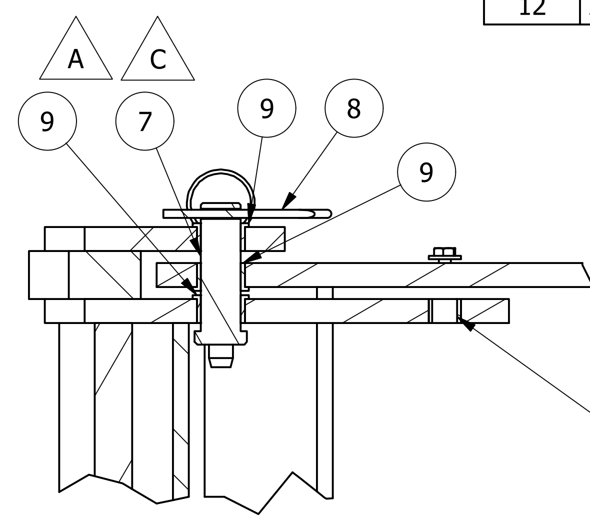
MATL CERT	TITLE ASSEMBLY - SIDE PLATFORM			
MATL TEST	NEXT ASSEMBLY 34-00304-001		DERIVED FROM	
WELD TEST	FIRST USED ON WO 1942		SHEET 1	OF 1
EST LBS 39 lbmass	DRAWN STC	CHECKED NSW	APPROVED NSW	34-00304-057 REV B
ACT LBS	DATE 08-Oct-19	SCALE 1/5		

ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	34-00304-029		WELDMENT - REAR PLATFORM		1
2	34-00304-078		WELDMENT - PANEL BRACKET, LOWER		1
3	34-00304-207		GRATING - REAR PLATFORM		1
4	5403586		GRATING FASTENER		4
5	34-00304-484		PLATFORM BUSHINGS		4
6	5407212		PIN, QUICK RELEASE		2
7	5409030		CLEVIS PIN; 5/8" DIA X 1-3/4" LG	SS 316	2
8	5402825		HAIRPIN COTTER PIN: 1/8"	SS 316	2
9	5409031		FLG SLEEVE BEARING 5/8" ID X 1/2" LG	SAE 841	6
10	5408705		LANYARD, 18-8 SS, 8" LG, LOOP-TAB		2
11	186801		MACH SCR HEX HD #10-24NC X 3/8 LG	SS 316	2
12	181192		FLAT WASHER- #10	SS 316	2

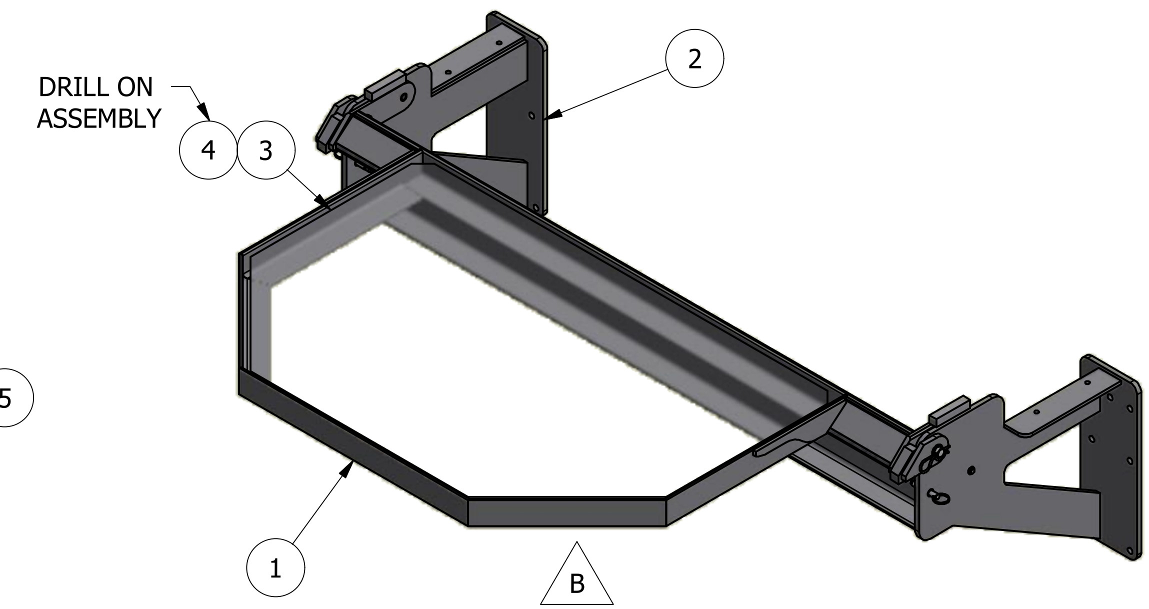
C

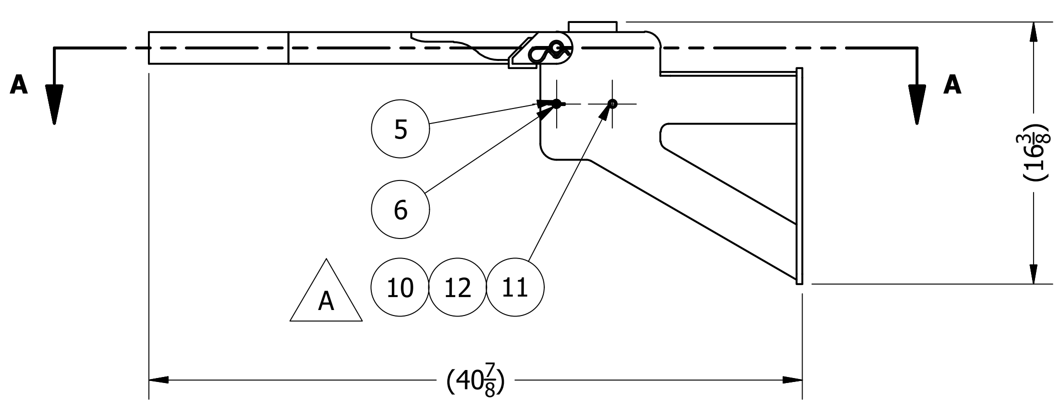


SECTION A-A
SCALE 1/12



DETAIL B
SCALE 1/3





NOTES:

1) ATTACH LANYARD TO REMOVABLE PIN (ITEM 6).
2) FIX LANYARD TO ITEM 2 WITH ITEM 11.
3) ENSURE LANYARDS WORK IN BOTH POSITIONS.

REV	DATE	ECN	AMENDMENTS	BY	APPD
C	04-Feb-20	4357	NEW CLEVIS PIN & BUSHINGS	NSW	DHM
B	29-Nov-19	4251	PLATFORM CORNERS MITERED	JSK	
A	23-Oct-19	4140	ADDED LANYARDS & FLANGED BUSHINGS; GRATING FASTENER QTY	PMK	BBF

STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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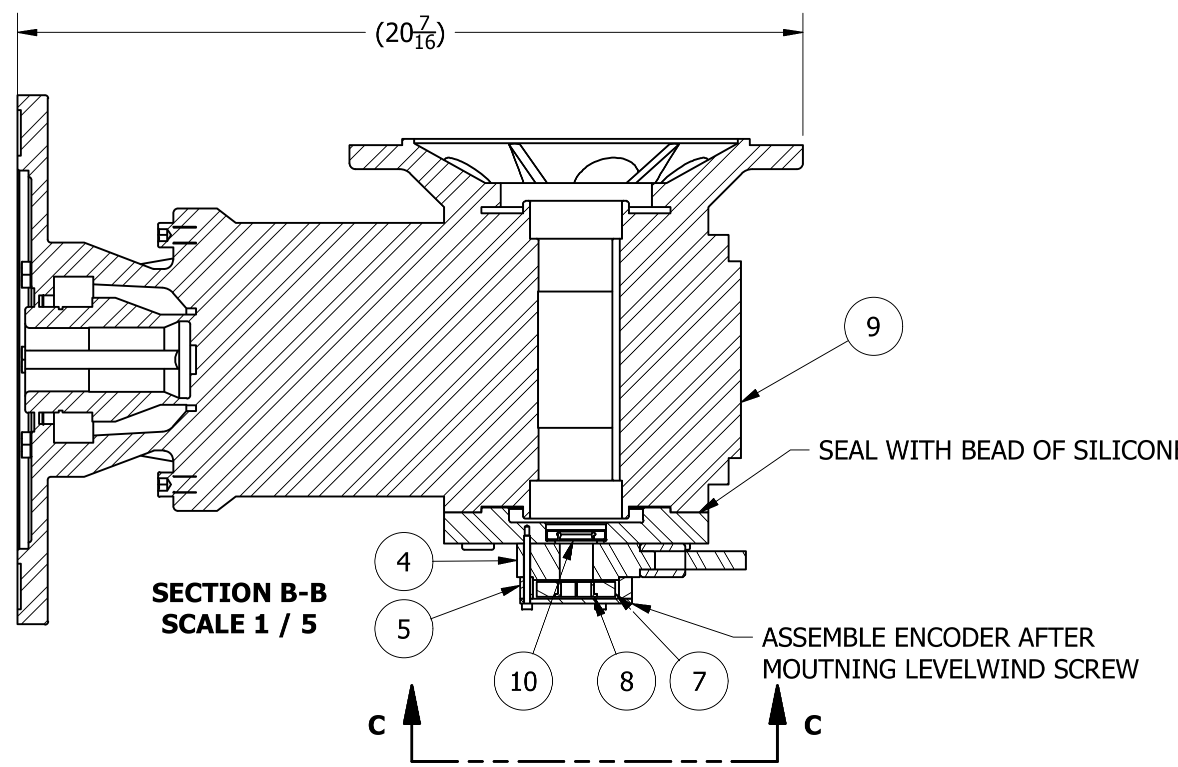
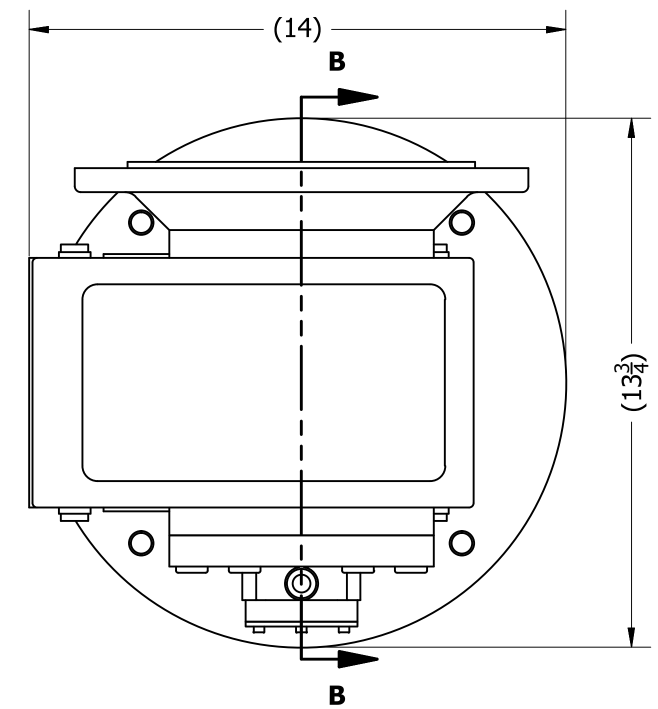
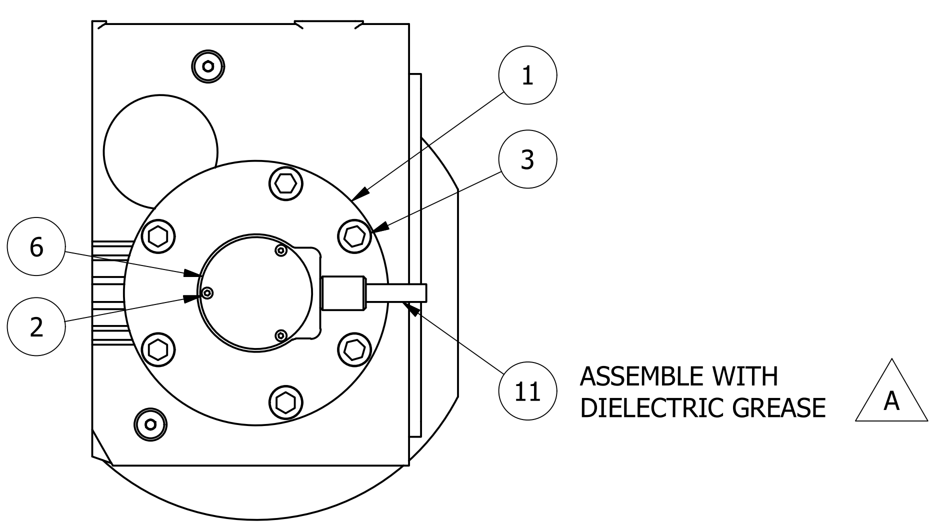
MATL CERT		TITLE	ASSEMBLY - REAR PLATFORM
MATL TEST		NEXT ASSEMBLY	34-00304-001
DERIVED FROM			
WELD TEST		FIRST USED ON WO	1942
SHEET	1	OF	1
EST LBS	121 lbmass	DRAWN	CDC
CHECKED	NSW	APPROVED	NSW
ACT LBS		DATE	08-Oct-19
SCALE	1/12		
DWG NO	34-00304-058	REV	C

ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	34-00304-865		ENCODER MOUNT		1
2	300464		SHCS M4-0.70 X 45 MM LG	SS A4	3
3	301461		SHCS M14-2.00 X 30 MM LG	SS A4	6
4	5406446		ENCODER, INCREMENTAL	SS 316	1
5	5406447		PROTECTION RING, ENCODER ACCESSORY	Plastic	1
6	5406448		COVER, ENCODER ACCESSORY	SS 316	1
7	5406449		POSITIONING ELEMENT, ENCODER ACCESSORY	Plastic	1
8	5406450		ADAPTER SLEEVE, ENCODER ACCESSORY	SS 316	1
9	5408558		GEARBOX, RIGHT ANGLE, 13.1:1		1
10	5408639		SEAL, RADIAL SHAFT 20X40X7		1
11	5406451		CABLE, ENCODER ACCESSORY		1



SECTION B-B
SCALE 1 / 5





VIEW C-C
SCALE 1 / 5

REV	DATE	ECN	AMENDMENTS	BY	APPD
A	30-Oct-19	4159	DIELECTRIC GREASE NOTE	PMK	NSW

STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER ± 1/16	2 PLC. DECIMAL ± .01
FRACTIONAL ± 1/16	3 PLC. DECIMAL ± .005
ANGLES ± 1/2°	4 PLC. DECIMAL ± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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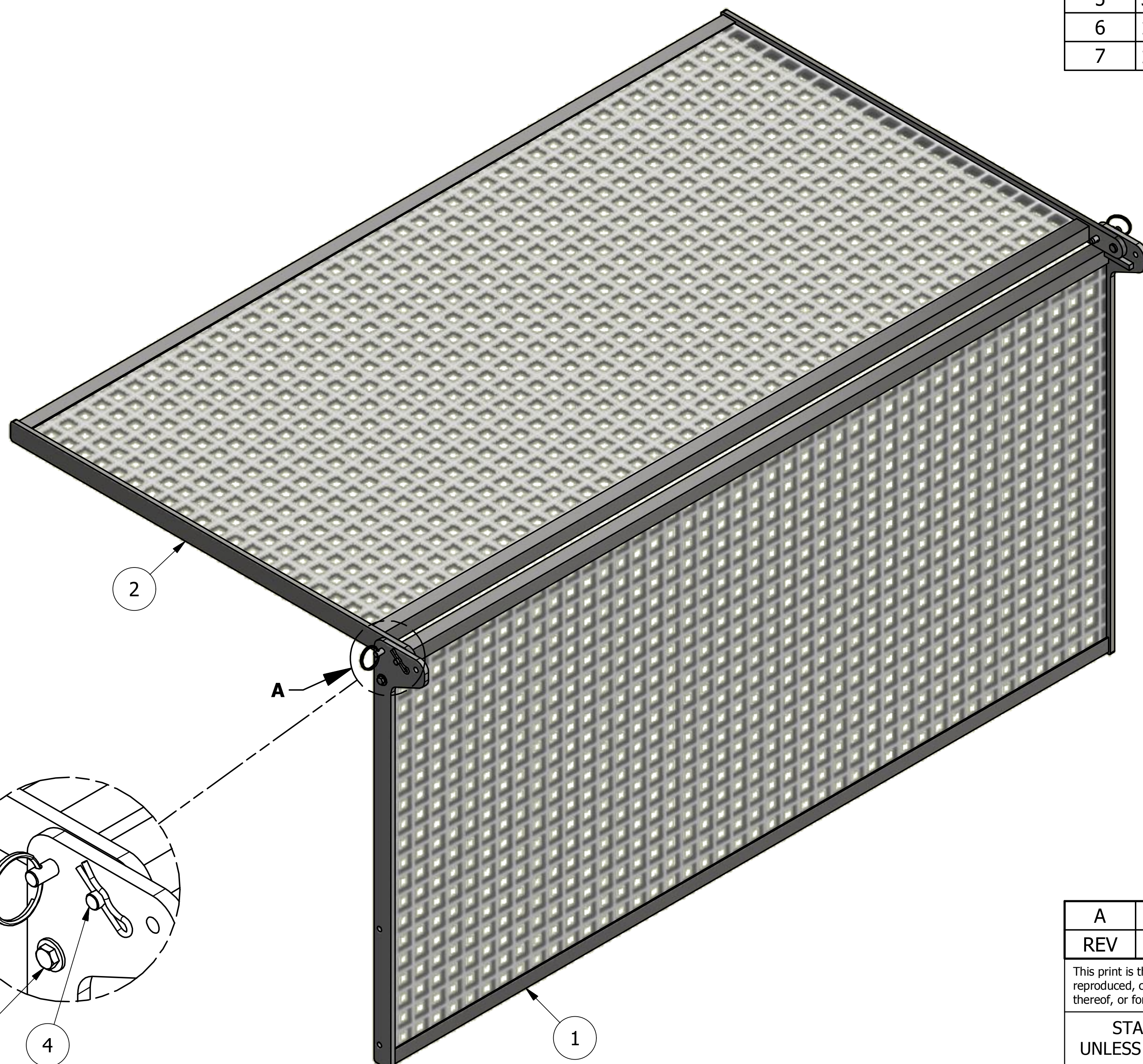
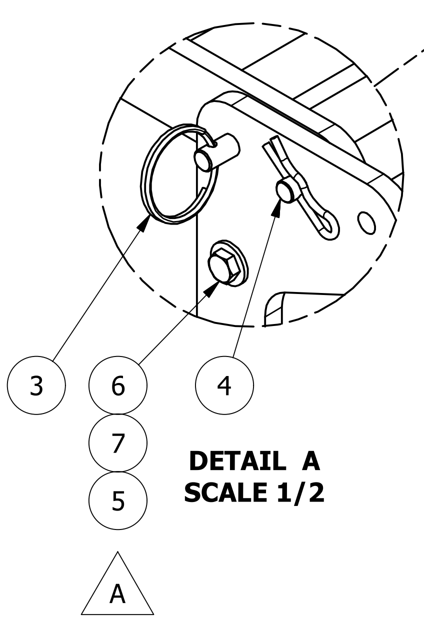
MATL CERT	TITLE ASSEMBLY - LEVELWIND GEARBOX		
MATL TEST	NEXT ASSEMBLY 34-00304-001	DERIVED FROM	
WELD TEST	FIRST USED ON WO 1942	SHEET 1	OF 1
EST LBS 161 lbmass	DRAWN CDC	CHECKED NSW	APPROVED NSW
ACT LBS	DATE 08-Oct-19	SCALE 1 / 5	

34-00304-061

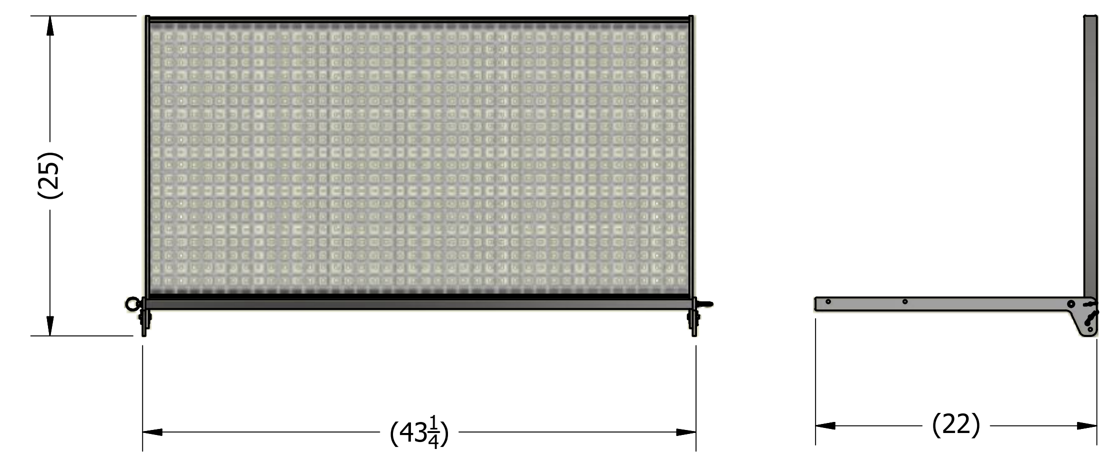
REV A

ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	34-00304-071		WELDMENT - MIDDLE GUARD		1
2	34-00304-072		WELDMENT - TOP GUARD		1
3	5408630		PIN, QUICK RELEASE; 1/4" OD X 13/16" LG		2
4	5408631		CLEVIS PIN; 1/4" DIA X 9/16" LG		2
5	5408716		WIRE ROPE LANYARD, 18-8 SS, 6" LG		2
6	186801		MACH SCR HEX HD #10-24NC X 3/8 LG	SS 316	2
7	181192		FLAT WASHER- #10	SS 316	2





DETAIL A
SCALE 1/2



SCALE 1/15

NOTES:

1) ATTACH LANYARD (ITEM 5) LOOP TO REMOVABLE PIN (ITEM 3).

2) FIX LANYARD TAB TO FRAME WITH BOLT (ITEM 6).

REV	DATE	ECN	AMENDMENTS	BY	APPD
A	24-Oct-19	4150	ADDED LANYARDS	PMK	BBF

STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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MATL CERT	
MATL TEST	
WELD TEST	
EST LBS	46 lbmass
ACT LBS	

TITLE: ASSEMBLY - UPPER GUARD

NEXT ASSEMBLY: 34-00304-001

DERIVED FROM:

FIRST USED ON WO: 1942

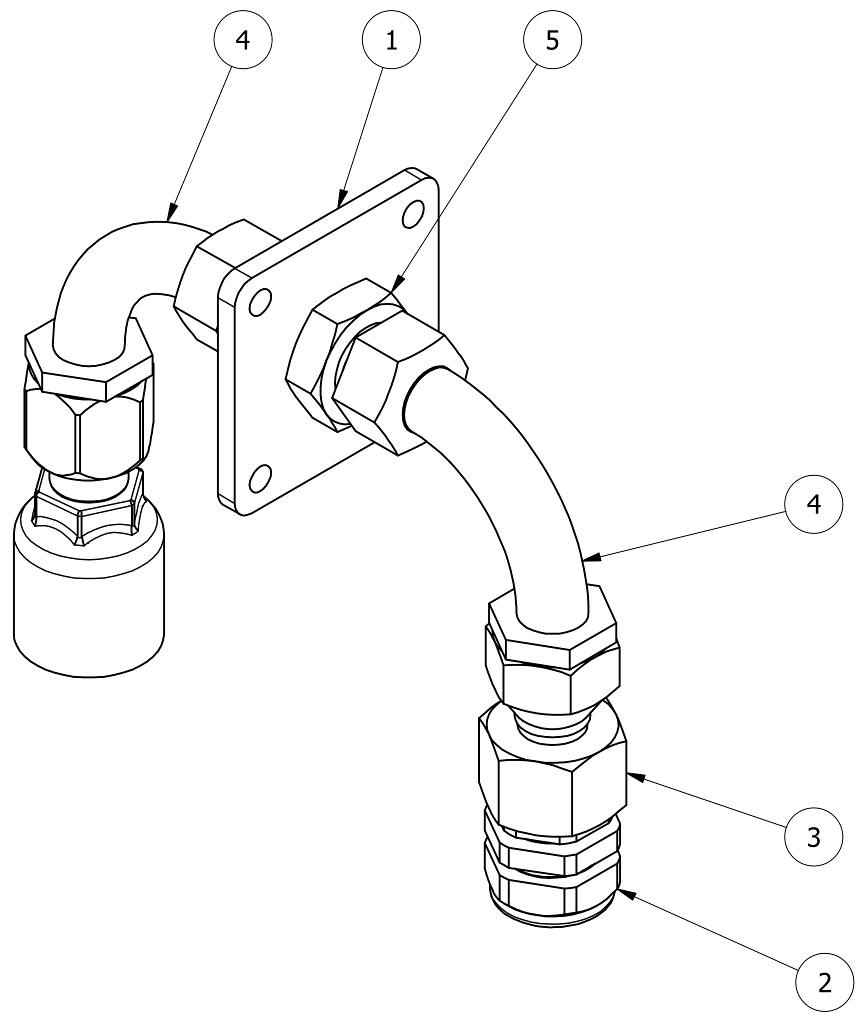
SHEET 1 OF 1

DRAWN	CHECKED	APPROVED
STC	NSW	NSW

DATE: 09-Oct-19 | SCALE: 1/6

34-00304-070 | REV A

ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	34-00304-438		CABLE GUIDE FITTING MOUNT		1
2		FI	CABLE GLAND - 0.75" NPT CABLE DIA .35" to .63"	Nickel-Plated Brass	1
3	434056S		CONN, 12 JICFS- 12 NPTF	SS 316	1
4	430304		CONN, 12JICM, 12JICFS 90 TUBE	STL	2
5	431707S		CONNECTOR, 12JICM-12JICM BLKD STRT	SS 316	1



NOTES:

1) USE PAINT OR DENSO TAPE TO PROTECT STEEL HYDRAULIC ADAPTERS FROM CORROSION.

REV	DATE	ECN	AMENDMENTS	BY	APPD
A	18-Nov-19	4199	ADDED PART NUMBERS FOR FREE ISSUE PARTS; ADDED NOTE #1; CHANGED ITEM 2 TO FREE ISSUE.	PMK	DHM

STANDARD TOLERANCE UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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MATL CERT	
MATL TEST	
WELD TEST	
EST LBS	3 lbmass
ACT LBS	
TITLE	CABLE GUIDE FITTING ASSEMBLY
NEXT ASSEMBLY	34-00304-001
DERIVED FROM	34-00296-065
FIRST USED ON WO	1942
SHEET	1 OF 1
DRAWN	NSW
CHECKED	CDC
APPROVED	NSW
DATE	09-Oct-19
SCALE	1 / 2
DRAWING NO.	34-00304-079
REV	A

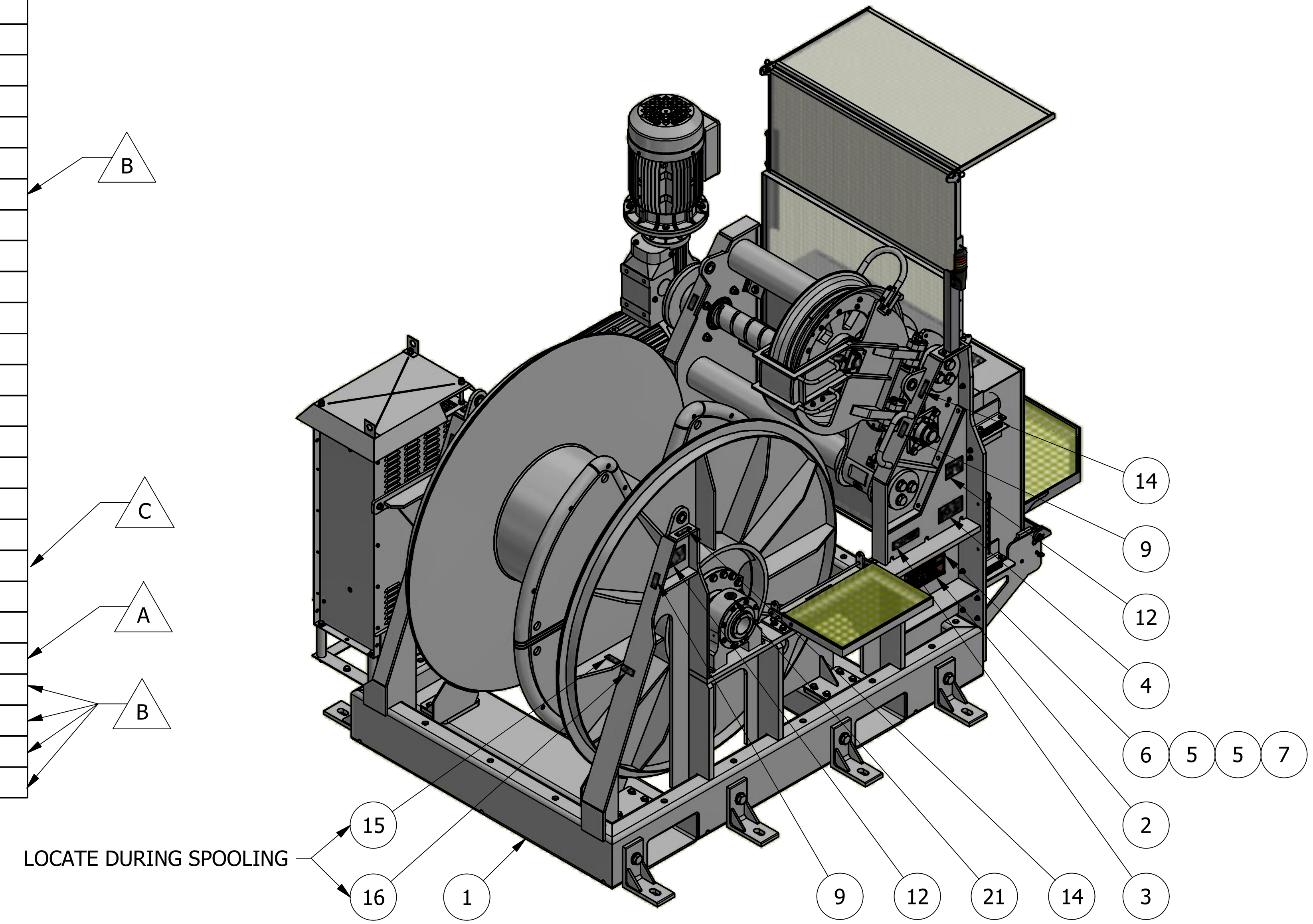
ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	34-00304-001	1	SPRE-3464 GENERAL ASSEMBLY		REF
2	5400001		4 X 10 MGB NAME PLATE		1
3	D400160		MADE IN CANADA		1
4	D401006		RATING - SPRE-3464	ALUMINUM	1
5	181072		FLAT WASHER- 1/4	SS 316	8
6	187108		HHCS 1/4-20NC X 1 1/2 LG	SS 316	4
7	181202		HEX NUT- 1/4-20NC	SS 316	4
8	5402120		DRIVE SCREW, SS 18-8, #6 X 3/8 LG		76
9	D400796		PINCH POINT, LAMACOID		7
10	D400031		CAUTION PINCH POINT		1
11	D400196		CAUTION MISUSE OF EQUIPMENT		1
12	D400166		DANGER		4
13	D400173		WARNING - UNDERSTAND OPERATION		1
14	D400159		LIFTING LUG		4
15	D400772		DRUM HOME - LEFT; LAMACOID		1
16	D400773		DRUM HOME - RIGHT; LAMACOID		1
17	D400345		GREASE ARROW RIGHT, LARGE, LAMACOID		1
18	D400108		GREASE ARROW RIGHT, LARGE		1
19	D400605		GREASE ARROW LEFT, LARGE		1
20	D400114		GREASE ARROW RIGHT		1
21	D400298		GREASE POINT ROUND 1.88 OD X 1 ID		4
22	D400594		GREASE POINT ROUND 1.88 OD X 1-1/8 ID		1
23	D401013		UNOLS RATING - SWT, DLT		1
24	D401024		DANGER, ENSURE BONDING BAR SECURELY		1
25	D401025		LOAD PIN ARROW DOWN		2
26	D401026		OPERATION PLATFORM MAX CAP		1
27	D401027		DANGER WATER FLOODING DECK		1

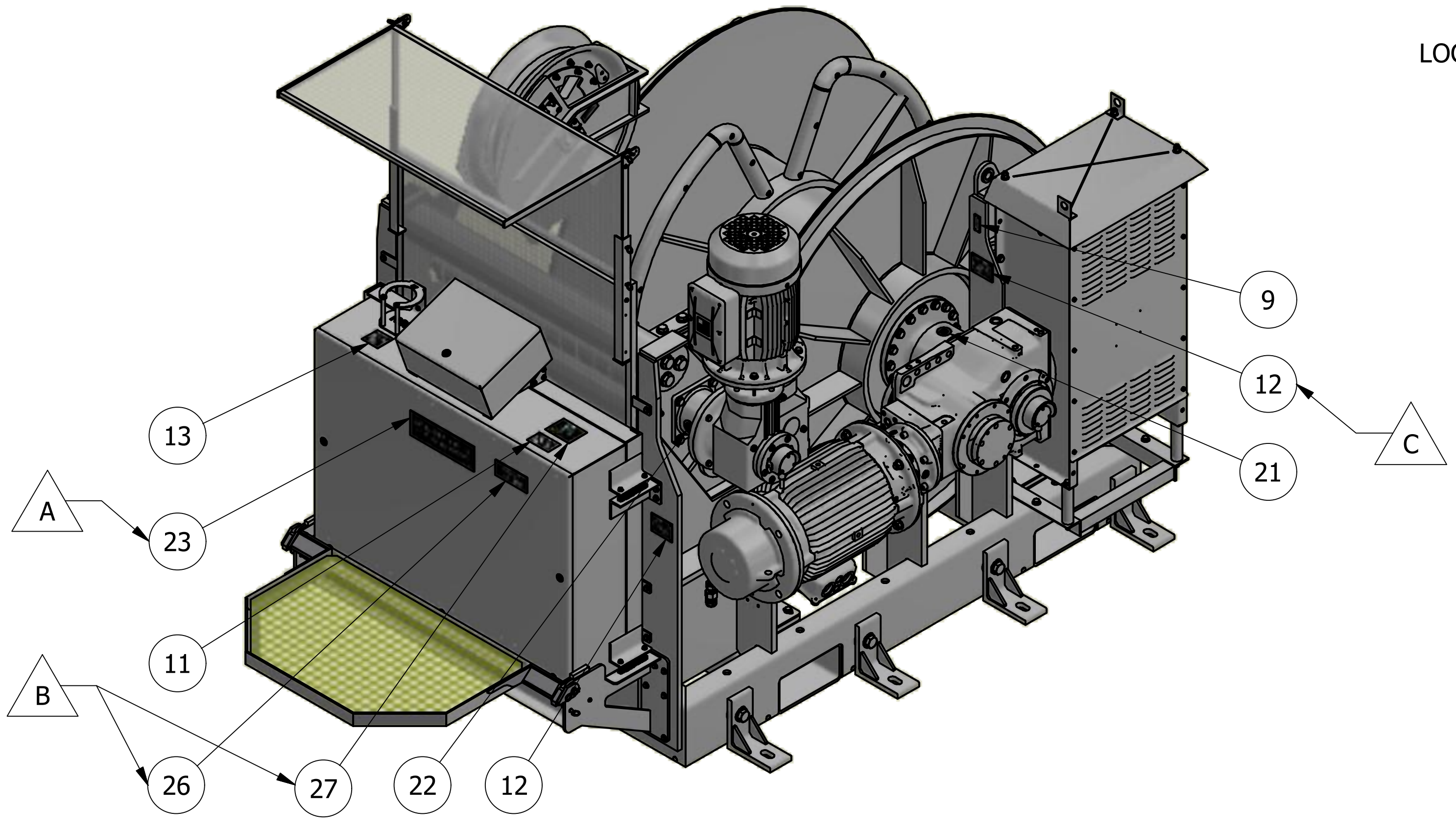
B

C

A

B





C	06-Feb-20	4360	ITEM 20 P/N CHANGE AND MOVED A DANGER DECAL.	STC	NSW
B	03-Feb-20	4348	DECALS 24 TO 27 ADDED, ITEM 8 QTY CHANGE AND DWG TITLE CHANGE	STC	NSW
A	08-Nov-19	4178	ITEM 23 ADDED UNOLS RATING DECAL	STC	NSW
REV	DATE	ECN	AMENDMENTS	BY	APPD

STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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MATL CERT

MATL TEST

WELD TEST

EST LBS 9773 lbmass

ACT LBS

TITLE DECAL LAYOUT - SPR-3464

NEXT ASSEMBLY 34-00304-001

DERIVED FROM

FIRST USED ON WO 1942

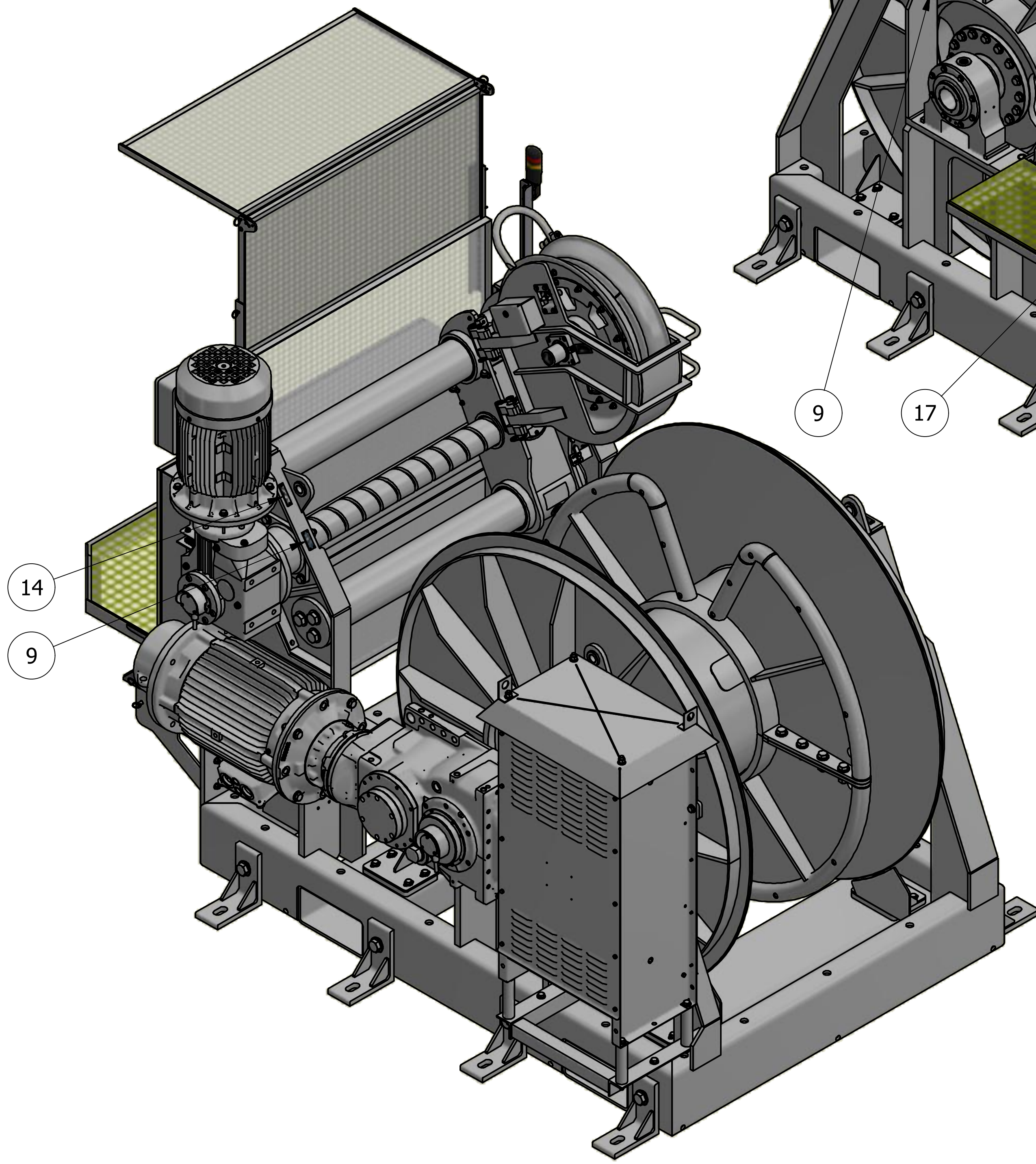
SHEET 1 OF 3

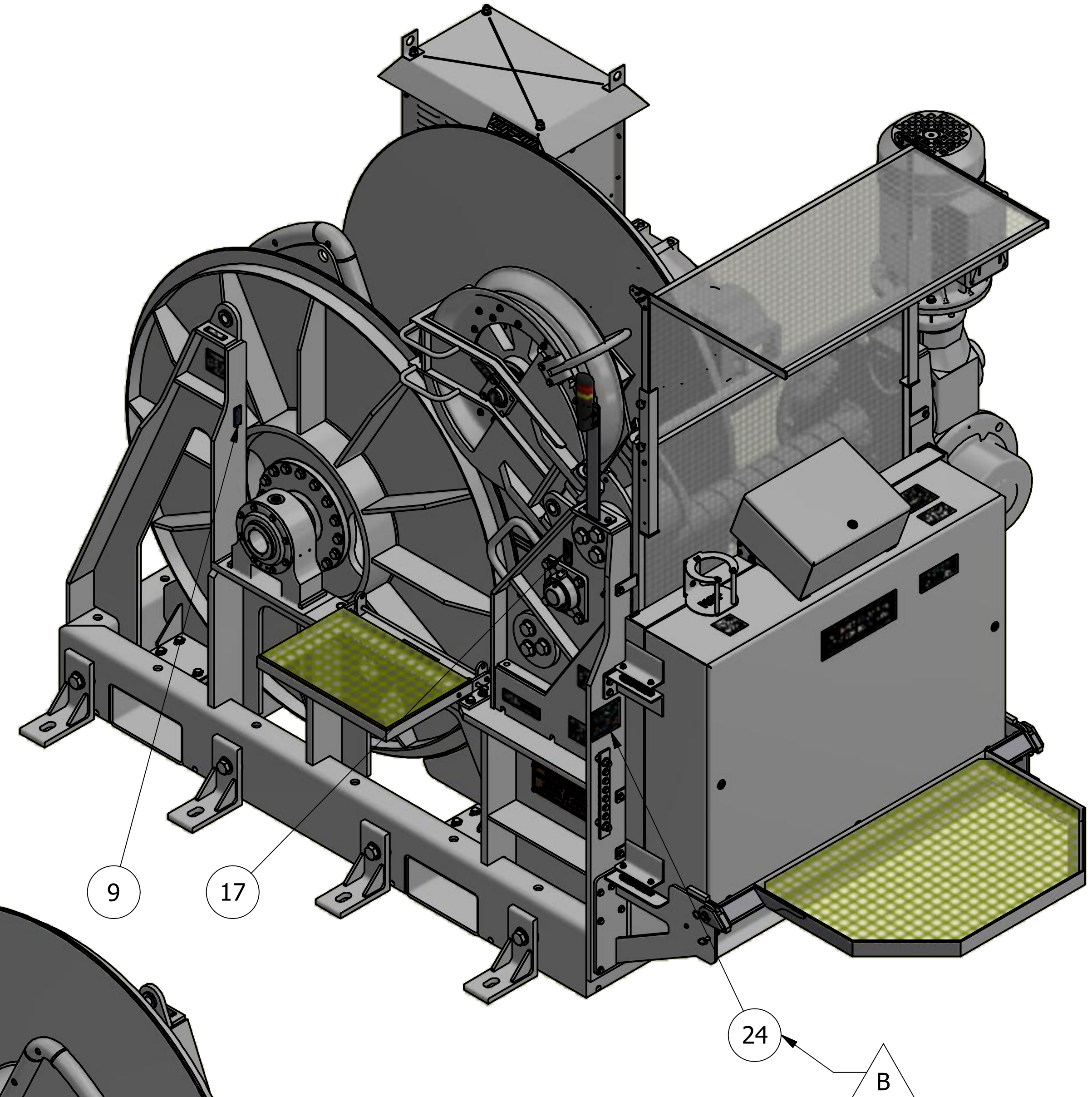
DRAWN STC | CHECKED NSW | APPROVED NSW

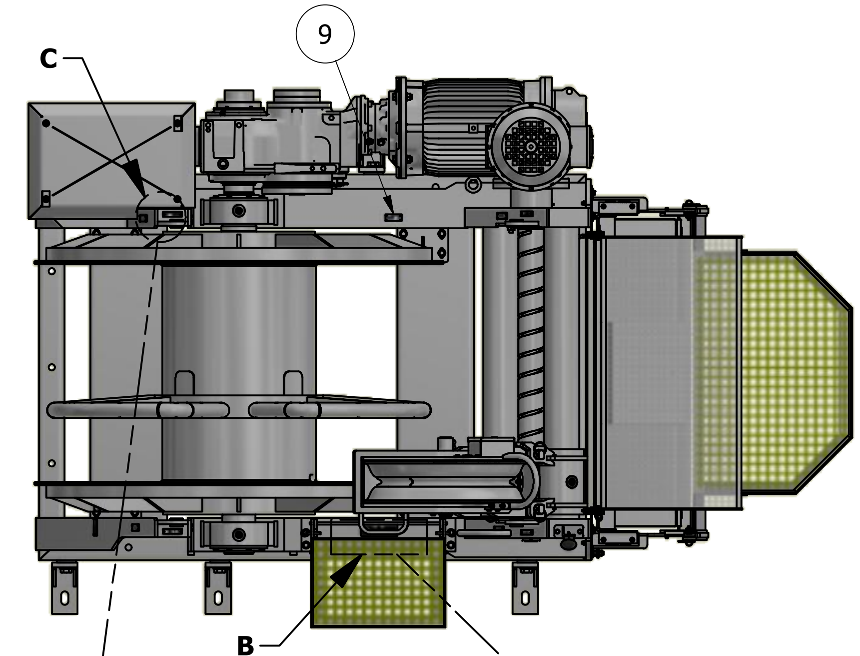
DATE 11-Oct-19 | SCALE 1/25

34-00304-081

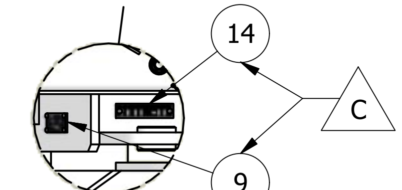
REV C



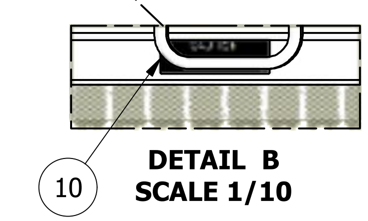




TOP VIEW
SCALE 1/30



DETAIL C
SCALE 1/10



DETAIL B
SCALE 1/10

STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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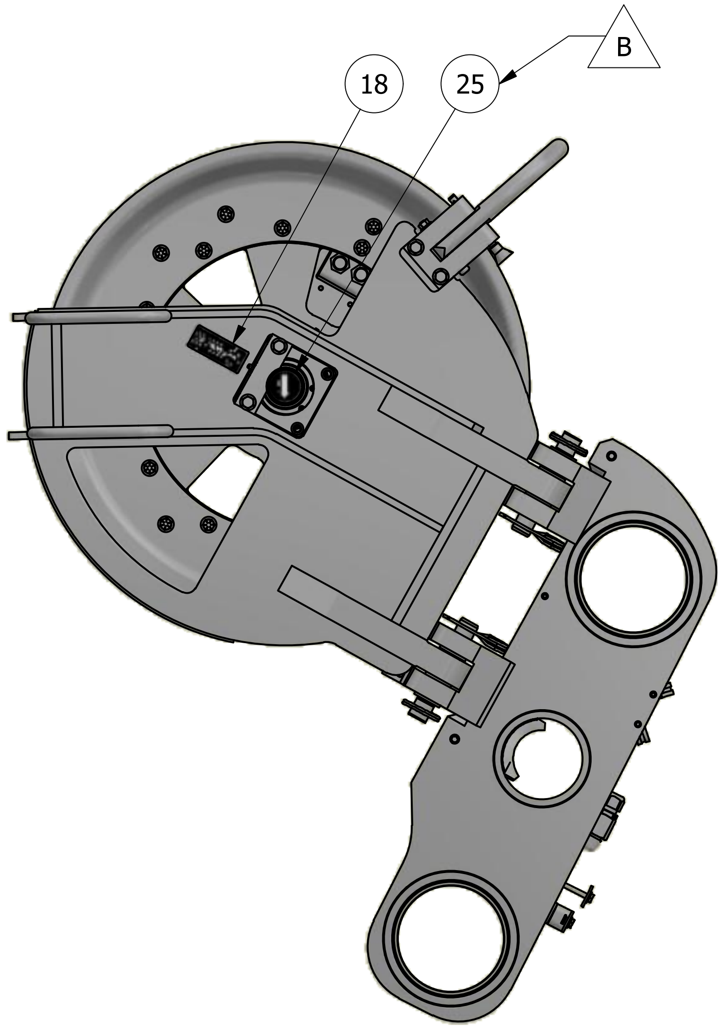
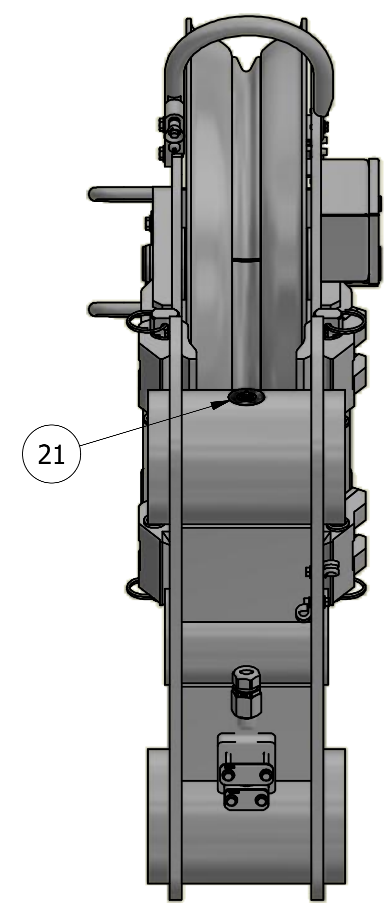
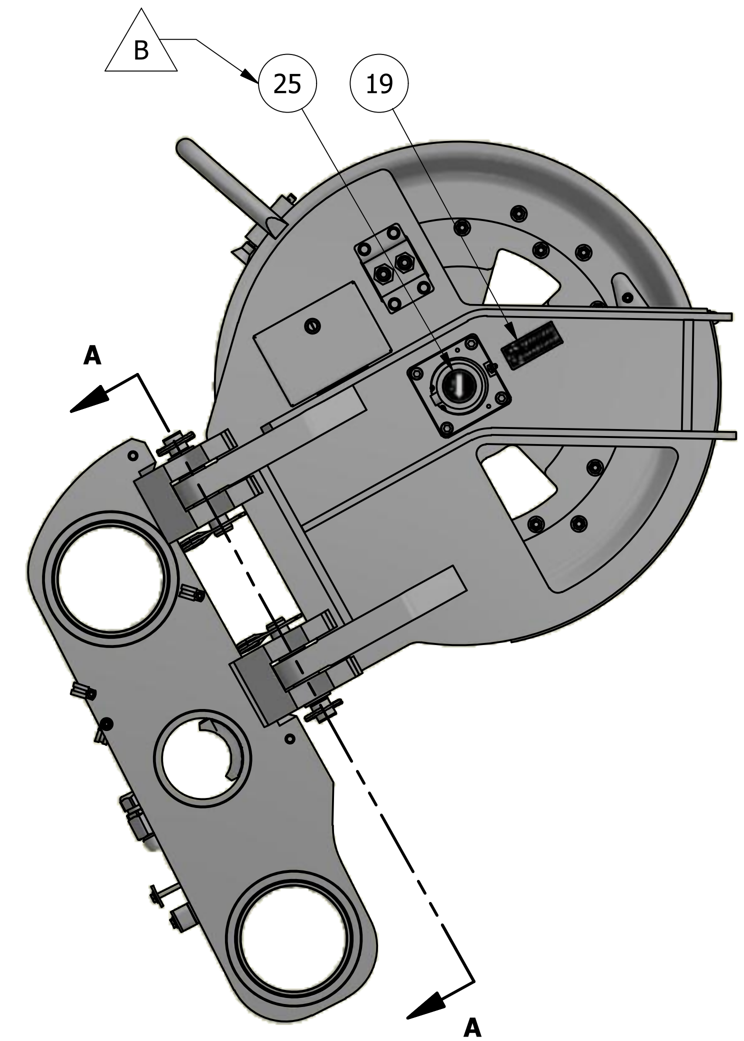
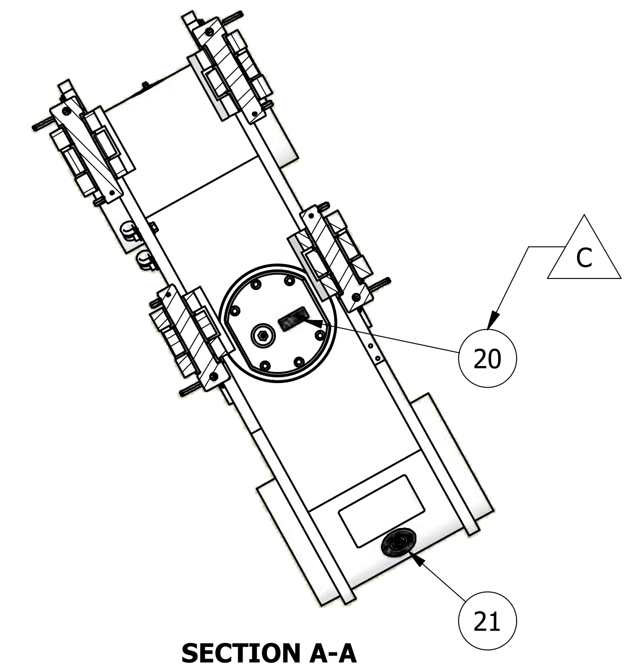
MATL CERT		TITLE	DECAL LAYOUT - SPR-3464		
MATL TEST		NEXT ASSEMBLY	34-00304-001	DERIVED FROM	
WELD TEST		FIRST USED ON WO	1942	SHEET 2	OF 3
EST LBS	9773 lbmass	DRAWN STC	CHECKED NSW	APPROVED NSW	REV
ACT LBS		DATE 11-Oct-19	SCALE 1/20	34-00304-081	C









SECTION A-A
SCALE 1/10

STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

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WHOLE NUMBER ± 1/16	2 PLC. DECIMAL ± .01	MATL CERT	TITLE DECAL LAYOUT - SPR-3464
FRACTIONAL ± 1/16	3 PLC. DECIMAL ± .005	MATL TEST	NEXT ASSEMBLY 34-00304-001 / DERIVED FROM
ANGLES ± 1/2°	4 PLC. DECIMAL ± .0005		
BREAK ALL SHARP CORNERS AND EDGES		WELD TEST	FIRST USED ON WO 1942 / SHEET 3 OF 3
FINISH ON MACHINED SURFACES 125		EST LBS 9773 lbmass	DRAWN STC / CHECKED NSW / APPROVED NSW
		ACT LBS	DATE 11-Oct-19 / SCALE 1/10

34-00304-081 REV C

LUBRICATION POINTS			
LOCATION	DESCRIPTION	INTERVAL	TYPE
G1	DRUM BEARING	20 HRS OPERATION	EP2 GREASE
G2	SHEAVE BEARING	20 HRS OPERATION	EP2 GREASE
G3	LOAD PIN BEARING	20 HRS OPERATION	EP2 GREASE
G4	LEVELWIND CARRIAGE BUSHING	20 HRS OPERATION	EP2 GREASE
G5	LEVLEWIND SCREW BLADE	20 HRS OPERATION	EP2 GREASE
G6	SCREW BEARING	20 HRS OPERATION	EP2 GREASE
G7	LW BEARING HOUSING	20 HRS OPERATION	EP2 GREASE
G8	LW HINGE PINS	MAINTAIN THIN LAYER	EP2 GREASE
G9	GUIDE RODS AND SCREW	MAINTAIN THIN LAYER	EP2 GREASE
G10	TORQUE ARM BEARINGS	20 HRS OPERATION	EP2 GREASE
G11	MAIN GEARBOX OIL	8000 HRS OPERATION	ISO VG 220 SYNTHETIC
G12	LEVELWIND GEARBOX OIL	6000 HRS OPERATION	ISO VG 220 SYNTHETIC

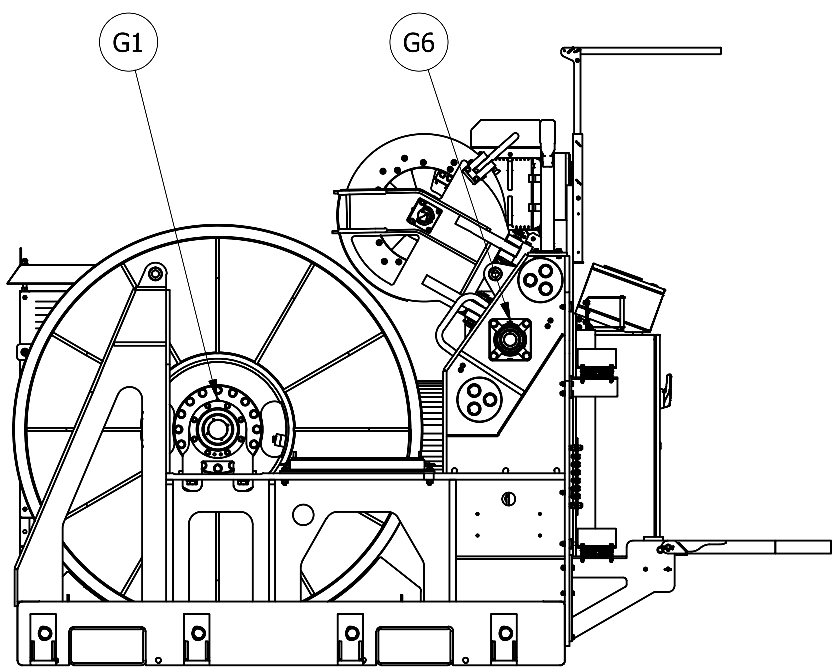
INSTRUCTIONS:

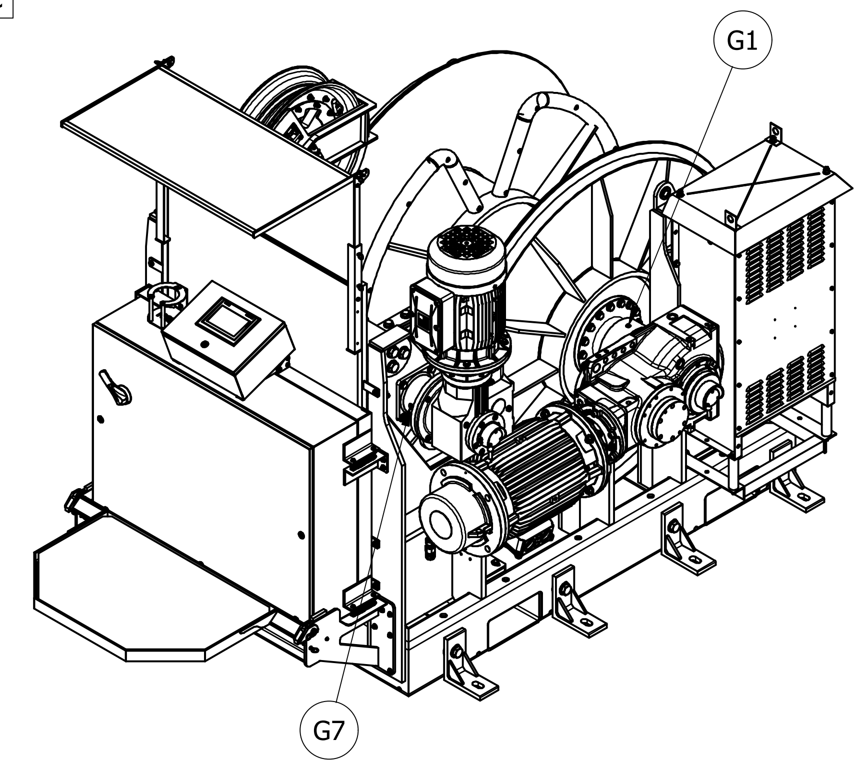
1) HAWBOLDT TECHNICIAN SHALL INITIAL EACH POINT AS IT IS GREASED.
ALL POINTS MUST BE GREASED PRIOR TO SHIPPING.

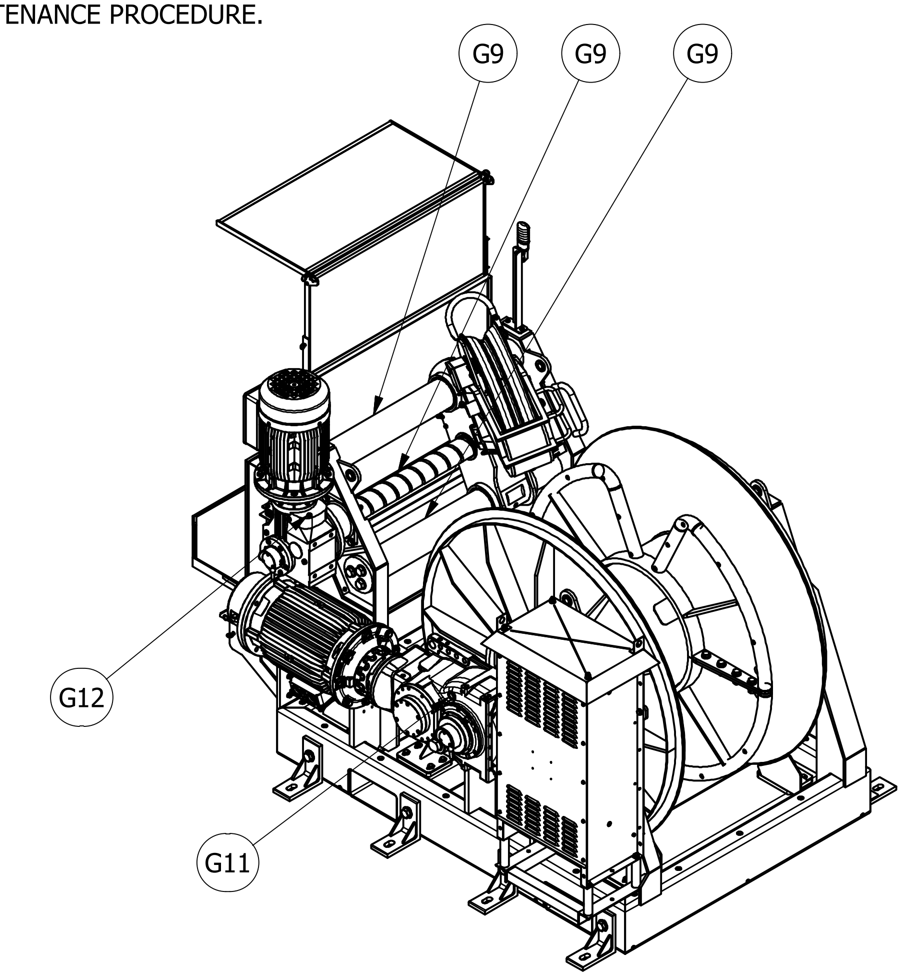
2) LUBRICATION MAINTENANCE SHOULD BE RECORDED IN THE MAINTENANCE LOG
IN THE HAWBOLDT INSTALLATION AND MAINTENANCE MANUAL.

3) THE FIRST GEARBOX OIL CHANGE SHOULD OCCUR AFTER 100 HOURS OF OPERATION.

4) REFER TO GEARBOX MAINTENANCE MANUAL FOR THE PROPER MAINTENANCE PROCEDURE.







STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

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DIMENSIONS IN [ ] ARE IN MM

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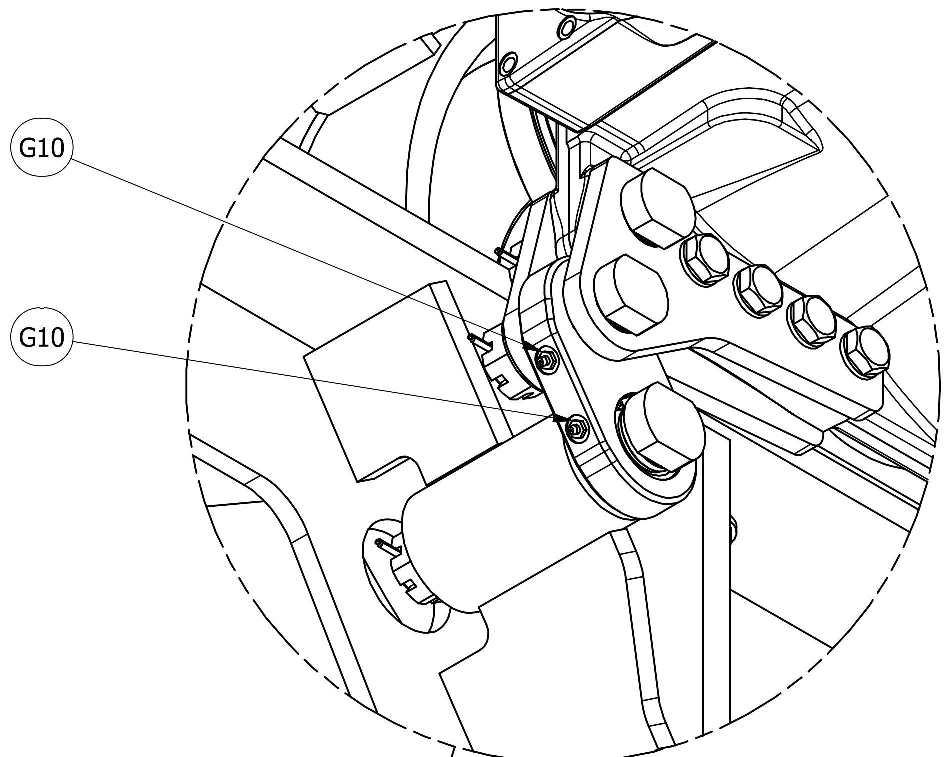
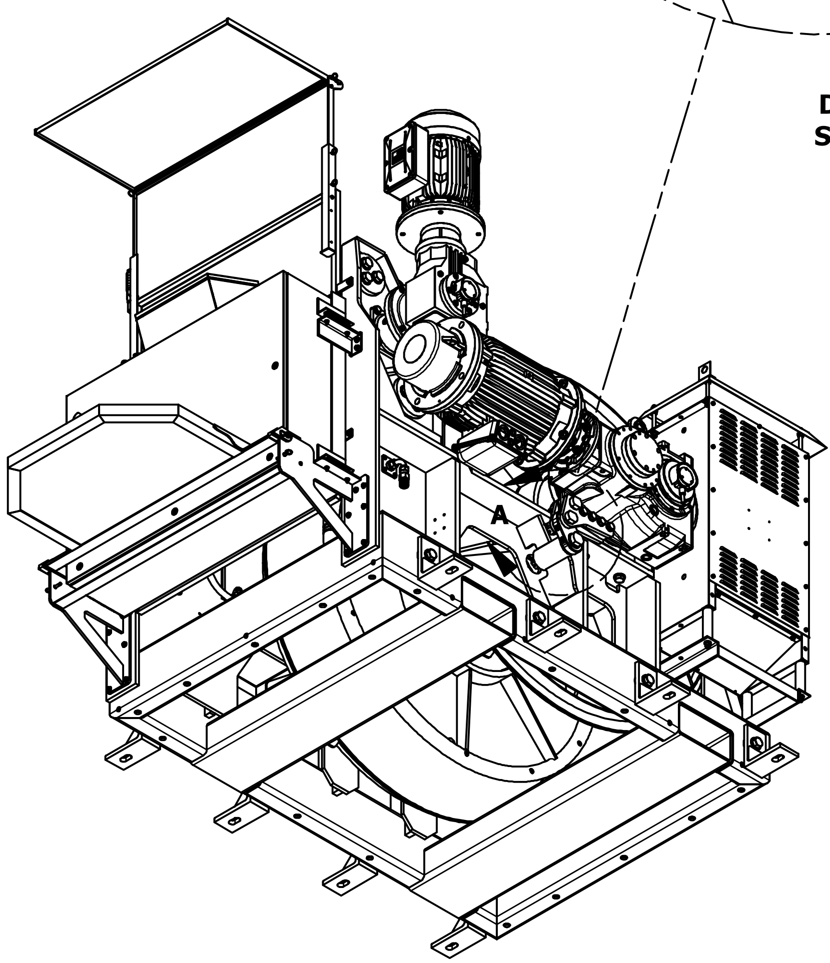
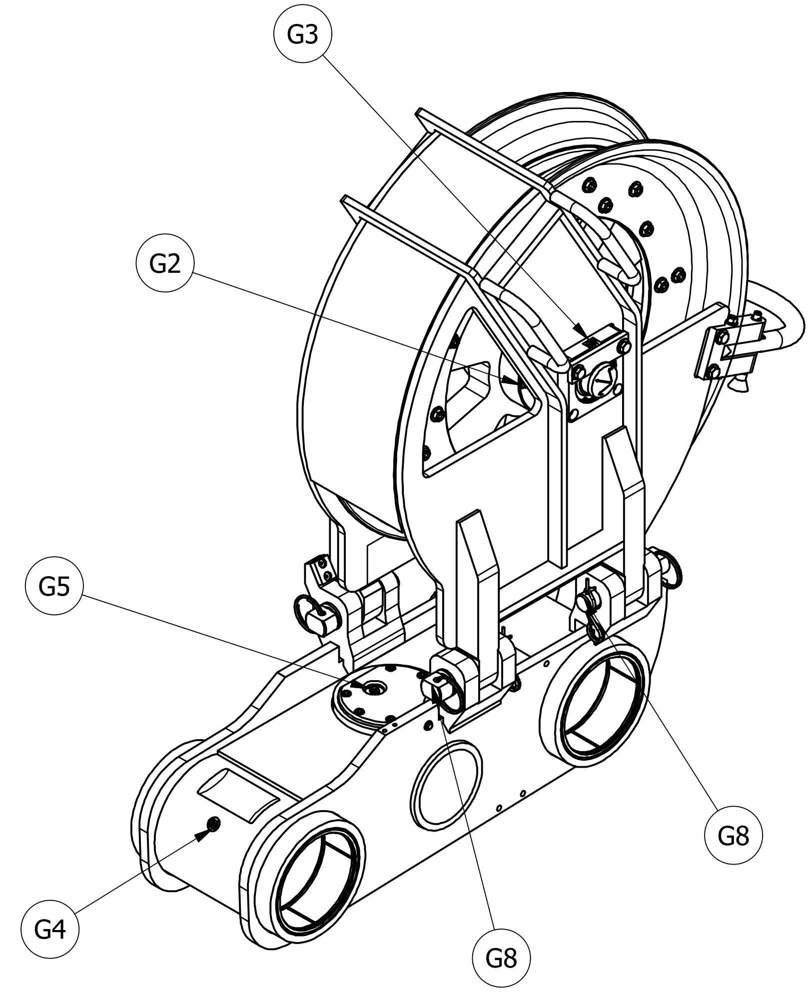
WHOLE NUMBER ± 1/16	2 PLC. DECIMAL ± .01	MATL CERT	TITLE SPRE-3464 LUBRICATION DIAGRAM
FRACTIONAL ± 1/16	3 PLC. DECIMAL ± .005	MATL TEST	NEXT ASSEMBLY F400942
ANGLES ± 1/2°	4 PLC. DECIMAL ± .0005		DERIVED FROM
BREAK ALL SHARP CORNERS AND EDGES		WELD TEST	FIRST USED ON WO 1942
			SHEET 1 OF 2
FINISH ON MACHINED SURFACES 125		EST LBS 0 lbmass	DRAWN NSW / CHECKED DHM / APPROVED DHM
		ACT LBS	DATE 29-Feb-20 / SCALE 1/30
			34-00304-082 / REV

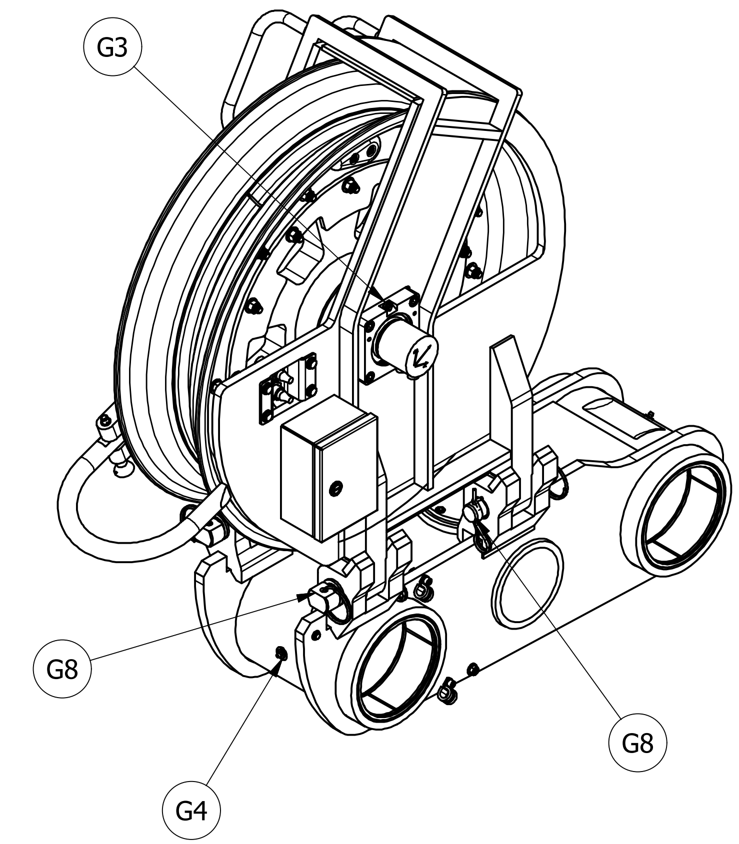


DETAIL A
SCALE 1/5





ISO RIGHT
SCALE 1/10



ISO LEFT
SCALE 1/10

STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

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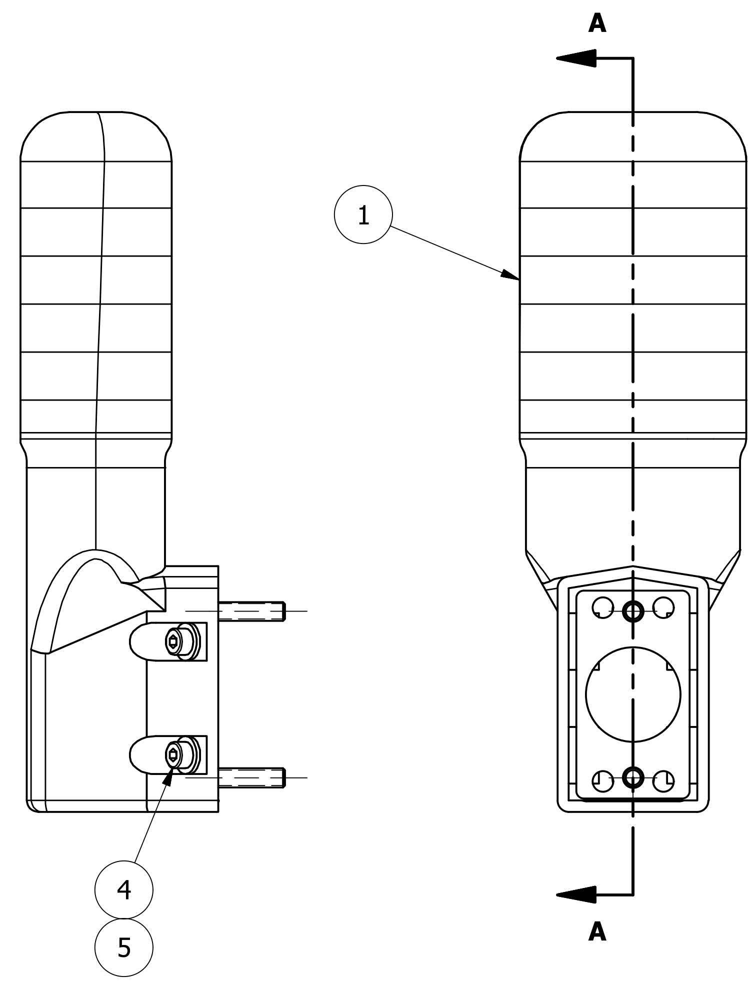
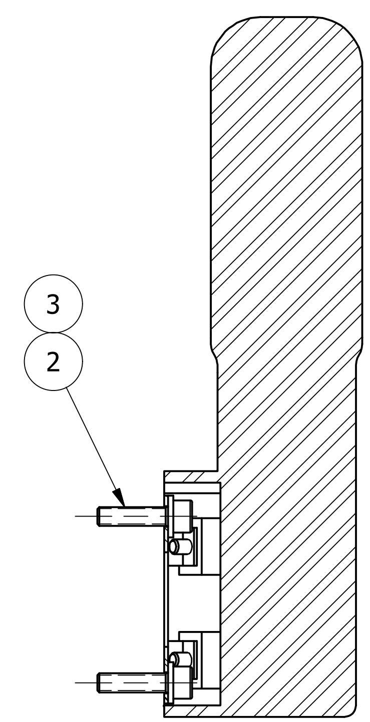
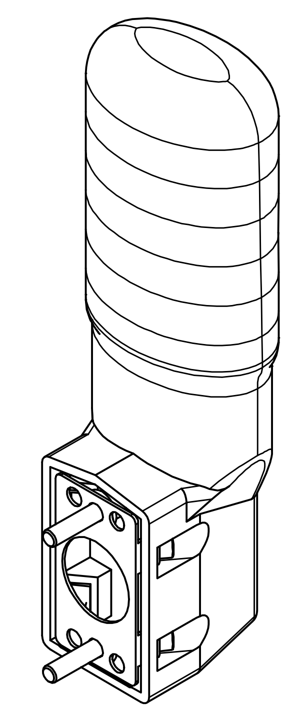
WHOLE NUMBER ± 1/16	2 PLC. DECIMAL ± .01	MATL CERT		TITLE SPRE-3464 LUBRICATION DIAGRAM		
FRACTIONAL ± 1/16	3 PLC. DECIMAL ± .005	MATL TEST		NEXT ASSEMBLY F400942	DERIVED FROM	
ANGLES ± 1/2°	4 PLC. DECIMAL ± .0005	WELD TEST		FIRST USED ON WO 1942	SHEET 2	OF 2
BREAK ALL SHARP CORNERS AND EDGES		EST LBS	0 lbmass	DRAWN NSW / CHECKED DHM / APPROVED DHM	34-00304-082	REV
FINISH ON MACHINED SURFACES 125		ACT LBS		DATE 29-Feb-20 / SCALE 1/30		

ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	5406402		LIGHT, BEACON, RED, YELLOW, 24VDC, IP65		1
2	300558		SHCS M5-0.80 X 20 MM LG	SS A4	2
3	255555		FLAT WASHER- M5	SS A4	2
4	300451		SHCS M4-0.70 X 8 MM LG	SS A4	4
5	255554		FLAT WASHER- M4	SS A4	4





SECTION A-A
SCALE 1/2



NOTES:

1) REPLACE INCLUDED BEACON FASTENERS WITH 316 SS FASTENERS.

2) PAINT METAL MOUNTING PLATE.

STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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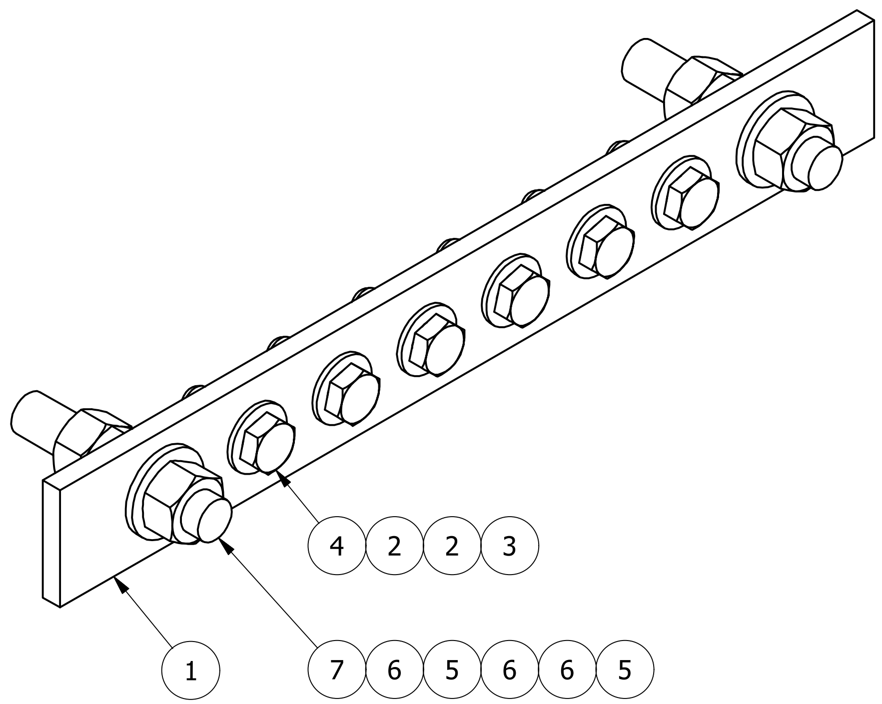
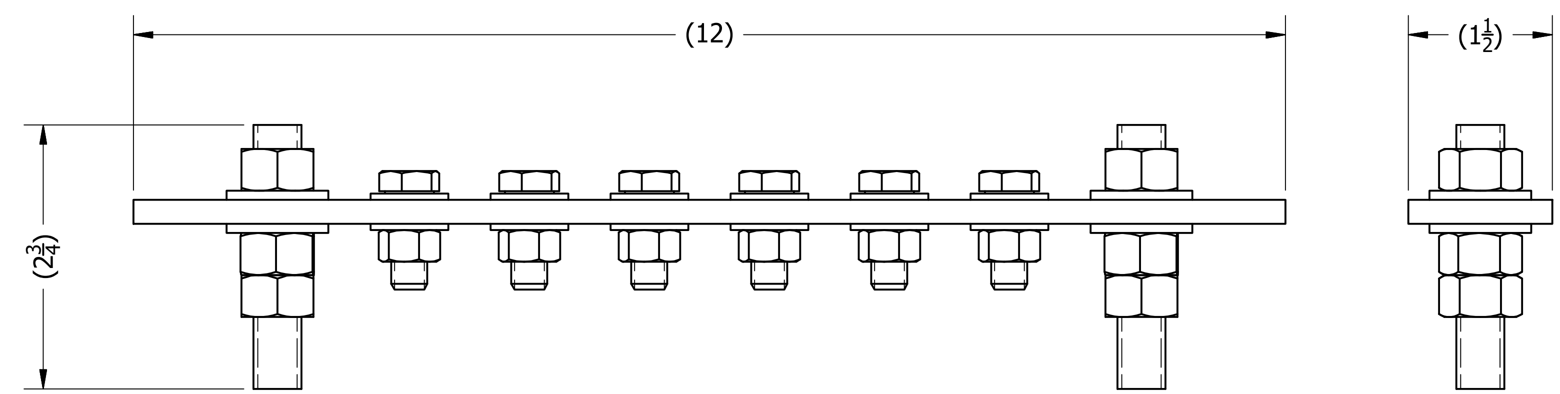
MATL CERT	
MATL TEST	
WELD TEST	
EST LBS	1 lbmass
ACT LBS	

TITLE	ASSEMBLY - BEACON KIT
NEXT ASSEMBLY	34-00297-001
DERIVED FROM	
FIRST USED ON WO	1928
SHEET	1
OF	1
DRAWN	PMK
CHECKED	NSW
APPROVED	NSW
DATE	06-Nov-19
SCALE	1/2
DRAWING NO.	34-00304-085
REV	

ITEM	PART NUMBER	OPER	DESCRIPTION	MATERIAL	UNIT QTY
1	34-00304-457		GROUNDING BOSS		1
2	181074		FLAT WASHER- 3/8	SS 316	12
3	181204		HEX NUT- 3/8-16NC	SS 316	6
4	187306		HHCS 3/8-16NC X 1 LG	SS 316	6
5	181076		FLAT WASHER- 1/2	SS 316	4
6	181206		HEX NUT- 1/2-13NC	SS 316	6
7	128131		2 3/4 LG - 1/2 DIA THREADED ROD	SS 316	2





STANDARD TOLERANCE
UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN [ ] ARE IN MM

WHOLE NUMBER	± 1/16	2 PLC. DECIMAL	± .01
FRACTIONAL	± 1/16	3 PLC. DECIMAL	± .005
ANGLES	± 1/2°	4 PLC. DECIMAL	± .0005

BREAK ALL SHARP CORNERS AND EDGES

FINISH ON MACHINED SURFACES 125

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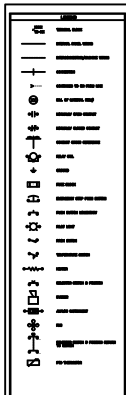
MATL CERT		TITLE	ASSEMBLY - BONDING/GROUNDING KIT
MATL TEST		NEXT ASSEMBLY 34-00304-001	DERIVED FROM 5011796
WELD TEST		FIRST USED ON WO 1942	SHEET 1 OF 1
EST LBS	2 lbmass	DRAWN STC / CHECKED NSW / APPROVED DHM	34-00304-089 REV
ACT LBS		DATE 06-Feb-20 / SCALE 1/2	



CONDUCTOR COLOR AND SIZE

WIRE TYPE :R90, RW90, T90 NYLON, SOOW,TEW

CIRCUIT TYPE	COLOUR	SIZE
24VDC(+)	BLUE	18 AWG
24VDC(-)	BLUE/WHITE STRIPE	18 AWG
EARTH	GREEN/YELLOW STRIPE	AS INDICATED
120VAC	RED	16 AWG
NEUTRAL	WHITE	16 AWG
220VAC	BLACK	14 AWG
SAFETY E-STOP	ORANGE	18 AWG
SAFETY RESET	ORANGE	18 AWG
POWER	BLACK	AS AMPERE REQUIREMENT

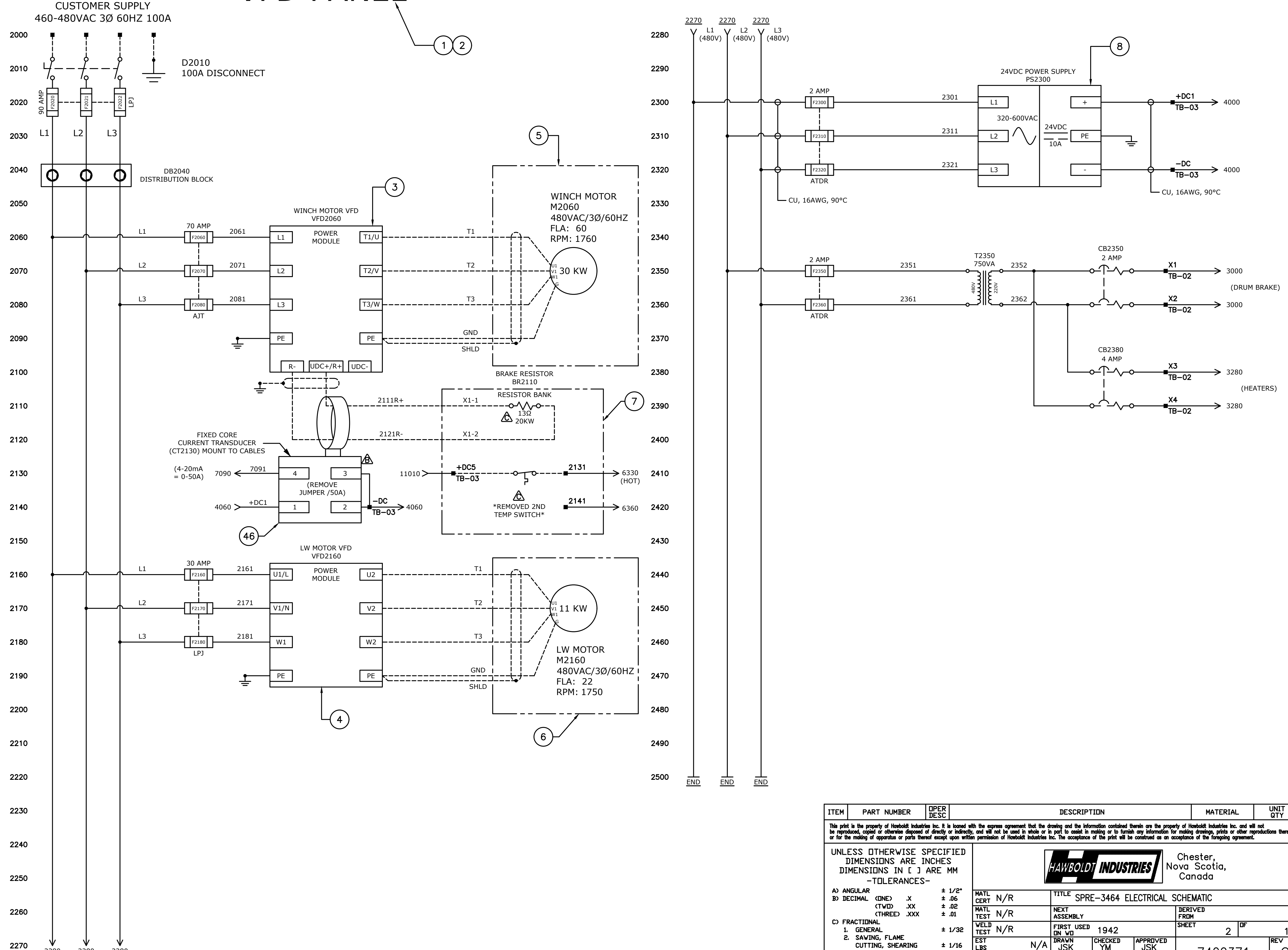
7400371

C

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD

VFD PANEL

NOTE:
ALL BUILDER SELECTED EXTERNAL PANEL COMPONENTS TO BE NEMA 4X OR GREATER.



ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
DIMENSIONS IN [ ] ARE MM
-TOLERANCES-

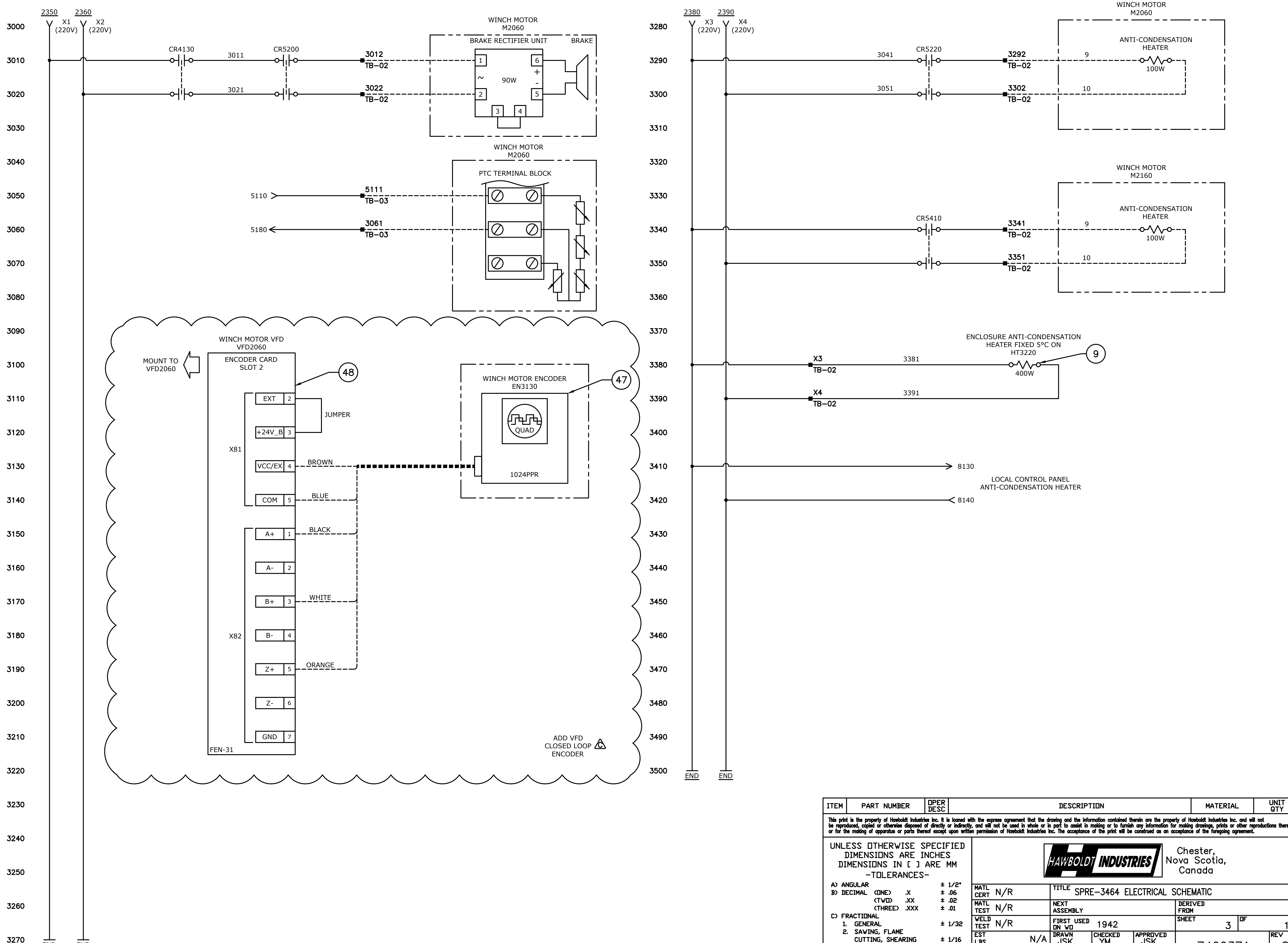
A) ANGULAR	± 1/2°
B) DECIMAL (ONE) .X	± .06
(TWO) .XX	± .02
(THREE) .XXX	± .01
C) FRACTIONAL	
1. GENERAL	± 1/32
2. SAWING, FLAME CUTTING, SHEARING & BREAKING	± 1/16
3. WELDING	± 1/8

HAWBOLDT INDUSTRIES — Chester, Nova Scotia, Canada

MATL CERT N/R	TITLE SPRE-3464 ELECTRICAL SCHEMATIC		
MATL TEST N/R	NEXT ASSEMBLY	DERIVED FROM	
WELD TEST N/R	FIRST USED ON WO 1942	SHEET 2	OF 11
EST LBS N/A	DRAWN JSK	CHECKED YM	APPROVED JSK
ACT LBS N/A	DATE 10OCT19	SCALE 1/1	7400371 REV C

VFD PANEL

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD



ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
DIMENSIONS IN [ ] ARE MM
-TOLERANCES-

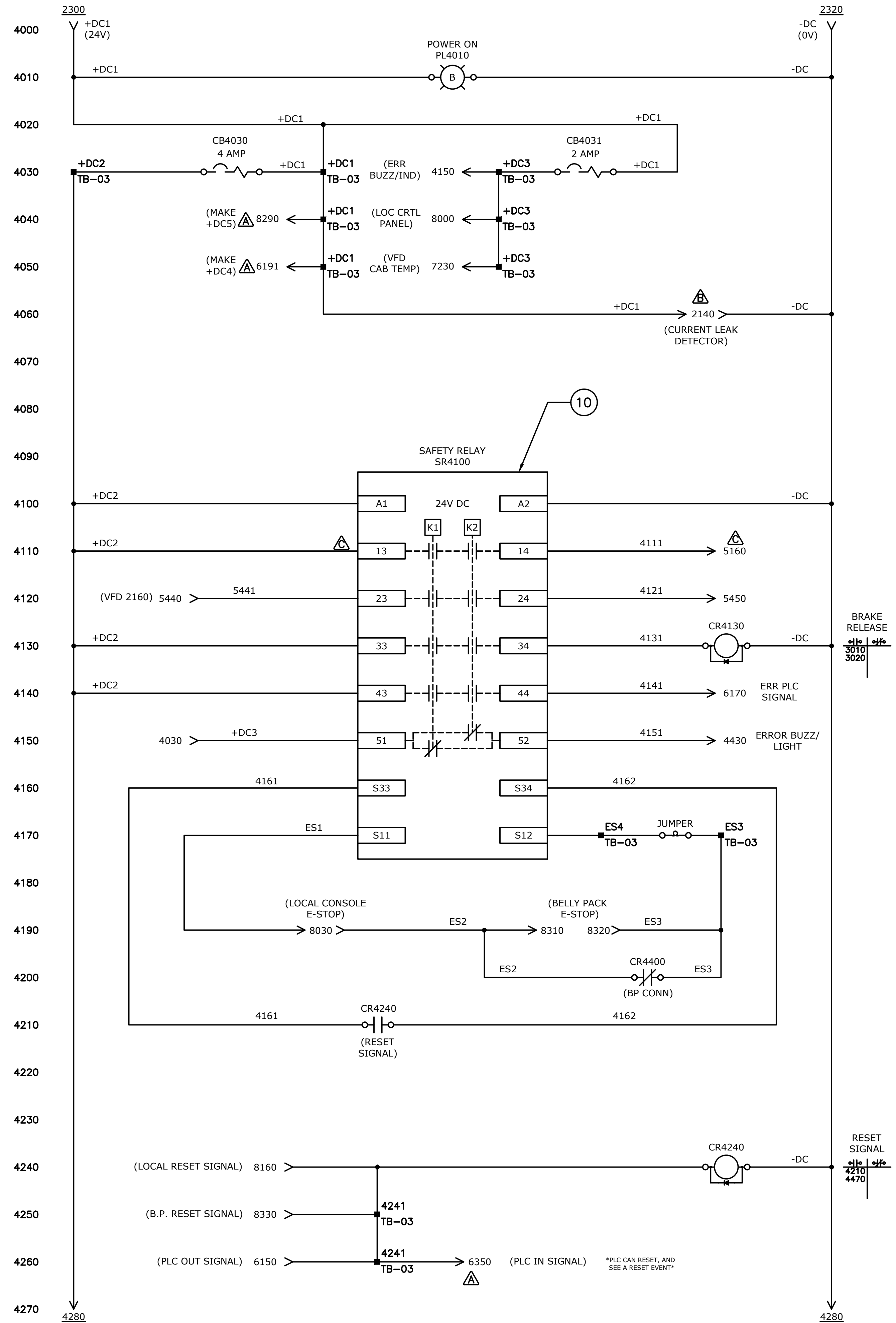
A) ANGULAR			± 1/2°
B) DECIMAL	(ONE)	.X	± .06
	(TWO)	.XX	± .02
	(THREE)	.XXX	± .01
C) FRACTIONAL			
1. GENERAL			± 1/32
2. SAWING, FLAME CUTTING, SHEARING & BREAKING			± 1/16
3. WELDING			± 1/8

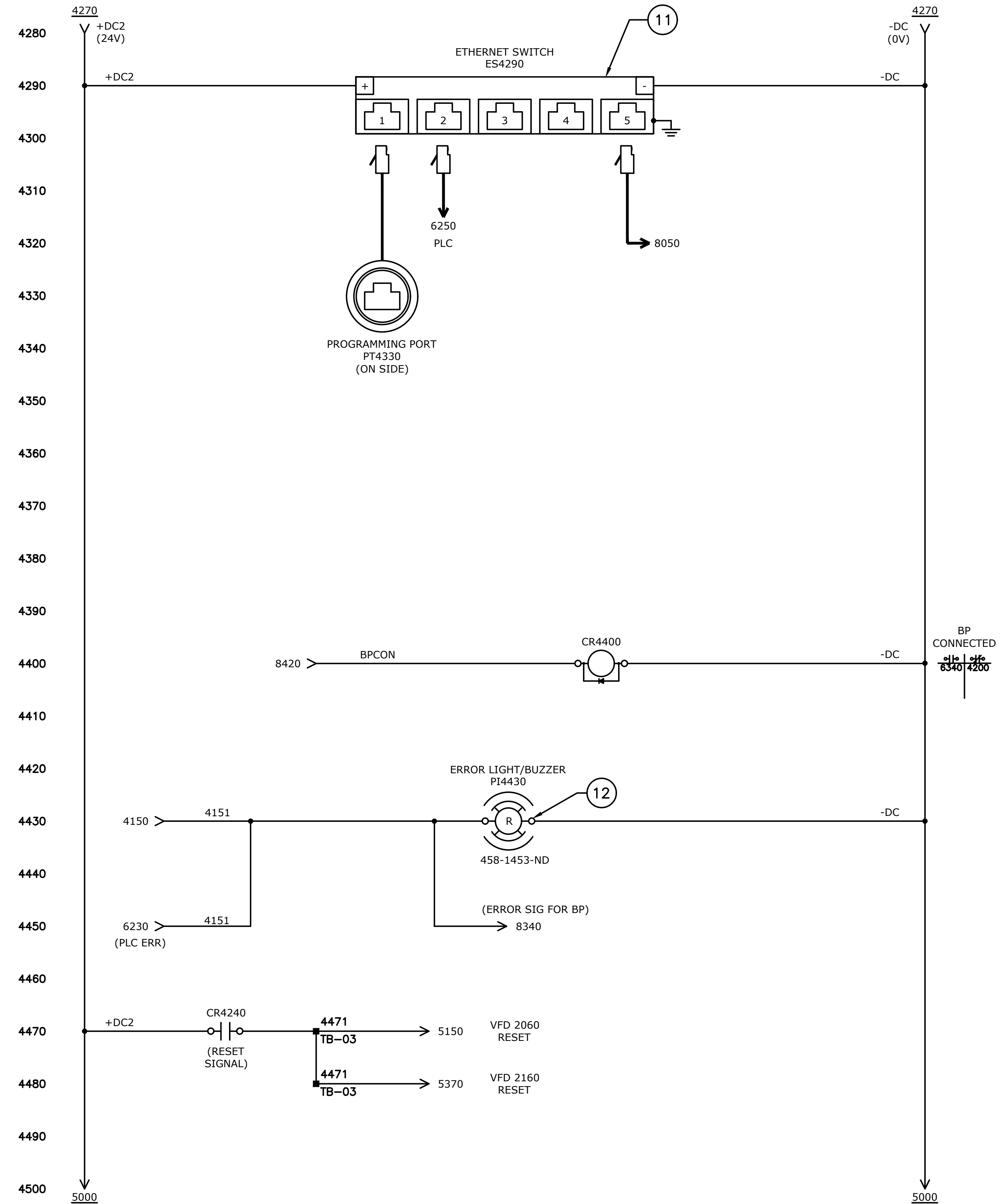
HAWBOLDT INDUSTRIES
Chester, Nova Scotia, Canada

MATL CERT N/R	TITLE SPRE-3464 ELECTRICAL SCHEMATIC		
MATL TEST N/R	NEXT ASSEMBLY	DERIVED FROM	
WELD TEST N/R	FIRST USED ON WO 1942	SHEET 3	OF 11
EST LBS N/A	DRAWN JSK / CHECKED YM / APPROVED JSK	7400371	REV C
ACT LBS N/A	DATE 10OCT19 / SCALE 1/1		

VFD PANEL

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD





ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
DIMENSIONS IN [ ] ARE MM
-TOLERANCES-

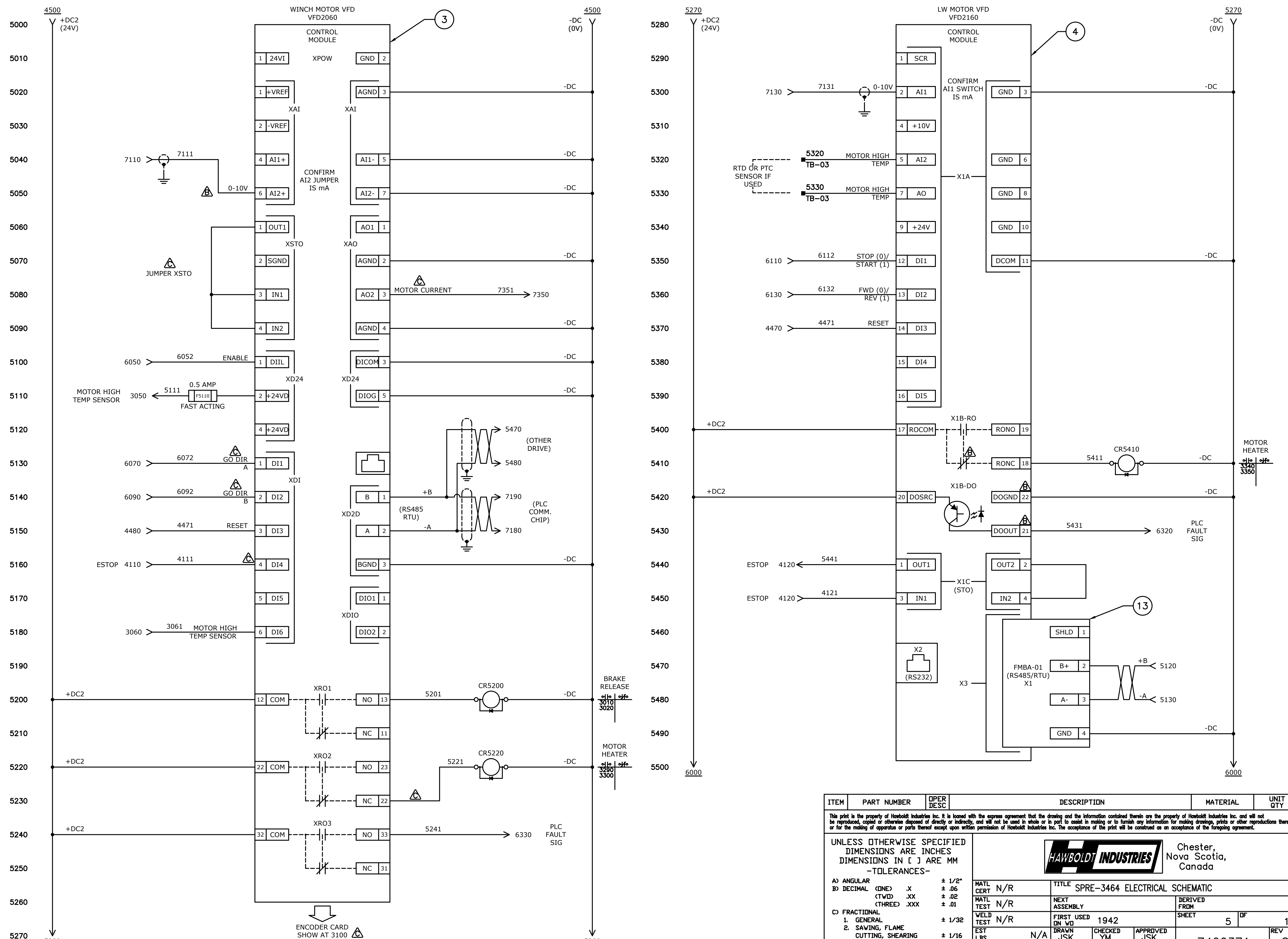
A) ANGULAR		± 1/2°
B) DECIMAL	(ONE) .X	± .06
	(TWO) .XX	± .02
	(THREE) .XXX	± .01
C) FRACTIONAL		
1. GENERAL		± 1/32
2. SAWING, FLAME CUTTING, SHEARING & BREAKING		± 1/16
3. WELDING		± 1/8

HAWBOLDT INDUSTRIES — Chester, Nova Scotia, Canada

MATL CERT N/R	TITLE SPRE-3464 ELECTRICAL SCHEMATIC		
MATL TEST N/R	NEXT ASSEMBLY	DERIVED FROM	
WELD TEST N/R	FIRST USED ON WO 1942	SHEET 4	OF 11
EST LBS N/A	DRAWN JSK / CHECKED YM / APPROVED JSK	7400371	REV C
ACT LBS N/A	DATE 10OCT19 / SCALE 1/1		

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD

VFD PANEL



ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
DIMENSIONS IN [ ] ARE MM
-TOLERANCES-

A) ANGULAR		± 1/2°
B) DECIMAL	(ONE) .X	± .06
	(TWO) .XX	± .02
	(THREE) .XXX	± .01
C) FRACTIONAL		
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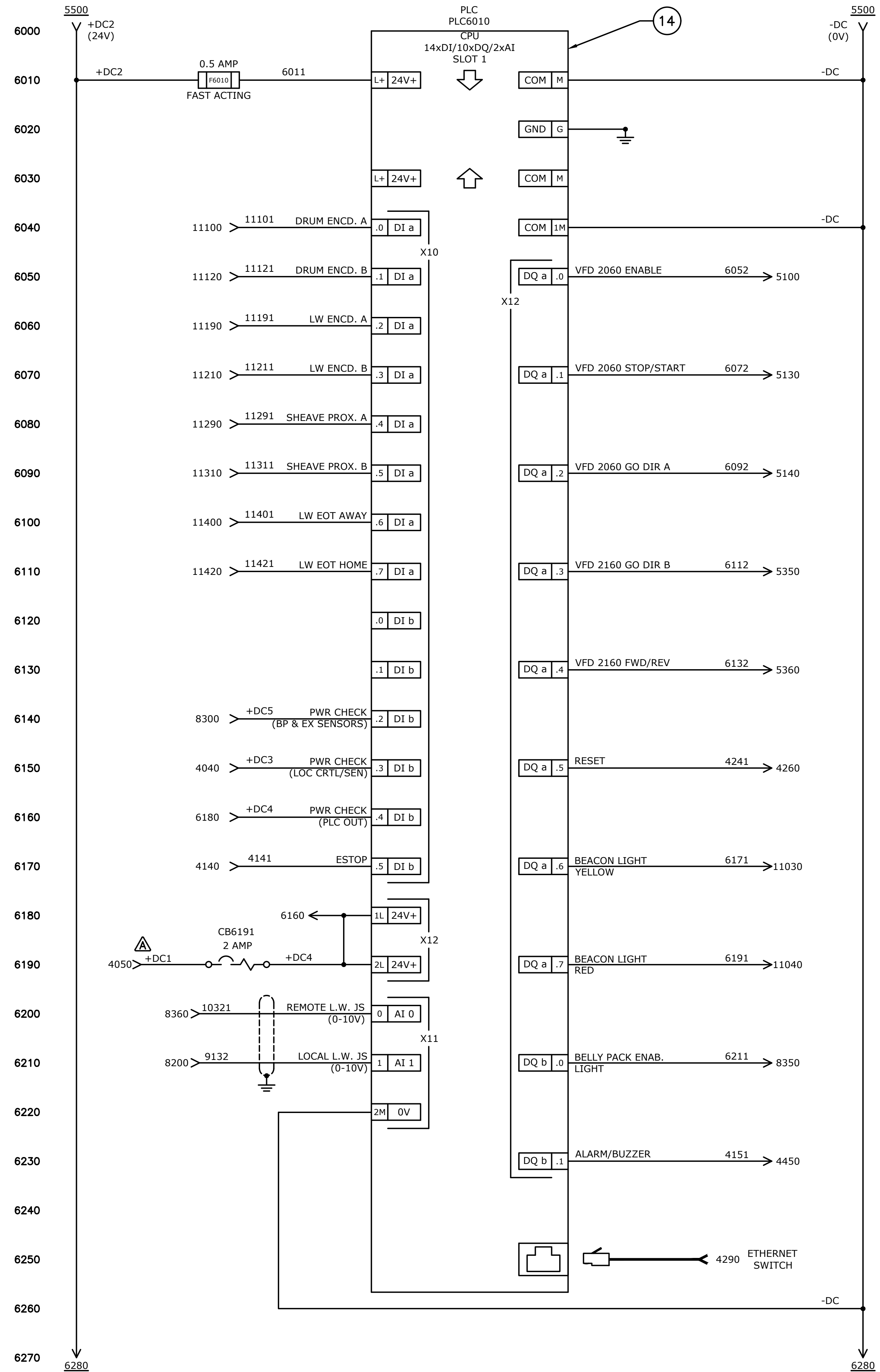
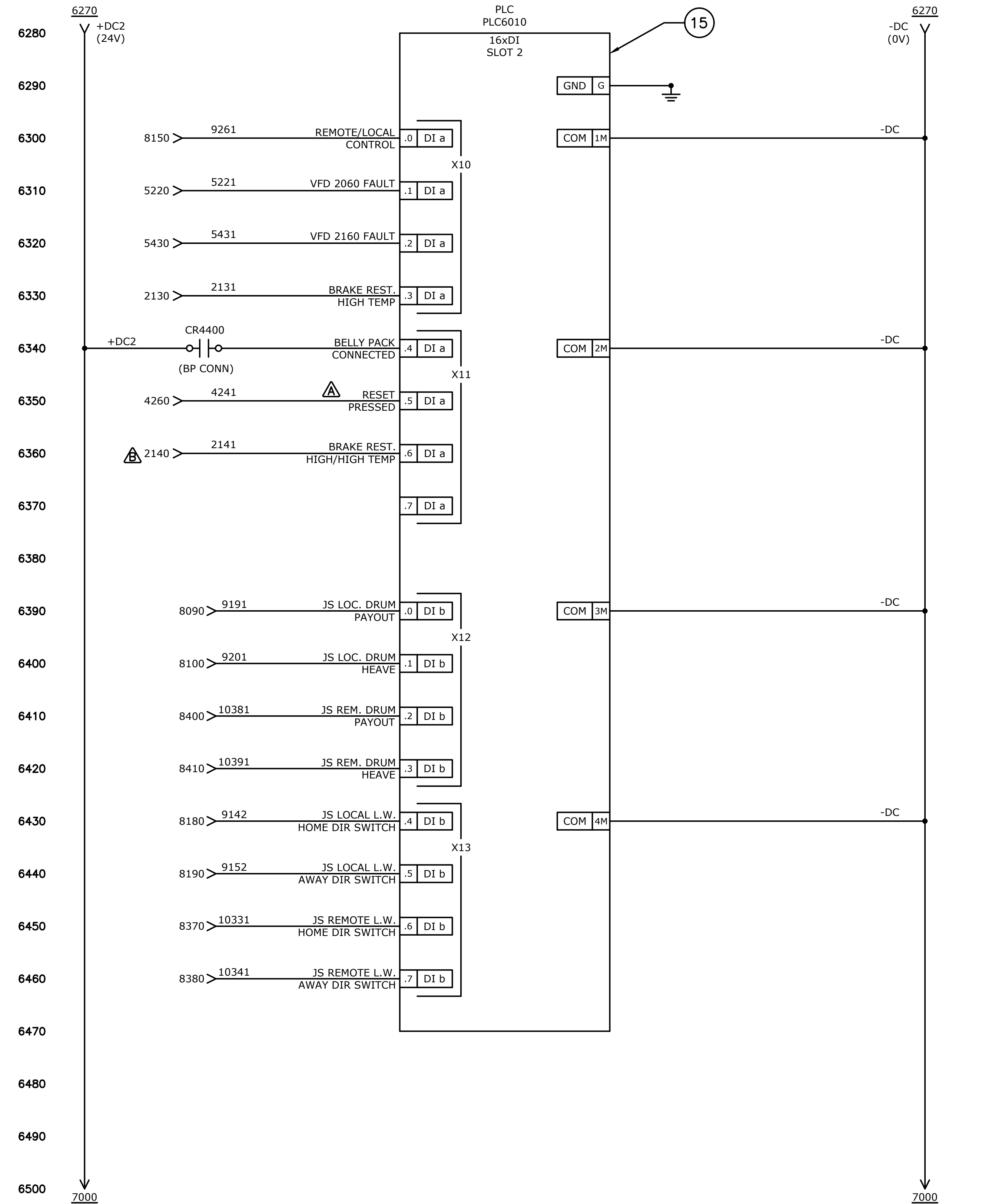
HAWBOLDT INDUSTRIES
Chester, Nova Scotia, Canada

MATL CERT N/R	TITLE SPRE-3464 ELECTRICAL SCHEMATIC		
MATL TEST N/R	NEXT ASSEMBLY	DERIVED FROM	
WELD TEST N/R	FIRST USED ON WO 1942	SHEET 5	OF 11
EST LBS N/A	DRAWN JSK / CHECKED YM / APPROVED JSK	7400371	REV C
ACT LBS N/A	DATE 10OCT19 / SCALE 1/1		

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APP'D

VFD PANEL





ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY

UNLESS OTHERWISE SPECIFIED
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DIMENSIONS IN [ ] ARE MM
-TOLERANCES-

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	(TWO) .XX	± .02
	(THREE) .XXX	± .01
C) FRACTIONAL		
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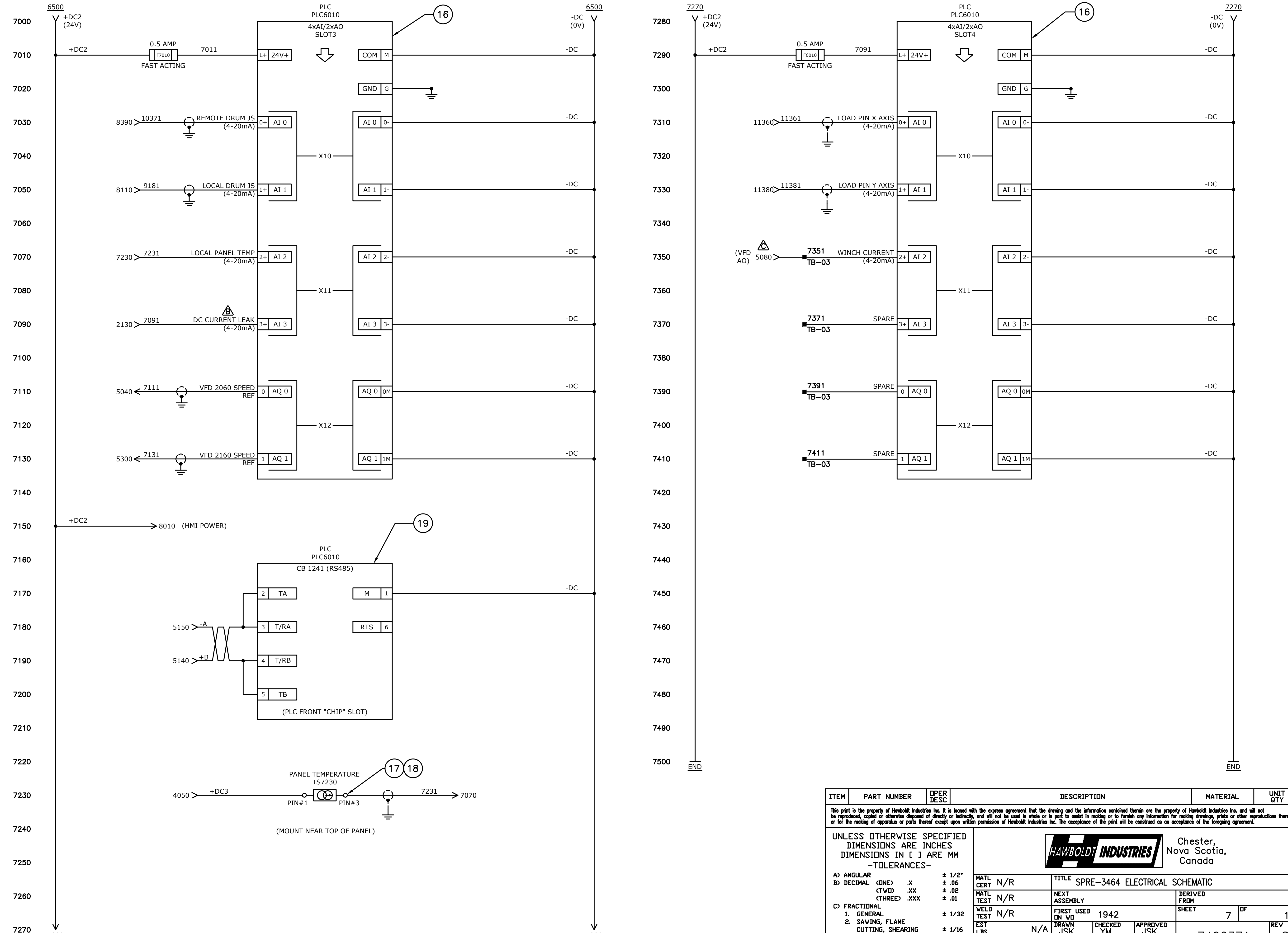
3. WELDING		± 1/8

HAWBOLDT INDUSTRIES — Chester, Nova Scotia, Canada

MATL CERT: N/R	TITLE: SPRE-3464 ELECTRICAL SCHEMATIC		
MATL TEST: N/R	NEXT ASSEMBLY	DERIVED FROM	
WELD TEST: N/R	FIRST USED ON WO: 1942	SHEET 6	OF 11
EST LBS: N/A	DRAWN: JSK / CHECKED: YM / APPROVED: JSK	7400371	REV: C
ACT LBS: N/A	DATE: 10OCT19 / SCALE: 1/1		

VFD PANEL

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD



ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY

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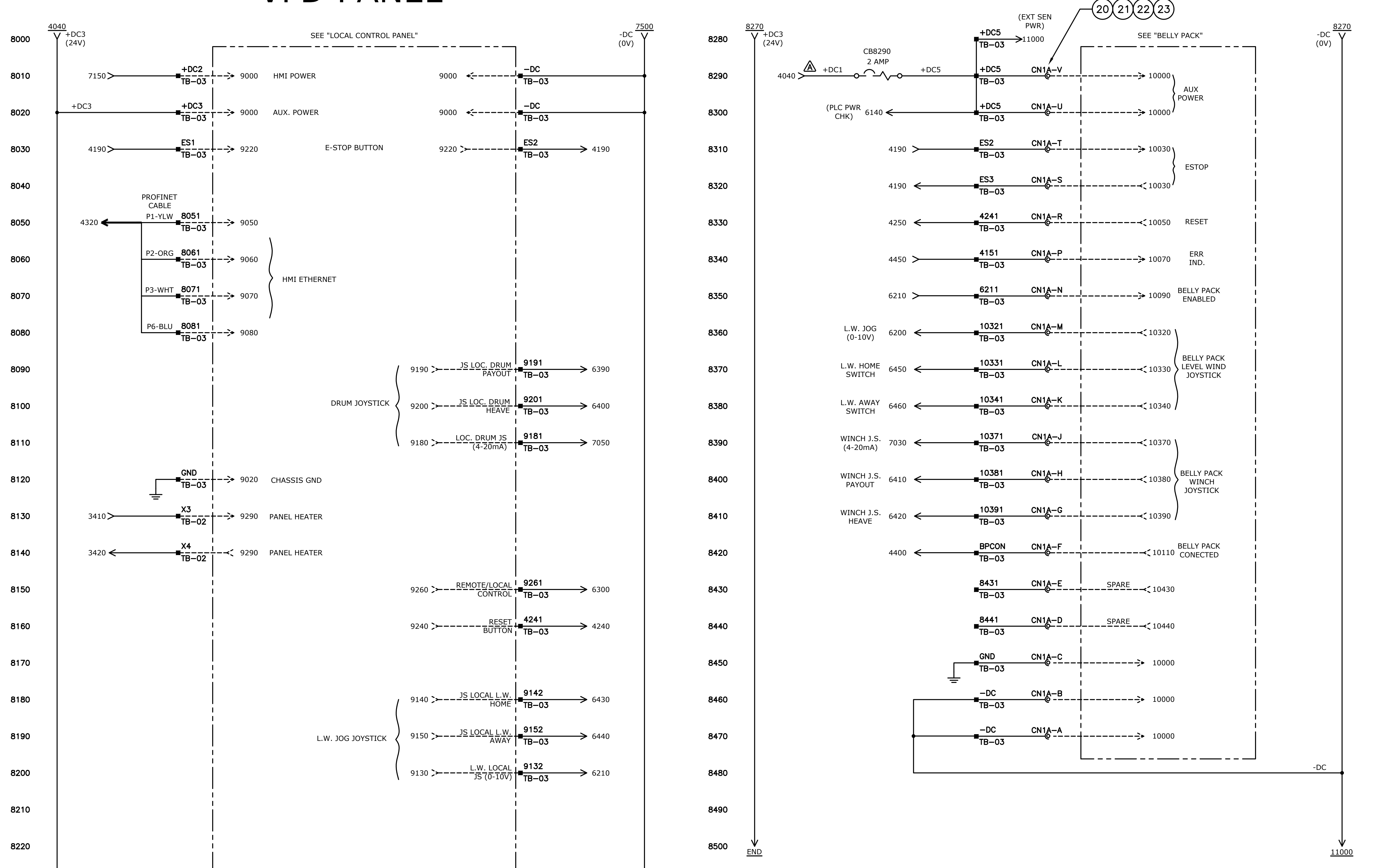
HAWBOLDT INDUSTRIES
Chester, Nova Scotia, Canada

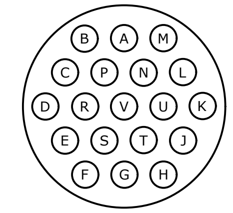
MATL CERT N/R	TITLE SPRE-3464 ELECTRICAL SCHEMATIC		
MATL TEST N/R	NEXT ASSEMBLY	DERIVED FROM	
WELD TEST N/R	FIRST USED ON WO 1942	SHEET 7	OF 11
EST LBS N/A	DRAWN JSK / CHECKED YM / APPROVED JSK	7400371	REV C
ACT LBS N/A	DATE 10OCT19 / SCALE 1/1		

VFD PANEL

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD



SOURIAU 19 REF. PINOUT



ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY

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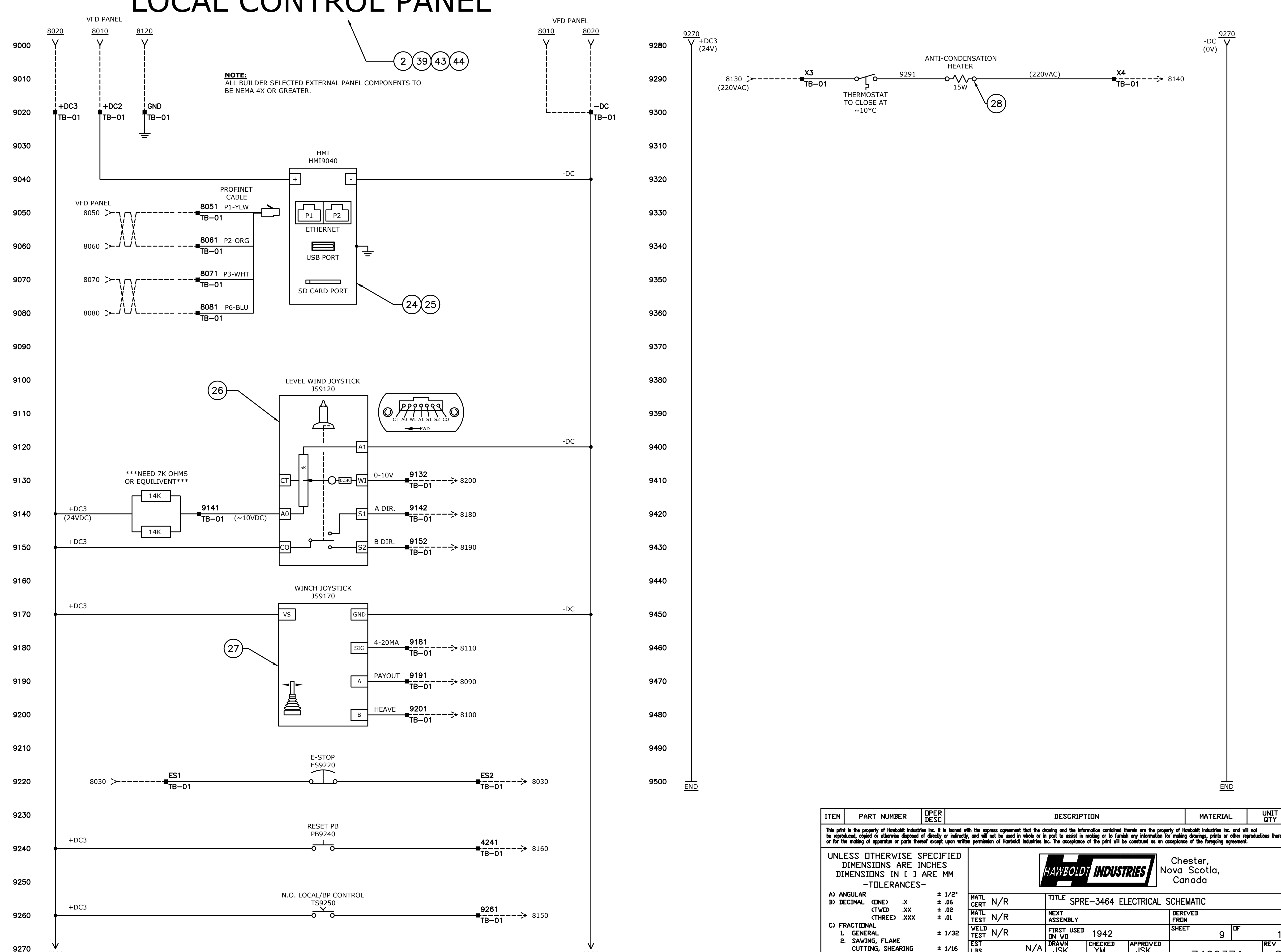
HAWBOLDT INDUSTRIES — Chester, Nova Scotia, Canada

MATL CERT N/R	TITLE SPRE-3464 ELECTRICAL SCHEMATIC		
MATL TEST N/R	NEXT ASSEMBLY	DERIVED FROM	
WELD TEST N/R	FIRST USED ON WO 1942	SHEET 8	OF 11
EST LBS N/A	DRAWN JSK / CHECKED YM / APPROVED JSK	7400371	REV C
ACT LBS N/A	DATE 10OCT19 / SCALE 1/1		

LOCAL CONTROL PANEL

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD



ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
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-TOLERANCES-

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(TWO) .XX ± .02
(THREE) .XXX ± .01
C) FRACTIONAL
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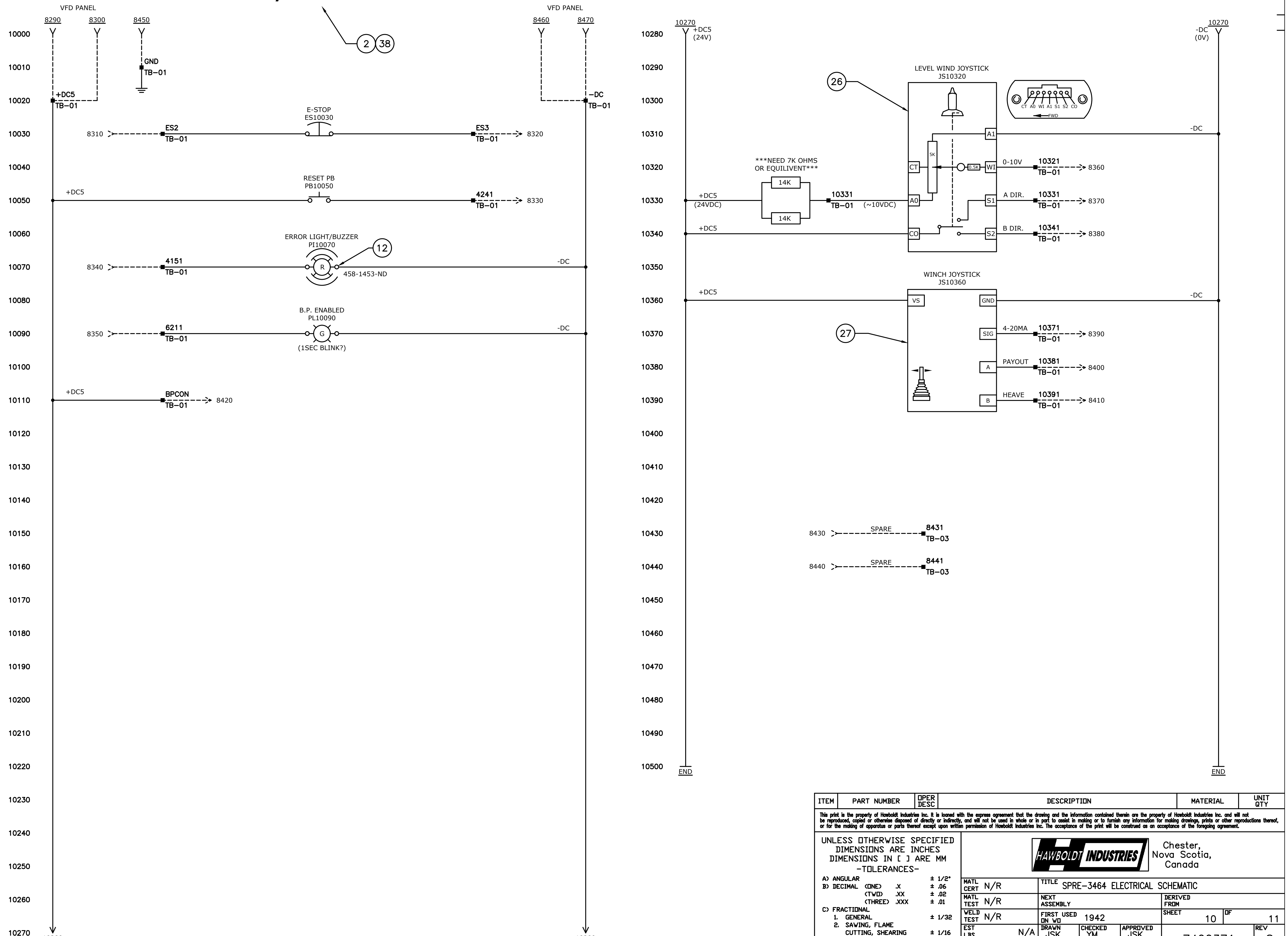
2. SAWING, FLAME CUTTING, SHEARING & BREAKING ± 1/16
3. WELDING ± 1/8

HAWBOLDT INDUSTRIES
Chester, Nova Scotia, Canada

MATL CERT N/R	TITLE SPRE-3464 ELECTRICAL SCHEMATIC		
MATL TEST N/R	NEXT ASSEMBLY	DERIVED FROM	
WELD TEST N/R	FIRST USED ON WO 1942	SHEET 9	OF 11
EST LBS N/A	DRAWN JSK / CHECKED YM / APPROVED JSK	7400371	REV C
ACT LBS N/A	DATE 10OCT19 / SCALE 1/1		

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD

REMOTE/BELLY PACK



ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY

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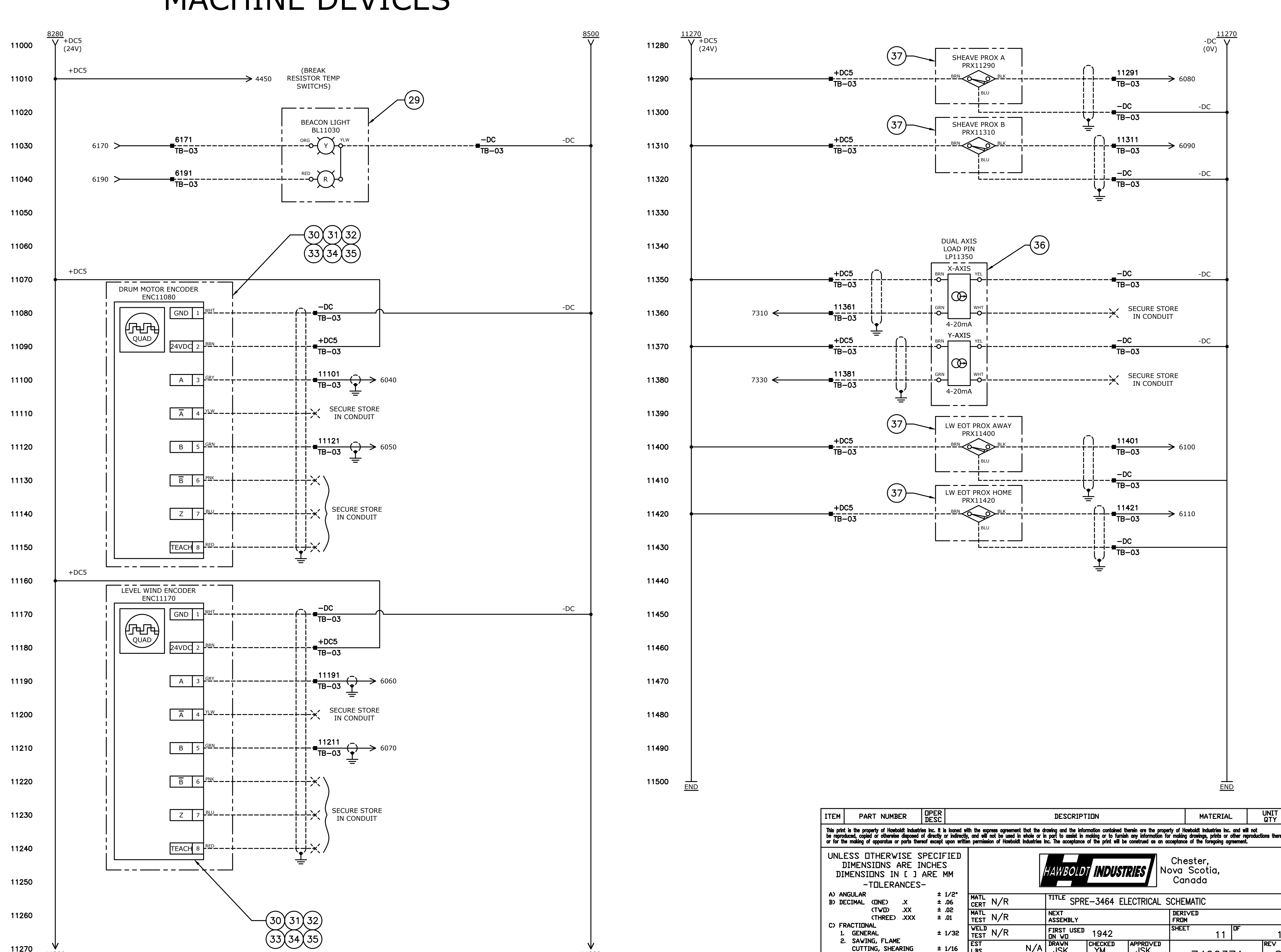
HAWBOLDT INDUSTRIES
Chester, Nova Scotia, Canada

MATL CERT	N/R
MATL TEST	N/R
WELD TEST	N/R
EST LBS	N/A
ACT LBS	N/A
TITLE	SPRE-3464 ELECTRICAL SCHEMATIC
NEXT ASSEMBLY	
DERIVED FROM	
FIRST USED ON WO	1942
SHEET	10
OF	11
DRAWN	JSK
CHECKED	YM
APPROVED	JSK
DATE	10OCT19
SCALE	1/1
DRAWING NO.	7400371
REV	C

MACHINE DEVICES

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APP'D



ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY

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C) FRACTIONAL		
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3. WELDING		± 1/8

HAWBOLDT INDUSTRIES
Chester, Nova Scotia, Canada

MATL CERT N/R	TITLE SPRE-3464 ELECTRICAL SCHEMATIC		
MATL TEST N/R	NEXT ASSEMBLY	DERIVED FROM	
WELD TEST N/R	FIRST USED ON WO 1942	SHEET 11	OF 11
EST LBS N/A	DRAWN JSK	CHECKED YM	APPROVED JSK
ACT LBS N/A	DATE 10OCT19	SCALE 1/1	7400371 REV C

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD
A	01NOV19	4162	ADDED LAYOUT SHEET WITH DECALS, ADD JUNCTION BOX	JSK	

SPECIFICATIONS

1. PANEL DESIGN AND BUILD SHALL BE PER ELECTRICAL SCHEMATIC 7400371.
2. "VFD PANEL" PROVIDED BY HAWBOLDT SHALL HAVE THE HINGE ON THE TOP SIDE. "LOCAL CONTROL PANEL" PROVIDED BY HAWBOLDT SHALL HAVE THE HINGE ON THE TOP.
3. ALL EXTERNAL / THROUGH COMPONENTS ON ENCLOSURES SHALL HAVE NEMA 4X OR GREATER SEALING. BUILD AND SELECT COMPONENTS FOR MARINE USE.
4. ALL TERMINAL BLOCKS SHALL HAVE NON-LOOSING FEATURE (SPRING / DETENT)
5. 10% SPARE TERMINAL BLOCKS SHALL BE PROVIDED IF SPACE IS AVAILABLE.
6. TERMINAL BLOCK SECTION SHALL BE IDENTIFIED WITH THE IDENTIFIER INDICATED ON THE DRAWINGS.
7. ALL WIRES TO BE FERRULED.
8. ALL WIRE NUMBERS ARE TO BE SELF-LAMINATING OR THERMAL TRANSFER HEAT SHRINK TYPE.
9. ALL COMPONENTS WITHIN THE ENCLOSURES SHALL BE IDENTIFIED WITH ENGRAVED LAMINATED PLASTIC OR EQUIVALENT NAMEPLATES.
10. NO SUBSTITUTIONS WILL BE PERMITTED WITHOUT PREVIOUS AUTHORIZATION FROM HAWBOLDT OR ITS AGENTS.
11. NAMEPLATES SHALL BE SUPPLIED FOR ALL COMPONENTS OUTSIDE OF PANEL.
12. JUMPERS TO BE INSTALLED ON TERMINALS AS REQUIRED.
13. PANEL BUILDER WILL SUPPLY ALL MATERIALS AND COMPONENTS EXCEPT FREE-ISSUED PARTS.
14. PANEL BUILDER WILL BE RESPONSIBLE FOR ALL ASPECTS OF THE ELECTRICAL INSTALLATION:
    *SECURING OF CABLES OR CONDUITS
    *LAYOUT AND DRILLING OR PUNCHING HOLES IN ALL ENCLOSURES
    *ROUTING OF CABLES
    *FASTENERS FOR CONDUITS OR CABLES AND CABLE BUNDLING (TIE-RAPS)
15. PANEL BUILDER WILL ENSURE THAT PANEL DOES NOT EXCEED RECOMMENDED SIZE, WHERE STATED, AND WILL FIT MECHANICAL FOOTPRINT.
16. ALL PUSH BUTTONS AND OPERATORS SHALL BE SUITABLE AND RATED FOR THE APPLICATION.
17. ALL CONDUCTORS AND CABLES SHALL BE APPROVED FOR THE AREA OF INSTALLATION.
18. PANEL BUILDER HAS FREEDOM OF SELECTION OF OTHER NON FREE-ISSUED COMPONENTS HOWEVER THEY WILL REQUIRE APPROVAL AND MUST COMPLY WITH ALL APPLICABLE CODES AND SPECIFICATIONS.
19. PANEL SHALL BE BUILT TO MAINTAIN INTERNAL "TOUCH SAFE" STATUS
20. ALL DISCONNECT/CONTACTOR LUGS AND DISTRIBUTION BLOCKS SHALL BE SHROUDED, AND ALL FUSE HOLDERS SHALL BE OF DEAD FRONT DESIGN.
21. EARTH CONNECTION SHALL BE AVAILABLE ACROSS THE BOTTOM OF THE PANEL FOR BONDING (GROUND BAR).
22. PILOT LIGHTS AND PUSH BUTTON COLORS SHALL BE AS PER DRAWING.
23. TERMINALS SHALL BE GROUPED ON THE DIN RAIL BY POTENTIAL TO FACILITATE WIRE SEPARATION WITHIN EACH POTENTIAL GROUP.
24. TERMINALS SHALL BE INSTALLED IN NUMERICAL ORDER. CABLE SHIELD DRAIN TERMINALS SHALL BE INSTALLED ADJACENT TO THE TERMINALS UPON WHICH THEIR CABLE'S CONDUCTORS TERMINATE.
25. VOLTAGE SUPPLY DISTRIBUTION TERMINALS (VAC & VDC) SHALL BE GROUPED BY POTENTIAL, AND TERMINALS OF SAME POTENTIAL CONNECTED VIA A COMMON BUS ACROSS THE TERMINALS. THESE SUPPLY GROUPS SHALL BE INDIVIDUALLY SUPPLIED WITH 10% SPARE CAPACITY, OR THE CAPACITY TO CONNECT FOUR ADDITIONAL WIRES, WHICHEVER IS GREATER.
26. WIRES SHALL BE ROUTED IN DUCTS, AND ROUTED TO MAINTAIN SEPARATION OF UNLIKE VOLTAGES WHERE FEASIBLE. DUCTS SHALL BE FILLED NO MORE THAN 40% BY CALCULATED CROSS-SECTIONAL AREA.
27. WHERE NECESSARY TO ROUTE WIRING EXTERNAL TO DUCTS, WIRES SHALL BE NEATLY BUNDLED AND RUN IN PARALLEL/PERPENDICULAR PATHS.
28. ALL SHIELDING, INDIVIDUAL OR GENERAL SHALL HAVE A DRAIN WIRE.
29. PANEL BUILDER SHALL SUBMIT PROPOSED PANEL LAYOUT DRAWINGS TO HAWBOLDT FOR REVIEW BEFORE COMMENCING FABRICATION.
30. CABLES SHALL BE FASTENED AT INTERVALS APPROPRIATE TO ENSURE A NEAT APPEARANCE AND ELIMINATE SAG OR THE POSSIBILITY OF ENTANGLEMENT IN MOVING PARTS.
31. BOLTS, NUTS AND WASHERS USED IN THE CONSTRUCTION OF PANELS SHALL BE STEEL AND TREATED TO RESIST CORROSION.
32. ELECTRICAL DEVICES INSTALLED ON DOORS SHALL BE FULLY INSULATED OR DEVICES SHALL BE BONDED TO DOOR THROUGH INSTRUMENT BODY OR FIXING POINTS.
33. DOORS AND PANELS SHALL BE BONDED TO THE ENCLOSURE USING EXTRA FLEXIBLE BRAIDED COPPER CABLE CONNECTION WIRES FITTED WITH A CABLE LUG AND BOLTED TO A STUD PERMANENTLY AFFIXED TO THE DOOR.
34. EQUIPMENT WITH CURRENT CARRYING COMPONENTS ON HINGED DOORS SHALL HAVE A GROUND WIRE ACROSS DOOR HINGES.
35. ALL GROUND WIRES SHALL BE COLORED GREEN.
36. PANEL BUILDER SHALL SUPPLY ALL PANEL LAYOUT DRAWINGS INCLUDING BILL OF MATERIAL IN CAD FORMAT.
37. CONTROL RELAYS SHALL BE PLUG-IN MINIATURE TYPE.
38. HAWBOLDT RESERVES THE RIGHT TO REVIEW AND REJECT ANY AND ALL PANEL BUILDER SELECTED COMPONENTS.
39. ADHESIVE BACKED TIE WRAPS AND CABLE CLAMPING DEVICES SHALL BE RATED FOR SEVERE USE. HIGH CONDENSATION, TEMPERATURE RANGE, AND GOOD MECHANICAL PULL PROPERTIES ARE DESIRED.
40. WIRING AROUND SHARP EDGES, SUCH AS PANEL DOORS, SHALL BE WRAPPED IN PROTECTIVE SLEEVES SUCH AS SPIRAL WRAP TO PREVENT WIRING INSULATION DAMAGE FROM CHAFFING, CUTTING, OR ABRASION.

SCOPE OF SUPPLY

1. VFD PANEL (QTY = 1)
2. LOCAL CONTROL PANEL (QTY = 1)
3. BELLY PACK (QTY = 1)
4. JUNCTION BOX (QTY = 1) A

* = FREE ISSUE TO PANEL BUILDER

	ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY
A *	45	5401402	1	ENCLOSURE		REF
A *	44	D401010	1	LOCAL CONSOLE LAYOUT		REF
A *	43	D401009	1	LEVELWIND JOG		REF
A *	42	D401008	1	LARGE BELLY PACK DECAL		REF
	41	7400371	1	SPRE-3464 ELECTRICAL SCHEMATIC		REF
	40	7400373	1	SPRE-3464 INTERCONNECT DIAGRAM		REF
*	39	5408660	1	ENCLOSURE, 16X12X6, 316SS		REF
*	38	5407112	1	BELLY PACK; 14X8X4IN; METAL HANDLES		REF
	37	5405988	4	SENSOR, PROXIMITY		REF
	36	34-00304-586	1	LOAD PIN		REF
	35	5406446	2	ENCODER, INCREMENTAL		REF
	34	5406447	2	PROTECTION RING, ENCODER ACCESSORY		REF
	33	5406448	2	COVER, ENCODER ACCESSORY		REF
	32	5406449	2	POSITIONING ELEMENT, ENCODER ACCESSORY		REF
	31	5406450	2	ADAPTER SLEEVE, ENCODER ACCESSORY		REF
	30	5406451	2	CABLE, ENCODER ACCESSORY		REF
	29	5406402	1	LIGHT, BEACON, RED, YELLOW, 24VDC, IP65		REF
*	28	5402033	1	HAMMOND PANEL HEATER - 15W		REF
*	27	5408650	2	JOYSTICK, 20MA-12MA-4MA, DIR SW, LOCK		REF
*	26	5407909	2	JOYSTICK, THUMB, 10-90% OUTPUT		REF
*	25	5406867	1	SD MEMORY CARD, 32GB		REF
*	24	5406400	1	HMI, PANEL, 7IN, DAYLIGHT READABLE		REF
*	23	5406916	1	CONNECTOR, PLUG, 19PIN, FEMALE		REF
*	22	5406243	1	CONNECTOR ACCESSORY, CAP, PLUG		REF
*	21	5406244	1	CONNECTOR ACCESSORY, CAP, RECEPTACLE		REF
*	20	5406915	1	CONNECTOR, RECEPTACLE, 19PIN, MALE		REF
*	19	5408350	1	SIMATIC S7-1200 COMMUNICATION BOARD		REF
*	18	5408674	1	FIELD WIREABLE M12 4-PIN CONNECTOR		REF
*	17	5408671	1	TEMP TRANSMITTER 0-300F 4-20MA		REF
*	16	5406021	2	SIMATIC S7-1200 SIGNAL MODULE 4AI/2AO		REF
*	15	5404756	1	SIMATIC S7-1200 DIGITAL I/O 16DI		REF
*	14	5404607	1	SIMATIC S7-1200 PLC		REF
*	13	5408670	1	ABB MODBUS ADAPTER		REF
*	12	5408669	2	PANEL ERROR BUZZER AND INDICATOR		REF
*	11	5406542	1	UNMANAGED IE SWITCH, 5 PORTS		REF
*	10	5004553	1	24VDC SAFETY RELAY		REF
*	9	5408338	1	HOFFMAN PANEL HEATER - 400W		REF
*	8	5408352	1	POWER SUPPLY, 24VDC		REF
	7	5408621	1	DYNAMIC BRAKE RESISTOR, 22KW		REF
	6	5408557	1	ELECTRIC MOTOR, 11 KW		REF
	5	5408411	1	40HP ELECTRIC MOTOR - 480/3/60		REF
*	4	5408564	1	VFD, 380-480VAC, 23A		REF
*	3	5408563	1	VFD, 380-500VAC, 65A		REF
*	2	5407211	4	ENCLOSURE DRAIN		REF
*	1	5408659	1	ENCLOSURE, 48X36X12, 316SS		REF

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(TWO)	.XX	± .02
(THREE)	.XXX	± .01
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HAWBOLDT INDUSTRIES
Chester, Nova Scotia, Canada

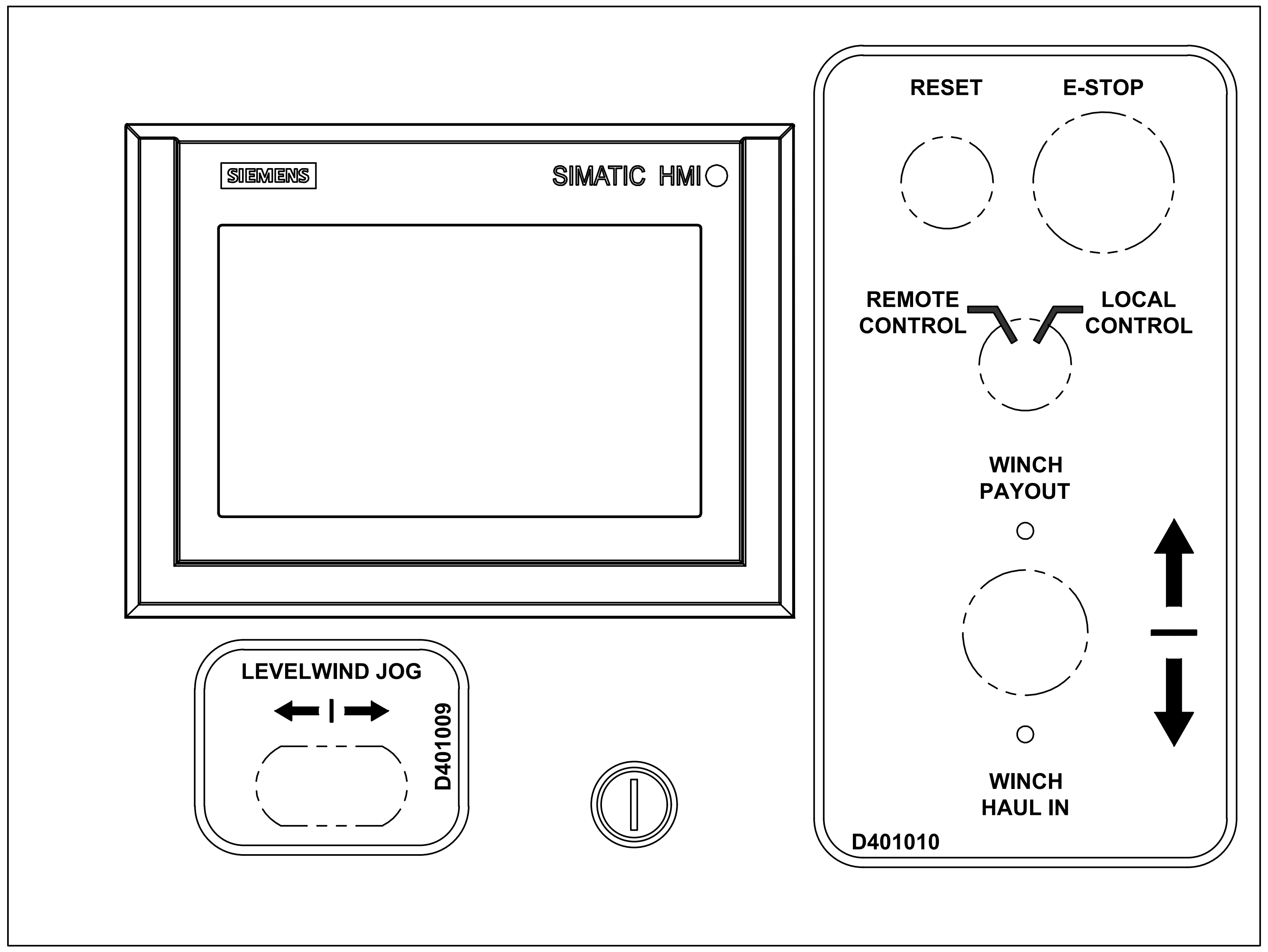
MATL CERT N/R	TITLE SPRE-3464 PANEL PAYOUT			
MATL TEST N/R	NEXT ASSEMBLY		DERIVED FROM	
WELD TEST N/R	FIRST USED ON WO 1942		SHEET 1	OF 2
EST LBS N/A	DRAWN JSK	CHECKED BFF	APPROVED JSK	7400372 REV A
ACT LBS N/A	DATE 10OCT19	SCALE 1/1		

(WHOLE SHEET)

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD

LOCAL CONTROL PANEL LAYOUT

(HINGE AT TOP)

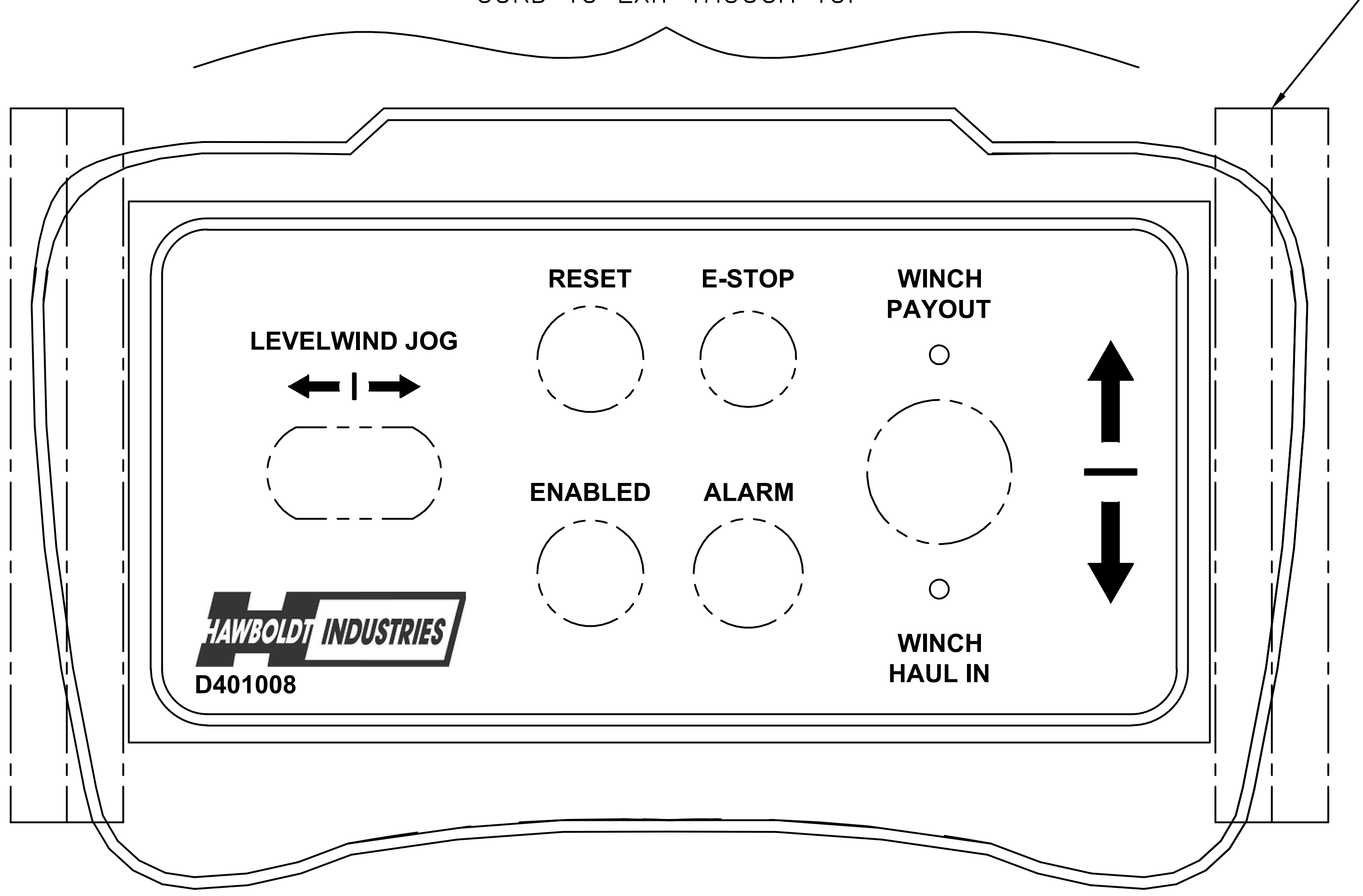


POSITION COMPONENTS TO SUIT DECALS / AVAILABLE ENCLOSURE SPACE

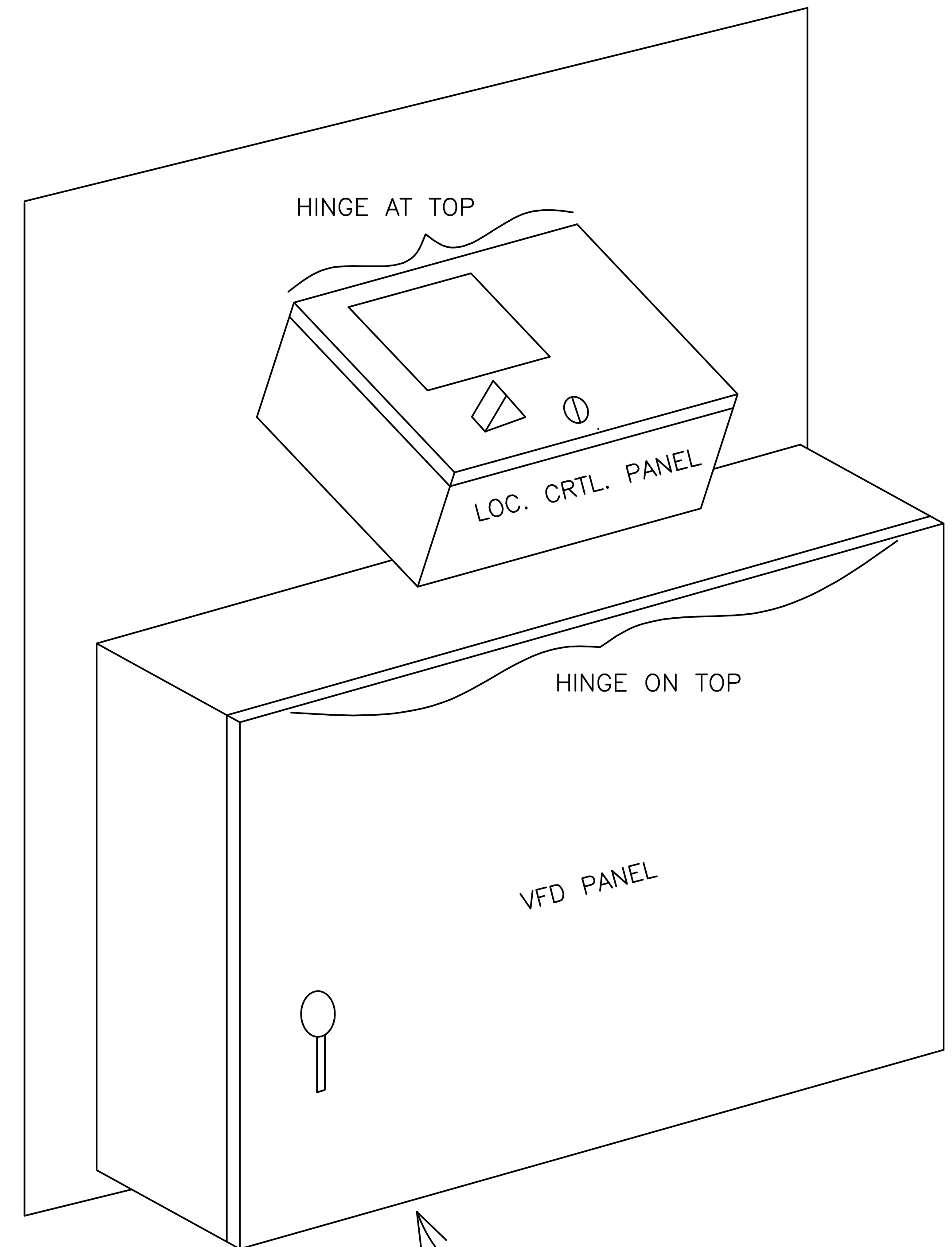
BELLY PACK LAYOUT

CORD TO EXIT THOUGH TOP

HANDLE POSITION



ASSEMBLY LAYOUT



BELLY PACK CONNECTION, PROGRAMMING/ INTERNET PORTS ON SIDE, TOWARDS TOP

ALL OTHER CONNECTIONS TO BE MADE THOUGH THE BOTTOM

ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY

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-TOLERANCES-

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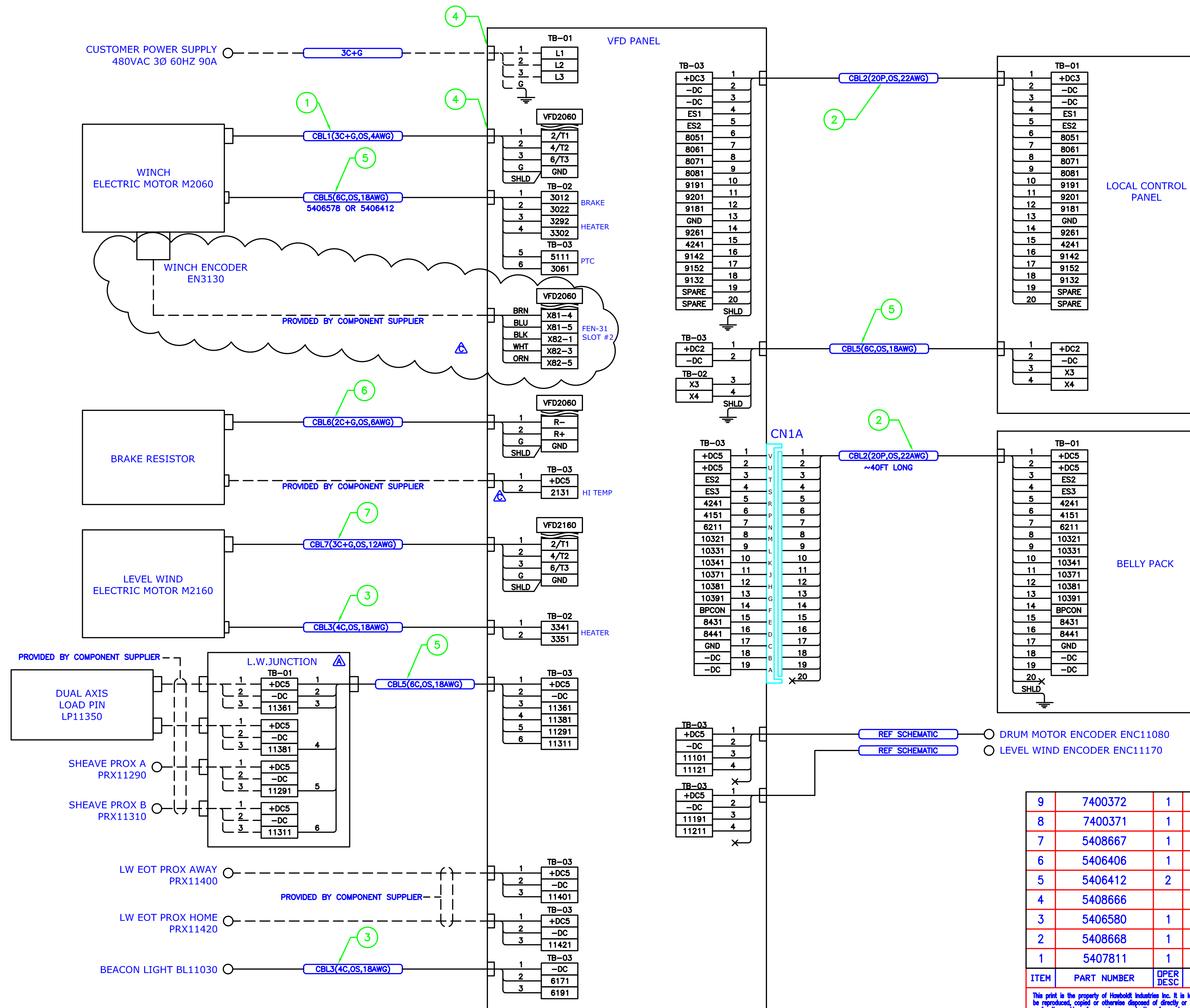
HAWBOLDT INDUSTRIES — Chester, Nova Scotia, Canada

MATL CERT N/R	TITLE SPRE-3464 PANEL PAYOUT				
MATL TEST N/R	NEXT ASSEMBLY			DERIVED FROM	
WELD TEST N/R	FIRST USED ON WO 1942			SHEET 2	OF 2
EST LBS N/A	DRAWN JSK	CHECKED BFF	APPROVED JSK	7400372	REV A
ACT LBS N/A	DATE 10OCT19	SCALE 1/1			

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD
A	01NOV19	4165	SHOW JUNCTION BOX	JSK	BBF
B	10MAR20	4441	AS BUILT UPDATES	JSK	BBF
C	17MAR22	6021	ADDED MOTOR ENCODER, NEW BR. RESISTOR SINGLE TEMP ALARM	JSK	PMV



9	7400372	1	SPRE-3464 PANEL LAYOUT		REF
8	7400371	1	SPRE-3464 ELECTRICAL SCHEMATIC		REF
7	5408667	1	168 LG - ELECTRIC MOTOR CABLE		14.0FT
6	5406406	1	168 LG - CABLE, ELECTRICAL, 6AWG, 3C		14.0FT
5	5406412	2	150 LG - CABLE, ELECTRICAL, 18AWG, 7C, OS		25.0FT
4	5408666		CABLE GLAND		2
3	5406580	1	216 LG - CABLE, ELECTRICAL, 18AWG, 4C, OS		18.0FT
2	5408668	1	600 LG - CONTROL CABLE		50.0FT
1	5407811	1	120 LG - CABLE, ELECTRICAL, 4AWG, 4C, OS		10.0FT
ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
DIMENSIONS IN [ ] ARE MM
-TOLERANCES-

A) ANGULAR ± 1/2°
B) DECIMAL (ONE) .X ± .06
(TWO) .XX ± .02
(THREE) .XXX ± .01
C) FRACTIONAL
1. GENERAL ± 1/32
2. SAWING, FLAME CUTTING, SHEARING & BREAKING ± 1/16
3. WELDING ± 1/8

HAWBOLDT INDUSTRIES
Chester, Nova Scotia, Canada

MATL CERT N/R	TITLE SPRE-3464 INTERCONNECT DIAGRAM		
MATL TEST N/R	NEXT ASSEMBLY	DERIVED FROM	
WELD TEST N/R	FIRST USED ON WO 1942	SHEET 1	OF 1
EST LBS N/A	DRAWN JSK	CHECKED BFF	APPROVED JSK
ACT LBS N/A	DATE 10OCT19	SCALE 1/1	

7400373 REV C

NOTES:
- C = CONDUCTORS
- P = TWISTED PAIRS
- OS = OVERALL SHIELD
- NUMBER OF CONDUCTORS PER CABLE ARE MINIMUM
- CABLE AWG SIZES ARE MINIMUM
- CABLE LENGTHS ARE APPROXIMATE
- REFER TO ELECTRICAL SCHEMATIC FOR WIRING DETAILS

× SECURE EXTRA CABLES IN CONDUIT
CABLE GLAND/CONDUIT FITTING
CABLE & FITTINGS SUPPLIED BY HAWBOLDT
CABLE & FITTINGS SUPPLIED BY CUSTOMER

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD
A	01MAR20	4436	UPDATED INFO, ADDED IT 7,8 TO BOM	DHM	DHM

MODEL: SPRE 3464

DESCRIPTION: GENERAL PURPOSE WINCH

CUSTOMER: WEST COAST WINCH POOL

END-USER: VARIOUS

SERIAL NUMBERS: 1942

IN ACCORDANCE WITH: HAWBOLDT QUOTE: Q12536A
HAWBOLDT SALES ORDER: 38579
CUSTOMER PO: 92043515

PERFORMANCE: 10000 LB PULL BARE DRUM @ 92 FT/MIN
3950 LB FULL DRUM PULL @ 232 FT/MIN

SWT: 10000 LB
DLT: 20000 LB

ELECTRICAL SUPPLY: 460VAC/3PH/60HZ

DESIGN TEMPERATURE: NO SPECIAL REQUIREMENTS

PAINT SPECIFICATION: HOT DIPPED GALVANIZED FRAME
ALL OTHER PARTS ARE HAWBOLDT STANDARD HAZE GRAY

SPARE PARTS LIST: INCLUDED IN MANUAL

MANUAL REQUIREMENTS: SOFT COPY

CERTIFICATIONS: DESIGNED IN ACCORDANCE WITH UNOLS RVSS & 46 CFR 189.35

FACTORY ACCEPTANCE TESTING: SEE FAT DOCUMENT

ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY
8	5406843		PAINT TOUCH-UP KIT		1
7	34-00204-082		SPRE-3464 LUBRICATION DIAGRAM		REF
6	7400373		SPRE-3464 INTERCONNECT DIAGRAM		REF
5	7400371		SPRE-3464 ELECTRICAL SCHEMATIC		REF
4	7400372		SPRE-3464 PANEL LAYOUT		REF
3	34-00304-081		SPRE-3464 DECAL DRAWING		1
2	34-00304-000		SPRE-3464 GENERAL ARRANGEMENT		REF
1	34-00304-001		SPRE-3464 GENERAL ASSEMBLY		1

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
DIMENSIONS IN [ ] ARE MM
-TOLERANCES-

A) ANGULAR ± 1/2°
B) DECIMAL (ONE) .X ± .06
(TWO) .XX ± .02
(THREE) .XXX ± .01
C) FRACTIONAL
1. GENERAL ± 1/32
2. SAWING, FLAME CUTTING, SHEARING & BREAKING ± 1/16
3. WELDING ± 1/8

HAWBOLDT INDUSTRIES

Chester, Nova Scotia, Canada

MATL CERT: N/R	TITLE: SPRE 3464 ELEC SCRIPPS		
MATL TEST: N/R	NEXT ASSEMBLY	DERIVED FROM: F400941	
WELD TEST: N/R	FIRST USED ON WO	SHEET: 1	OF: 1
EST LBS: N/A	DRAWN: LRK / CHECKED: DHM / APPROVED: NSW	F400942	REV: A
ACT LBS: N/A	DATE: 16JUL19 / SCALE: 1/1		

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD
A	01MAR20	4436	UPDATED INFO, ADDED IT 7,8 TO BOM	DHM	DHM

MODEL: SPRE 3464

DESCRIPTION: GENERAL PURPOSE WINCH

CUSTOMER: WEST COAST WINCH POOL

END-USER: VARIOUS

SERIAL NUMBERS: 1943

IN ACCORDANCE WITH: HAWBOLDT QUOTE: Q12536A
HAWBOLDT SALES ORDER: 38579
CUSTOMER PO: 92043515

PERFORMANCE: 10000 LB PULL BARE DRUM @ 92 FT/MIN
3950 LB FULL DRUM PULL @ 232 FT/MIN

SWT: 10000 LB
DLT: 20000 LB

ELECTRICAL SUPPLY: 460VAC/3PH/60HZ

DESIGN TEMPERATURE: NO SPECIAL REQUIREMENTS

PAINT SPECIFICATION: HOT DIPPED GALVANIZED FRAME
ALL OTHER PARTS ARE HAWBOLDT STANDARD HAZE GRAY

SPARE PARTS LIST: INCLUDED IN MANUAL

MANUAL REQUIREMENTS: SOFT COPY

CERTIFICATIONS: DESIGNED IN ACCORDANCE WITH UNOLS RVSS & 46 CFR 189.35

FACTORY ACCEPTANCE TESTING: SEE FAT DOCUMENT

ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY
8	5406843		PAINT TOUCH-UP KIT		1
7	34-00204-082		SPRE-3464 LUBRICATION DIAGRAM		REF
6	7400373		SPRE-3464 INTERCONNECT DIAGRAM		REF
5	7400371		SPRE-3464 ELECTRICAL SCHEMATIC		REF
4	7400372		SPRE-3464 PANEL LAYOUT		REF
3	34-00304-081		SPRE-3464 DECAL DRAWING		1
2	34-00304-000		SPRE-3464 GENERAL ARRANGEMENT		REF
1	34-00304-001		SPRE-3464 GENERAL ASSEMBLY		1

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
DIMENSIONS IN [ ] ARE MM
-TOLERANCES-

A) ANGULAR		± 1/2°
B) DECIMAL (ONE)	.X	± .06
(TWO)	.XX	± .02
(THREE)	.XXX	± .01
C) FRACTIONAL		
1. GENERAL		± 1/32
2. SAWING, FLAME CUTTING, SHEARING & BREAKING		± 1/16
3. WELDING		± 1/8

HAWBOLDT INDUSTRIES

Chester, Nova Scotia, Canada

MATL CERT: N/R	TITLE: SPRE 3466 ELEC WHOI		
MATL TEST: N/R	NEXT ASSEMBLY	DERIVED FROM: F400942	
WELD TEST: N/R	FIRST USED ON WO: 1943	SHEET: 1	OF: 1
EST LBS: N/A	DRAWN: LRK / CHECKED: DHM / APPROVED: NSW	F400943	REV: A
ACT LBS: N/A	DATE: 16JUL19 / SCALE: 1/1		

10.0: MCD DOCUMENT

This section contains the Maximum Capability Document (MCD) per UNOLS requirements.

Maximum Capability Document

Hawboldt SPRE-3464 General Purpose – 1943-1

This document has been prepared in accordance with Appendices A and B from the UNOLS RVSS. This machine is primarily used with the following tension members:

Wire rope tension members of varying size and breaking strength

Synthetic tension members of varying size and breaking strength

0.322" Tension members, with a 11,600 lbf breaking strength

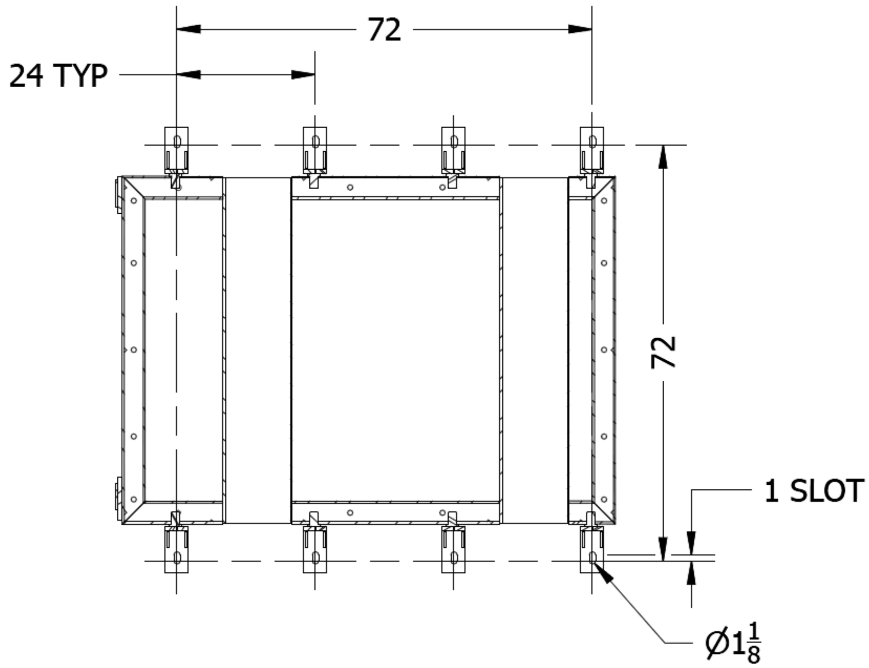
The machine's levelwind sheave has a sheave liner grooved for ø1/2" wire. Other size sheave liners are available. Per Appendix A, Tables A.8.1 to A.8.4, the machine qualifies for the following Factor of Safety (FS) based on tension member breaking strength:

- FS = 1.5 when used with wire rope and matching sheave groove.
- FS = 2.0 when used with EM cable and matching sheave groove.
- FS = 2.5 when used with wire rope or EM cable and oversized sheave groove.

System Characterizations

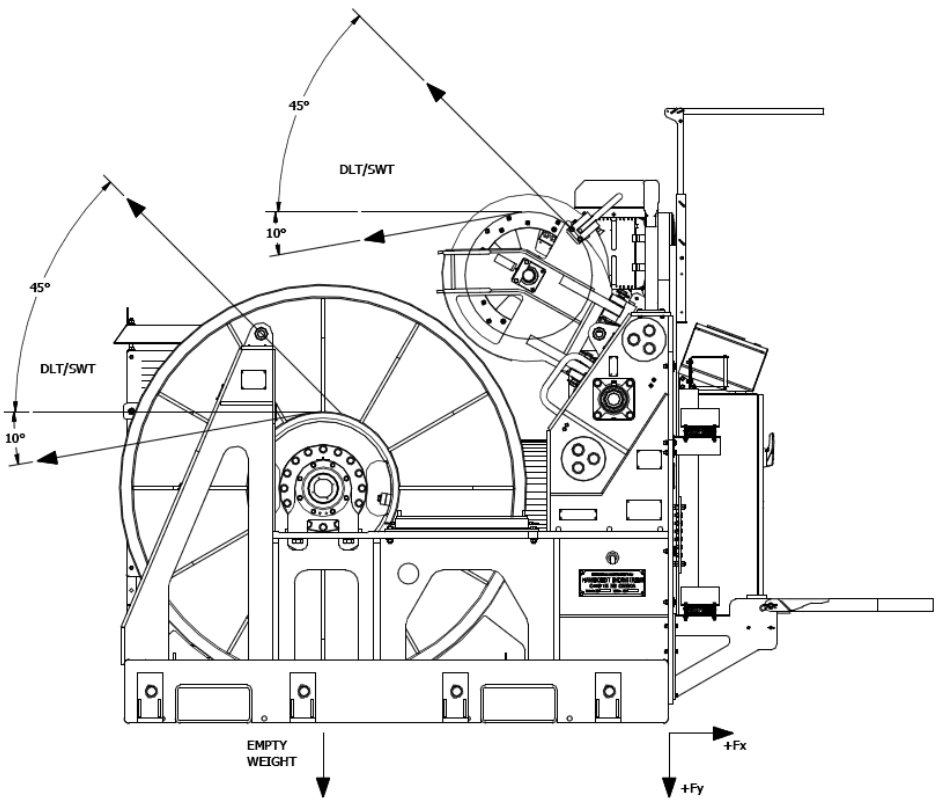
Empty Weight	9,200 lbf
SWT of Winch	10,000 lbf
SWT Fleet Tolerance	+45°/-10° vertical, +/- 5° horizontal
DLT of Winch	20,000 lbf
Max. Line Speed @ Bare Drum	92 ft/min
Power Requirements	480VAC/3PH/60HZ
Bare Drum Pull	10,000 lbf
Full Drum Pull	3,950 lbf

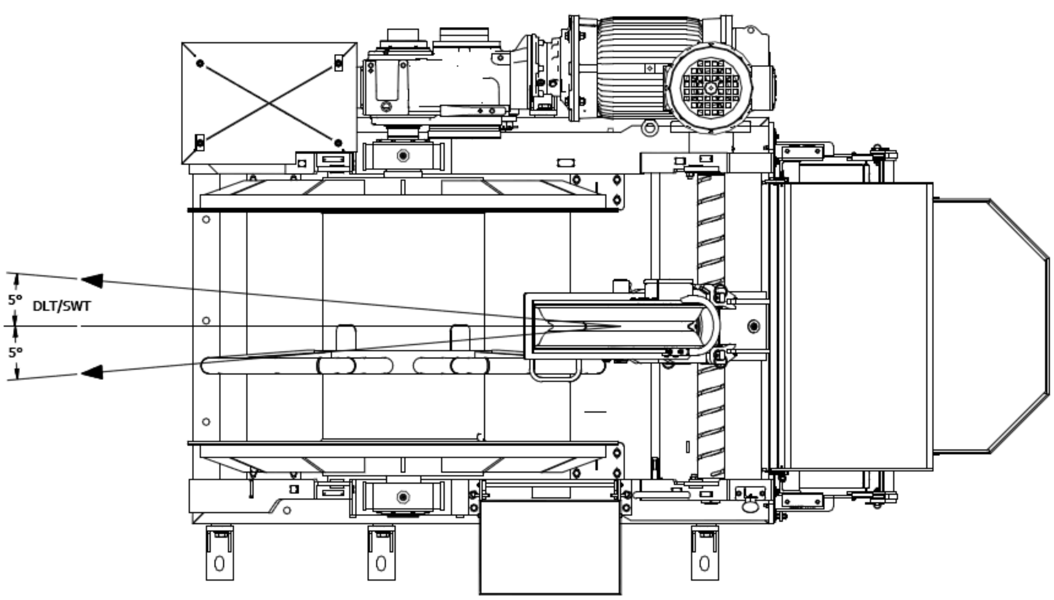
Bolt Pattern



The winch can be mounted with 8 bolts on a UNOLS 2’x2’ bolt pattern using the Hawboldt supplied mounting brackets shown in the image above. Alternative mounting brackets can be used however the installer is responsible for re-calculating the bolt loads.

Free Body Diagram





Forces are maximum forces per bolt, at SWT & DLT, for the 8 bolt pattern. The analysis is valid for a vertical fleet angle of +45 ^{o}/-10^{o} and horizontal fleet angle of +/-5^{o}. The analysis is also valid for both reeving options shown, with and without levelwind.

	Reaction @ SWT	**Reaction @ DLT**	**Mounting Fasteners**
Fx [lbf]	1,250	2,500	1"-8 UNC
Fy [lbf]	2,450	6,650	316 SS (σ_y=40 ksi)

Mounting fasteners shall be lubricated and torqued to 273 ft.lb (K=0.15).

APPENDIX A – MAINTENANCE LOGS

The following tables can be used to log maintenance tasks.

Lubrication Maintenance Log

HAWBOLDT INDUSTRIES

This maintenance log is used to record lubrication. Lubrication instructions can be found in Section 6 of this maintenance manual.

HOURS	DATE	INITIALS	Drum Bearings Grease	Sheave Bearing Grease	Levelwind Carriage Bushings Grease	Screw Blade Grease	Screw Bearings Grease	Guide Rods & Screw Grease	Main Gearbox Oil	Levelwind Gearbox Oil	Torque Arm Grease	NOTES

Mechanical Maintenance Log

HAWBOLDT INDUSTRIES

This maintenance log is used to record mechanical maintenance. Mechanical maintenance instructions can be found in Section 6 of this maintenance manual.

HOURS	DATE	INITIALS	Ball & Roller Bearings	Tightening of Critical Bolts	Parking Brake		NOTES

APPENDIX B – BOLT TORQUE CHARTS

FASTENAL®

QUALITY FNL SINCE 1967

TORQUE-TENSION REFERENCE GUIDE

TORQUE-TENSION RELATIONSHIP FOR A307A, GRADE 5, 8 & 9 BOLTS

Nominal Dia. (in.)	Threads per inch	ASTM A307 Grade A				SAE J429 Grade 5					SAE J429 Grade 8					FNL Grade 9				
		Clamp Load (Lbs.)	Tightening Torque			Clamp Load (Lbs.)	Tightening Torque				Clamp Load (Lbs.)	Tightening Torque				Clamp Load (Lbs.)	Tightening Torque			
			K = 0.15	K = 0.17	K = 0.20		Ecoguard™	K = 0.15	K = 0.17	K = 0.20		Eco-guard™	K = 0.15	K = 0.17	K = 0.20		Eco-guard™	K = 0.15	K = 0.17	K = 0.20
Coarse Thread Series																				
1/4	20	859	32 in-lbs	37 in-lbs	43 in-lbs	2029	61 in-lbs	76 in-lbs	86 in-lbs	10 1in-lbs	2864	86 in-lbs	107 in-lbs	122 in-lbs	143 in-lbs	3357	101 in-lbs	126 in-lbs	143 in-lbs	168 in-lbs
5/16	18	1416	66	75	88	3342	125	157	178	209	4719	177	221	251	295	5531	207	259	294	346
3/8	16	2092	10 ft-lbs	1 1 ft-lbs	13 ft-lbs	4940	19 ft-lbs	23 ft-lbs	26 ft-lbs	31 ft-lbs	6974	26 ft-lbs	33 ft-lbs	37 ft-lbs	44 ft-lbs	8174	31 ft-lbs	38 ft-lbs	43 ft-lbs	51 ft-lbs
7/16	14	2870	16	18	21	6777	30	37	42	49	9568	42	52	59	70	11214	49	61	70	82
1/2	13	3831	24	27	32	9046	45	57	64	75	12771	64	80	90	106	14969	75	94	106	125
9/16	12	4912	35	39	46	11599	65	82	92	109	16375	92	115	130	154	19193	108	135	153	180
5/8	11	6102	48	54	64	14408	90	113	128	150	20340	127	159	180	212	23840	149	186	211	248
3/4	10	9030	85	96	113	21322	160	200	227	267	30101	226	282	320	376	35281	265	331	375	441
7/8	9	12467	136	155	182	29436	258	322	365	429	41556	364	455	515	606	48707	426	533	604	710
1	8	16355	204	232	273	38616	386	483	547	644	54517	545	681	772	909	63899	639	799	905	1065
1-1/4	7	26166	409	463	545	53786	672	840	952	1121	87220	1090	1363	1545	1817	102229	1278	1597	1810	2130
1-3/8	6	31182	536	607	715	64096	881	1102	1249	1469	103939	1429	1768	2025	2382	121826	1675	2094	2373	2792
1-1/2	6	37942	711	806	949	77991	1170	1462	1657	1950	126473	1897	2371	2688	3162	148237	2224	2779	3150	3706
Fine Thread Series																				
1/4	28					2319	70 in-lbs	87 in-lbs	99 in-lbs	116 in-lbs	3274	98 in-lbs	123 in-lbs	139 in-lbs	164 in-lbs	3837	115 in-lbs	144 in-lbs	163 in-lbs	192 in-lbs
5/16	24					3702	139	174	197	231	5226	196	245	278	327	6125	230	287	325	383
3/8	24					5599	21 ft-lbs	26 ft-lbs	30 ft-lbs	35 ft-lbs	7905	30 ft-lbs	37 ft-lbs	42 ft-lbs	49 ft-lbs	9265	35 ft-lbs	43 ft-lbs	49 ft-lbs	58 ft-lbs
7/16	20					7568	33	41	47	55	10684	47	58	66	78	12523	55	68	78	91
1/2	20					10197	51	64	72	85	14396	72	90	102	120	16873	84	105	120	141
9/16	18					12940	73	91	103	121	18268	103	128	146	171	21412	120	151	171	201
5/8	18					16317	102	127	144	170	23036	144	180	204	240	27000	169	211	239	281
3/4	16					23776	178	223	253	297	33566	252	315	357	420	39343	295	369	418	492
7/8	14					32479	284	355	403	474	45853	401	502	568	669	53743	470	588	666	784
1	14					43343	433	542	614	722	61190	612	765	867	1020	71720	717	896	1016	1195
1-1/4	12					59548	744	930	1055	1241	96565	1207	1509	1710	2012	113182	1415	1768	2004	2358
1-3/8	12					72967	1003	1254	1421	1672	118324	1627	2034	2305	2712	138686	1907	2384	2701	3278
1-1/2	12					87747	1316	1645	1865	2194	142292	2134	2668	3024	3557	166778	2502	3127	3544	4169

ELECTRODEPOSITED ZINC & LUBRICATED PREVAILING-TORQUE ALL-METAL TYPE NUTS

Locknut Size	Threads per inch	Steel Hex Locknut						Steel Hex Flange Nut					
		Grade C			FNL Grade 9			Grade F			Grade G		
		Clamp Load (lbs.)	Tightening Torque min	Tightening Torque max	Clamp Load (lbs.)	Tightening Torque min	Tightening Torque max	Clamp Load (lbs.)	Tightening Torque min	Tightening Torque max	Clamp Load (lbs.)	Tightening Torque min	Tightening Torque max
Coarse Thread Series													
1/4	20	2864	93.1 in-lbs	144 in-lbs	3357	100.7 in-lbs	134.3 in-lbs	2029	76.1 in-lbs	96.4 in-lbs	2864	107.4 in-lbs	136 in-lbs
5/16	18	4719	192	251	5531	207	277	3342	157	198	4719	221	280
3/8	16	6974	28.3 ft-lbs	37 ft-lbs	8174	30.7 ft-lbs	40.9 ft-lbs	4940	23.2 ft-lbs	29.3 ft-lbs	6974	32.7 ft-lbs	41.4 ft-lbs
7/16	14	9568	45	59	11214	49	65	6777	37	47	9568	52	66
1/2	13	12771	69	90	14969	75	100	9046	57	72	12771	80	101
9/16	12	16375	100	130	19193	108	144	11599	82	103	16375	115	146
5/8	11	20340	138	180	23840	149	199	14408	113	143	20340	159	201
3/4	10	30101	245	320	35281	265	353	21322	200	253	30101	282	357
7/8	9	41556	394	515	48707	426	568						
1	8	54517	591	772	63899	639	852						
1-1/8	7	68695	837	1095	80516	906	1208						
1-1/4	7	87220	1181	1545	102229	1278	1704						
Fine Thread Series													
1/4	28	3274	90 in-lbs	130.9 in-lbs	3837	105.5 in-lbs	153.5 in-lbs						
5/16	24	5226	180	261	6125	211	306						
3/8	24	7905	27.2 ft-lbs	39.5 ft-lbs	9265	31.8 ft-lbs	46.3 ft-lbs						
7/16	20	10684	43	62	12523	50	73						
1/2	20	14396	66	96	16873	77	112						
9/16	18	18268	94	137	21412	110	161						
5/8	18	23036	132	192	27000	155	225						
3/4	16	33566	231	336	39343	270	393						
7/8	14	45853	368	535	53743	431	627						
1	14	61190	561	816	71720	657	956						
1-1/8	12	77015	794	1155	90268	931	1354						
1-1/4	12	96565	1106	1609	113182	1297	1886						

METRIC FASTENERS

Nominal Dia. (mm)	Pitch	Class 4.6				Class 8.8				Class 10.9				Class 12.9			
		Clamp Load (lbs)	Tightening Torque			Clamp Load (lbs)	Tightening Torque			Clamp Load (lbs)	Tightening Torque			Clamp Load (lbs)	Tightening Torque		
			K = 0.15	K = 0.17	K = 0.20		K = 0.15	K = 0.17	K = 0.20		K = 0.15	K = 0.17	K = 0.20		K = 0.15	K = 0.17	K = 0.20
4	0.7	333	7.9 in-lbs	8.9 in-lbs	10.5 in-lbs	858	20.3 in-lbs	23 in-lbs	27 in-lbs	1228	29 in-lbs	32.9 in-lbs	38.7 in-lbs	1436	33.9 in-lbs	38.4 in-lbs	45.2 in-lbs
5	0.8	538	15.9	18.0	21.2	1387	40.9	46.4	54.6	1985	58.6	66.4	78.1	2319	68.5	77.6	91.3
6	1	763	27.0	30.7	36.1	1968	69.7	79.0	92.9	2816	99.8	113.1	133.0	3291	116.6	132.1	155.4
7	1	1095	45.3	51.3	60.3	2822	116.6	132.2	155.5	4039	167	189	223	4720	195	221	260
8	1.25	1389	65.6	74.4	87.5	3580	169.1	191.6	225.4	5123	242	274	323	5987	283	320	377
10	1.5	2200	10.8 ft-bs	12.3 ft-lbs	14.4 ft-lbs	5671	27.9 ft-lbs	31.6 ft-lbs	37.2 ft-lbs	8115	39.9 ft-lbs	45.2 ft-lbs	53.2 ft-lbs	9484	46.7 ft-lbs	52.9 ft-lbs	62.2 ft-lbs
12	1.75	3197	18.9	21.4	25.2	8240	48.7	55.1	64.9	11792	69.6	78.9	92.8	13781	81.4	92.2	108.5
14	2	4379	30.2	34.2	40.2	11289	77.8	88.1	103.7	16154	111.3	126.1	148.4	18879	130.0	147.4	173.4
16	2	5943	47	53	62	15320	121	137	161	21924	173	196	230	25622	202	229	269
18	2.5	7301	65	73	86	18822	167	189	222	26934	239	270	318	31477	279	316	372
20	2.5	9286	91	104	122	23938	236	267	314	34256	337	382	449	40034	394	446	525
22	2.5	11509	125	141	166	29669	321	364	428	42457	460	521	613	49619	537	609	716
24	3	13372	158	179	211	34471	407	461	543	49329	582	660	777	57649	681	771	908
27	3	17428	232	262	309	44924	597	676	796	64288	854	968	1139	75132	998	1131	1331
30	3.5	21266	314	356	419	54819	809	917	1079	78448	1158	1312	1544	91680	1353	1534	1804
33	3.5	26310	427	484	570	67821	1101	1248	1468	97055	1576	1786	2101	113425	1842	2087	2455
36	4	30982	549	622	732	79866	1415	1603	1886	114291	2024	2294	2699	133569	2366	2681	3154

* Tightening Torque (in-lbs through M8; M10 & over ft-lbs)

A2 OR A4 METRIC STAINLESS STEEL FASTENERS

Nominal Dia. (mm)	Pitch	Torque (in-lbs through M8; M10 & over ft-lbs) Dry	Lubricated
3	0.5	7.5 in-lbs.	7.0 in-lbs.
4	0.7	17.5	16.2
5	0.8	35.4	32.7
6	1	60.3	55.8
8	1.25	146.2	135.2
10	1.5	24.1 ft-lbs	22.3 ft-lbs
12	1.75	42.1	38.9
14	2	67.2	62.2
16	2	104	96
18	2.5	144	133
20	2.5	204	188
22	2.5	208	193
24	3	264	244

CAUTION: All material included in these charts is advisory only, and its use by anyone is voluntary. In developing this information, Fastenal has made a determined effort to present its contents accurately. Extreme caution should be used when using a formula for torque/tension relationships. Torque is only an indirect indication of tension. Under/over tightening of fasteners can result in costly equipment failure or personal injury.

ALLOY STEEL LOW HEAD SOCKET HEAD CAP SCREW

Nominal Size		Alloy Steel Socket Head Other Configurations Torque (in-lbs.)			
Size	Inch	Flat Head	Button Head	Shoulder Screw	Low-Head
#1	0.073	2.5	2	-	
#2	0.086	4.5	4	-	
#3	0.099	7	7	-	
#4	0.112	9	8.5	-	5
#5	0.125	13	13	-	9.5
#6	0.138	17	15	-	9.5
#8	0.164	32	30	-	19
#10	0.190	60	55	-	30.5
1/4	0.250	125	105	50	75
5/16	0.313	225	200	125	150
3/8	0.375	375	350	265	275
1/2	0.500	1100	950	470	600
5/8	0.625	1900	1700	1150	1300
3/4	0.750	3500	-	2000	-
7/8	0.875	5750	-	-	-
1	1.000	8000	-	-	-

For additional technical information, contact Fastenal Engineering at engineer@fastenal.com.

ASTM A574 SOCKET HEAD CAP SCREWS

Nominal Size or Basic Screw Dia.		Threads per inch	Tensile Stress Area (sq. in.)	ASTM A574 Clamp Load (lbs)	Tightening Torque K = 0.15	K = 0.17	K = 0.20
Coarse Thread Series							
#1	0.0730	64	0.0026	275	3.0 in-lbs	3.4 in-lbs	4.0 in-lbs
#2	0.0860	56	0.0037	388	5.0	5.7	6.7
#3	0.0990	48	0.00492	511	7.6	8.6	10.1
#4	0.1120	40	0.006	633	10.6	12.1	14.2
#5	0.1250	40	0.008	835	16	18	21
#6	0.1380	32	0.0091	954	20	22	26
#8	0.1640	32	0.014	1471	36	41	48
#10	0.1900	24	0.0175	1841	52	59	70
1/4	0.2500	20	0.0318	3341	125	142	167
5/16	0.3125	18	0.0524	5505	258	292	344
3/8	0.3750	16	0.0775	8136	38 ft-lbs	43 ft-lbs	51 ft-lbs
7/16	0.4375	14	0.1063	11162	61	69	81
1/2	0.5000	13	0.1419	14899	93	106	124
5/8	0.6250	11	0.226	22883	179	203	238
3/4	0.7500	10	0.3345	33864	317	360	423
7/8	0.8750	9	0.4617	46751	511	580	682
1	1.0000	8	0.6057	61332	767	869	1022
1-1/4	1.2500	7	0.9691	98123	1533	1738	2044
1-1/2	1.5000	6	1.4053	142282	2668	3023	3557
Fine Thread Series							
#0	0.0600	80	0.0018	189	1.7 in-lbs	1.9 in-lbs	2.3 in-lbs
#1	0.0730	72	0.0028	292	3.2	3.6	4.3
#2	0.0860	64	0.0039	413	5.3	6.0	7.1
#3	0.0990	56	0.0052	549	8.2	9.2	10.9
#4	0.1120	48	0.0066	693	11.7	13.2	15.5
#5	0.1250	44	0.0083	872	16	19	22
#6	0.1380	40	0.0101	1065	22	25	29
#8	0.1640	36	0.0147	1546	38	43	51
#10	0.1900	32	0.02	2099	60	68	80
1/4	0.2500	28	0.0364	3819	143	162	191
5/16	0.3125	24	0.0581	6097	286	324	381
3/8	0.3750	24	0.0878	9222	43 ft-lbs	49 ft-lbs	58 ft-lbs
7/16	0.4375	20	0.1187	12465	68	77	91
1/2	0.5000	20	0.16	16795	105	119	140
5/8	0.6250	18	0.256	26876	210	238	280
3/4	0.7500	16	0.373	39161	367	416	490
7/8	0.8750	14	0.5095	53495	585	663	780
1	1.0000	14	0.6799	71388	892	1011	1190
1-1/4	1.2500	12	1.0729	112659	1760	1995	2347
1-1/2	1.5000	12	1.581	166007	3113	3528	4150

ASTM A193 B7

Nominal Dia.	ASTM A193 B7 Threads per inch	Clamp Load (lbs)	Tightening Torque K=0.12 (ft-lbs.)	K = 0.15 (ft-lbs.)	K = 0.17 (ft-lbs.)	K = 0.20 (ft-lbs.)
Coarse Thread Series						
1/4	20	2506	75.2 in-lbs	94 in-lbs	106.5 in-lbs	125.3 in-lbs
5/16	18	4129	155	194	219	258
3/8	16	6102	22.9 ft-lbs	28.6 ft-lbs	32.4 ft-lbs	38.1 ft-lbs
7/16	14	8372	37	46	52	61
1/2	13	11175	56	70	79	93
5/8	11	17798	111	139	158	185
3/4	10	26339	198	247	280	329
7/8	9	36362	318	398	451	530
1	8	47702	477	596	676	795
1-1/8	7	60108	676	845	958	1127
1-1/4	7	76318	954	1192	1351	1590
1-3/8	6	90947	1251	1563	1772	2084
1-1/2	6	110664	1660	2075	2352	2767
UN8 Thread Series						
1-1/8	8	62248	700 ft-lbs	875 ft-lbs	992 ft-lbs	1167 ft-lbs
1-1/4	8	78727	984	1230	1394	1640
1-3/8	8	97138	1336	1670	1892	2226
1-1/2	8	117483	1762	2203	2497	2937
Fine Thread Series						
1/4	28	2864	85.9 in-lbs	107.4 in-lbs	121.7 in-lbs	143.2 in-lbs
5/16	24	4573	171	214	243	286
3/8	24	6916	25.9 ft-lbs	32.4 ft-lbs	36.7 ft-lbs	43.2 ft-lbs
7/16	20	9349	41	51	58	68
1/2	20	12596	63	79	89	105
5/8	18	20157	126	157	178	210
3/4	16	29371	220	275	312	367
7/8	14	40121	351	439	497	585
1	14	53541	535	669	758	892
1-1/8	12	67388	758	948	1074	1264
1-1/4	12	84494	1056	1320	1496	1760
1-3/8	12	103534	1424	1779	2017	2373
1-1/2	12	124506	1868	2334	2646	3113

- If using API bolting requirements, refer to applicable API specification for tightening torque values.
- These recommendations are for non-gasketed metal-to-metal joints.

STAINLESS STEEL AND NON-FERROUS FASTENERS (INCH SERIES)

Nom Dia	Threads per inch	18-8 and 316 Stainless Steel Dry	18-8 and 316 Stainless Steel Lubricated	Silicon Bronze	Monel	Brass	2024-T4 Aluminum
Coarse Thread Series							
2	56	2.5 in-lbs	2.3 in-lbs	2.3 in-lbs	2.5 in-lbs	2.0 in-lbs	1.4 in-lbs
4	40	5.4	4.9	4.8	5.3	4.3	2.9
5	40	8.0	7.2	7.1	7.8	6.3	4.2
6	32	10.0	9.0	8.9	9.8	7.9	5.3
8	32	18.4	16.5	18.4	20.2	16.2	10.8
10	24	26.6	24.0	21.2	25.9	18.6	13.8
1/4	20	63.6	57.3	68.8	85.3	61.5	45.6
5/16	18	131	118	123	149	107	80
3/8	16	19.4 ft-lbs	17.4 ft-lbs	18.3 ft-lbs	22.2 ft-lbs	16.0ft-bs	11.9 ft-lbs
7/16	14	31.0	27.9	29.1	35.6	26.4	19.0
1/2	13	47	43	40	48.7	35.2	26
5/8	11	94	85	86	111	76	60
3/4	10	125	113	118	153	104	82
7/8	9	202	182	178	231	159	124
1	8	303	273	265	344	235	184
Fine Thread Series							
2	64	2.7 in-lbs	2.4 in-lbs	2.8 in-lbs	3.1 in-lbs	2.5 in-lbs	1.7 in-lbs
4	48	5.9	5.3	6.1	6.7	5.4	3.6
5	44	8.3	7.5	8.7	9.6	7.7	5.1
6	40	11.2	10.1	11.2	12.3	9.9	6.6
8	36	19.3	17.4	20.4	22.4	18.0	12.0
10	32	30.4	27.4	29.3	34.9	25.9	19.2
1/4	28	73	65	87	106	77	57
5/16	24	145	131	131	160	116	86
3/8	24	22.0 ft-lbs	19.8 ft-lbs	20.0 ft-lbs	24.5 ft-lbs	17.7 ft-lbs	13.1 ft-lbs
7/16	20	34.6	31.2	30.9	37.6	27.3	20.2
1/2	20	53	48	42	51	37	27
5/8	18	107	96	96	123	85	67
3/4	16	140	126	115	149	102	80
7/8	14	223	201	177	230	158	124
1	14	340	306	240	311	212	166

NOTES:

1) The torque values can only be achieved if nut or tapped hole has a proof load greater than or equal to the bolt's minimum tensile strength.
2) For A307A, J429 Grade 5 and 8, FNL Grade 9, EcoGuard™, A574, A193 B7, Class 4.6, 8.8, 10.9, and 12.9 externally thread fasteners and Prevailing Torque All-Metal Nut chart, the torque values were calculated from the formula Torque=KDF, where
   K is the estimated torque coefficient
   (for full details contact engineer@fastenal.com).
   K = 0.12 when using EcoGuard™ coated nut, bolt and washer
   K = 0.15 for "lubricated" conditions including EcoGuard™, some oil, tapping fluid, etc.
   K = 0.17 for some anti-seize, thread lockers, and some plain conditions
   K = 0.20 for zinc and dry conditions
   K = 0.12 is listed for A193 B7, which would be used for some general PTFE coatings
   When using zinc plated lubricated with wax prevailing torque lock nuts, the K value can vary between 0.12–0.18. Use Prevailing Torque All-Metal Nut chart if using this style of nut.
   D = Nominal Diameter
   F = Clamp Load
   For J429 Grade 5 and 8, FNL Grade 9, A574, Class 4.6, 8.8, 10.9 and 12.9, the clamp loads are listed at 75% of the proof loads specified by the standard. For A307 Grade A, 75% of 36,000 PSI is utilized. A193 B7 uses 75% of the yield strength. The prevailing torque lock nut clamp loads are listed at 75% of the proof loads specified for the appropriate grade bolt: Grade C – SAE J429 Grade 8, FNL Grade 9 – FNL Grade 9 bolt, Grade F – SAE J429 Grade 5, Grade G – SAE J429 Grade 8.
3) With the exception of the F835 Countersunk and Button Head, Alloy Steel Socket Shoulder and Alloy Steel Low Head Socket Head Cap Screw, torque values for inch series charts up through and including 5/16-in diameter are in inch-pounds; diameters 3/8-in and larger are in foot-lbs. Torque values for metric fasteners up through and including M8 are in inch-pounds; diameters M10 and larger are in foot-lbs.
4) Torque values for F835 Countersunk and Button Head, Alloy Steel Socket Shoulder and Alloy Steel Low Head Socket Head Cap Screw are given for "as-received" screws in rigid joints when torqued with standard hex keys; all are listed in inch-pounds.
5) Stainless Steel and Non-Ferrous are suggested maximum torque values based on actual lab testing.
6) Stainless steel fasteners tend to gall while being tightened. The risk of galling or thread seizing can be reduced by: using lubrication, tightening fasteners with low RPMs and without interruptions, applying only light pressure, and avoiding prevailing torque lock nuts when possible.

CONVERSION FACTORS:

To convert inch-pounds (in-lbs) to Newton meters (Nm), multiply by 0.113
To convert foot-pounds (ft-lbs) to Newton meters (Nm), multiply by 1.35
To convert pounds (lbs) to Newtons (N), multiply by 4.448
To convert inches (in) to millimeters (mm), multiply by 25.4

Note: When using Zinc Plated (lubricated with wax) Top Lock Nuts, the K value can vary between 0.12-0.16.

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APPENDIX C – ADDITIONAL EQUIPMENT PRESERVATION

Interfine 629HS

Modified Acrylic

PRODUCT DESCRIPTION	A low VOC, high performance, two pack isocyanate free cross linking acrylic finish with low solar absorption (LSA) pigmentation which provides good durability in terms of colour and gloss retention.	
INTENDED USES	As a cosmetic finish on above water areas. For use at Newbuilding and Maintenance & Repair.	
PRODUCT INFORMATION	**Colour**	HYA001-LSA Lt W/work Grey. Selective shades are available in Low Solar Absorption pigmentation
	Finish/Sheen	Gloss
	Part B (Curing Agent)	HYA340
	Volume Solids	65% ±3% (ISO 3233:1998)
	Mix Ratio	7.0 volume(s) Part A to 1.0 volume(s) Part B
	Typical Film Thickness	50 microns dry (77 microns wet)
	Theoretical Coverage	13.00 m²/litre at 50 microns dft, allow appropriate loss factors
	Method of Application	Airless Spray, Brush, Roller
	Flash Point (Typical)	Part A 32°C; Part B 40°C; Mixed 40°C
	Induction Period	Not applicable

Drying Information	10°C	15°C	25°C	40°C
Touch Dry [ISO 9117/3:2010]	2 hrs	90 mins	60 mins	45 mins
Hard Dry [ISO 9117-1:2009]	30 hrs	24 hrs	18 hrs	6 hrs
Pot Life	10 hrs	5 hrs	2 hrs	60 mins

Overcoating Data - see limitations — **Substrate Temperature**

	10°C		15°C		25°C		40°C	
Overcoated By	Min	Max	Min	Max	Min	Max	Min	Max
Interfine 629HS	30 hrs	ext	24 hrs	ext	18 hrs	ext	6 hrs	ext

Note Drying and overcoating times quoted are measured at 50 microns dry, at higher film thickness times will be increased.

REGULATORY DATA	**VOC**	339 g/lt as supplied (EPA Method 24) 212 g/kg of liquid paint as supplied. EU Solvent Emissions Directive (Council Directive 1999/13/EC)

Note: VOC values are typical and are provided for guidance purposes only. These may be subject to variation depending on factors such as differences in colour and normal manufacturing tolerances.

SYSTEMS AND COMPATIBILITY

Interfine 629HS should only be applied over epoxy anticorrosive primers or tiecoats. The primer to be used will depend upon vessel area and application location. Typical primer/tie coats include:

Interbond 808
Intergard 400
Intergard 840

Consult your International Paint representative for the system best suited for the surfaces to be protected.

SURFACE PREPARATIONS

Use in accordance with the standard Worldwide Marine Specifications.
All surfaces should be fresh water washed to remove all dirt and contamination.
High pressure fresh water wash or fresh water wash, as appropriate, and remove all oil or grease, soluble contaminants and other foreign matter in accordance with SSPC-SP1 solvent cleaning.

NEWBUILDING/MAJOR REFURBISHMENT

Interfine 629HS should always be applied over a recommended primer coating scheme. The primer surface should be dry and free from all contamination, and Interfine 629HS must be applied within the overcoating intervals specified (consult the relevant product data sheet).Areas of breakdown, damage etc., should be prepared to the specified standard (e.g. Sa2½ (ISO 8501-1:2007) and primed prior to the application of Interfine 629HS

REPAIR

Interfine 629HS should always be applied over a recommended primer coating scheme. The primer surface should be dry and free from all contamination, and Interfine 629HS must be applied within the overcoating intervals specified (consult the relevant product data sheet).Areas of breakdown, damage etc., should be prepared to the specified standard (e.g. Sa2½ (ISO 8501-1:2007) and primed prior to the application of Interfine 629HS
Interfine 629HS may be applied directly over aged Interfine 629HS following thorough fresh water washing and degreasing provided the coating to be overcoated is in an intact and tightly adherent condition. Loose or flaking coatings should be removed back to a firm edge and Interfine 629HS or an appropriate primer should be used to repair the area before application of the full coat.

Consult International Paint for application of Interfine 629HS over other existing coatings.

Consult your International Paint representative for specific recommendations.

APPLICATION

Mixing	Material is supplied in 2 containers as a unit. Always mix a complete unit in the proportions supplied. (1) Agitate Base (Part A) with a power agitator. (2) Combine entire contents of Curing Agent (Part B) with Base (Part A) and mix thoroughly with power agitator.
Thinner	Not recommended. Use International GTA220 only in exceptional circumstances (max 5% by volume). DO NOT USE ANY OTHER THINNER. DO NOT thin more than allowed by local environmental legislation.
Airless Spray	Recommended Tip Range 0.32-0.48 mm (13-19 thou) Total output fluid pressure at spray tip not less than 155 kg/cm² (2200 p.s.i.)
Conventional Spray	Use suitable proprietary equipment. Thinning may be required.
Brush	Suitable.
Roller	Suitable.
Cleaner	International GTA822
Work Stoppages and Cleanup	Do not allow material to remain in hoses, gun or spray equipment. Thoroughly flush all equipment with International GTA822. Once units of paint have been mixed they should not be resealed and it is advised that after prolonged stoppages work recommences with freshly mixed units. Clean all equipment immediately after use with International GTA822. It is good working practice to periodically flush out spray equipment during the course of the working day. Frequency of cleaning will depend upon amount sprayed, temperature and elapsed time, including any delays. Do not exceed pot life limitations. All surplus materials and empty containers should be disposed of in accordance with appropriate regional regulations/legislation.
Welding	In the event welding or flame cutting is performed on metal coated with this product, dust and fumes will be emitted which will require the use of appropriate personal protective equipment and adequate local exhaust ventilation. In North America do so in accordance with instruction in ANSI/ASC Z49.1 "Safety in Welding and Cutting."

SAFETY

All work involving the application and use of this product should be performed in compliance with all relevant national Health, Safety & Environmental standards and regulations.

Prior to use, obtain, consult and follow the Material Safety Data Sheet for this product concerning health and safety information. Read and follow all precautionary notices on the Material Safety Data Sheet and container labels. If you do not fully understand these warnings and instructions or if you can not strictly comply with them, do not use this product. Proper ventilation and protective measures must be provided during application and drying to keep solvent vapour concentrations within safe limits and to protect against toxic or oxygen deficient hazards. Take precautions to avoid skin and eye contact (ie. gloves, goggles, face masks, barrier creams etc.) Actual safety measures are dependant on application methods and work environment.
EMERGENCY CONTACT NUMBERS:
USA/Canada - Medical Advisory Number 1-800-854-6813
Europe - Contact (44) 191 4696111. For advice to Doctors & Hospitals only contact (44) 207 6359191
R.O.W. - Contact Regional Office

LIMITATIONS

This product is not recommended for use in immersed conditions.
For brush and roller application, and in some colours, two coats of Interfine 629HS may be required to give uniform coverage, especially when applying Interfine 629HS over dark undercoats and when using certain lead-free bright finish colours such as yellows and oranges. Best practice is to use a colour compatible intermediate or anticorrosive coating under Interfine 629HS.
This product will not cure adequately below 5°C. For maximum performance ambient curing temperatures should be above 10°C.
High relative humidity, fog or condensation occurring during or immediately after Interfine 629HS application may result in a matt finish and a film with inferior properties. Premature exposure to ponding water (eg. on external decks) will cause colour change, especially in dark shades. Low temperatures will increase these effects.
Overcoating information is given for guidance only and is subject to regional variation depending upon local climate and environmental conditions. Consult your local International Paint representative for specific recommendations.
Apply in good weather. Temperature of the surface to be coated must be at least 3°C above the dew point. For optimum application properties bring the material to 21-27°C, unless specifically instructed otherwise, prior to mixing and application. Unmixed material (in closed containers) should be maintained in protected storage in accordance with information given in the STORAGE Section of this data sheet. Technical and application data herein is for the purpose of establishing a general guideline of the coating application procedures. Test performance results were obtained in a controlled laboratory environment and International Paint makes no claim that the exhibited published test results, or any other tests, accurately represent results found in all field environments. As application, environmental and design factors can vary significantly, due care should be exercised in the selection, verification of performance and use of the coating.
In the overcoating data section 'ext' = extended overcoating period. Please refer to our Marine Painting Guide - Definitions and Abbreviations available on our website.

UNIT SIZE

Unit Size	Part A		Part B	
	Vol	Pack	Vol	Pack
20 lt	17.5 lt	20 lt	2.5 lt	2.5 lt

For availability of other unit sizes consult International Paint

UNIT SHIPPING WEIGHT (TYPICAL)

Unit Size	Unit Weight
20 lt	33.1 Kg

STORAGE

Shelf Life	18 months minimum at 25°C. Subject to reinspection thereafter. Store in dry, shaded conditions away from sources of heat and ignition.

WORLDWIDE AVAILABILITY Consult International Paint.

IMPORTANT NOTE

www.international-marine.com

Tectyl®
INDUSTRIAL PRODUCTS

PRODUCT INFORMATION

DAUBERT CHEMICAL COMPANY, INC.

TECTYL® 506

Description

TECTYL® 506 is a solvent cutback corrosion preventive compound. The dry film is firm, amber, and translucent. TECTYL® 506 is excellent for protection of metallic surfaces against corrosion in long-term indoor or outdoor exposure and during domestic and overseas shipment.

Laboratory Data	Typical Properties
Flash, PMCC*, Minimum	**106°F**
Density, Weight/Gallon @ 77°F (25°C)	**7.4 ± 0.1 lbs./gallon**
Specific Gravity @ 60°F (15.6°C)	**0.89**
Recommended Dry Film Thickness over Metal Profile	**1.3 mils**
Theoretical Coverage @ Recommended DFT	**592 sq. ft./gallon**
Non-Volatile % by Weight	**55 ± 2**
Non-Volatile % by Volume	**48 ± 2**
Volatile Organic Content (VOC), Maximum	**3.48 lbs./gallon**
Approximate Dry to Touch Time @ 77°F (25°C)	**1 hour**
Cure Time	**24 hours**
High Temperature Flow Point, Minimum	**300°F**

Accelerated Corrosion Tests:

5% Salt Spray (Hours)	
ASTM B-117 @ Recommended DFT (2x4x1/8 in. Polished Steel Panels)**	**2496**
100% Relative Humidity (Hours)	
ASTM D-1748 @ Recommended DFT (2x4x1/8 in. Polished Steel Panels)	**1500**

*PMCC (Penske Martin Closed Cup)
**ASTM (American Society for Testing and Materials)

Surface Preparation

The maximum performance of TECTYL® 506 can be achieved only when the metal surfaces to be protected are clean, dry and free of rust, oil and mill scale. Daubert Chemical Company recommends that the metal substrate temperature be 50-95°F (10-35°C) at the time of product application.

Application

TECTYL® 506 is formulated to be used as supplied. Ensure uniform consistency prior to use. Continued stirring is generally not required. If the product thickens due to cold storage or loss of solvent during use, contact Daubert Chemical Company. DO NOT THIN TECTYL® 506. Incorrect thinning will affect film build, dry time and product performance. Daubert Chemical Company recommends that the ambient and product temperature be 50 - 95°F (10 - 35°C) at time of application. TECTYL® 506 can be spray or dip applied. DO NOT FREEZE TECTYL® 506.

Removal

TECTYL® 506 can be removed with TECTYL® HPS solventborne thinner, vapor degreasing, hot alkaline wash, or low pressure steam. TECTYL® 506 can be removed from fabrics by normal dry cleaning procedures. Avoid the use of chlorinated or highly aromatic solvents when removing from painted surfaces, as these solvents may adversely affect paint.

Storage

Store TECTYL® 506 at temperatures between 50-95°F (10-35°C). Mild agitation is recommended prior to use.

Caution

Adequate ventilation is required for cure and to ensure against formation of a combustible liquid. THE PARTIALLY CURED FILM SHOULD NOT BE EXPOSED TO IGNITION SOURCES SUCH AS FLARES, FLAMES, SPARKS, EXCESSIVE HEAT, OR TORCHES. Refer to Daubert's Material Safety Data Sheet for additional handling and first aid information.

Note:

The addition of any product over or under this coating is not recommended. The use of additional coatings could result in chemical incompatibility, thus adversely affecting the performance of this coating as stated in the lab data section. If a product other than Daubert Chemical Company's recommended product is required, written authorization must be obtained from Daubert Chemical Company.

3/24/04:kp

REFER TO MATERIAL SAFETY DATA SHEET FOR HEALTH AND SAFETY INFORMATION.

Safety Data Sheet

Revision Date 03-10-2015
Revision Number 3

SECTION 1 Identification of the substance/mixture and of the company/undertaking

Product identification used on label

Product identifier	3009 TECTYL 506
Details of the supplier of the safety data sheet	Daubert Chemical Company 4700 S. Central Avenue Chicago, IL 60638 708-496-7350
Emergency telephone number	Chemtrec: (800) 424-9300
Relevant identified uses of the substance or mixture and uses advised against	Corrosion Preventive Compound

SECTION 2 Hazards identification

Classification of the chemical in accordance with paragraph (d) of §1910.1200;

GHS Hazard Symbols

GHS Classification	Aspiration Hazard Category 1 Skin Corrosion/Irritation Category 2 Serious Eye Damage/Eye Irritation Category 2B Flammable Liquid Category 3 Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 3 Acute Toxicity - Inhalation Vapour Category 4
Signal Word	Danger
Hazard Statements	Flammable liquid and vapour. May be fatal if swallowed and enters airways. Causes skin and eye irritation Harmful if inhaled. May cause respiratory irritation. May cause drowsiness or dizziness.
Precautionary Statements	
Prevention	Keep away from heat/sparks/open flames/hot surfaces. – No smoking. Keep container tightly closed. Ground/bond container and receiving equipment. Use explosion-proof equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Avoid breathing dust/fume/gas/mist/vapours/spray. Wash thoroughly after handling.

	Use only outdoors or in a well-ventilated area. Wear protective gloves/protective clothing/eye protection/face protection.
Response	IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician. IF ON SKIN: Wash with plenty of soap and water. IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Call a POISON CENTER or doctor/physician if you feel unwell. Specific treatment: None known Do NOT induce vomiting. If skin irritation occurs: Get medical advice/attention. If eye irritation persists: Get medical advice/attention. Take off contaminated clothing and wash before reuse. Use dry chemical, water fog, CO2, foam or sand/earth for extinction.
Storage	Keep container tightly closed. Store in a well-ventilated place. Keep container tightly closed. Store in a well-ventilated place. Keep cool. Store locked up.
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulation for hazardous wastes.

SECTION 3 Composition/information on ingredients

Chemical Name	CAS #	%
Hydrotreated light distillate (Petroleum)	64742-47-8	10 - 30
Stoddard solvent	8052-41-3	10 - 30

Note: Specific chemical identities and/or exact percentages have been withheld as a trade secret.

SECTION 4 First aid measures

Inhalation	If symptoms are experienced remove source of contamination or move victim to fresh air and obtain medical advice.
Eyes	Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.
Skin Contact	Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.
Ingestion	Do not induce vomiting and seek medical attention immediately. Provide medical care provider with this SDS.
Note to Doctor	Treat symptomatically.

SECTION 5 Firefighting measures

Extinguishing media	Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water may be ineffective but water spray can be used extinguish a fire if swept across the base of the flames. Water can absorb heat and keep exposed material from being damaged by fire.

Fire and/or Explosion Hazards	Vapors may be ignited by sparks, flames or other sources of ignition if material is above the flash point giving rise to a fire (Class B). Vapors are heavier than air and may travel to a source of ignition and flash back. Empty containers that retain product residue (liquid, solid/sludge, or vapor) can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose container to heat, flame, sparks, static electricity, or other sources of ignition. Any of these actions can potentially cause an explosion that may lead to injury or death.
Fire Fighting Methods and Protection	Do not enter fire area without proper protection including self-contained breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.
Hazardous Combustion Products	Carbon dioxide, Carbon monoxide, Sulfur compounds, Hydrocarbons

SECTION 6 Accidental release measures

Personal precautions, protective equipment and emergency procedures	Exposure to the spilled material may be irritating or harmful. Follow personal protective equipment recommendations found in Section VIII of this SDS. Additional precautions may be necessary based on special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred. Also consider the expertise of employees in the area responding to the spill.
Methods and materials for containment and cleaning up	Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section VIII at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal evaluation.

SECTION 7 Handling and storage

Precautions for safe handling	Avoid contacting and avoid breathing the material. Use only in a well ventilated area. As with all chemicals, good industrial hygiene practices should be followed when handling this material. Wash thoroughly after handling. Do not get in eyes, on skin and clothing. Ground and bond containers when transferring material. "Empty" containers retain product residue (liquid and/or vapor) and can be dangerous.
Conditions for safe storage, including any incompatibilities	Store in a cool dry place. Isolate from incompatible materials.Keep container closed when not in use. Keep away from sources of ignition.
Incompatible materials	Strong oxidizing agents, Strong alkalies, Acids

SECTION 8 Exposure controls/personal protection

Control parameters

Chemical Name	ACGIH TLV	ACGIH STEL	OSHA PEL
Hydrotreated light distillate (Petroleum)	212 ppm (8 hrs)		
Stoddard solvent	100 ppm TWA; 525 mg/m3 TWA		500 ppm TWA; 2900 mg/m3 TWA

Engineering Measures	Local exhaust ventilation or other engineering controls are normally required when handling or using this product to avoid overexposure. Engineering controls must be designed to meet the OSHA chemical specific standard in 29 CFR 1910. Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits
Respiratory Protection	Proper ventilation (at a minimum) will be required when handling this product. Use respirators (NIOSH approved) only if ventilation cannot be used to eliminate symptoms or reduce the exposure to below acceptable levels. Follow a respiratory protection program that meets 29 CFR 1910.134 and ANSI Z88.2 requirements whenever work place conditions warrant the use of a respirator.
Eye Protection	Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.
Skin Protection	Wear protective gloves. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work.
Gloves	Chemically resistant gloves

SECTION 9 Physical and chemical properties (Typical, not specification)

Physical State	Liquid
Color	Amber
Odor	Slight Solvent Odor
Odor Threshold	No data available
pH	No data available
Melting Point, °C	No data available
Boiling Point, °C	No data available
Flash Point	>= 100 °F(38 °C)
Evaporation Rate	No data available
Flammability (Solid, Gas)	No data available
Lower Flammable/Explosive Limit, % in air	No data available
Upper Flammable/Explosive Limit, % in air	No data available
Vapor Pressure	2 mmHg
Vapor Density	>1 (Air=1)
Specific Gravity @ 25°C	0.86
Solubility in Water	Negligible; 0-1%
Octanol/Water Partition Coefficient	No data available
Autoignition Temperature	No data available

Decomposition Temperature	No data available
Viscosity	No data available
Volatiles, % by weight	44
VOC, lb/gal	3.21
VOC, grams/liter	385
VOC minus exempt solvents & water, lb/gal	3.21

SECTION 10 Stability and reactivity

Chemical stability	Stable under normal conditions. Hazardous polymerization will not occur.
Possibility of hazardous reactions	Under normal conditions of storage and use, hazardous reactions will not occur.
Conditions to avoid	Contamination. Elevated temperatures.
Incompatible materials	Strong oxidizing agents, Strong alkalies, Acids
Hazardous decomposition products	Decomposition and hazardous decomposition products are unlikely.

SECTION 11 Toxicological information

Likely Routes of Entry	Inhalation, Skin contact, Eye contact
Target Organs Potentially Affected by Exposure	Central Nervous System, Respiratory Tract, Skin, Eyes, Kidneys, Liver, Nervous System
Chemical Interactions That Change Toxicity	No chemical interaction known to affect toxicity.
Medical Conditions Aggravated	Skin contact may aggravate existing skin disease, Respiratory disease including asthma and bronchitis

Immediate (Acute) Health Effects by Route of Exposure

Inhalation Irritation	Can cause moderate respiratory irritation, dizziness, weakness, fatigue, nausea and headache.Other possible symptoms include; wheezing and coughing due to pulmonary edema (fluid build-up in lungs).
Skin Contact	Can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.
Eye Contact	Can cause moderate irritation, tearing and reddening, but not likely to permanently injure eye tissue.
Ingestion Irritation	Irritating to mouth, throat, and stomach. Can cause abdominal discomfort, nausea, vomiting and diarrhea. Substance is harmful if swallowed. Large exposure may be fatal.
Ingestion Toxicity	Harmful if swallowed.

Long-Term (Chronic) Health Effects

Carcinogenicity	Not listed by ACGIH, IARC, NIOSH, NTP OR OSHA.
Reproductive and Developmental Toxicity	No data available to indicate product or any components present at greater than 0.1% may cause birth defects.
Inhalation	Upon prolonged and/or repeated exposure, can cause severe respiratory irritation, dizziness, weakness, fatigue, nausea, headache and possible unconsciousness.
Skin Contact	Upon prolonged or repeated contact, can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.

Safety Data Sheet

Component Toxicology Data

Chemical Name	CAS Number	LD50/LC50
Stoddard solvent	8052-41-3	Oral LD50 Rat > 5000 mg/kg Inhalation LC50 (4h) Rat > 5500 MG/CU M

SECTION 12 Ecological information

Overview	No ecological information available
Mobility	No data
Persistence	No data
Bioaccumulation	No data
Degradability	No data

Ecotoxicity Data

Chemical Name	CAS Number	Aquatic EC50 Crustacea	Aquatic ERC50 Algae	Aquatic LC50 Fish
No data available				

SECTION 13 Disposal considerations

Waste Description for Spent Product	Spent or discarded material is a hazardous waste.
Disposal Methods	Dispose of by incineration following Federal, State, Local, or Provincial regulations.
Waste Disposal Code(s)	D001

SECTION 14 Transport information

Full Shipping Name for Export, Air, Sea (any quantity) or vessels of 119 gal. or more:	UN1268, PETROLEUM DISTILLATES, N.O.S., (Naphtha Solvent), 3, PG III
Domestic Ground in vessels < 119 gal.	Not Regulated

SECTION 15 Regulatory information

TSCA Status	All components in this product are on the TSCA Inventory or exempt.
Canadian DSL status:	All chemical substances in this material are included on or exempted from listing on the Canadian DSL.

Chemical Name	CAS #	Regulation	Percent
No 313-listed chemicals in this product		SARA 313	

SECTION 16 Other information

Revision Date	03-10-2015
Disclaimer	Although the information contained herein is believed to be reliable, it is furnished without warranty of any kind. This information is not intended to be all-inclusive as to the manner and conditions of use, handling, and storage.
Version	Revised
Comments	Approved: J. Kump / M. Duncan

APPENDIX D – PROSPOOL & EZ SPOOL MANUALS

About

This document outlines how to set up and use EZ Spool. EZ Spool is a simplified spooling program that uses very little settings, and provides accurate positioning. It has a stripped back user interface for simplicity.

Intro

EZ Spool has three operational modes.

"**Manual LW**", which allows the levelwind to be jogged by the user and no automatic functions occur.

"**EZ Auto LW**", will position the levelwind on its own to a calculated set point based off setup variables. While in auto mode, you can jog on the fly and if the jog lands inside the spooling zone, the auto mode will continue from this point. If you jog outside the "spooling zone", the automatic spooling will be paused and the LW can be moved by jogging. Once you jog back into the spooling zone, the auto mode will reactivate, and pick up where the jog landed. It will continue spooling in the same direction that it was feeding when the levelwind exited the spooling zone. Auto mode also has a "Reverse LW" button that simply reversed the feeding direction on the fly.

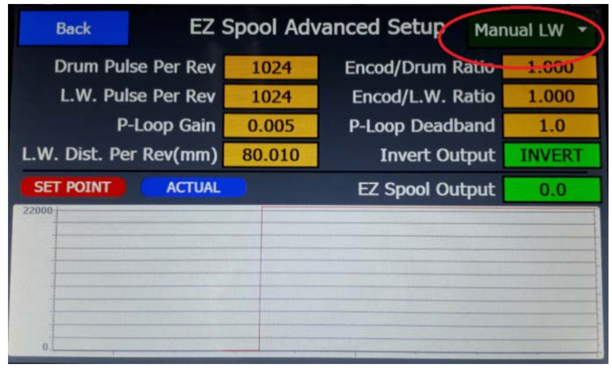
"**LW Park**", prohibits any levelwind motion, including manual jog commands.

Initial Setup

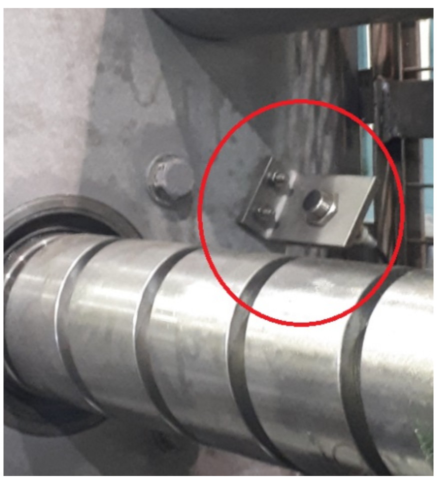
Hardware Checks

These checks only need to be done once, or when sensors are replaced. The machine must be running, and the levelwind and drum must be free to move for these tests.

Find an EZ Spool mode control box, and set it to "Manual LW". You may need to activate EZ Spool If "ProSpool" is also available on the system.



It is assumed the winch drum and levelwind encoders are working correctly. The count is usually available in other menus of the PLC. The counts should move up and down as the drum and levelwind are moved. It does not matter which direction they are counting, or where their “zero” is. We do need to make sure the end of travel sensors are working. These sensors will ensure the levelwind will stop before crashing into the winch frame. This may happen by operator error, encoder failure. These sensors are usually a “proximity” sensor at both ends of the levelwind.

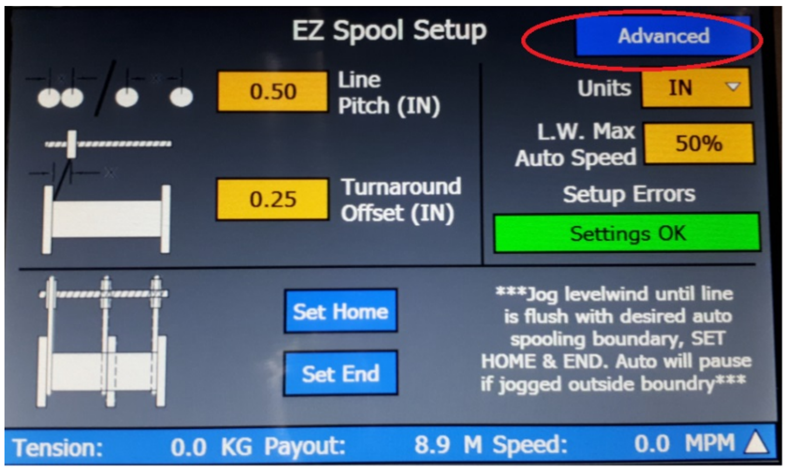


As you approach the end of travel sensor, carefully jog over it. The levelwind should automatically shut down. If nothing happens, and the levelwind can move past the sensor, the sensor will have to be adjusted. If the sensor is adjusted, it may be broken or disconnected.

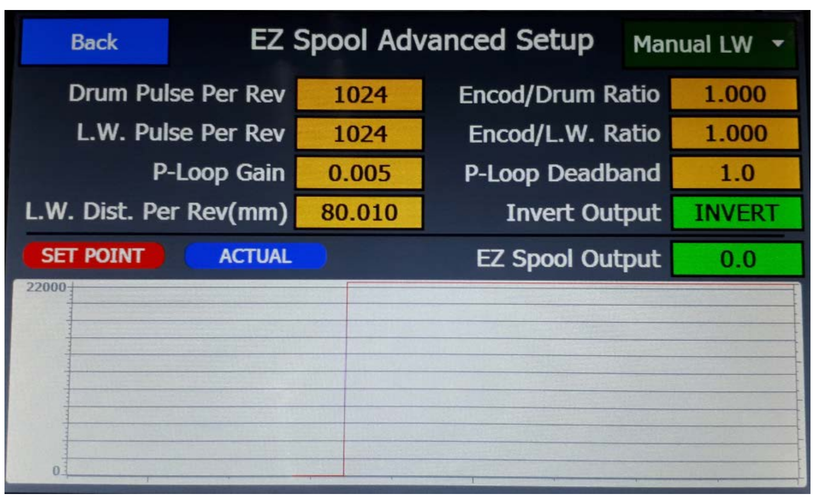
Initial Software Setup

If it’s the first time using EZ Spool. Some settings will have to be entered once. From the main menu, find the “EZ Spool Setup” menu button.

Next enter the "Advanced" menu, no log in is required.



In the advanced menu, fill out the winch hardware information.



Drum Pulse Per Rev: Enter the drum encoder resolution per rev. Depending on the sensors being used, this value can greatly differ.

Encod/Drum Ration: If the encoder is not directly mounted to the drum, it may be on the other side of a gearbox. The ratio will have to be entered.

L.W. Pulse Per Rev: Enter the levelwind encoder resolution per rev. Depending on the sensors being used, this value can greatly differ.

Encod/L.W. Ratio: If the encoder is not directly mounted to the levelwind, it may be on the other side of a gearbox. The ratio will have to be entered.

P-Loop Gain: Sets how reactive the levelwind moves to set point. To high and the levelwind will be "jumpy". Too low and the levelwind will be sluggish and fall behind. See **Auto Control Tuning** for more in-depth description.

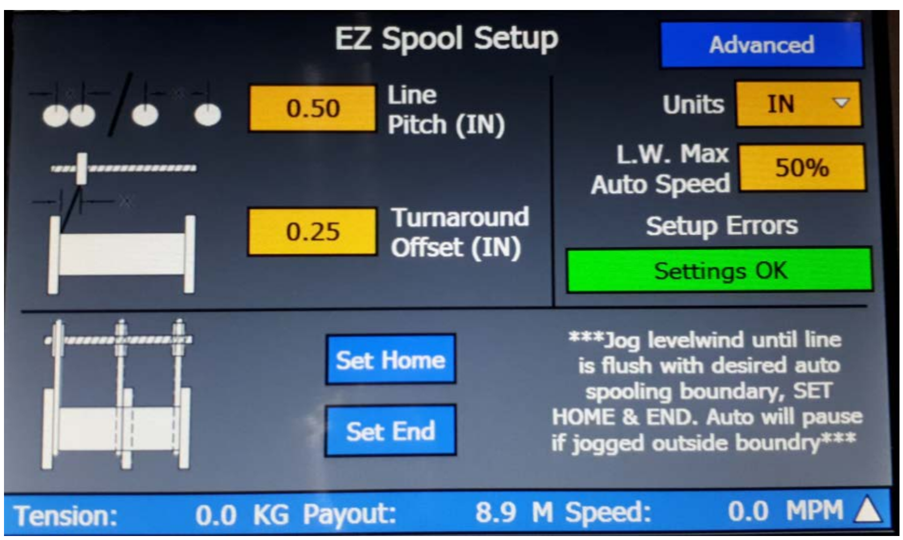
P-Loop Dead Band: Set between 0.5 and 3.0 to allow the levelwind to stop when it is close to the set point, and not overshoot it.

L.W. Dist. Per Rev(mm): Enter a linear dimension the levelwind will travel per revolution (screw pitch). The units are in mm.

Invert Output: Reverse what way to send the levelwind to get it closer to set point.

EZ Spool Setup

The set up will have to be used when a different spooling pitch or "spooling zone" is required.



Units: Select between (mm) and (in) for the units.

L.W. Max Auto Speed: Set the maximum speed allowable for auto mode (0-100%).

Line Pitch: Set how far apart you wish the line to be spooled (center to centre).

Turnaround Offset: Set how far you wish the levelwind to stay back from the Home and End set points. This is typically ½ of the line diameter.

[Set Home]: Jog to the beginning of a desired spooling zone. The line should be flush with a drum flange or drum core divider. Press and hold until check mark appear, signaling the new position has been saved.

[Set End]: Jog to the end of a desired spooling zone. The line should be flush with a drum flange or drum core divider. Press and hold until check mark appear, signaling the new position has been saved.

Setup Errors [Settings OK]: If there is a setting or setup issue preventing the program from running, it is displayed here.

'Line Pitch is Zero'	Line pitch must be set higher than zero.
'Set End/Home'	The spooling boundaries are not set. Note these are cleared if another program re-sets the drum or levelwind counter (ProSpool Home/LW home)
'PGain is Zero'	P-gain must be above zero.
'Dist. / Rev is Zero'	The levelwind distance per revolution must be greater than zero.
'Drum PPR is Zero'	The drum pulses per rev must be greater than zero.
'Drum PPR Ratio Zero'	The drum to encoder ratio must not be zero.
'L.W. PPR is Zero'	The levelwind pulses per rev must be greater than zero.
'L.W. PPR Ratio Zero'	The levelwind to encoder ratio must not be zero.
'End Of Travel Switch'	An end of travel switch is currently active.
'Max Auto Speed Zero'	The max auto speed has to be greater than zero.
'Max Spd < Deadband'	The P-loop deadband must be less than max winch speed.
'Home > End Set Pnt'	The Home set point from the LW encoder counter has to be less than the End set point. Swap setting Home [SET] and End [SET] if this error persists.

Once all the settings are entered, and “Setup Errors” displays “Settings OK”; we can navigate to the “Advanced” screen to ensure the automatic position is working correctly.

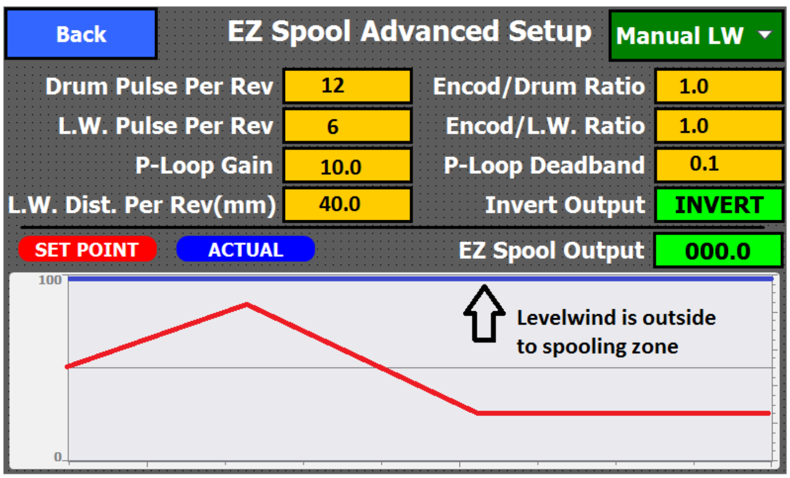
Auto Control Tuning

While the machine is on, and the drum and levelwind are free to move, as well as all the setting have been entered; we can now activate “EZ Auto LW”. We will check the functionality of the p-loop and then can continue with regular operations. Checking and setting the p-loop only needs to be done once.

First select “EZ Auto LW” from the mode selector box.

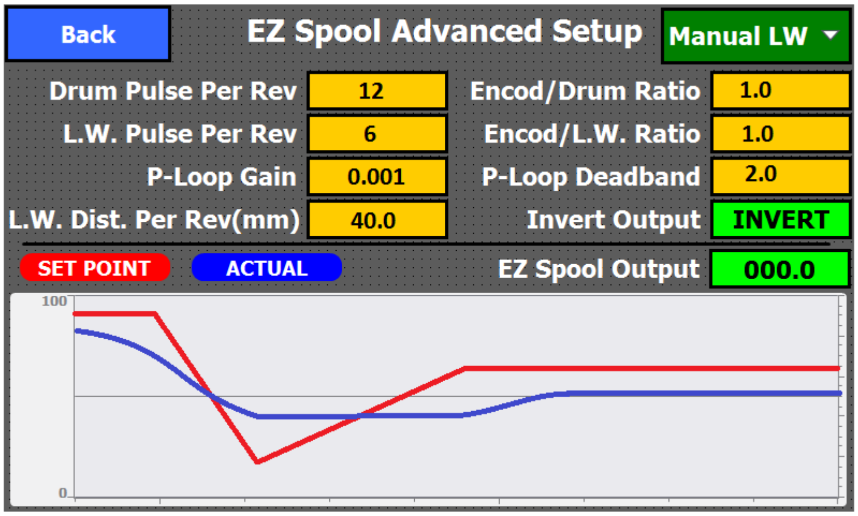
As the drum is turned, and the levelwind is inside the boundaries, auto mode should be moving the levelwind. Below are some issues that may arise if settings are off.

******If "EZ Auto LW" is not positioning the levelwind, ensure the levelwind is inside the [Home] and [End] bounds that were set. ******



LW Slow to React: While in auto mode, the levelwind is very sluggish and may not get completely close to the drum position set point. This is probably happening because the "P Gain" value that is too low.

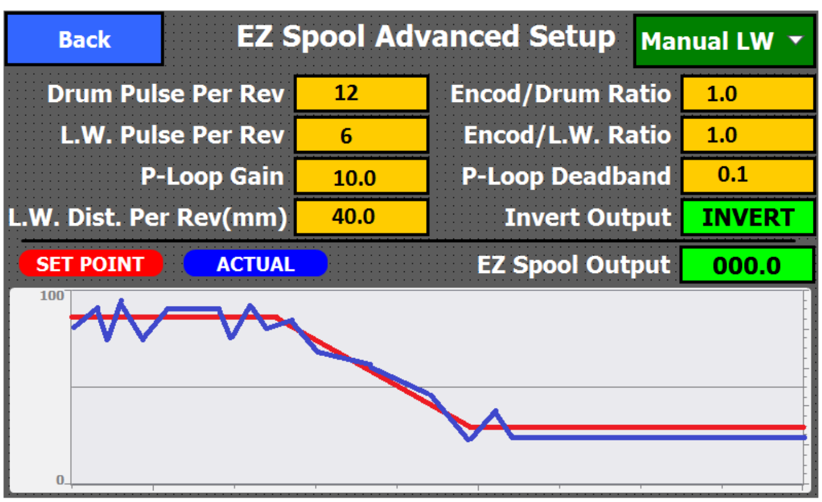
If you are in the Auto Control Setup Menu when this happens, the graph will look like this. We can see the actual tails the set point by a lot. As it does get close to set point, it will slow down more or even stop.



To fix this, increase the “P Gain” value until it becomes more reactive.

LW is Jumpy / Jerks Back and Forth: While in Auto mode, the levelwind will quickly move to the drum set point, but it may over shoot it, it may jump back and forth near the drum set point. This can either be from the “Dead band” being too low, or the “P Gain” is too high.

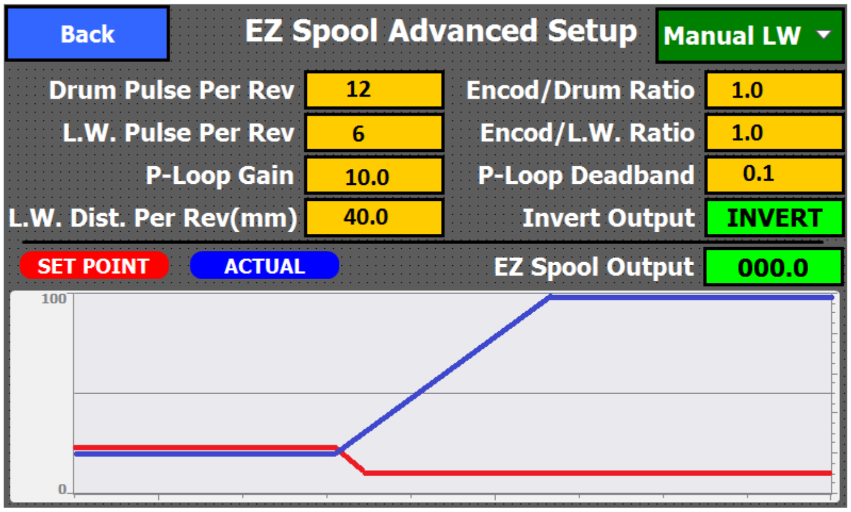
If you are in the Auto Control Setup Menu when this happens, the graph will look like this. We can see the levelwind actual “hunt” around the set point until it settles down.



To fix this ensure the “Output Deadband (%)” is at least 1.0. Then turn down the “P Gain” until the levelwind meets the set point smoothly.

Invert Output Issue: While in auto mode, the levelwind position will “take off” and quickly move away from the drum position. This is because the levelwind is being told to go the wrong direction when trying to get to the drum position set point.

If you are in the Auto Control Setup Menu when this happens, the graph will look like this. We can see the set point remains the same, and the levelwind is being sent away from it.



To fix this, simply press the "Invert Output" button in the bottom right. This setting will be automatically saved.

Regular Use

Once all the setup is complete, EZ Spool can be used from the selection box. It also has a "Reverse LW" button that will reverse the EZ Auto feeding direction on the fly if the spooling encounters an issue.

The "EZ Setup" screen will only need to be accessed again if the line pitch has to be changed of the spooling zone [Home] and [End] have to be re-set.

About

This document outlines how to set up and use the ProSpool program. ProSpool uses information about the winch and line geometry to accurately position the winch levelwind to assist the line in spooling on, and off the winch drum. If used with a grooved shell and machined winch drum, the best possible spooling performance can be achieved.

Intro

ProSpool has three operational modes.

“Manual LW”, which allows the levelwind to be jogged by the user and no automatic functions occur.

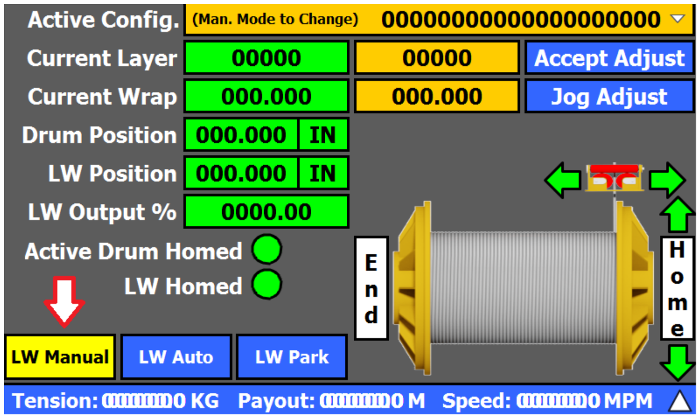
“LW Auto”, will position the levelwind on its own to a calculated set point based on setup for the line selected. You can manually jog the levelwind, but it will immediately return to the auto set point after the jog. You can jog in manual, but once switched back to auto the LW will drive to the calculated set point.

“Park”, prohibits any levelwind motion, including manual jog commands.

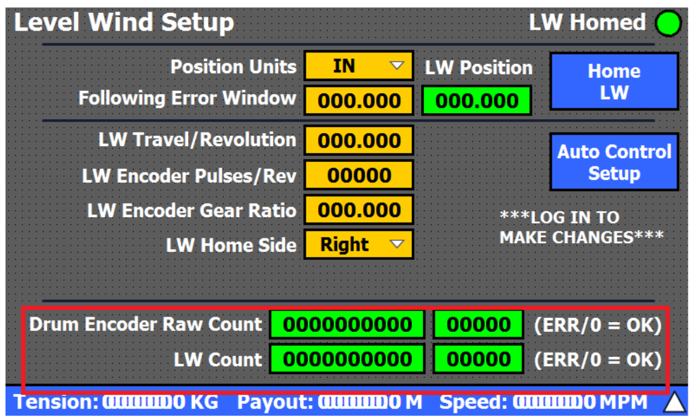
Initial Setup

Initial Checks: These checks only need to be done once, or when drum or level wind encoders are replaced. Log in to make the “LW Setup” and “Spooling Configs” menus available. The machine must be running, and the levelwind and drum must be free to move for these tests.

First enter the “LW Control” menu and set the mode to “manual”. Then navigate back to the main menu.



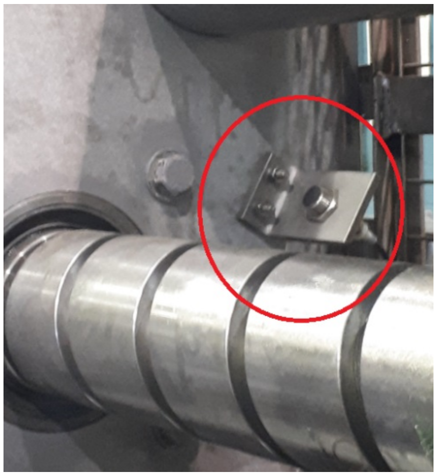
Now enter “LW Setup”. The first is to ensuring that the encoders are working properly.



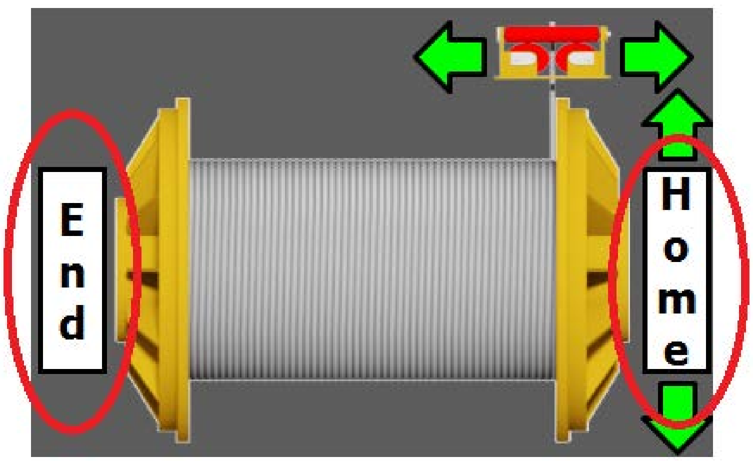
“Drum Encoder Raw Count” should be counting up as the drum hauls line in. “LW Count” should be counting up and down as the levelwind is manually jogged from side to side. If they are not counting correctly or at all, troubleshoot the system for damaged or faulty components.

Next we need to make sure the end of travel sensors are working. These sensors will ensure the levelwind will stop before crashing into the frame. This may happen by operator error, encoder failure, or if the levelwind is moved while the machine is powered down, then placed in “ProSpool Auto Mode”.

Navigate back to the “LW Control” menu and manually jog the levelwind near the end of travel switch. These may be physical switches or proximity sensors at both ends of the levelwind.

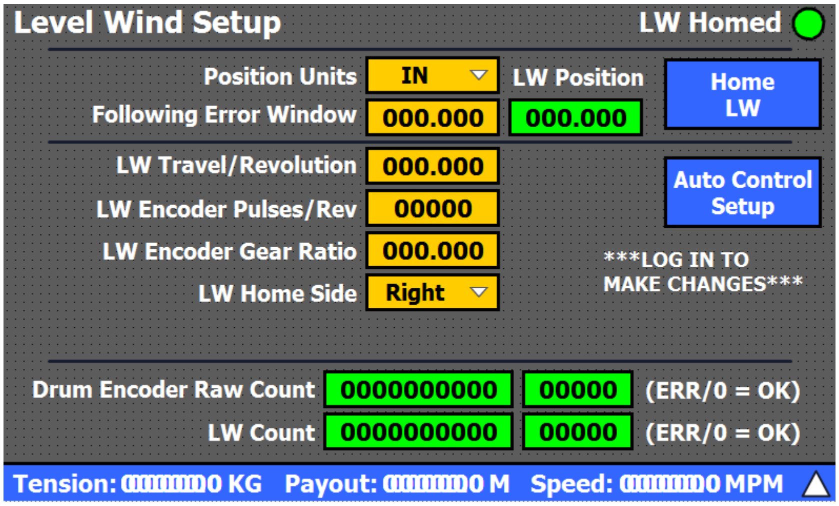
 

As you approach the end of travel sensor, carefully jog over it. In the "LW Control" screen, the corresponding "END", and "HOME" icons on the drum will turn red. An alarm may sound. If nothing happens, and the levelwind can move past the sensor, the sensor will have to be adjusted. If the sensor is adjusted, it may be broken or disconnected.



Lastly for the initial checks; if there are sensors on the levelwind sheave for payout and speed, or a tension pin. Ensure they are working correctly (*not covered in this manual*).

<u>Initial Software Setup:</u> If it's the first time using ProSpool, or an encoder has been replaced, the levelwind settings have to be checked. Navigate to the "LW Setup" menu.

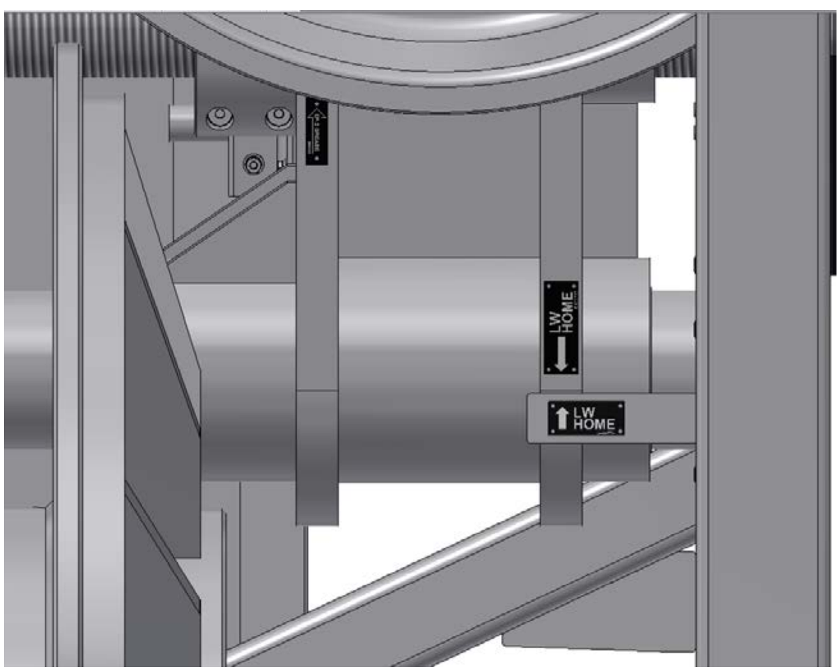


LW Homed Icon: This will be red if the levelwind is not currently homed, green if it has been homed.

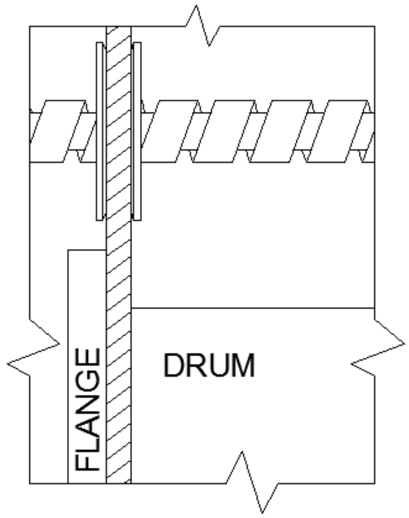
Position Units: Select the units (in or mm) you wish to use for the ProSpool Settings.

Following Error Window: How far away from the calculated set point can the levelwind be in auto mode. If it remains outside this window for too long, manual mode will be activated. This is typically 1/10 the total levelwind travel.

Home LW: The levelwind home can be anywhere, but typically alignment decals are provided to position the levelwind near the drum “home”. The drum “home” side is the side of the drum where the line first starts to spool. The line usually passed though the drum core, or out the side of the flange and then clamped to the drum. On new Hawbolt machinery, a decal on the level wind carriage can be aligned to a stationary decal on the winch frame for simple levelwind home position.

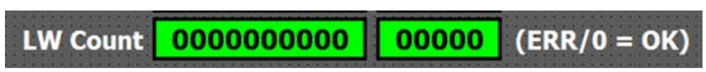


If the winch does not have alignment decals, place the line on the same side as the drum home, with the line flush against the drum flange.



Once the levelwind is in this position press “Home LW”; this will be the LW zero reference that “home offset” will be applied to for each line configuration.

Note that after levelwind home is set, the “LW Count” has to increase, as you move into the spooling zone. **If it is not counting up, reverse the encoder “A” and “B” signal wires. If it’s not counting at all, troubleshoot the encoder sensor.**



LW Travel/Revolution: Enter a linear dimension the levelwind will travel per revolution (screw pitch). The units will be either inches or mm (depending on what was set above).

LW Encoder Pulses/Rev: Enter the levelwind encoder resolution per rev. Depending on the sensors being used, this value can greatly differ.

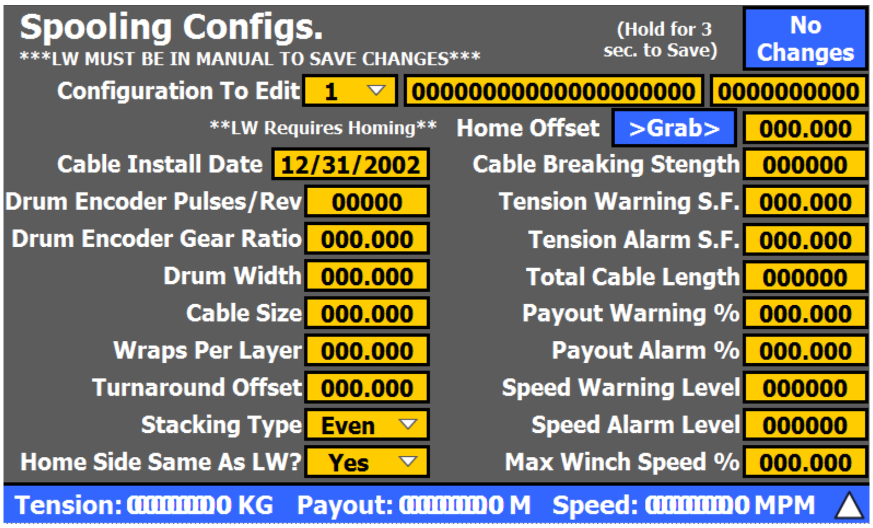
LW Encoder Gear Ratio: If the encoder is not directly mounted to the levelwind screw, it may be on the other side of a gearbox. The ratio will have to be entered.

LW Home Side: This is for the drum display, to show what side to start from.

Auto Control Setup: Activates a “P-Loop” setup screen, which will have to be tuned once while in auto mode. This menu will be covered below.

Spooling Config Setup

For each type of line or winch drum geometry change, a “spooling configuration” has to be set up once. ProSpool allows for 10 different spooling configurations. After a configuration is edited, it can be saved, and the configuration can simply be selected when it is time to be used. This will allow for one winch to be used with different drums, or a drum divider, or different lines. Navigate to the “Spooling Configs” menu to set up a line.

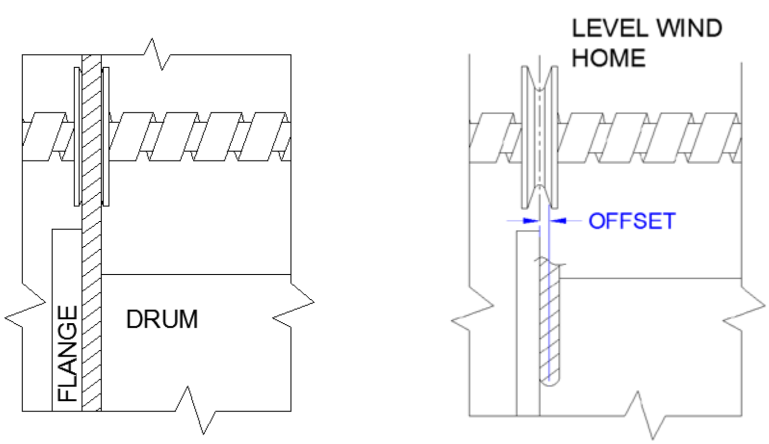


Configuration To Edit: Select an available slot (1-10). The line can also have a short name and serial number.

Home Offset: This can be either manually entered, or “Grab”, which is the current levelwind location. The purpose of “home offset” is to give each line configuration relative distance from the levelwind home location. This is important if each configuration has different diameter line. This ensure the levelwind starts at the correct position for the diameter line being used.

If you are able to jog the levelwind with the line on the sheave, you can “Grab” the home offset when the line is just starting to touch the flange. If you cannot jog with the line, the dimension can be manually entered.

Home Offset dimension “>Grab>”, versus manually entering a dimension from a known LW home



To manually enter an offset, you must know where the levelwind home was taken, and then enter a dimension that would place the line flat against the drum flange. This can be easily calculated if you used the drums flange as the levelwind home. The offset would just be the radius of the line.

Cable Install Date: Can be entered and used for cable inspections.

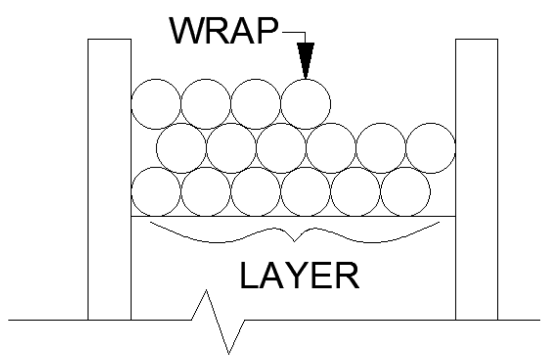
Drum Encoder Pulses/Rev: Enter the drum encoder resolution per rev. Depending on the sensors being used, this value can greatly differ.

Drum Encoder Gear Ratio: If the encoder is not directly mounted to the drum, it may be on the other side of a gearbox. The ratio will have to be entered.

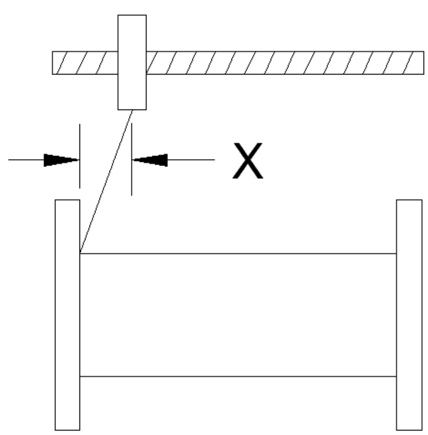
Drum Width: Enter the inside flange to inside flange dimension of the drum.

Cable Size: Enter the diameter of the line being used.

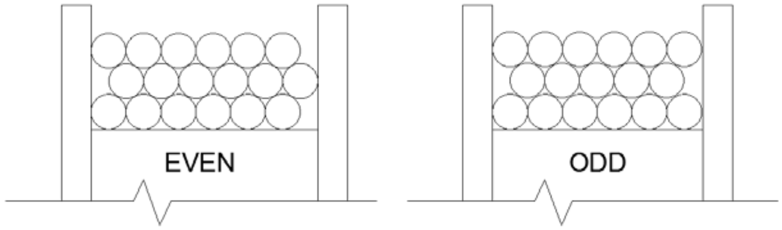
Wraps Per Layer: Enter how many "wraps" of the line are expected to fit in the "Drum Width". This diagram would be six wraps per layer.



Turn Around Offset: Enter how far the levelwind should be away from the inside flanges while it waits for the line to start feeding back. Typically this is half the line diameter.



Stacking Type: Select even or odd stacking type. “Odd” stacking has one less wrap every other layer. “Even” has the same number of wraps, for every layer.



Home Side Same as LW?: If the drum home is the same as the levelwind home side, select yes. If it is not, select no. The drum “home” side is the side of the drum where the line first starts to spool. The line usually passed though the drum core, or out the side of the flange and then clamped to the drum.

If a load pin is used, fill out the cable tension alarm and warning level boxes. Leave as “0” to disable.

Cable Breaking Strength: Enter the lines known braking strength.

Tension Warning S.F.: Is the warning safety factor applied to the cable breaking strength and provided an alarm warning.

Tension Alarm S.F.: Is the alarm safety factor applied to the cable breaking strength and provided an alarm warning.

If a sheave encoder is used for winch payout and speed, fill out the alarm and warning level boxes.

Total Cable Length: Is the total amount of cable on the drum. The units are whatever is currently selected from payout setup (M, KM, FT, MI, NM).

Payout Warning %: Is the percent of the “total cable length” that a warning alarm will sound.

Payout Alarm %: Is the percent of the “total cable length” that an alarm will sound.

Speed Warning Level: Is the line speed in the current selected units (MPM, KPH, FPM, MPH, KNOT), that a warning will sound.

Speed Alarm Level: Is the line speed in the current selected units (MPM, KPH, FPM, MPH, KNOT), that a alarm will sound.

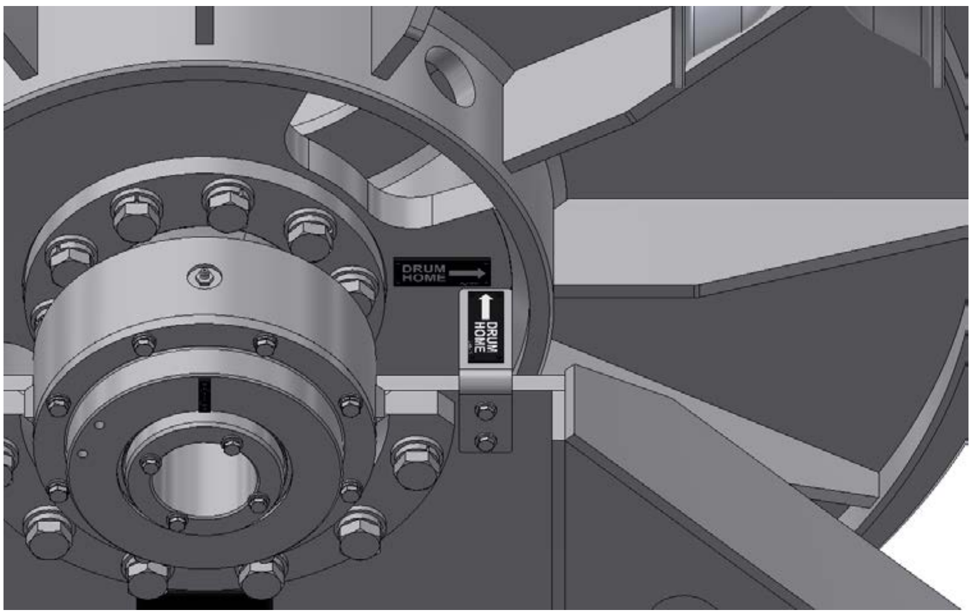
If the ProSpool PLC is controlling the winch drum drive, fill out the max winch speed. There may be a winch joystick scaling % outside of ProSpool; during operation the program will use the smaller value.

Max Winch Speed %: Is the max winch speed allowed for the line.

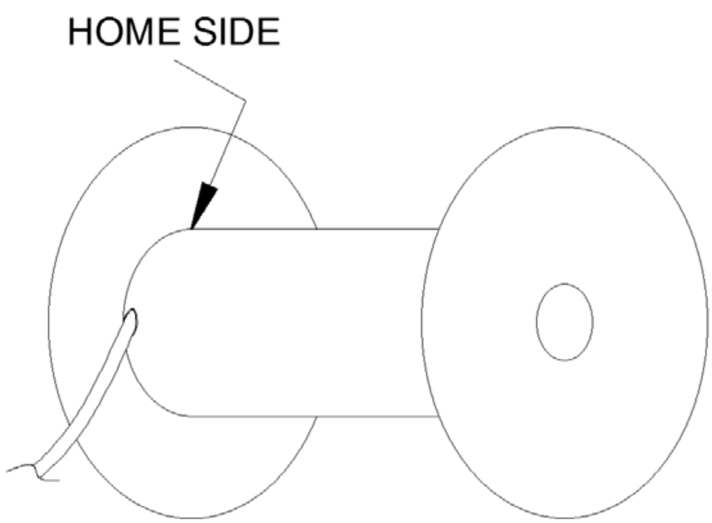
Drum Home

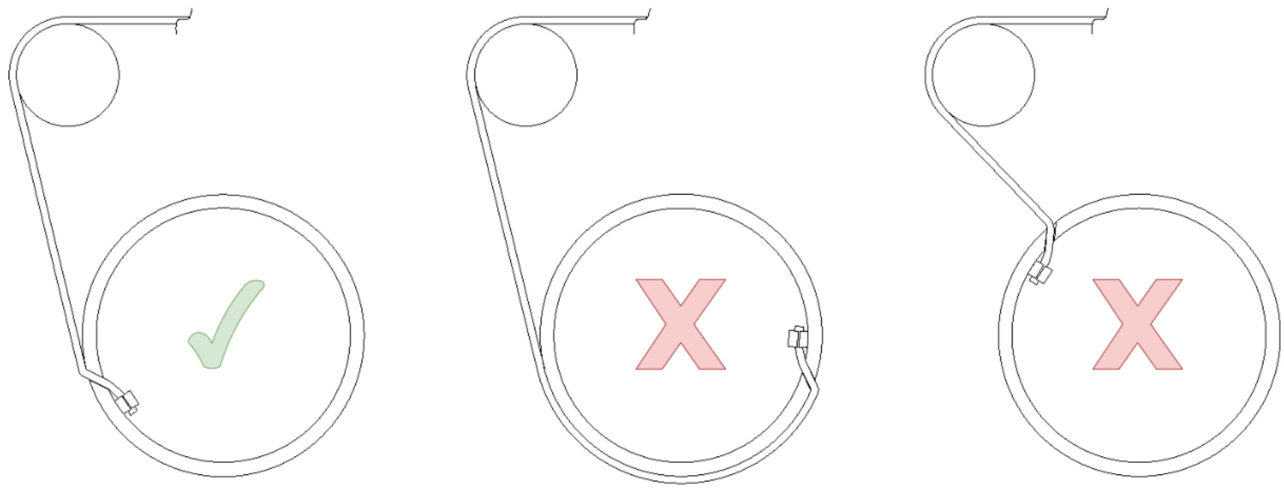
"Drum Home" is used to ensure the exact layer, and wrap are being displayed on the screen. This step can only be done when there is no line on the drum, and only needs to be done once. Note, ProSpool can still operate without this step, but if it is not feeding correctly you will have to manually adjust layers and wraps described below in "Spooling Test/Auto Mode Error Correction".

Drum home is with an empty drum, and the cable is tangent from the cable exit on the drum, to the levelwind sheave. On new Hawbolt machinery, a decal is provided on the drum to indicate the drum home position while you are on the first wrap.



If there is no decal available, these illustrations further describe drum home/layer 1/wrap1 position.





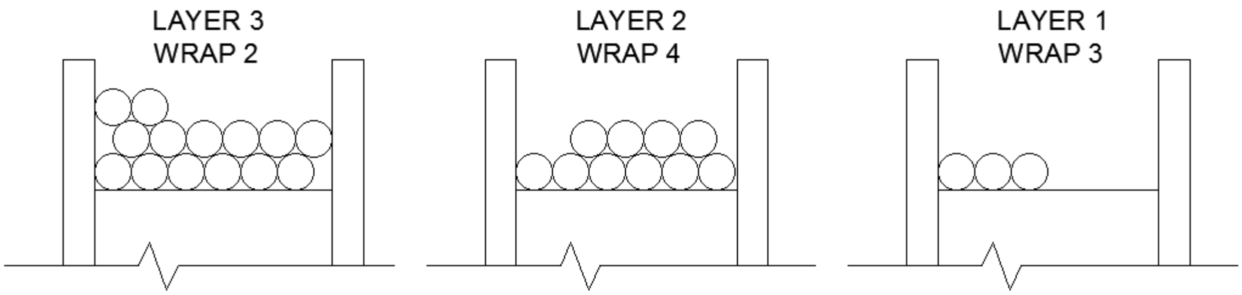
At the drum home position described, the display should show “layer 1 and wrap 1”. If the home layer and wrap are incorrect, they need to be set to “layer 1 and wrap 1”. Updating the wrap and layer is described below in “Auto Mode Error Correction”. Note with nothing on the drum, this means that drum is spooling first layer and first wrap. Notice that the wrap displays “1”, although there are no wraps spooled yet, as system displays current wrap being spooled, not number of completely spooled wraps. After spooling one complete wrap (turning drum one full turn), display shows layer 1 and wrap 2. Drum now has one complete wrap spooled and is starting to spool second wrap.

Spooling Test

Now that the initial checks, levelwind setup, and spooling configuration have been entered; it is time to test spooling. At this point, we need to find out how many “layers” of line are on the drum and how many “wraps” on the current layer. If the drum is empty, you are simply on “Layer 1” and “Wrap 1”. Navigate to the “LW Control” menu. Ensure the mode is still set to “Manual”, and select the “Active Config” which is the configuration for the current line and drum being used.

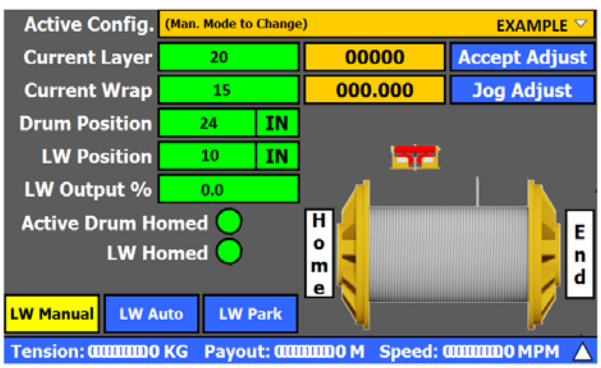
ProSpool uses the “layer” to know which way the levelwind should be feeding between drum flanges. Even layers will feed in one direction, and odd layers will feed in the other. Then it used the “wrap” to know where to place the levelwind, since we entered “wraps per layer” into the spooling configuration.

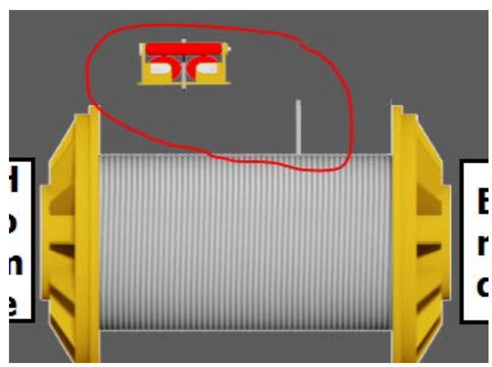
If there is a known amount of line on the drums enter the current wraps and layer. Here are some examples.



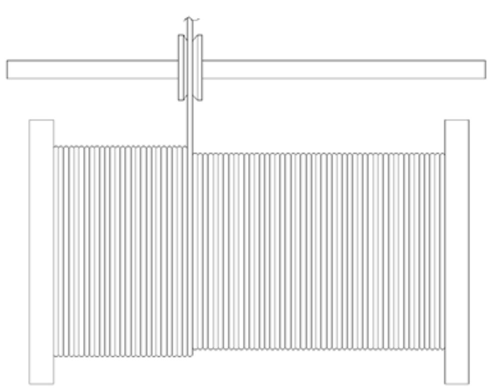
If it is impossible to calculate, or find out how many layers are on the drum, it is best to enter a value mush higher then what could be on there. Due to limitations in the program, ProSpool is unable to go below layer 1. If it does, ProSpool will continually feed the levelwind in layer ones direction. At the end of the layer, it will return to the opposite side of the drum and try to feed layer one again. This can potentially cause damage to the line or levelwind if it is under load.

After we enter a “Current Layer” and “Current Wrap”, the screen will show us where it is calculating the line to be, and where the levelwind position is. Here is an example of entering estimated layers and wraps.

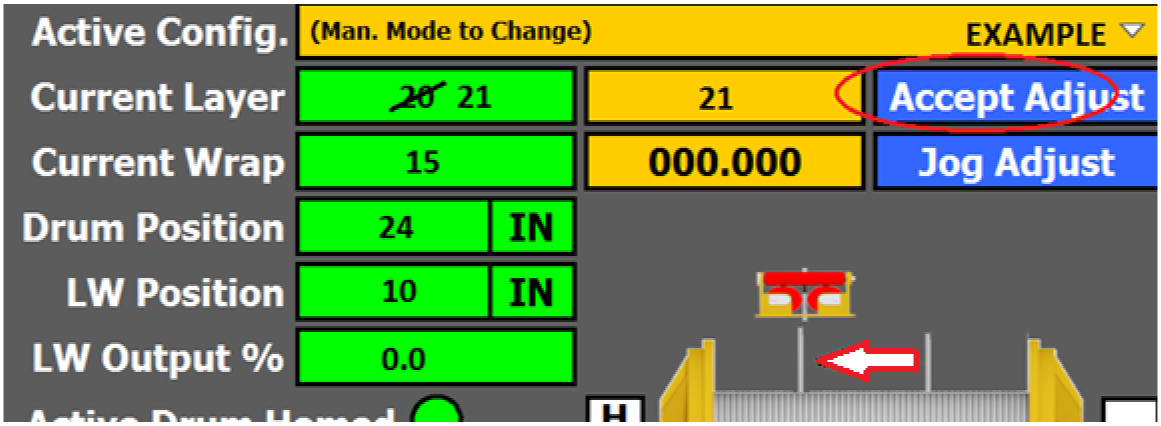




In this example we can see there the cable does not line up with the levelwind. In reality, the winch and levelwind may look like this.



We can see that “wraps” are being applied to the wrong side and if we tried to use auto mode, and the levelwind would be feeding the opposite direction then the drum. This means we need to add or subtract one layer in order to for the program to feed in the correct direction for that layer.



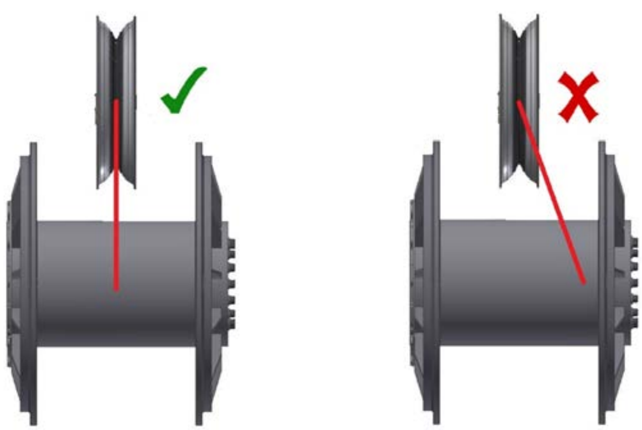
If we enter a new layer, and press “Accept Adjust”, we will see the cable coming off the drum “jump” to a new calculated position.

Now that the levelwind is close to the calculated drum position, we can test the auto function. **Be prepared to move the LW to manual or park if this is the first time using auto**. Press “LW Auto”. The buttons should illuminate and the levelwind may move slightly into the calculated position.

If the mode immediately switches back to manual mode, it means either the levelwind, or current drum is not homed. If the levelwind takes off, and it moves away from the drum position, switch to manual mode and review “Invert Output” in “Auto Control Setup” menu.

If auto mode is working correctly, it will now track with the drum as line is paid out, or hauled in. Ensure there is at least a small load on the line while doing this.

<u>**Auto Mode Error Correction**</u>

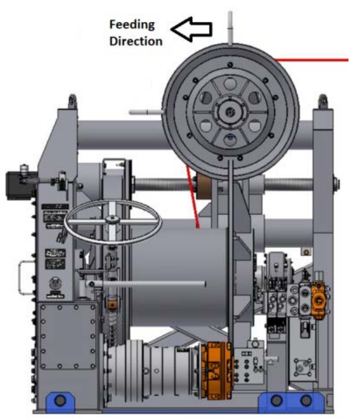


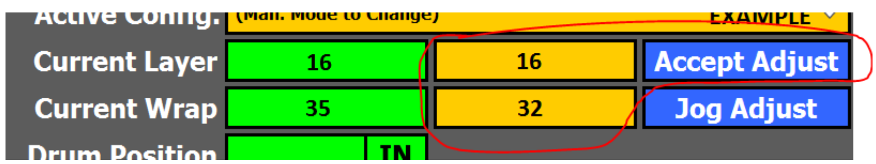
In some cases the levelwind may fall behind, or get ahead the drum feeding position. The graphic display will in the “LW Control” screen will show everything is lined up, but in reality it is off. This can happen if some layers have less wraps then others form a poorly spooled drum, or a few wraps were added or subtracted from the drum while the winch was not on. Correcting the position can be done two ways.

Manually Entering Wraps:

Note that to adjust layers or wraps, you must be in manual mode

If the levelwind is not aligned (ahead or behind actual), count the actual wraps from the flange; enter this value into the adjustment box next to the “Current Wrap” display. Note the system displays current wrap being spooled, not number of completely spooled wraps. So if you count 31 wraps, you should actually enter 32. Be careful to keep the “layer” the same! Press “Accept Adjust” to load the new position.





Entering New Wraps With Jog:

Note that to adjust layers or wraps, you must be in manual mode

While in manual mode, press the “Jog Adjust” button to prime ProSpool, you are about to jog. Jog the levelwind to the correct position. Once it is lined up, press “Accept Adjust”. The levelwind position will add or subtract the correct amount of wraps.

“P” Loop Tuning:

If the levelwind is falling behind and never seems to catch up, or it continually jerks back and forth and never settles to the set point, the “P Gain”, and “Dead band” will have to be adjusted in the “Auto Control Setup” menu.

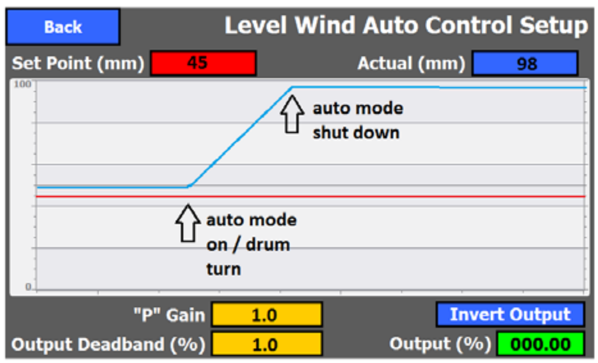
Auto Control Setup

The Auto Control Setup menu contains settings that only need to be set once. After they are set and tested, they should not require any further tuning.

At this point, auto has been used, and they may be some undesired effects. Here are solutions to these issued.

Invert Output Issue: While in auto mode, the levelwind position will "take off" and quickly move away from the drum position. This is because the levelwind is being told to go the wrong direction when trying to get to the drum position set point.

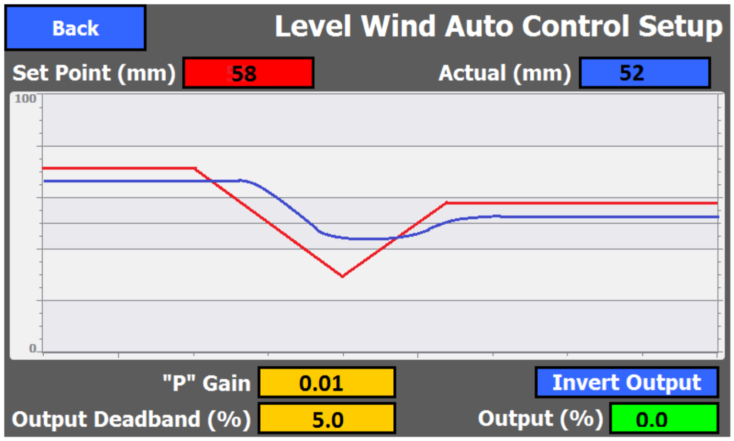
If you are in the Auto Control Setup Menu when this happens, the graph will look like this. We can see the set point remains the same, and the levelwind is being sent away from it.



To fix this, simply press the "Invert Output" button in the bottom right. This setting will be automatically saved.

LW Slow to React: While in auto mode, the levelwind is very sluggish and may not get completely close to the drum position set point. This is probably happening to a "P Gain" value that is too low.

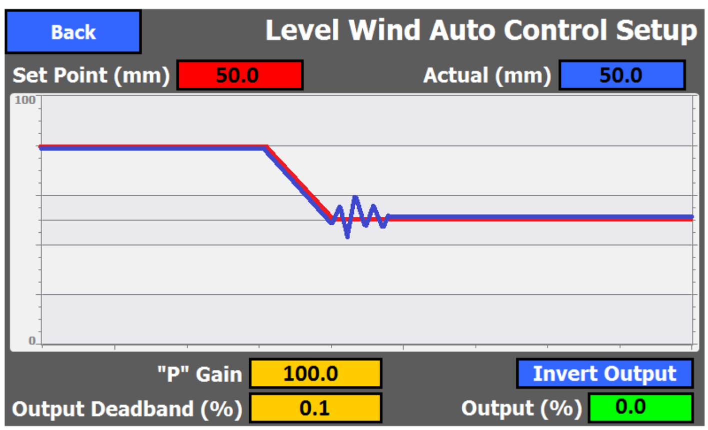
If you are in the Auto Control Setup Menu when this happens, the graph will look like this. We can see the actual trails the set point by a lot. As it does get close to set point it will slow down more or even stop.



To fix this, increase the “P Gain” value until it becomes more reactive.

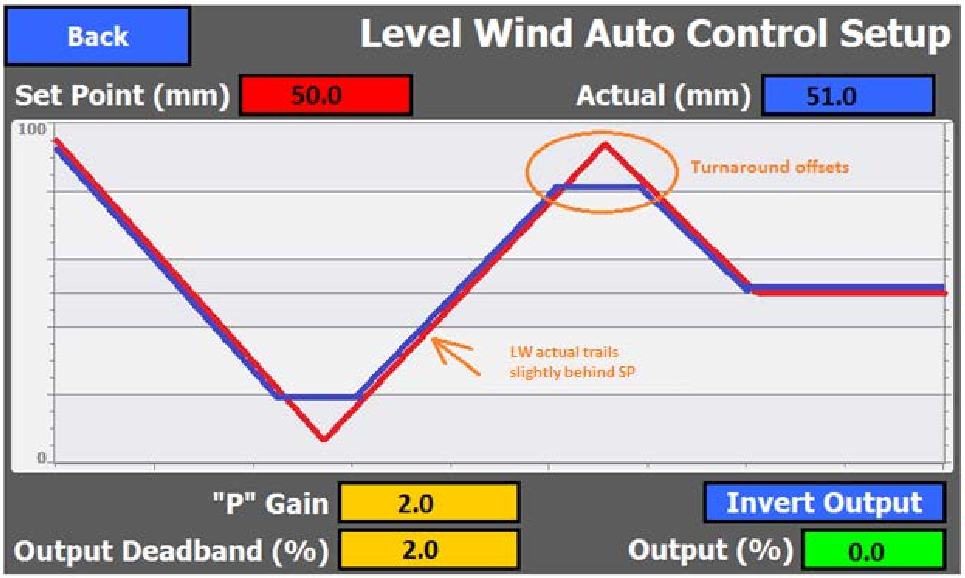
LW is Jumpy / Jerks Back and Forth: While in Auto mode, the levelwind will quickly move to the drum set point, but it may over shoot it, it may jump back and forth near the drum set point. This can either be from the “Dead band” being too low, or the “P Gain” is too high.

If you are in the Auto Control Setup Menu when this happens, the graph will look like this. We can see the levelwind actual “hunt” around the set point until it settles down.



To fix this ensure the “Output Deadband (%)” is at least 1.0. Then turn down the “P Gain” until the levelwind meets the set point smoothly.

Ideal Settings: If the “P Gain”, “Dead band”, and “Invert Output” are set correctly; the “Auto Control Setup” graph will look like this as ProSpool spools the drum.



Regular Operation

After all the setup is done and tested, ProSpool auto mode can be active and you can move to any other screen for winching operations. The levelwind can be jogged, but immediately after a jog, the levelwind will move back to the auto set point. If you switch it to manual, you can jog and the levelwind will remain stationary. When you move back to auto mode, the levelwind will automatically jog back to the drum set point.

APPENDIX E – VFD SETTINGS

The winch has two variable frequency drives, one for the levelwind, and the winch. The setting have been entered and tested at Hawboldt Industries. Modifying these settings may result in loss of control of the winch or level wind. Do not adjust these settings unless advised by experienced personal.

Levelwind Settings - ACS355-03U-23A1-4+J404 **(Ensure to set analog signal jumper reference to current)**

Parameter	Setting	Description
1001	2	DI1 on, DI2 direction
1003	3	Enable multi direction
2001	-1750	Min rpm
2002	1750	Max rpm
2003	40A	Max Current (higher then FLA)
1103	1	AI1 for input ref
1104	5	min hz value
1105	80	Max hz value
1301	20	20% for a 4-20ma input
1302	100	100% for 4-20ma input
1401	2	Relay for heat page 207
1405	90	off delay 90.0 seconds of no run turn on heaters
1604	3	Digital IN3 for fault reset
1804	0	Transistor out as digital
1805	4	Use fault as output
2007	5	5hz min frequency
2008	80	80hz max frequency
2202	1	Ramp up time
2203	0.1	Ramp down time
2602	2	Flux braking (1 = some, 2 = most)
2601	1	Enable flux braking
9905	460	460V motor
9906	23	23 FLA motor
9907	60	60hz nominal
9908	1750	nom rpm
9909	13	12 kw motor
9910	1	Run ID (Done at Hawboldt)

Winch Settings ACS880-01-052A-5 **(Ensure to set analog signal jumper reference to current)**

PARAMETER		**NAME**	**HAWBOLDT SETTING**
10	24	RO1 source	Open brake command
10	29	RO2 OFF delay	60
10	30	RO3 source	Fault
12	16	AI1 filter time	0.01
12	27	AI2 min	4
12	29	AI2 scaled at AI2 min	1
12	30	AI2 scaled at AI2 max	1760
13	12	AO1 source	Zero
13	19	A01 Out at Min.	4mA
13	22	AO2 source	Motor Current
13	29	A02 Out at Min.	4mA
20	1	Ext1 Commands	In1 Start fwd; In2 Start rev
20	2	Ext1 start trigger type	Level
20	11	Run enable stop mode	Ramp
20	30	Enable signals warning function	0b0010
21	3	Stop mode	Ramp
21	4	Emergency stop mode	Eme Ramp Stop (Off3)
21	5	Emergency Stop Source	DI4
22	11	Speed ref1 source	AI2 scaled
23	11	Ramp set selection	Acc/Dec time 1
23	12	Acceleration time 1	3
23	13	Deceleration time 1	0.5
23	23	Emergency Stop Time	0.1
25	2	Speed proportional gain	15
25	3	Speed integration time	0.5
30	11	Minimum speed	-1760
30	12	Maximum speed	1750
30	13	Minimum frequency	-60
30	14	Maximum frequency	60
30	15	Maximum start current enable	Disable
30	16	Maximum start current	76.5
30	17	Maximum current	65
30	30	Overvoltage control	Disable
31	25	Stall current limit	150%
31	26	Stall speed limit	10000
31	27	Stall frequency limit	500
31	28	Stall time	60
31	54	Fault Action	Emergency Ramp
35	11	Temperature 1 source	PTC DI6

43	6	Brake chopper function	Enabled with thermal model
43	8	Brake resistor thermal tc	200
43	9	Brake resistor Pmax cont	20.0
43	10	Brake resistance	13
43	11	Brake resistor fault limit	105
44	2	Brake torque memory	-0.8
44	6	Brake control enable	Selected
44	8	Brake open delay	0.3
44	9	Brake open torque source	Brake torque memory
44	10	Brake open torque	-1%
44	13	Brake close delay	3
44	14	Brake close level	50
44	15	Brake close level delay	0.1
44	17	Brake fault function	Warning
45	17	Tariff currency unit	USD
46	1	Speed scaling	1765
46	2	Frequency scaling	60
90	41	Motor Feedback Selection	Encoder 1
91	11	Module 1 Type	FEN-31
92	1	Encoder 1 Type	HTL
92	10	Pulse/Rev	1024
92	21	Encoder Cable Fault Mode	A,B,Z
95	1	Supply voltage	440...480 V
95	2	Adaptive Voltage Limits	Enable
96	1	Language	English
99	6	Motor nominal current	44.0
99	7	Motor nominal voltage	480
99	8	Motor nominal frequency	60
99	9	Motor nominal speed	1765
99	10	Motor nominal power	30
99	12	Motor nominal torque	163