Telemecanique

Technical Documentation

Product manual

AC servo drive

LXM05A

Document: 0198441113232

Edition: V1.04, 01.2006

a brand of Schneider Electric

Important information

The drive systems described here are products for general use that conform to the state of the art in technology and are designed to prevent any dangers. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or unbraked movements can never be totally excluded without additional safety equipment. For this reason personnel must never be in the danger zone of the drives unless additional suitable safety equipment prevents any personal danger. This applies to operation of the machine during production and also to all service and maintenance work on drives and the machine. The machine design must ensure personal safety. Suitable measures for prevention of property damage are also required.

See safety section for additional critical instructions.

Not all product variants are available in all countries.
Please consult the current catalogue for information on the availability of product variants.

We reserve the right to make changes during the course of technical developments.

All details provided are technical data and not promised characteristics.

In general, product names must be considered to be trademarks of the respective owners, even if not specifically identified as such.

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Writing conventions and symbols

Work steps

If work steps must be carried out in sequence, they are shown as follows:

- ■ Special prerequisites for the following work steps
- ▶ Step 1
- ◁ Important response to this work step
- ▶ Step 2

If a response to a work step is specified, this will inform you that the step has been carried out correctly.

Unless otherwise stated, the individual instruction steps must be carried in the given sequence.

Lists

Lists can be sorted alphanumerically or by priority. Lists are structured as follows:

- Point 1
- Point 2
  - – Subpoint to 2
  - – Subpoint to 2
- Point 3

Making work easier

Information on making work easier can be found at this symbol:

This offers supplementary information on making work easier.
See the chapter on safety for an explanation of the safety instructions.

Parameter display

The parameters are shown in the text with parameter name and HMI code, e.g. CTRL_n_max (nMAX). The tabular view is explained in the chapter on Parameters on page 11-1. The parameter list is alphabetically arranged by parameter name.

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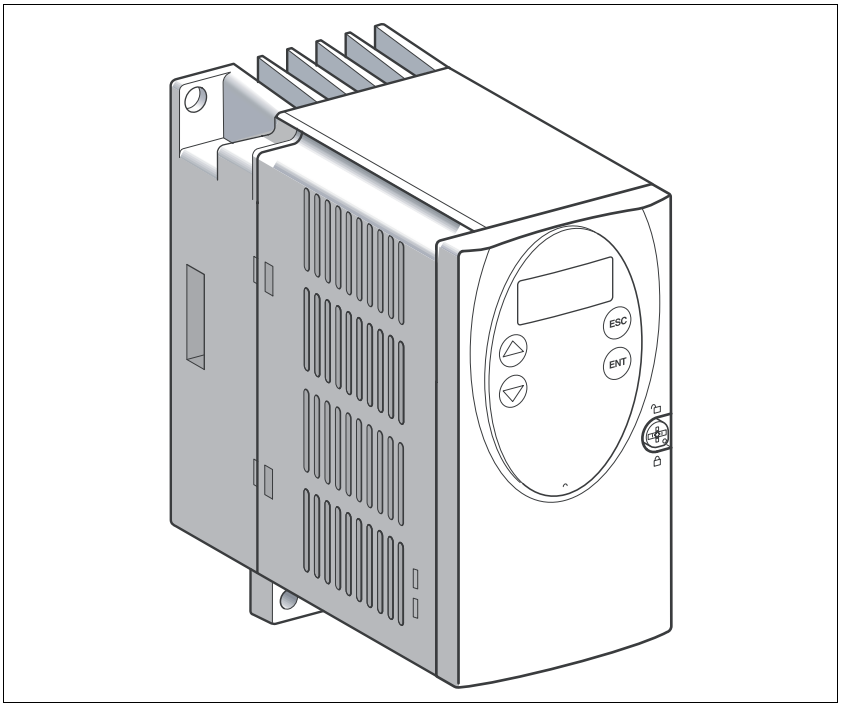
1 Introduction

1.1 Unit overview



Drive system

The LXM05A is an AC servo drive that can be used anywhere.

Reference values are normally specified and monitored by a higher-level PLC, e.g. Premium.

It offers a very compact and powerful drive system in combination with selected Schneider Electric servomotors.

The front panel includes an input panel (HMI, **H**uman**M**achine**I**nterface) with display and keypad for setting parameters.

Reference value default

The setpoint value can be specified via:

- Fieldbus: Modbus or CANopen for profile positioning movements, speed control and torque/speed control
- ±10V analogue signals for torque control or speed control. Positional feedback of the actual motor position is accomplished by A/B encoder signals
- Position interface: pulse/directions signals or A/B encoder signals for implementation of an electronic gear

Safety function

The integrated safety function "Power Removal" enables a stop of category 0 or 1 as per EN60204-1 without external power contactors. The supply voltage must not be interrupted. This reduces the system costs and the response times.

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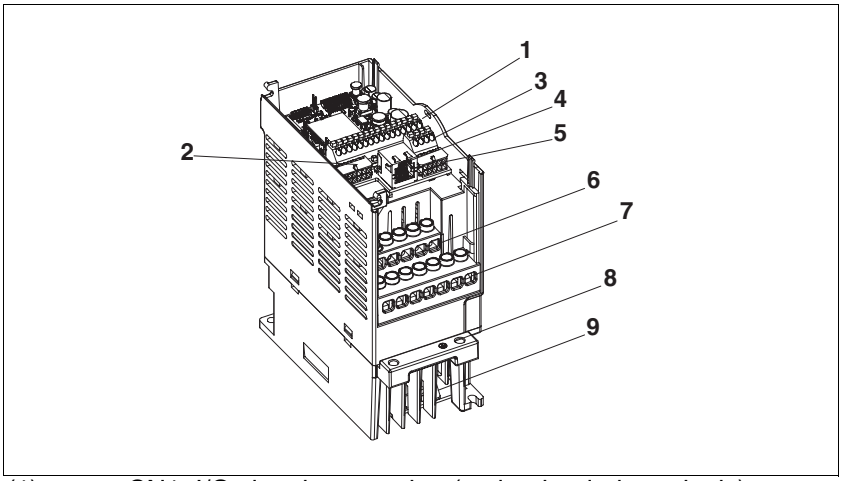
1.2 Components and interfaces



(1) CN1, I/O signal connection (spring-loaded terminals)
- Two ±10 V analogue setpoint inputs in the speed control and current control operating modes (torque regulation)
- Eight digital inputs/outputs. The assignment depends on the selected operating mode
- CANopen for fieldbus control

(2) 12-pin CN2 socket for motor encoder (SinCos Hiperface® sensor)

(3) CN3, terminal for 24 V power supply

(4) CN4, RJ45 socket for connecting
- Fieldbus: Modbus or CANopen
- PC with "PowerSuite" software
- Decentralised control terminal

(5) 10-pin CN5 socket for
- Output of actual motor position via A/B encoder signals in speed control and current control operating modes for position feedback for a higher level position controller (e.g. PLC with motion-control card).
- Feed of pulse/direction of A/B encoder signals in electronic gear operating mode

(6) Screw terminals for connecting the mains supply

(7) Screw terminals for connecting the motor and external braking resistors

(8) Bracket for EMC mounting plate

(9) Heat sink

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1.3 Type code

Example: Lexium 05, universal drive, peak current 10A_{pk}, power amplifier supply voltage 3~, 230V_{AC}, no internal mains filter	**LXM**	**05**	**A**	**D10**	**M3**	**X**	**(•••)**
Product name LXM - Lexium	**LXM**	05	•	•••	••	X	(•••)
Product type 05 - AC servo drive for one axis	LXM	**05**	•	•••	••	X	(•••)
Interfaces A - analogue, pulse direction and fieldbus (CANopen and Modbus) B - Profibus	LXM	05	•	•••	••	X	(•••)
Peak current (peak value Î) [A_{pk}] D10 - 10A_{pk} D14 - 14A_{pk} D17 - 17A_{pk} D28 - 28A_{pk} D34 - 34A_{pk} D42 - 42A_{pk} D57 - 57A_{pk}	LXM	05	•	•••	••	X	(•••)
Power amplifier supply voltage [V_{AC}] F1 - 1~, 115V_{AC} M2 - 1~, 230V_{AC} M3 - 3~, 230V_{AC} N4 - 3~, 480V_{AC}	LXM	05	•	•••	••	X	(•••)
Mains filter X - no integrated mains filter	LXM	05	•	•••	••	**X**	(•••)
Other options	LXM	05	•	•••	••	X	**(•••)**

1.4 Documentation and literature references

The following User's manuals are supplied with this drive system:

- **Product manual**, describes the technical data, installation, commissioning and all operating modes and operating functions.
- **Fieldbus manual**, important description of integrating the product into a fieldbus.
- **Motor manual**, describes the technical properties of the motors, including correct installation and commissioning.

The user's manuals can be found on the CD or at http://www.telemecanique.com.

Additional literature

We recommend the following literature for more in-depth information:

- Ellis, George: Control System Design Guide. Academic Press
- Kuo, Benjamin; Golnaraghi, Farid: Automatic Control Systems. John Wiley & Sons

1.5 Directives and standards

CE mark

With the declaration of conformity and the CE mark on the product the manufacturer certifies that the product complies with the requirements of all relevant EC directives. The drive systems described here can be used anywhere in the world.

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EC Machine Directive

The drive systems described here are not machines as defined by the EC Machine Directive (98/37/EEC) but components for installation in machines. They do not have moving parts designed for specific purposes. However, they can be components of a machine or system.

The manufacturer must certify that the complete system conforms to the machine directive with the CE mark.

EC EMC Directive

The EC Electromagnetic Compatibility Directives (89/336/EEC) applies to products that cause electromagnetic interference or whose operation may be be adversely affected by electromagnetic interference.

Conformity with the EMC Directive can only be expected of drive systems after correct installation in the machine. The information on ensuring electromagnetic compatibility given in the chapter on "Installation" must be followed to ensure that the drive system in the machine or system is EMC-compatible and that the product can legally be operated.

EC Low-Voltage Directive

The EC Low-Voltage Directive (73/23/EEC) lays down safety requirements for 'electrical apparatus' as protection against the risks that can originate in such devices and can be created in response to external influences.

The drive systems described here comply with the EN 50178 Standard as per the Low-Voltage Directive.

Declaration of conformity

The declaration of conformity certifies that the drive system complies with the specific EC directive.

Standards for safe operation

EN 60204-1: Electrical equipment of machines, General requirements

EN 60529: IP degrees of protection

IEC 61508; SIL 2; Functional safety of safety-related electric, electronic and programmable electronic systems.

pr IEC 62061; SIL 2; Safety of Machines - Functional safety of electrical, electronic and programmable controllers of machines

EN 954-1: Safety of machines, Safety of components of control devices, Part 1: General design requirements

pr EN 13849-1; Safety of machines - safety-related components of controllers - Part 1: General design requirements

Standards for retention of EMC limiting values

EN 61000-4-1: Measuring and test procedures, overview

EN 61800-3: Variable-speed electrical drives

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1.6 Declaration of conformity

EC Declaration of Conformity
Year 2005

Schneider Electric Machine Automation

☒ according to EC Directive Low Voltage 73/23/EEC; changed by CE Marking Directive 93/68/EEC
☒ according to EC Directive on Machinery 98/37/EEC
☒ according to EC Directive EMC 2004/108/EEC

We declare that the products listed below meet the requirements of the mentioned EC Directives with respect to design, construction and version distributed by us. This declaration becomes invalid with any modification on the products not authorized by us.

Designation:	AC Servo Drive
Type:	LXM05Axxxxxx, LXM05Bxxxxxx
Product number:	01637x1701xxx, 01637x1721xxx
Applied harmonized standards, especially:	EN ISO 13849-1:2004, Performance Level "d" EN 61508:2002, SIL 2 EN 50178:1998 EN 61800-3:2001, second environment according to Berger Lahr EMC test conditions
Applied national standards and technical specifications, especially:	UL 508C Berger Lahr EMC test conditions 200.47-01 EN Product documentation
Company stamp:	Berger Lahr GmbH & Co. KG Postfach 11 80 · D-77901 Lahr Breslauer Str. 7 · D-77933 Lahr
Date/ Signature:	28 July 2005
Name/ Department:	Wolfgang Brandstätter/R & D Drive Systems

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1.7 TÜV certificate for functional safety

Certificate

The Certification Body RWTÜV Systems GmbH of
Product Safety and Medical Devices hereby certify

Schneider Electric Motion GmbH

Breslauer Str. 7

77933 Lahr

Germany

for the realisation of the function "Safe Standstill" and "Emergency Stop" in the servo drive Lexium 05

Type: LMX05xxx

the compliance of the below mentioned requirements:

- IEC 61508:2000; SIL 2; Functional safety of electrical/electronic/programmable electronic safety-related systems
- pr IEC 62061:2003; SIL 2; Safety of machinery; Safety-related parts of control systems. Part 1: General principles for design
- pr DIN EN ISO 13849-1:2004; Performance-Level „d" (Category 3); Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design

Based on the report No.: 701-045/2003CPD in the valid version this certificate entitles the owner to use the mark:

IEC 61508/ SIL2
IEC 62061/SIL2
DIN EN ISO 13849
p-level "d" (Cat. 3)
PFH = 2.85*10⁻⁹
Lifetime:
20 years
SAS-0657/05

RWTÜV
Safety Approved

Certificate-Register-No.: SAS-0657/05, Vers. 1.1, Essen, 2005-08-11
File reference: 2.4-4079/05
Valid to: 2010-01-13

05

RWTÜV Systems GmbH
Postfach 10 32 61 - 45032 Essen

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2 Safety

2.1 Qualification of personnel

Only technicians who are familiar with and understand the contents of this manual and the other relevant manuals are authorised to work on and with this drive system. The technicians must be able to detect potential dangers that may be caused by setting parameters, changing parameter values and generally by the mechanical, electrical and electronic equipment.

The technicians must have sufficient technical training, knowledge and experience to recognise and avoid dangers.

The technicians must be familiar with the relevant standards, regulations and safety regulations that must be observed when working on the drive system.

2.2 Intended use

The drive systems described here are products for general use that conform to the state of the art in technology and are designed to prevent any dangers. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or unbraked movements can never be totally excluded without additional safety equipment. For this reason personnel must never be in the danger zone of the drives unless additional suitable safety equipment prevents any personal danger. This applies to operation of the machine during production and also to all service and maintenance work on drives and the machine. The machine design must ensure personal safety. Suitable measures for prevention of property damage are also required.

In the system configuration described the drive systems must be used in industrial applications only and must have a fixed connection only.

In all cases the applicable safety regulations and the specified operating conditions, such as environmental conditions and specified technical data, must be observed.

The drive system must not be commissioned and operated until completion of installation in accordance with the EMC regulations and the specifications in this manual.

To prevent personal injury and damage to property damaged drive systems must not be installed or operated.

Changes and modifications of the drive systems are not permitted and if made all no warranty and liability will be accepted.

The drive system must be operated only with the specified wiring and approved accessories. In general, use only original accessories and spare parts.

The drive systems must not be operated in an environment subject to explosion hazard (ex area).

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2.3 General safety instructions

⚠ DANGER

Electric shock, fire or explosion

- Only qualified personnel who are familiar with and understand the contents of this manual are authorised to work on and with this drive system.
- The system manufacturer is responsible for compliance with all applicable regulations relevant to earthing the drive system.
- Many components, including printed wiring boards, operate at mains voltage. **Do not touch**. Do **not** touch unshielded components or screws of the terminals with voltage present.
- Install all covers and close the housing doors before applying power.
- The motor generates voltage when the shaft is rotated. Lock the shaft of the motor to prevent rotation before starting work on the drive system.
- Before working on the drive system:
  - Switch off power to all terminals.
  - Place a sign "DO NOT SWITCH ON" on the switch and lock to prevent switching on.
  - **Wait 6 minutes** (for discharge of DC bus capacitors). Do **not** short-circuit DC bus
  - Measure voltage at DC bus and check for <45V. (The DC bus LED is not a safe indication for absence of the DC bus voltage).

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

Injury from unexpected movements

Drives may execute unexpected movements because of incorrect wiring, incorrect settings, incorrect data or other errors.

Malfunctions (EMC) may cause unpredictable responses in the system.

- Install the wiring carefully in accordance with the EMC requirements.
- Disable the inputs $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ (status 0) to prevent unexpected movements before switching on and configuring the drive system.
- Do not operate a drive system with unknown settings or data.
- Carry out a comprehensive commissioning test.

Failure to follow these instructions can result in death or serious injury.

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⚠ WARNING

Danger of injury by loss of control!

- Observe the accident prevention regulations. (For USA see also NEMA ICS1.1 and NEMA ICS7.1)
- The system manufacturer must take the potential error possibilities of the signals and the critical functions into account to ensure a safe state during and after errors. Some examples are: emergency stop, final position limitation, power failure and restart.
- The assessment of error possibilities must also include unexpected delays and the failure of signals or functions.
- Suitable redundant control paths must be in place for dangerous functions.
- Check that measures taken are effective.

Failure to follow these instructions can result in death or serious injury.

2.4 Safety functions

Using the safety functions integrated in this product requires careful planning. For more information see 5.3 “Safety function "Power Removal"“ on page 5-2.

2.5 Monitoring functions

The monitoring functions in the drive protect the system and reduce the risk in the event of system malfunction. The monitoring functions are not designed for personal safety. The following faults and limit values can be monitored:

Monitoring	Task	Protective function
Data link	Error response in event of connection break	Functional safety and system protection
Limit switch signals	Monitoring of permissible area of travel	System protection
Tracking error	Monitoring of variation between motor position and setpoint position	Functional safety
Motor overload	Monitoring for excessively high current in the motor phases	Functional safety and device protection
Overvoltage and undervoltage	Monitoring for overvoltage and undervoltage of the power supply	Functional safety and device protection
Overtemperature	Monitoring device for overtemperature	Device protection
I^2t Limit	Power limitation in event of overloading	Device protection

Table 2.1 Monitoring functions

For the description of the monitoring function see 8.6.1 “Monitoring functions“ from page 8-45.

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3 Technical Data

This chapter contains information on the required environmental conditions and on the mechanical and electrical properties of the unit family and the accessories.

3.1 Testing agencies and certificates

This product or functions of this product have been certified by the following independent testing agencies:

Testing agency	Assigned number	Validity
RWTÜV	SAS-0078/05	2010-01-13
UL	File E153659	
CiA (Can in Automation)	CiA200412-301V402/20-0044	

3.2 Environmental conditions

When considering the ambient temperature a distinction is made between the permissible temperatures during operation and the permissible storage and transport temperature.

ambient operating temperature

The maximum permissible ambient air temperature during operation depends on the clearance between the units and the required output. The relevant requirements in the chapter on installation are also very important.

Temperature [1]	[°C]	0 to +50

1) no icing

Ambient climate for transport and storage

The environment during transport and storage must be dry and dust-free. The maximum oscillation and shock stress must be within the specified limits. The bearing and transport temperature must remain within the specified range.

Temperature	[°C]	-25 to +70

Pollution degree

Pollution degree	Step 2

Relative humidity

The relative humidity is allowed as follows:

rel. air humidity	conforming to IEC60721-3-3, Class 3K3, 5% to 85%, no condensation permitted

Installation height

Installation height above mean sea level for 100% power	[m]	<1000

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Max. ambient temperature 40°C, no protective foil and side distance >50 mm	[m]	<2000m

Vibration and shock loading

The strength during oscillation stress on the units corresponds to EN 50178 Section 9.4.3.2 and EN 61131 Section 6.3.5.1.

Oscillation and vibration	Conforming to IEC/EN 60068-2-6: 1.5 mm peak to peak from 3 to 13 Hz, 1 gn from 13 to 150 Hz
Shock loading	15 gn for 11 ms conforming to IEC/ EN 60068-2-27

Wiring

Use copper wiring resistant to at least 60°C or 75°C.

3.2.1 Degree of protection

The devices have the degree of protection IP20. The degree of protection IP40 is met for the top of the housing if the protective cover on top of the device has not been removed. The safety cover may need to be removed because of the ambient temperature or the device clearances, see chapter 6.2.1 “Mounting the device“ page 6-7.

Degree of protection when using "Power Removal"

It is important to ensure that there a re no conductive deposits on the product for the "Power Removal" function (pollution degree 2). Protect the product appropriately against dust and spray.

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3.3 Mechanical data

3.3.1 Dimensional drawings

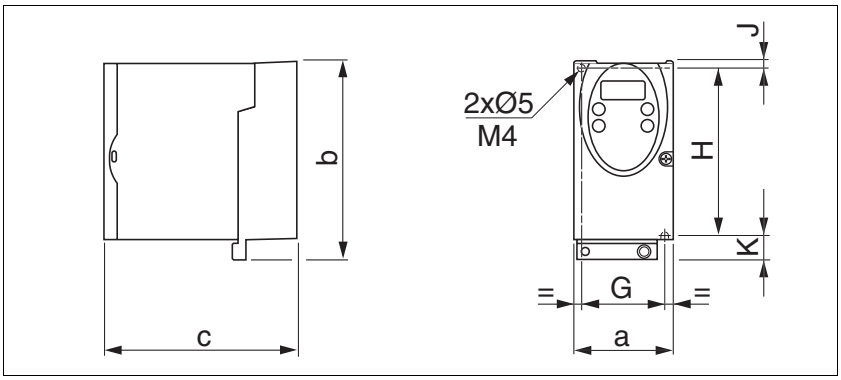

Figure 3.1 Dimensional drawing

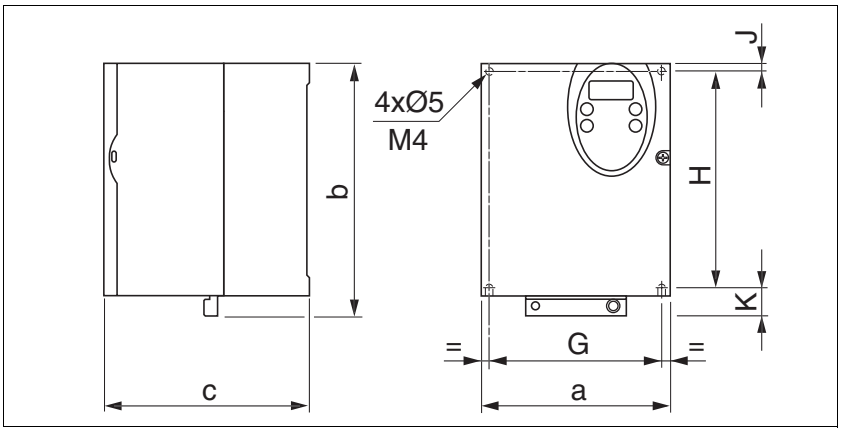

Figure 3.2 Dimensional drawing

LXM05•...		D10•••	D14•• D17•••	D2••• D3••• D4••••	D5•••
Figure		Figure 3.1	Figure 3.1	Figure 3.2	Figure 3.2
a	mm	72	105	140	180
b	mm	145	143	184	232
c	mm	140	150	150	170
G	mm	60	93	126	160
H	mm	121.5	121.5	157	210
J	mm	5	5	6.5	5
K	mm	18.5	16.5	20.5	17
Weight	kg	1.1	1.4	2	4.8
Type of cooling		Convection [1]	Ventilator	Ventilator	Ventilator
Top-hat rail installation		77.5 [2]	105 [2]	-	-

1) >1 m/s
2) Width of adapter plate

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3.4 Electrical Data

3.4.1 Performance data for power amplifier

Mains voltage: range and tolerance

$115V_{AC}$	[V]	100V -15% to 120V +10%
$230V_{AC}$	[V]	200V -15% to 240V +10%
$400V_{AC}$	[V]	380V -15% to 480V +10%
Frequency	[Hz]	50Hz-5% to 60 Hz +5%

transient overvoltages	overvoltage category III

Starting current and leakage current

Starting current	[A]	<60
Leakage current (as per IEC 60990, Figure 3)	[mA]	<30 [1)]

1) measured on mains with earthed neutral point, with no external mains filter. When using residual-current devices make sure that a 30 mA residual-current device can trigger at 15 mA. A high-frequency leakage current also flows, which is not considered in the measurement. Residual current devices respond differently to this.

Power consumption and impedance of mains supply

The specified power consumption refers to a mains with the specified reference voltage and the assumed short-circuit impedance at nominal power output. The power consumption depends strongly on the impedance of the supply mains. This is specified by a possible short-circuit current. If the actual mains deviates from this, mains reactors must be installed upstream.

Monitoring the continuous output current

The continuous output current at 4kHz and 8kHz is monitored by the device. If the value is continuously exceeded, the output current is reduced by the device. The internal overtemperature monitoring does not respond at the specified values so long as the ambient temperature remains below 40°C and no heat is generated at the internal braking resistor.

Peak output current for 3 seconds

The peak output current at 4kHz and 8kHz can be output by the device for 3 seconds. If the peak current flows at motor standstill, the higher heat build-up enables the current limiting of the device earlier that when the motor is rotating.

Continuous and peak currents are lower at 8kHz because of higher losses. This is particularly clear in devices with higher DC bus voltage.

Voltage against PE

The insulation of the devices is designed for a nominal voltage corresponding to the value of the reference voltage. The voltage against earth must not exceed these values.

Approved motors

For an overview of the approved motor series (BSH, SER, USD) that can be attached to this device series see the product catalogue. When making the selection consider the type and amount of the mains voltage.

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LXM05•...		D10F1	D17F1	D28F1	D10M2	D17M2	D28M2
Nominal voltage	[V]	115 (1~)	115 (1~)	115 (1~)	230 (1~)	230 (1~)	230 (1~)
Power consumption at nominal voltage	[A_{rms}]	7.3	11	21.6	7	11	20
nominal power (device power output)	[kW]	0.4	0.65	0.85	0.75	1.2	2.5
max. permissible short circuit current of mains	[kA]	1	1	1	1	1	1
power loss	[W]	43	76	150	48	74	142
continuous output current at 4kHz	[A_{rms}]	4	8	15	4	8	15
	[A_{pk}]	5.66	11.31	21.21	5.66	11.31	21.21
peak output current at 4kHz	[A_{rms}]	7	12	20	7	12	20
	[A_{pk}]	9.90	16.97	28.28	9.90	16.97	28.28
continuous output current at 8kHz	[A_{rms}]	3.2	7	13	3.2	7	13
	[A_{pk}]	4.53	9.90	18.38	4.53	9.90	18.38
peak output current at 8kHz	[A_{rms}]	6	11	20	6	11	20
	[A_{pk}]	8.49	15.56	28.28	8.49	15.56	28.28
Primary fuse	[A]	10	15/16	25	10	15/16	25

LXM05•...		D10M3X	D17M3X	D42M3X	D14N4	D22N4	D34N4	D57N4
Nominal voltage	[V]	230 (3~)	230 (3~)	230 (3~)	400 (3~)	400 (3~)	400 (3~)	400 (3~)
Power consumption at nominal voltage	[A_{rms}]	4.5	7.75	16.5	4	6	9.2	16.8
nominal power (device power output)	[kW]	0.75	1.4	3.2	1.4	2.0	3.0	6.0
max. permissible short circuit current of mains	[kA]	5	5	5	5	5	5	22
power loss [1)]	[W]	43	68	132	65	90	147	240
continuous output current at 4kHz	[A_{rms}]	4	8	17	6	9	15	25
	[A_{pk}]	5.66	11.31	24.04	8.49	12.73	21.21	35.36
peak output current at 4kHz	[A_{rms}]	7	12	30	10	16	24	40
	[A_{pk}]	9.90	16.97	42.43	14.14	22.63	33.94	56.57
continuous output current at 8kHz	[A_{rms}]	3.2	7	15	5	7	11	20
	[A_{pk}]	4.53	9.90	21.21	7.07	9.90	15.56	28.28
peak output current at 8kHz	[A_{rms}]	6	11	30	7.5	14	18	30
	[A_{pk}]	8.49	15.56	42.43	10.61	19.80	25.46	42.43
Primary fuse [2)]	[A]	10	10	25	10	15/16	15/16	25

1) condition: internal braking resistor not active; value with nominal current, nominal voltage and nominal power
2) Fuses: fusible links of class CC or J as per UL 248-4, alternatively miniature circuit-breakers with B or C-characteristic. 15/16A specification: circuit breakers are available with 16A nominal current, UL fuses with 15A.

The nameplate indicates whether or not your device has an integrated mains filter. Devices with the product identification LXM05••••M3X do not have an integrated mains filter.

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3.4.2 24VDC controller power supply

Spring loaded terminals

The spring loaded terminals have a maximum cross-section of 0.75mm^2 and a maximum current loading capacity of 2A.

24V power supply

The 24V supply voltage must meet the requirements of IEC 61131-2 (PELV standard power supply):

Input voltage	[V]	24V -15% / +20%
Power consumption (without load)	[A]	≤1
Ripple voltage		<5%

3.4.3 Signals

Signal inputs are reverse polarity protected, outputs are resistant to short-circuit. There is an electrical connection to 0VDC.

24V input signals

When configured for "source", the input levels correspond to EN 61131-2, type 1

Logic 1 (V_{high})	[V]	+15 to +30
Logic 0 (V_{low})	[V]	-3 to +5
Input current (typical)	[mA]	10
Debouncing time [1)]	[ms]	1 to 1.5
Debounce time $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$	[ms]	1 to 5
Debounce time CAP1 and CAP2	[µs]	1 to 10

1) except for $\overline{\text{PWRR\_A}}$, $\overline{\text{PWRR\_B}}$, CAP1 and CAP2

24V output signals

The 24V output signals correspond to IEC 61131-2.

Output voltage	[V]	≤30
max. switching current	[mA]	≤50
voltage drop at 50 mA load	[V]	≤1

Analogue input signals

Differential input voltage range	[V]	-10 to +10
Input resistance	[kΩ]	≥10
ResolutionANA1	[Bit]	14
Resolution ANA2	[Bit]	14
Sampling time ANA1	[ms]	0.25
Sampling time ANA2	[ms]	0.25

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Pulse/direction, A/B input signals

The pulse/direction and A/B signals conform to the RS422 interface specifications

Symmetrical		conforming to RS422
Input resistance	[kΩ]	5
Input frequency, pulse/direction	[kHz]	≤200
Input frequency, A/B	[kHz]	≤400

Encoder simulation output signal

The encoder simulation output signal complies with the RS422 interface specifications

Logic level		conforming to RS422
Output frequency per signal	[kHz]	≤450
Output frequency total	[MHz]	≤1.6

CAN bus signals

The CAN bus signals comply with the CAN standard and are short-circuit resistant.

Sensor signals

Output voltage for encoder		+10V / 100mA
SIN/COS input signalVoltage range		$1V_{pp}$ with 2.5V offset, $0.5V_{pp}$ at 100kHz
Input resistance	[Ω]	120

The output voltage is short-circuit protected and overload resistant. The transmission protocol is asynchronous half-duplex in compliance with RS485.

3.4.4 Safety functions

Data for maintenance schedule and safety calculations

Use the following data for your maintenance schedule and the safety calculations:

Service life corresponding to safety life cycle (IEC 61508)	20 years
SFF (Safe Failure Fraction) (IEC61508)	70%
Probability of failure (PFH) (IEC 61508	$2.85*10^{-9}$ 1/h
Response time (until shutdown of power amplifier)	<10ms

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3.4.5 Braking resistor

The device has an internal braking resistor. If this is insufficient, it will be necessary to use one or more external braking resistors, see chapter 6.3.5 “Connection of braking resistor“ page 6-20. For an overview of the available external braking resistors see the chapter on accessories on page 12-1.

The following minimum resistance values are required for the use of one or more external braking resistors. The internal resistance must be disabled, see also Commissioning, page 6-21.

The continuous output of the connected external braking resistors must not exceed the nominal power of the device.

LXM05•...		D10F1	D17F1	D28F1	D10M2	D17M2	D28M2
Energy consumption of internal capacitors E_{var}	[Ws]	10.8	16.2	26.0	17.7	26.6	43.0
resistance internal	[Ω]	40	40	10	40	40	20
Continuous output P_{PR}	[W]	20	40	60	20	40	60
Peak energy E_{CR}	[Ws]	500	500	1000	900	900	1600
Switch-on voltage	[V]	250	250	250	430	430	430
External braking resistor min	[Ω]	27	20	10	50	27	16
External braking resistor max	[Ω]	45	27	20	75	45	27

LXM05•...		D10M3X	D17M3X	D42M3X	D14N4	D22N4	D34N4	D57N4
Energy consumption of internal capacitors E_{var}	[Ws]	17.7	26.6	43.0	26.0 [1)]	52.0 [2)]	52.0 [2)]	104.0 [3)]
resistance internal	[Ω]	40	40	20	40	30	30	20
Continuous output P_{PR}	[W]	20	40	60	40	60	60	100
Peak energy E_{CR}	[Ws]	900	900	1600	1000	1600	1600	2000
Switch-on voltage	[V]	430	430	430	770	770	770	760
External braking resistor min	[Ω]	50	27	10	60	25	25	10
External braking resistor max	[Ω]	75	45	20	80	36	36	21

1) at 480V: 6.0Ws
2) at 480V: 12.0Ws
3) at 480V: 10.0Ws

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3.4.6 Internal mains filter

The EMC standards differentiate between various application cases:

EN 61800-3:2001-02; IEC 61800-3, Ed.2	Description
first environment, general availability; category C1	operation in living areas, e.g. sale by hardware supplier
first environment, limited availability; category C2	operation in living areas, sale through dealers only
second environment; category C3	operation in industrial mains

This drive system meets the EMC requirements for the second environment under the IEC 61800-3 standard if the measures described for the installation are taken into account. When operating outside this application area note the following:

⚠ WARNING

In a domestic environment, this product may cause radio interference, in which case supplementary mitigation measures may be required.

Better values can be achieved depending on the unit and the application and also the structure, e.g. on installation in an enclosed switch cabinet. If the limit values for the first environment (public networks, category C2) are required, external line filters must be connected in series.

The nameplate indicates whether or not your device has an integrated mains filter. Devices with the product identification LXM05••••M3X do not have an integrated mains filter.

The following limiting values for wiring related fault disturbances are met by EMC compatible designs:

Devices with internal mains filter	second environment (industrial, category C3) up to 10m motor cable length

An external line filter is required when using a unit without an integrated line filter or with long motor lines. The operator must ensure that the EMC directives are observed in this case. For order data for external line filters see the chapter on accessories on page 12-3.

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3.5 Technical Data accessories

3.5.1 External braking resistors

VW3A760...		1Rxx	2Rxx	3Rxx	4Rxx	5Rxx	6Rxx	7Rxx
Resistance value	[Ω]	10	27	27	27	72	72	72
Continuous output	[W]	400	100	200	400	100	200	400
max. make time at 115V	[ms]	300	180	420	1080	636	1680	4200
max. make time at 230V	[ms]	72	55.2	108	264	144	372	960
max. make time at 400V	[ms]	12	8.4	21.6	50.4	30	78	192
Peak output at 115V	[kW]	6.3	2.3	2.3	2.3	0.9	0.9	0.9
Peak output at 230V	[kW]	18.5	6.8	6.8	6.8	2.6	2.6	2.6
Peak output at 400V	[kW]	60.8	22.5	22.5	22.5	8.5	8.5	8.5
max. peak energy at 115V	[Ws]	18800	4200	9700	25000	5500	14600	36500
max. peak energy at 230V	[Ws]	13300	3800	7400	18100	3700	9600	24700
max. peak energy at 400V	[Ws]	7300	1900	4900	11400	2500	6600	16200

3.5.2 Line reactor

Line reactor

If the mains power does not correspond to the requirements described for impedance, line reactors may need to be installed, see also the chapter on installation. For order data see the chapter on accessories on page 12-4.

3.5.3 External mains filter

The EMC standards differentiate between various application cases; see Chapter 3.4.6 “Internal mains filter“, page 3-9.

Better values can be achieved depending on the unit and the application and also the structure, e.g. on installation in an enclosed switch cabinet. If the limit values for the first environment (public networks, category C2) are required, external line filters must be connected in series.

The following limiting values for wiring related fault disturbances are met by EMC compatible designs:

All devices with an external mains filter	first environment, restricted availability (public mains, category C2) up 20m motor cable length, device installed in an enclosed switching cabinet with 15 dB attenuation.
	second environment (industrial, category C3) up to 40m motor cable length (100m with 8kHz switching frequency)

An external line filter is required when using a unit without an integrated line filter or with long motor lines. The operator must ensure that the EMC directives are observed in this case. For order data for external line filters see the chapter on accessories on page 12-3.

3.5.4 Holding brake controller HBC

For motors with holding brake we recommend appropriate control logic (HBC) that releases the brake when the motor is powered and locks the

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motor axis at the correct moment before the power amplifier supply voltage is switched off and optionally reduces the braking voltage.

Dimensions

Dimensions (H * B * D)	[mm]	99 * 22.5 * 114.5
Installation on top-hat rail		

Electrical data

Input		
Supply voltage	[V]	19.2 to 30
Current consumption	[A]	0.5 + braking current
Output, brake		
DC voltage before voltage reduction	[V]	23 to 25
Maximum output current	[A]	1.6
Nominal time to voltage reduction	[ms]	1000
DC voltage with voltage reduction	[V]	17 to 19

The HBC holding brake controller has a safe electrical isolation between the 24 V input, control input and brake output. For more information see page 6-31, 7-28, 8-69 and 12-1.

3.5.5 Reference value adapter RVA

Dimensions

Dimensions (H * B * D)	[mm]	77 * 135 * 37
Installation on top-hat rail		

Electrical data

Input		
Supply voltage	[V]	19,2 to 30
Current consumption (5VSE unloaded)	[mA]	50
Current consumption (5VSE 300mA)	[mA]	150
Output, Encoder		
5VSE	[V]	4,75 to 5,25
Maximum output current	[mA]	300
sense-controlled, short-circuit and overload-proof		

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3.5.6 Cable

Overview of cables required

	max. length [m]	min. cross-section [mm²]	corr. PELV	shielded, earthed both ends	twisted pair
Controller supply voltage	–	0.75	X		
Power amplifier supply voltage	–	– 1)			
Motor phases	– 2)	– 3)		X	
Cable for HBC ⇒ motor see motor phases	– 2), max. 0.12 unshielded	– 3) 4)		X	
Cable for HBC ⇒ device	–	0.75 4)			
ext. braking resistor	3	as in power amplifier supply voltage		X	
Motor sensor	100	10*0,25mm² and 2*0,5mm²	X	X	X
Encoder signals A/B/I	100	0.25	X	X	X
PULSE/DIR	100	0.14 5)	X	X	X
ESIM	100	0.14 5)	X	X	X
Fieldbus CANopen	– 6)	0.14	X	X	X
Fieldbus Modbus	400	0.14	X	X	X
Analogue inputs	10	0.14 - 1.5	X	X 7)	X
Digital inputs/outputs	15	0.14	X		
PC, decentralised control terminal	400	0.14	X	X	X

1) see 6.3.6 “Connection of power amplifier supply voltage“
2) Length depends on required limit values for line interference, see 3.4.6 “Internal mains filter“ and 3.5.3 “External mains filter“.
3) see 6.3.4 “Motor phase connections“
4) Temperature range: up to 105°C
5) inside the switching cabinet
6) Depending on baud rate, see 6.3.14 “CANopen connection (CN1 or CN4)“
7) Earth shield of analogue signal lines directly on device (signal input). At the other end of the cable insulate the shield or if interference occurs earth via a capacitor (e.g. 10nF).

Table 3.1 Cable specifications

Motor and encoder cable

The motor cable and encoder cables are suitable for trailing and are available in various lengths. For the corresponding types see the accessories section on page 12-4.

Permissible voltage	[VAC]	600 (UL and CSA)
Shield		Shield braiding
Sheath		Oil-resistant PUR
Temperature range	[°C]	-40 to +90 (fixed) -20 to +80 (movable)
Minimum bending radius		4 x diameter (fixed) 7.5 x diameter (moving)

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4 Basics

4.1 Safety functions

Automation and safety engineering are two areas that were completely separate in the past but more recently have become more and more integrated. Planning and installation of complex automation solutions are greatly simplified by integrating safety functions.

In general the safety engineering requirements depend on the application. The degree of the requirements is oriented to the risk and the hazard potential arising from the specific application.

Working with IEC61508

IEC61508 standard

The IEC61508 standard "Functional safety of electrical/electronic/programmable electronic safety-related systems" covers the relevant safety-relevant function. This means that it is not only one single component but always a complete function chain (e.g. from the sensor through the logical processing unit to the actuator) that is considered as one single unit. The function chain must meet the requirements of the specific safety level as a whole. Systems and components that can be used in various applications for safety tasks with comparable risk can be developed in this base.

SIL, Safety Integrity Level

The standard IEC61508 specifies four safety integrity levels (SIL) for safety functions. SIL1 is the lowest level and SIL4 is the highest level. This is based on an assessment of the hazard potential derived from the hazard and risk analysis. This is used to decide whether the relevant function chain requires a safety function and which hazard potential it must cover.

PFH, Probability of a dangerous failure per hour

To maintain the safety function the IEC61508 standard, depending on the required SIL, requires staged fault-control and fault-prevention measures. All components of a safety function must be subjected to a probability analysis to assess the effectiveness of the fault-control measures that were taken. This assessment determines the dangerous probability of failure PFH (probability of a dangerous failure per hour)for protective systems. This is the probability per hour that a protective system fails in a hazardous manner and the protective function cannot be correctly executed. The PFH must not exceed the values calculated for the complete protective system depending on the SIL. The individual PFH of a chain must be calculated together, the total of the PFH must not exceed the maximum value specified in the standard.

SIL	PFH at high requirement rate or continuous requirement
4	$\geq 10^{-9}$ to $<10^{-8}$
3	$\geq 10^{-8}$ to $<10^{-7}$
2	$\geq 10^{-7}$ to $<10^{-6}$
1	$\geq 10^{-6}$ to $<10^{-5}$

HFT and SFF

The standard also requires a specific hardware fault tolerance HFT for the safety system depending on the SIL in connection with a specific proportion of safe failures SFF (safe failure fraction). The hardware fault

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tolerance is the property of a system that enables it to execute the desired safety function in spite of the presence of one or more hardware faults. The SFF of a system is defined as the ratio of the rate of safe failures to the total failure rate of the system. Under IEC61508 the maximum achievable SIL of a system is determined by the hardware fault tolerance HFT and the safe failure fraction SFF of the system.

SFF	HFT type A subsystem		
	0	1	2
< 60%	SIL1	SIL2	SIL3
60%- <90%	SIL2	SIL3	SIL4
90%- < 99%	SIL3	SIL4	SIL4
≥99%	SIL3	SIL4	SIL4

Fault-prevention measures

Systematic faults in the specifications, in the hardware and the software, usage faults and maintenance faults of the safety system must be avoided as much as possible. IEC61508 specifies a series of fault-prevention measures that must be implemented depending on the required SIL. The fault-prevention measures must accompany the complete life cycle of the safety system, i.e. from design to decommissioning of the system.

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5 Engineering

This chapter contains basic information on options for use of the product, which are essential for the engineering.

5.1 Logic type

This product can switch the 24V inputs and outputs as follows (drC- / oLt). Exception: the safety signals PWRR_A and PWRR_B are always logic type "Source".

Logic type	active status
"Source"	output sends current current flows to the input
"Sink"	output absorbs current current flows from the input

⚠ WARNING

Unintended equipment operation

Use of the logic type setting "Sink" allows the earth fault of a signal to be recognised as an On condition.

- Take extra care with the wiring to exclude any possibility of an earth fault.

Failure to follow these instructions can result in death, serious injury or equipment damage.

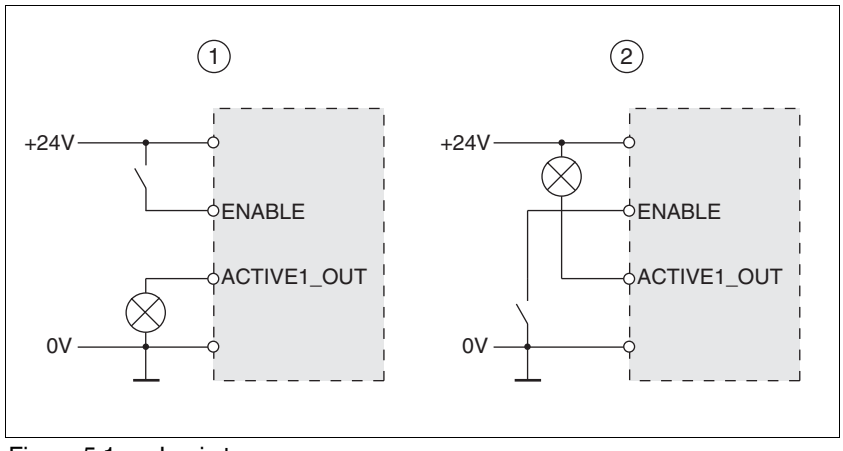

Figure 5.1 Logic type

(1) "Source"
(2) "Sink"

The setting is made via "first setup" with the IOLogicType parameter. This setting affects the wiring and the control of sensors and must therefore be thoroughly clarified during engineering with reference to the area of application.

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Special case: "Power Removal" safety function

The inputs for the "Power Removal" safety function (inputs $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$) are **always** executed in "Source" independently of the setting.

5.2 Specification of the control mode

Controller type: local or fieldbus

The basic specification of whether the system should be controlled locally or over the fieldbus must be made when the product is started for the first time. This specification can only be modified by restoring the factory setting, see chapter 8-73.

The availability of operating modes of the product also depends on this setting.

Local control mode

With a local control mode the movement is preset with analogue signals (±10V) or with RS422 signals (e.g. pulse/direction).

Limit switches and reference switches cannot be connected with the control mode.

Fieldbus control mode

In the fieldbus control mode all communications are made via fieldbus commands.

5.3 Safety function "Power Removal"

For some general information on the application of IEC 61508 see page 4-1.

5.3.1 Definitions

Power Removal

The "Power Removal" safety function switches off the motor torque safely. The supply voltage must not be interrupted. There is no monitoring at standstill.

Category 0 stop (EN60204-1)

Standstill by immediate power shutdown to the machine drive elements (i.e. an uncontrolled stop).

Category 1 stop (EN60204-1)

A controlled stop in which the machine drive elements are retained to effect the standstill. Power feed is only interrupted when everything has come to a standstill.

5.3.2 Function

The "Power Removal "safety function integrated into the product can be used to implement the "Standstill in Emergency" control function (EN 60204-1) for Category 0 Stop and Category 1 Stop. In addition, this safety function prevents the drive from restarting unexpectedly.

The safety function meets the following requirements of the standards for functional safety:

- IEC 61508:2000 SIL 2
- pr IEC 62061:2003 SIL 2
- EN 954-1 category 3
- pr EN ISO 13849-1:2004 PL d (Performance Level d)

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Function

The "Power Removal" safety function can be triggered via the two redundant PWRR_A and PWRR_B inputs. The circuits of the two inputs must be separate from each other to retain the two channels. The switching process must be simultaneous for both inputs (skew <1s).
The power amplifier is without power and an error message is sent, even if one of the two inputs is shut down. Then the motor cannot generate torque and runs down without braking. A restart is only possible after resetting the error message.

5.3.3 Requirements for safe application

⚠ DANGER

Electric shock caused by incorrect use!

The "Power Removal" function does not effect any electrical disconnection. The inter circuit voltage is still present.

- Turn off the mains voltage using an appropriate switch to achieve a voltage-free condition.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

Loss of the safety function

Incorrect usage may cause a safety hazard by loss of the safety function.

- Observe the requirements for the safety function.

Failure to follow these instructions can result in death or serious injury.

Stop of category 0

In a stop of category 0 the drive runs down uncontrolled. If access to the machine while it is running down is a hazard (result of hazard and risk analysis), suitable measures must be taken.

Stop of category 1

For a stop of category 1 a controlled stop can be requested with the HALT or over the fieldbus. The standstill is not monitored by the drive system and is not guaranteed if power fails or in the event of an error. The final shutdown is ensured by shutting down the PWRR_A and PWRR_B inputs. This is generally controlled by a standard EMERGENCY STOP module with safe time delay.

Vertical axes, external forces

If external forces act on the drive (vertical axis) and an unwanted movement, for example caused by gravity, could cause a hazard, the drive must not be operated without additional measures for drop protection corresponding to the required safety.

Prevention of unexpected restart

To prevent an unexpected restart after restoration of power (e.g. after power failure), the parameter IO_AutoEnable must be set to "off". Note that a higher level controller must not trigger a dangerous restart.

Degree of protection when using "Power Removal"

It is important to ensure that there a re no conductive deposits on the product for the "Power Removal" function (pollution degree 2). Protect the product appropriately against dust and spray.

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Protected layout

If short circuits and cross connections can be expected on the wiring of the $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ signals and they are not detected by upstream units, a protected layout is required.

A protected layout can be achieved as follows:

- Layout of $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ signal lines in different cables. If there are additional wires in the cables they must only carry voltages corresponding to PELV.
- Use of a shielded cable. The earthed shield protects the signals from outside voltages.

  If there are additional wires in the cable, the $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ signals are separated by the earthed shield of these wires.

Data for maintenance schedule and safety calculations

Use the following data for your maintenance schedule and the safety calculations:

Service life corresponding to safety life cycle (IEC 61508)	20 years
SFF (Safe Failure Fraction) (IEC61508)	70%
Probability of failure (PFH) (IEC 61508	$2.85*10^{-9}$ 1/h
Response time (until shutdown of power amplifier)	<10ms

Hazard and risk analysis

As a system manufacturer you must conduct a hazard and risk analysis (e.g. as per EN 1050) of the system. The results must be taken into account in the application of the "Power Removal" safety function.

The circuit resulting from the analysis may deviate from the following application examples. Additional safety components may be required. The results of the hazard and risk analysis always have priority.

5.3.4 Application examples

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Example: category 0 stop Circuit without EMERGENCY STOP module, Stop category 0.

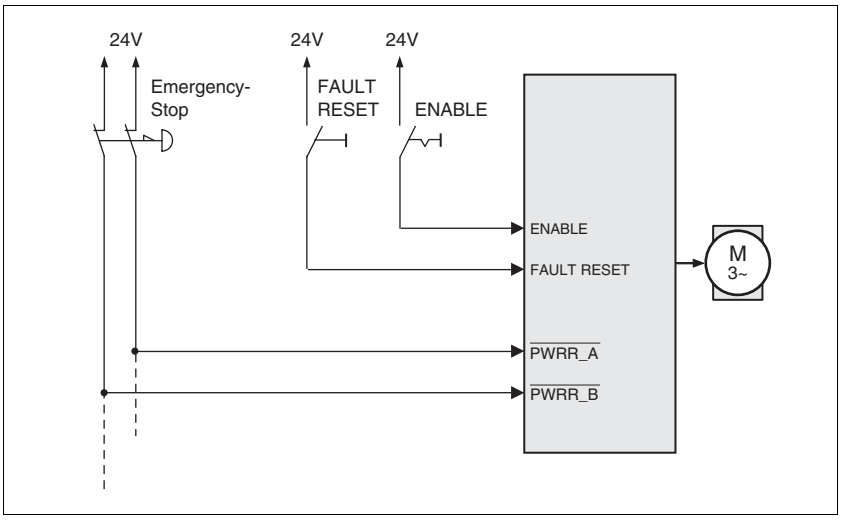

Figure 5.2 Example: category 0 stop

Please note:

- When the EMERGENCY STOP switch is tripped it initiates a stop of category 0

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Example: category 1 stop Circuit with EMERGENCY STOP module, Stop category 1,

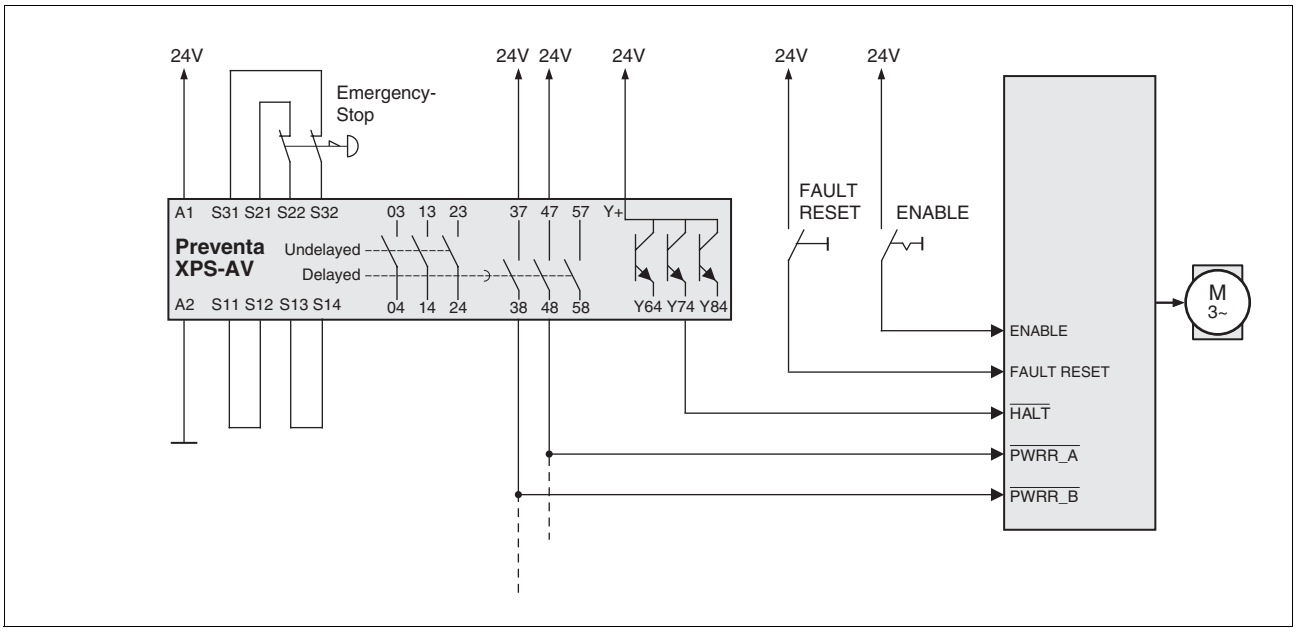

Figure 5.3 Example of category 1 stop with external Preventa XPS-AV EMERGENCY STOP module

Please note:

- A "Halt" is initiated without delay through the $\overline{\text{HALT}}$ input.
- The $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ inputs are shut down in accordance with the delay time specified in the EMERGENCY STOP module. If the drive has not yet stopped at this time, it runs down without control (uncontrolled standstill).
- The specified minimum current and the allowed maximum current of the relay must be maintained in the circuitry of the relay outputs at the EMERGENCY STOP module.

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6 Installation

⚠ WARNING

Danger of injury by loss of control!

- Observe the accident prevention regulations. (For USA see also NEMA ICS1.1 and NEMA ICS7.1)
- The system manufacturer must take the potential error possibilities of the signals and the critical functions into account to ensure a safe state during and after errors. Some examples are: emergency stop, final position limitation, power failure and restart.
- The assessment of error possibilities must also include unexpected delays and the failure of signals or functions.
- Suitable redundant control paths must be in place for dangerous functions.
- Check that measures taken are effective.

Failure to follow these instructions can result in death or serious injury.

The chapter on engineering contains basic information that you should know before starting the installation.

6.1 Electromagnetic compatibility, EMC

⚠ WARNING

Interference with signals and devices may cause injury

Distorted signals can cause unexpected device responses.

- Install the wiring in accordance with the EMC requirements.
- Check compliance with the EMC requirements, particularly in an environment subject to strong interference.

Failure to follow these instructions can result in death, serious injury or equipment damage.

This drive system meets the EMC requirements for the second environment under the IEC 61800-3 standard if the measures described for the installation are taken into account. When operating outside this application area note the following:

⚠ WARNING

In a domestic environment, this product may cause radio interference, in which case supplementary mitigation measures may be required.

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An EMC-compliant design is required to maintain the specified limit values. Depending in the case better results can be achieved with the following measures:

- Upstream mains reactors. Information on current distortions can be obtained on request.
- Upstream external mains filters, particularly to maintain limit values for the first environment (living area, category C2)
- Particularly EMC-compliant design, e.g. in an enclosed switch cabinet with 15dB damping of radiated interference

EMC scope of supply and accessories

The scope of supply includes earth clamps and an EMC plate.

For information on the prefabricated wiring see page 12-2.

Switching cabinet setup

EMC measures	Effect
Use EMC plate (included) or galvanised/chromed mounting plates, connect metal parts over wide area, remove coatings on contact surfaces.	Good conductivity due to two-dimensional contacts
Earth the control cabinet, door and EMC plate with metal tapes or cables with a cross section area greater than 10 mm^2.	Reduction of emissions.
Fit switching devices such as contactors, relays or solenoids with interference suppressors or spark suppressors (e.g.diodes, varistors, RC elements)	Reduction of mutual interference
Install power and control components separately.	Reduction of mutual interference

Cabling

EMC measures	Effect
Keep wiring as short as possible. Do not install "safety loops", short cables from the star point in the switch cabinet to outlying earth connection.	Avoidance of capacitive and inductive interference injection
Use cable clamps to connect a large surface area of the shield of all shielded cables to the mounting plate at the control cabinet entry.	Reduction of emissions.
Fieldbus lines and signal lines must not be laid in the same conduit with lines for DC and AC voltage over 60 V. (Fieldbus lines can be laid in the same conduit with signal and analogue lines) Recommendation: lay in separate conduits at least 20 cm apart.	Prevention of mutual interference
Connect large surface areas of cable shields, use cable clamps and tapes	Reduction of emissions.
Earth shields on digital signal lines over a wide area at both ends or via conductive plug housing.	Preventing interference on control cables, reduction of emissions
Use bonding conductors in system with – wide-area installation – different voltage infeed – networking between different buildings	Protection of wiring, reduction of emissions.
Use fine-core bonding conductors	Deflect even high-frequency interference currents

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EMC measures	Effect
Earth shield on analogue signal lines directly at the device (signal input), and insulate the shield at the other end of the cable or earth via a capacitor if interference occurs, e.g. 10 NF.	Preventing ripple loops due to low-frequency interference
Use only shielded motor cables with copper braiding and at least 85% covering, ground a large surface area of the shield at each end.	Controlled discharge of interference currents, reduction of emissions
If motor and machine are not conductively connected, e.g. by an insulated flange or a non-flat connection, earth the motor with an earth wire >10 mm^2 (>6 AWG) or ground strap.	Reduction of emissions, increase in resistance to interference
Lay connections of the 24 V_{DC} supply voltage as “twisted pair”.	Preventing interference on control cables, reduction of emissions

Power supply

EMC measures	Effect
Operate drive system on mains with earthed neutral point (not IT mains).	Mains filter is only effective on systems with an earthed star point.
Connect the negative output of the 24V power supply to PE.	Reduction of EMC emissions, safety
Circuit breaker if there is danger of overvoltage or lightning strike	Protection against damage by overvoltage

EMC requirement:motor and motor sensor cable

Motor leads and motor sensor cables are especially critical signal lines. Use the cables recommended by your local representative. They must be tested for EMC safety and must be suitable for trailing cables.

The motor cable and the motor sensor cable on the drive system must be laid out over a wide area with low resistance on the unit, the switch cabinet output and on the motor.

- ▶ Lay out motor and motor sensor cable without interruption (do not install switch components) from the motor and sensor to the unit. If a line has to be interrupted, shielded connections and metal casing must be used to prevent interference.
- ▶ Lay the motor cable at least 20 cm from the signal cable. If the distance is less than this, the motor cable and signal cables must be separated by grounded screening plates.
- ▶ For long lines equipotential bonding conductors with a suitable cross section must be used

Equipotential bonding conductors

The shields are connected at both ends for fault protection. Potential differences can result in excessive currents on the shield and must be prevented by equipotential bonding conductor cables.

If lines over 100 m are approved, the following applies: up to 200 m length a cable cross section of 16 mm^2 is sufficient, for greater lengths a cable cross section of 20 mm^2 is required.

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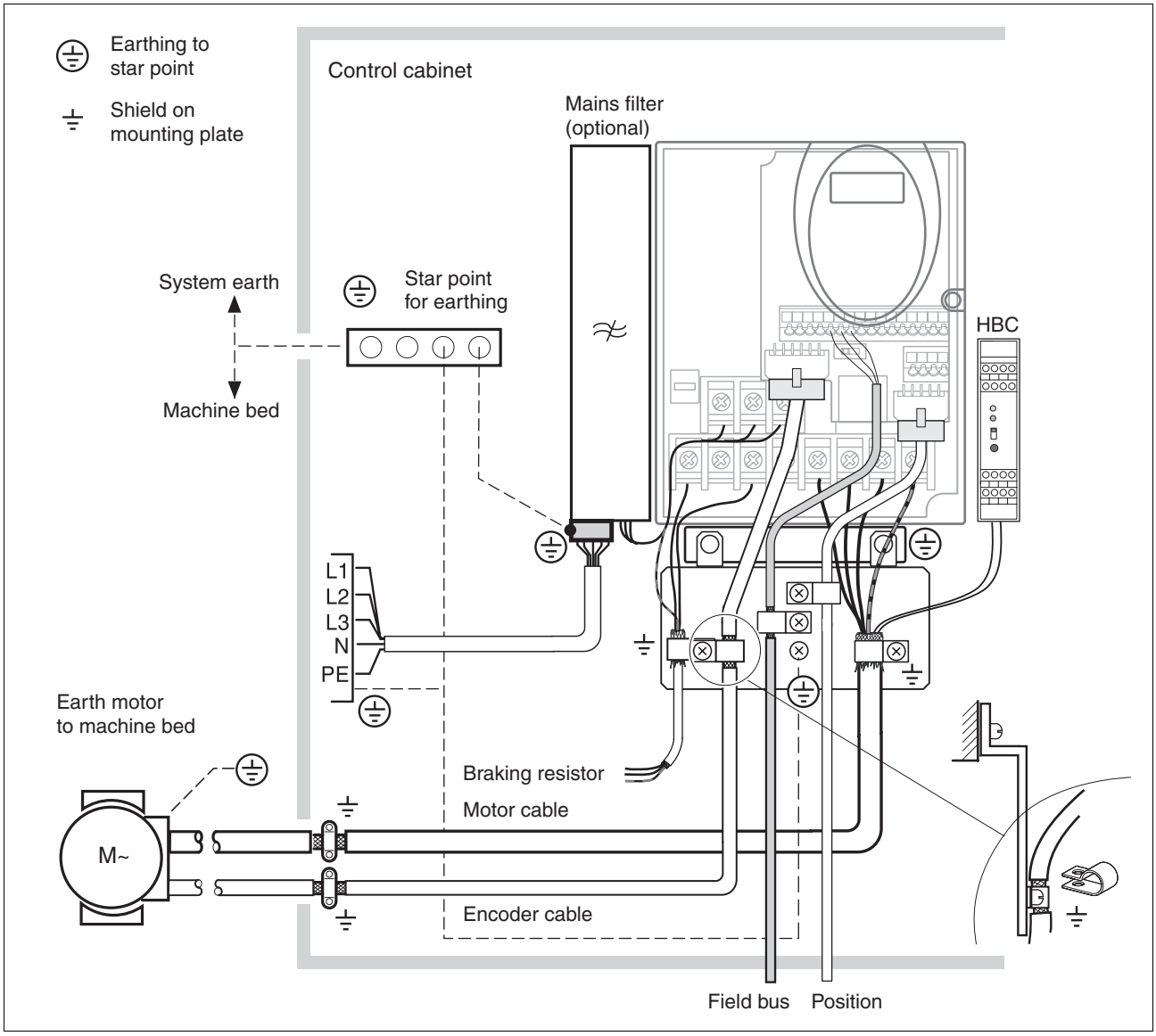

Figure 6.1 EMC measures

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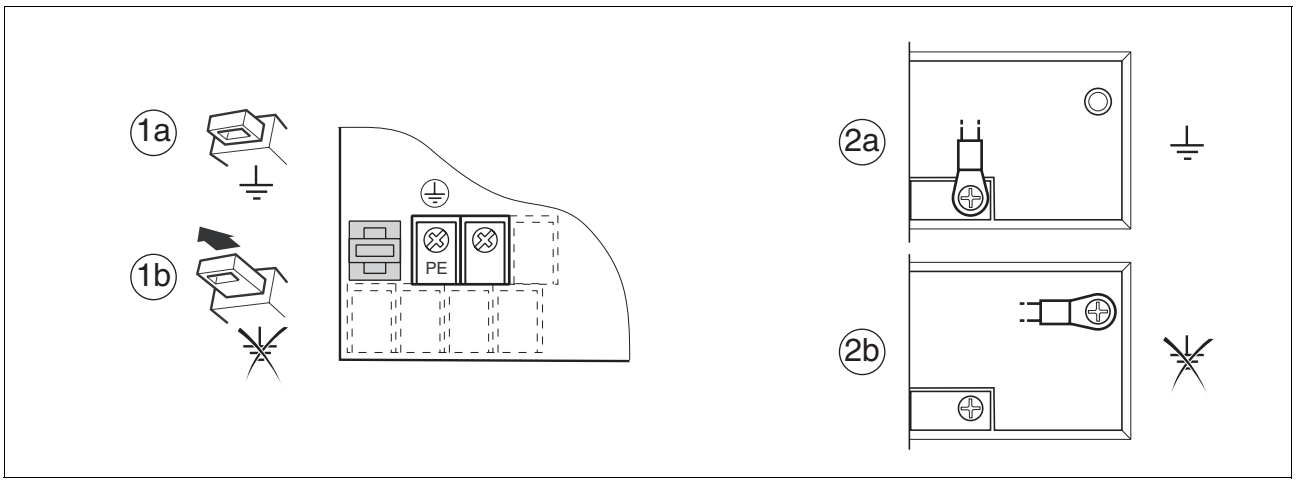
6.1.1 Operation in an IT mains

An IT mains is characterised by a neutral conductor that is insulated or earthed through a high impedance . If you use a permanent insulation monitor, it must be suited for non-linear loads (e.g. Type XM200 from Merlin Gerin). If, despite perfect wiring, a fault is indicated, you can, in the case of products with integrated mains filters, disconnect the earth connection to the Y- capacitors (deactivate the Y- capacitors).

With all other networks except for IT mains the earth connection via the Y- capacitors must be maintained.

If the earth connection to the Y- capacitors is removed, the specifications for the transmission of electromagnetic interference will no longer be maintained (specific categories see chapter page)!3.4.6 “Internal mains filter“3-9 Separate measures are required to comply with national regulations and standards.

CAUTION: the motor must be designed for operation in the IT mains.



LXM05•...	D10F1, D10M2, D14N4, D17F1, D17M2, D22N4, D28F1, D28M2, D34N4	D57N4
Insulation monitoring error	(1a) Y-capacitors of the internal filter effective (standard)	(2a) Y-capacitors of the internal filter effective (standard)
	(1b) Y-capacitors of the internal filter disabled (IT mains)	(2b) Y-capacitors of the internal filter disabled (IT mains)

Table 6.1 Y-capacitors

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6.2 Mechanical installation

⚠ DANGER

Electric shock from foreign bodies or damage.

Conductive foreign bodies in the product or serious damage can cause accidental energisation.

- Do not use damaged products.
- Prevent foreign bodies such as chips, screws or wire clippings from entering the product.
- Do not use products that contain foreign bodies.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

Danger of injury by loss of safety function!

The safety function may fail because of conductive foreign bodies, dust or liquids.

- The "Power Removal" safety function must only be used if the system is protected against conductive contamination..

Failure to follow these instructions can result in death or serious injury.

⚠ CAUTION

Hot surfaces can cause burns and damage to system components!

The heat sink on the product may heat up to over 100°C depending on the operating mode.

- Prevent contact with the hot heat sink.
- Do not install flammable or heat-sensitive components in the immediate vicinity.
- Follow the actions described for heat dissipation.

Failure to follow these instructions can result in injury or equipment damage.

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6.2.1 Mounting the device

Switching cabinet

The switching cabinet must be dimensioned so all devices and accessories can be fixed in place and wired to meet EMC standards. The components include a holding brake controller or braking resistors.

The switching cabinet ventilation must be capable of extracting the heat generated by all devices and components installed in the switch cabinet.

Installation spacing;ventilation

When selecting the position of the device in the switching cabinet, note the following instructions:

- Adequate cooling of the device must be ensured by complying with the minimum installation distances. Prevent heat accumulation.
- The device must not be installed close to heat sources or mounted on flammable materials.
- The warm airflow from other devices and components must not heat the air used for cooling the device.
- The drive will switch off as a result of overtemperature when operated above the thermal limits.

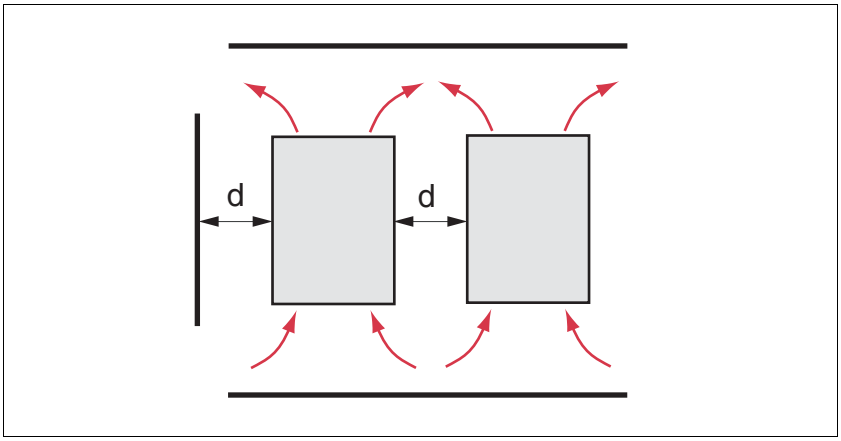

Figure 6.2 Installation spacing and air circulation

Temperature	Distance [1]	Measures without protective foil [2]	Measures with protective foil in place
0°C to +40°C (32°F to 104°F)	d > 50mm (d > 1.97 in.)	None	None
	d < 50mm (d < 1.97 in.)	None	d > 10 mm (d > 0.39 in.)
+40°C to +50°C (104°F to 122°F)	d > 50mm (d > 1.97 in.)	None	Reduce nominal current and continuous current [3]
	d < 50mm (d < 1.97 in.)	Reduce nominal current and continuous current [3]	Operation not possible

1) Distance in front of the device: 10mm (0.39 in.), above: 50mm (1.97 in.), below: 200 mm (7.87 in.)
2) Recommendation: remove protective foil on completion of the installation
3) by 2.2% per °C above 40°C (by 1.22% per °F above 104 °F)

At least 10mm of free space is required in front of the device. Make sure that the operator elements are accessible.
At least 50 mm of free space is required above the device.
The connecting cables come out of the bottom of the housing. At least

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200 mm free space under the device is required to ensure that wiring can be installed without excessive bending.

Installing the device

For the dimensions of the fastening holes see 3.3.1 “Dimensional drawings“ from page 3-3.

- ▶ Install the device in a vertical position (±10°). This is particularly important for cooling the device.
- ▶ Attach the supplied EMC plate at the bottom of the device, see also Figure 6.1, or use alternative attaching elements (comb bars, shield clamps, busbars).

Attach plate with safety instructions

- ▶ Attach the plate with safety instructions included with the device in a visible position on the front panel as specified by the national regulations.

An alternative to fastening the unit directly to the switching cabinet mounting plate is adapter plates for mounting to top-hat rails, see chapter .12-1

In this case mains filters cannot be attached directly beside or behind the device.

Painted surfaces have an insulating effect. Remove the paint from the attachment points over a wide area (bright metal) before attaching the unit to a painted mounting plate.

Remove the protective foil

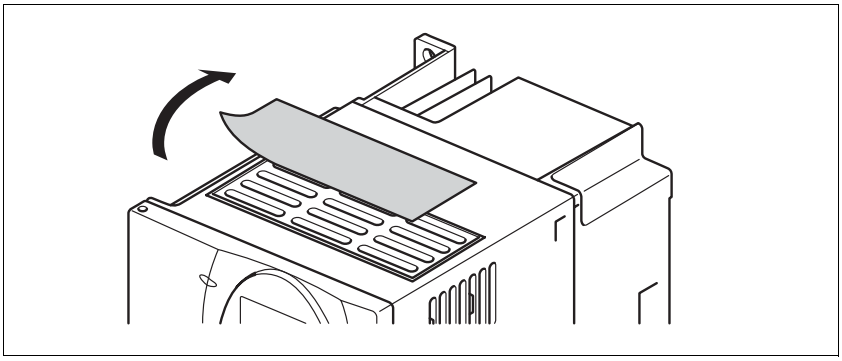

Figure 6.3 Removing protective foil

Remove the protective foil only after completion of all installation work. The protective foil must be removed if required by the thermal conditions.

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6.2.2 Installing mains filter, mains reactor and braking resistor

External line filter

You can check whether the your unit has an integrated line filter by the type code and the specifications (see page 3-1).

An external line filter is required when using a unit without an integrated line filter or with long motor lines. The operator must ensure that the EMC directives are observed in this case.

For specifications of external mains filters see page 3-9.
For directions on electrical installation see mains supply from page 6-26.

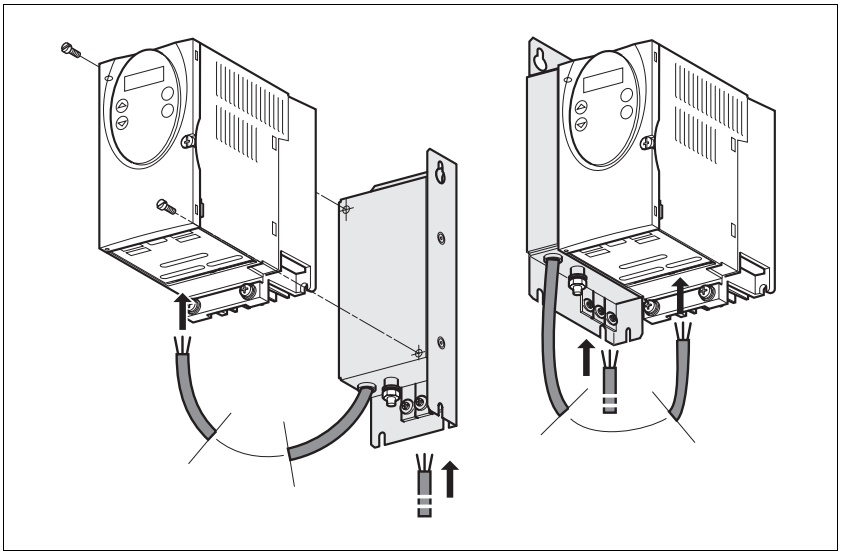

Figure 6.4 Mounting of mains filters

▶ Mount the mains filter at the rear or the left side of the device.

If the line filter is mounted behind the unit, the line filter terminals will not be accessible after installation of the EMC plate.

If you are using the top-hat rail mounting plates, the line filter cannot be mounted directly beside or behind the unit.

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Line reactor

A line reactor must be used under the following conditions:

- operation on power supply networks with low impedance (maximum possible short circuit current of the network greater than specified in the Technical Data), see Technical Data from page 3-4
- at high average output power that is greater than half the rated power
- where there are special requirements for the service life of the unit (24h operation)
- operation on networks with reactive-current compensation systems
- for improvement of the power factor at the network input and to reduce the network feedback
- if overvoltages greater than overvoltage category III could occur

Multiple units can be operated with one line reactor. The rated current of the reactor must be considered.

In the case of a network impedance that allows a short-circuit current greater than 1kA the inductivity of the reactor must be greater than 0.8mH.

Supplementary current harmonics place a heavy load on the DC bus capacitors. This has a substantial influence on the service life of the unit. For appropriate line reactors see accessories from page 12-4.

The information sheet included with the mains reactor contains additional information on mounting. For directions on electrical installation see power supply from page 6-26.

External braking resistor

⚠ WARNING

Hot surfaces can cause burns, fire and damage to system components.

The braking resistor may heat up to over 250°C depending on the operating mode.

- Prevent contact with the hot braking resistor.
- Do not place flammable or heat-sensitive components in the immediate vicinity of the braking resistor.
- Ensure good heat dissipation.
- Check the temperature of the braking resistor by conducting a test run under the most critical conditions.

Failure to follow these instructions can result in death, serious injury or equipment damage.

The braking resistors recommended in accessories from page 12-1 comply with degree of protection IP65. They can be installed outside a switching cabinet in an environment with this degree of protection.

The information sheet included with the external braking resistor contains additional information for the mounting.

For information on the function and the electrical installation see page 6-20.

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6.3 Electrical installation

⚠ DANGER

Electric shock, fire or explosion

- Only qualified personnel who are familiar with and understand the contents of this manual are authorised to work on and with this drive system.
- The system manufacturer is responsible for compliance with all applicable regulations relevant to earthing the drive system.
- Many components, including printed wiring boards, operate at mains voltage. **Do not touch**. Do **not** touch unshielded components or screws of the terminals with voltage present.
- Install all covers and close the housing doors before applying power.
- The motor generates voltage when the shaft is rotated. Lock the shaft of the motor to prevent rotation before starting work on the drive system.
- Before working on the drive system:
  - Switch off power to all terminals.
  - Place a sign "DO NOT SWITCH ON" on the switch and lock to prevent switching on.
  - **Wait 6 minutes** (for discharge of DC bus capacitors). Do **not** short-circuit DC bus
  - Measure voltage at DC bus and check for <45V. (The DC bus LED is not a safe indication for absence of the DC bus voltage).

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

Electric shock from foreign bodies or damage.

Conductive foreign bodies in the product or serious damage can cause accidental energisation.

- Do not use damaged products.
- Prevent foreign bodies such as chips, screws or wire clippings from entering the product.
- Do not use products that contain foreign bodies.

Failure to follow these instructions will result in death or serious injury.

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⚠ DANGER

Electric shock because of insufficient earthing.

With insufficent earthing these is hazard of electric shock.

- Earth the drive system before applying power.
- Do not use metallic conduits as a earth conductor. Use a conductor housed within the conduit as the earth conductor.
- Use cross-sections of the protective earth conductor that comply with the applicable codes.
- Earth the cable shields on both ends, but do not regard the shields as protective earth.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

This product can cause a direct current in the protective earth conductor!

If a residual current device (FI protection switch, RCD) is used then peripheral conditions are to be observed.

Failure to follow these instructions can result in death or serious injury.

Peripheral conditions for the use of a residual-current-operated protective device

If the installation regulations foresee upstream protection in the form of a residual-current-operated protective device (FI protection switch, RCD) then a residual-current-operated protective device "Type A" can be used for a single-phase drive booster with a connection between N and L. A "Type B" device must be used in all other cases.

The following properties should be taken into account:

- Filtering high frequency currents.
- Delay which prevents triggering due to possible charged fault capacities when switching on. This delay is not possible for 30 mA devices. In this case you should select devices which are not prone to unintentional triggering, for example a residual-current-operated protective device with increased interference resistance of the type s.i (super-immunised) (trademark Merlin Gerin).

If the plant consists of a number of drive boosters then a residual-current-operated protective device must be used for each drive booster.

Suitability of wiring

Cables must not be twisted, stretched, crushed or kinked. Use only cables that comply with the cable specification. For example, make sure that it is suitable for:

- Use as a trailing cable
- Temperature range
- Chemical resistance
- Layout outdoors
- Layout underground

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6.3.1 Overview of procedure

▶ Observe the basic settings described in 5 “Engineering“ from page 5-1. The selected settings influence the complete installation:

- 5.1 “Logic type“Chapter from page5-1
- 5.2 “Specification of the control mode“Chapter from page5-2
- 5.3 “Safety function "Power Removal"“Chapter from page5-2

▶ Unlock the front panel of the device and open it.

▶ Connect the earth terminal of the device or the EMC plate to the earthing star point of the system.

▶ Connect the required terminal corresponding to the sequence of Table 6.2. If a different connection sequence is followed, terminals may be covered by other lines.

Follow the EMC requirements, see page 6-1.

▶ Then lock the front panel.

Connection from	Connection to	from page
Motor phases		6-16
External braking resistor		6-20
Mains supply		6-26
Motor rotary encoder	CN2	6-28
Holding brake controller (HBC)	CN1 and CN3	6-31
24V controller supply voltage	CN3	6-33
Encoder A, B, I	CN5	6-35
Pulse direction, PULSE	CN5	6-36
Encoder simulation, ESIM	CN5	6-39
Fieldbus CANopen	CN1 or CN4	6-41
Fieldbus Modbus	CN4	6-43
Analogue inputs	CN1	6-45
Digital inputs/outputs	CN1	6-43
PC or remote terminal	CN4	6-47

Table 6.2 Installation overview

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6.3.2 Overview of all connections

Power connections

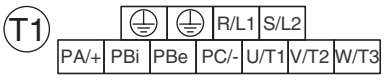
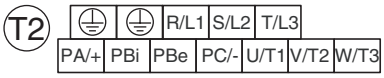
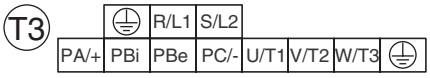
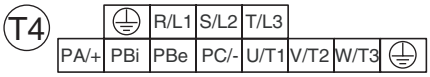
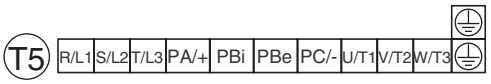
Power connections	device	
	LXM05•...	
	D10F1	(T1)
	D10M2	(T1)
	D10M3X	(T2)
	D14N4	(T4)
	D17F1	(T3)
	D17M2	(T3)
	D17M3X	(T4)
	D22N4	(T4)
	D28F1	(T3)
	D28M2	(T3)
	D34N4	(T4)
	D42M3X	(T4)
	D57N4	(T5)

Table 6.3 Designations of the power connections

Power connections	Description
PE	Earth connection (protective earth)
R/L1, S/L2/N	Mains connection, single phase devices
R/L1, S/L2, T/L3	Mains connection, 3-phase devices
PA/+	DC bus
PBi	Braking resistor internal
PBe	Braking resistor external
PC/-	DC bus
U/T1,V/T2, W/T3	Motor connections

Table 6.4 Designations of the power connections

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Signal connections

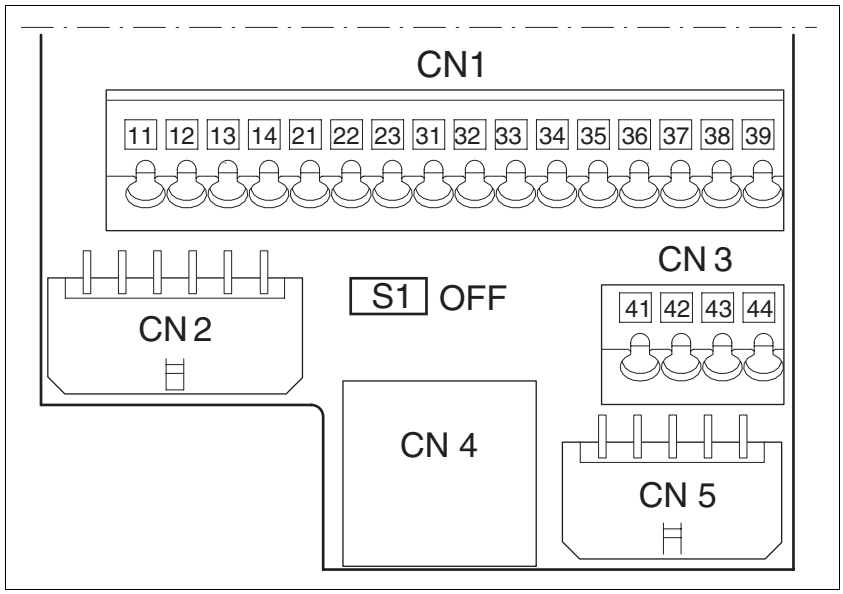

Figure 6.5 Overview of the signal connections

Connection/ switch	Assignments
CN1	Analogue inputs ±10V, pin 11 to 14
	CANopen, pin 21-23
	Digital inputs/outputs, pin 31-39
CN2	Motor encoder (Hiperface Sensor)
CN3	24V PELV controller supply voltage
CN4	PC, remote terminal, Modbus, CANopen; (RJ45)
CN5	ESIM (A/B/I out), PULSE/DIR in, encoder signals A/B/I in [1)]
S1	Switch for fieldbus terminating resistor

1) depending on the “First Setup”

Table 6.5 Assignment of the signal connections

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6.3.3 Reference value signals and limits

External limits can be specified for the external reference value signals for operation. Table 6.6 shows the assignment options depending on the operating modes.

Operating mode	External reference value	Terminal	External limit	Terminal
Current control	ANA_IN1 (current)	CN1, Pin 11, 12 [1]	None	
	ANA_IN1 (current)	CN1, Pin 11, 12 [1]	ANA_IN2 (current)	CN1, Pin 13, 14 [1]
	ANA_IN1 (current)	CN1, Pin 11, 12 [1]	ANA_IN2 (rpm)	CN1, Pin 13, 14 [1]
Speed control	ANA_IN1 (rpm)	CN1, Pin 11, 12 [1]	None	
	ANA_IN1 (rpm)	CN1, Pin 11, 12 [1]	ANA_IN2 (current)	CN1, Pin 13, 14 [1]
	ANA_IN1 (rpm)	CN1, Pin 11, 12 [1]	ANA_IN2 (rpm)	CN1, Pin 13, 14 [1]
electronic gearbox	PULSE/DIR Signal	CN5	None	
	A/B Signal	CN5	None	
Profile position	None, generated by profile generator	CN4 [2]	$\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$	CN1, Pin 34, 35
Profile velocity	None, generated by profile generator	CN4 [2]	$\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$	CN1, Pin 34, 35
Homing	None, generated by profile generator	CN4 [2]	$\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$	CN1, Pin 34, 35
Jog	None, generated by profile generator		Local: None fieldbus: $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$	- CN1, Pin 34, 35

1) CN1, Pin 11-14 = 14-bit analogue input; alternatively, via parameter value in fieldbus control mode
2) CN4 = CANopen, Modbus connection

Table 6.6 Reference value signals and limits

6.3.4 Motor phase connections

⚠ DANGER

Electric shock

High voltages can occur unexpectedly at the motor connection.

- The motor generates voltage when the shaft is rotated. Lock the shaft of the motor to prevent rotation before starting work on the drive system.
- AC voltages may jump over unused wires in the motor cable. Isolate unused wires at both ends of the motor cable.
- The system manufacturer is responsible for compliance with all applicable regulations relevant to earthing the drive system. Extend the earth through the motor cable with an additional earth at the motor housing.

Failure to follow these instructions will result in death or serious injury.

Cable specifications

- Shielded cable
- Minimum cross section of wires: see table.

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- Earthing of the shield at both ends
- Maximum cable length: depends on required limit values for line-related interference, see chapter 3.4.6 “Internal mains filter“ page 3-9 and chapter 3.5.3 “External mains filter“ page 3-10.
- For more information see 3.5.6 “Cable“ on page 3-12.

LXM05•...		**D10•••**	**D14••** **D17•••** **D2•••** **D3•••** **D4••••**	**D5•••**
Connection cross section	mm^2	0.75 to 1.5	1.5 to 4	3.3 to 16 [1)]
AWG		14 to 20	10 to 16	6 to 12 [1)]
Starting torque	Nm	0.5 to 0.6	1.2 to 1.5	2.2 to 2.8

1) Wire end ferrules or fork-type cable lugs are required with a cross section of 2.5 mm^2 (AWG 14).

The wiring must have a sufficiently large cross section to ensure that the fuse at the mains connection can be tripped in the event of a fault.

▶ Use prefabricated cables to minimise the risk of a wiring error (from page 12-2).

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Preparing cables Note the dimensions specified when fabricating cables.

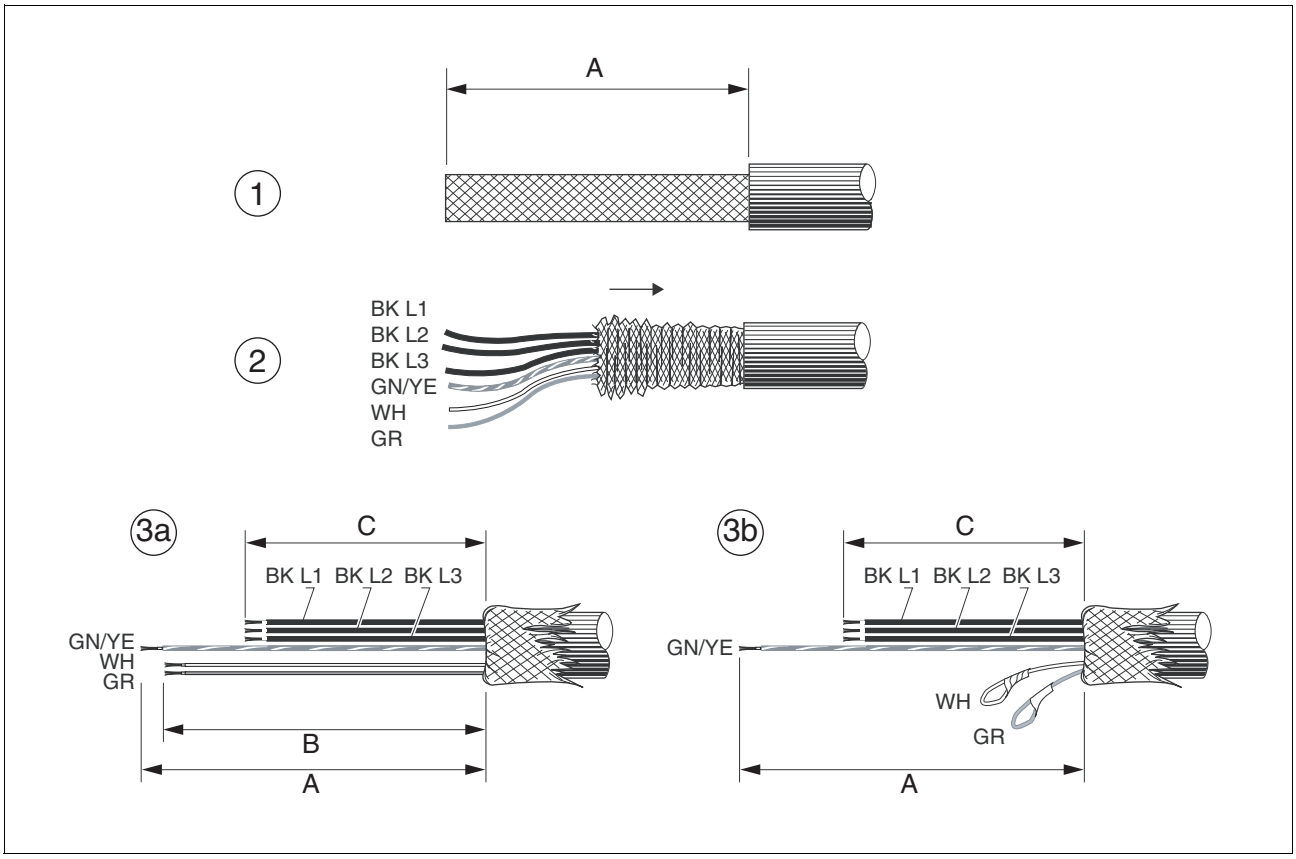

Figure 6.6 Steps (1-3) for fabrication of the motor cable

LXM05•...		D10••	D14•• D17•••	D2••• D3••• D4•••• D5•••
A	mm	130	130	130
B	mm	120	120	120
C	mm	75	85	90

- (1) Remove the cable sheath, length A depends on the device, see the table above.
- (2) Slide the shield braiding back over the cable sheath and store the shield braiding. Note that during installation the shield braiding must be positioned flat on the EMC plate.
- (3) Shorten the wires for the holding brake to length B and the three motor lines to length C. The protective conductor has length A.
  (3a) The two brake connection lines must have length B for motors with holding brake.
  (3b) The two brake connection lines must be separately insulated for motors without a holding brake.

Use fork-type cable lugs or wire end ferrules. The lead must fill the sleeve for its entire length to ensure maximum current carrying capacity and vibration resistance.

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Monitoring

The motor lines are monitored for:

- short circuit between the motor phases
- short circuit between the motor phases and PE

A short circuit between the motor phases against the DC bus or the braking resistor is not monitored.

Connecting the motor cable

- ▶ Follow the EMC requirements for motor cables, see page 6-3.
- ▶ Insulate unused wires at both ends and individually, see Figure 6.7, Pos 1.
- ▶ Connect the motor leads and protective conductor to terminals U/T1, V/T2, W/T3 and PE. The cable assignment at the motor and device sides must match.
- ▶ Fix the cable shielding flat on the EMC plate.

Wiring diagram

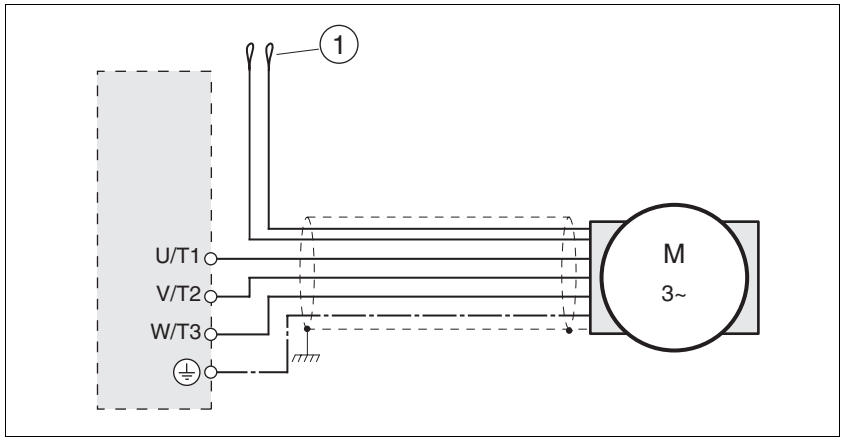

Figure 6.7 Motor wiring diagram, here without holding brake

Terminal	Description	Colour
U/T1	Motor lead	black L1 (BK)
V/T2	Motor lead	black L2 (BK)
W/T3	Motor lead	black L3 (BK)
PE	Protective conductor	green/yellow (GN/YE)
(1)	Holding brake connection cable For motors with holding brake see page 6-31	white (WH), grey (GR)

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6.3.5 Connection of braking resistor

⚠ WARNING

Risk of injury and damage to system components by unbraked motor!

An insufficient braking resistor causes overvoltage on the DC bus and switches off the power amplifier. The motor is no longer actively braked.

- Make sure that the braking resistor is sufficiently dimensioned.
- Check the setting of the parameter for the braking resistor.
- Check the temperature of the braking resistor by conducting a test run under the most critical conditions.
- During the test make sure that at higher mains voltage there is less reserve in the capacitors on the DC bus.

Failure to follow these instructions can result in death, serious injury or equipment damage.

6.3.5.1 Internal braking resistor

A braking resistor is integrated in the device to absorb braking energy. If the DC bus voltage exceeds a specified value, this braking resistor is switched on. The returned energy is converted to heat by the resistance. See also dimensioning aid, page 6-22.

The internal braking resistor is connected on delivery.

The internal braking resistor is at the back of the device.

6.3.5.2 External braking resistor

An external braking resistor is required for applications in which the motor must be heavily braked and the internal braking resistor cannot dissipate the excess braking energy. Two or more braking resistors can also be connected.

Monitoring

The device monitors the power of the braking resistor. The load on the resistance can be read out.
The connection of the external resistance is protected against short circuit.

Selection of the external braking resistor

The size of an external braking resistor is specified by the required peaks and the continuous output at which the braking resistor can be operated. If applicable, see the section on dimensioning aid, page 6-22.

The resistance value R [Ω] is derived from the required peak power and the DC bus voltage.

$R = U^2 / P_{max}$

U : Switching threshold [V]
P_{max} : Peek power [W]
R: Resistance [Ohm]

Figure 6.8 Calculating the resistance R of an external braking resistor

It two or more resistances are connected, not the following criteria:

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- The resistors must be wired in parallel or in series so the required resistance is reached.
- The resistance value of the external resistance must not fall below a bottom limit, see chapter 3.4.5 “Braking resistor“.
- The total continuous output of the individual resistors must yield the required continuous output.

For suitable braking resistors, see accessories on page 12-1.

Cable specifications

- Shielded wires
- minimum cross-section: as with mains power, see page 6-26. The wiring must have a sufficiently large cross section to ensure that the fuse at the mains connection can be triggered in the event of a fault.
- Earthing of the shield at both ends
- Maximum cable length: 3m

The braking resistors recommended in accessories have a 3-wire, temperature-resistant cable with a length of 0.75 m to 3 m.

Use fork-type cable lugs or wire end ferrules. The lead must fill the sleeve for its entire length to ensure maximum current carrying capacity and vibration resistance.

Connecting external braking resistor

▶ Observe the safety instructions for the electrical installation.

▶ Before opening the device disconnect it from the supply voltage.

▶ Remove the jumper, see Figure 6.9.

If the jumper is not removed, the internal braking resistor may be destroyed during operation.

▶ Earth the PE connection of the braking resistor.

▶ Connect the braking resistor to the device, see Figure 6.9.

▶ Spread the shielding of the cables out flat on the EMC plate.

Test the function of the braking resistor under realistic conditions during commissioning (page 7-19).

Wiring diagram

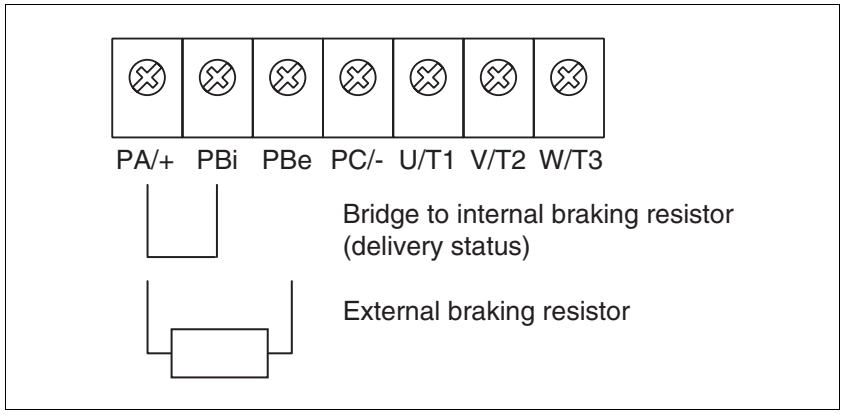

Figure 6.9 Wiring diagram, braking resistor

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6.3.5.3 Dimensioning aid

The elements contributing towards the absorption of braking energy are calculated to assist in specification. This is used to calculate the size of the braking resistor.

An external braking resistor is required if the kinetic energy that must be absorbed exceeds the total of internal components, including the internal braking resistor.

Internal energy absorption

Braking energy is absorbed internally by the following mechanisms:

- DC bus capacitor W_{ZW}
- Internal braking resistor W_{IN}
- Electrical losses in the drive W_E
- Mechanical losses in the drive W_M

The energy W_{ZW} depends in a square-law function on the difference between the voltage before the braking operation and the response threshold.

The voltage before the braking operation depends on the line voltage. The energy absorption by the DC bus capacitors is lowest when the line voltage is highest. Use the values for the highest line voltage.

Energy absorption of the internal braking resistor

Two characteristic values relating to the internal braking resistor determine its energy absorption.

- The continuous output P_{AV} shows how much energy can be continuously dissipated without overloading the braking resistor.
- The maximum energy W_{peak} limits the higher heat loss which can be dissipated in the short term.

If the continuous output is exceeded for a specified time, the braking resistors remain unloaded for a correspondingly period. This ensures that the braking resistor is not destroyed.

The characteristic values P_{AV} and W_{peak} of the internal braking resistor can be found from page 3-8.

Electrical losses WE

The electrical losses W_E in the drive can be estimated from the peak power of the drive. The maximum power loss is around 10% of peak power for a typical efficiency factor of 90%. If the current on braking is lower, the power loss will be reduced accordingly.

Mechanical losses W_M

The mechanical losses result from absorption by friction, which occurs when the system is running. Mechanical losses can be ignored if the system requires a much longer time to coast to a stop than the time required to stop the system under braking. The mechanical losses can be calculated from the load torque and the speed from which the motor is to stop.

Example

Braking of a motor with the following data (AC IN equal to $400V_{AC}$):

- Starting speed: $n = 4000\ min^{-1}$
- Rotor inertia: $J_R = 4\ kgcm^2$
- Load inertia: $J_L = 6\ kgcm^2$

The energy to be absorbed is given by:

$W_B = 1/2 * J * (2*\pi*n)^2$

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to 88 Ws

Electrical and mechanical losses are ignored.

23 Ws are absorbed in the DC bus capacitors at a power supply of 400 V.

The internal braking resistor must absorb the residual 65 Ws. It can absorb a pulse of 80 Ws. The internal braking resistor is sufficient if the load is stopped once under braking.

If the braking process is repeated cyclically, the continuous output must be considered. If the cycle time is longer than the ratio of the energy to be absorbed W_B and the continuous power P_{AV}, the internal braking resistor is sufficient. If braking takes place more frequently, the internal braking resistor will not be sufficient.

In the example the ratio W_B/P_{AV} is 1.3 s. An external braking resistor is required with a shorter cycle time.

Ratings the external braking resistor

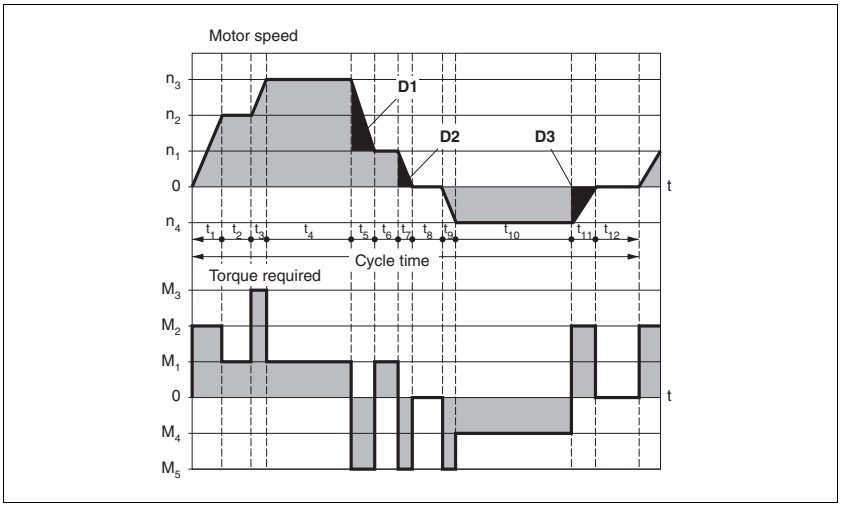

Figure 6.10 Characteristics for rating the braking resistor

These two characteristics are also used for the rating the motor. The segments of the characteristic under consideration in which the motor brakes are identified by (D_i)

Calculation of the energy at constant runout:

The total inertia (J_t) must be known.

J_t is given by:

$J_t = J_m + J_c$

J_m: Motor inertia with and without brake

J_c: Load inertia

The energy for each runout segment is calculated as follows:

$$E_i = \frac{1}{2} J_t \cdot \omega_i^2 = \frac{1}{2} J_t \cdot \left[\frac{2\pi n_i}{60}\right]^2$$

The following is derived for the segments (D_1) … (D_3):

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$$E_1 = \frac{1}{2} J_t \cdot \left[\frac{2\pi(n_3 - n_1)}{60} \right]^2$$

$$E_2 = \frac{1}{2} J_t \cdot \left[\frac{2\pi n_1}{60} \right]^2$$

Units: E_i in joules, J_t in kg/m², w in rad and n_i in rpm.

The table shown below gives the energy uptake capacity, Evar, for the individual drive regulators (without regard to an internal or external braking resistor).

When continuing with the calculation, take into account only those segments Di whose energy Ei exceeds the uptake capacity shown in the table. These excess energies E_{Di} should be removed via the braking resistors (internal or external).

The calculation of E_{Di} is accomplished using the formula:

$E_{Di} = E_i - E_{var}$ (in Joules)

The continuous power P_c is calculated for each machine cycle

$$P_c = \frac{\sum E_{Di}}{\text{Cycletime}}$$

Units: P_c in [W], E_{Di} in [J] and cycle time T in [s]

Selection takes place in two steps:

- The maximum energy during the braking process must be less than the peak energy that the braking resistor can accommodate: $(E_{Di})<(E_{Cr})$. In addition the continuous output of the internal braking resistor must not be exceeded: $(P_C)<(P_{Pr})$. If these conditions are met, then the internal braking resistor is adequate.
- If any one of the conditions is not met, it is necessary to use an external braking resistor. The resistance should be chosen such that the conditions are met. The value of the resistance must be between the specified minimum and maximum values, since otherwise the load can no longer be safely braked or the product could be destroyed.

For the order data for the external braking resistors see the accessories section from page 12-4.

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LXM05•...		D10F1	D17F1	D28F1	D10M2	D17M2	D28M2
Energy consumption of internal capacitors E_{var}	[Ws]	10.8	16.2	26.0	17.7	26.6	43.0
resistance internal	[Ω]	40	40	10	40	40	20
Continuous output P_{PR}	[W]	20	40	60	20	40	60
Peak energy E_{CR}	[Ws]	500	500	1000	900	900	1600
Switch-on voltage	[V]	250	250	250	430	430	430
External braking resistor min	[Ω]	27	20	10	50	27	16
External braking resistor max	[Ω]	45	27	20	75	45	27

LXM05•...		D10M3X	D17M3X	D42M3X	D14N4	D22N4	D34N4	D57N4
Energy consumption of internal capacitors E_{var}	[Ws]	17.7	26.6	43.0	26.0 1)	52.0 2)	52.0 2)	104.0 3)
resistance internal	[Ω]	40	40	20	40	30	30	20
Continuous output P_{PR}	[W]	20	40	60	40	60	60	100
Peak energy E_{CR}	[Ws]	900	900	1600	1000	1600	1600	2000
Switch-on voltage	[V]	430	430	430	770	770	770	760
External braking resistor min	[Ω]	50	27	10	60	25	25	10
External braking resistor max	[Ω]	75	45	20	80	36	36	21

1) at 480V: 6.0Ws
2) at 480V: 12.0Ws
3) at 480V: 10.0Ws

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6.3.6 Connection of power amplifier supply voltage

⚠ DANGER

Electric shock because of insufficient earthing

This drive system has an increased leakage current > 3.5mA.

- Use a protective conductor at least 10 mm² (AWG 6) or two protective conductors with the same cross section as the power supply conductors. Observe the local regulations for earthing.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

Inadequate overcurrent protection

- Use the external fuses specified in the "Technical Data" chapter.
- Do not connect the product to mains if the short-circuit capacity exceeds the maximum short-circuit current specified in the "Technical Data" chapter.

Failure to follow these instructions can result in death, serious injury or equipment damage.

CAUTION

Destruction by incorrect mains voltage!

The incorrect mains voltage may destroy the product.

- Before switching on and configuring the product, make sure that the type is approved for the mains voltage.

Failure to follow these instructions can result in equipment damage.

Cable specifications

The wiring must have a sufficiently large cross section to ensure that the fuse at the mains connection can be tripped in the event of a fault.

When connecting the device in an IT mains follow the directions in 6.1.1 “Operation in an IT mains“.

In addition, note the suitability of the wiring, see page 6-12 and the EMC-compliant connection, see page 6-2.

LXM05•...		**D10•••**	**D14••** **D17•••** **D2•••** **D3•••** **D4••••**	**D5•••**
Connection cross section	mm^2	0.75 to 1.5	1.5 to 4	3.3 to 16 [1)]
AWG		14 to 20	10 to 16	6 to 12 [1)]
Starting torque	Nm	0.5 to 0.6	1.2 to 1.5	2.2 to 2.8

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1) Wire end ferrules or fork-type cable lugs are required with a cross section of 2.5 mm^2 (AWG 14).

Preparing cables

Use fork-type cable lugs or wire end ferrules. The lead must fill the sleeve for its entire length to ensure maximum current carrying capacity and vibration resistance.

Connecting mains power

Observe the following instructions at all times:

- 3-phase devices must only be connected and operated on 3-phase.
- For devices with external mains filter the power cable must be shielded from 200 mm length between the external mains filter and the device and earthed at both ends.
- Observe the EMC requirements. If necessary, use overvoltage arrestors, mains filters and mains reactors, see page 6-9.
- Follow the requirements for design of corresponding UL, see page 3-1.
- The PE connection on the case must be connected to the mounting plate because of the high leakage currents.

Wiring diagram of 1-phase device

Figure 6.11 shows the connection of the mains power supply for a single phase device. The diagram also shows the wiring of the optional external mains filter and mains reactor .

CAUTION: in three-phase systems the neutral conductor N must generally be used instead of L2.

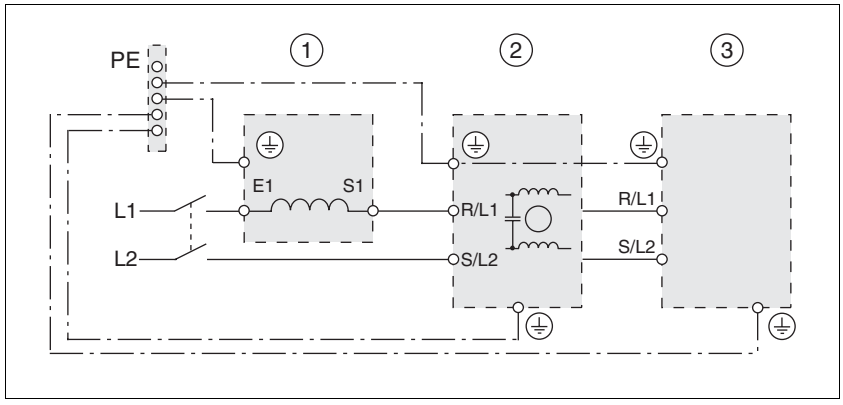

Figure 6.11 Wiring diagram:mains power for a single phase device

(1) Mains reactor (optional)
(2) Mains filter (optional)
(3) Product

If neutral conductor N is used instead of L2, a fuse is only required with L1.

▶ Connect the power cables. Note the exact terminal assignment of your device, see chapter 6.3.2 “Overview of all connections“.

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Wiring diagram of 3-phase device

Figure 6.12 shows the connection of the mains power supply for a 3-phase device. The diagram also shows the wiring of the optional external mains filter and mains reactor .

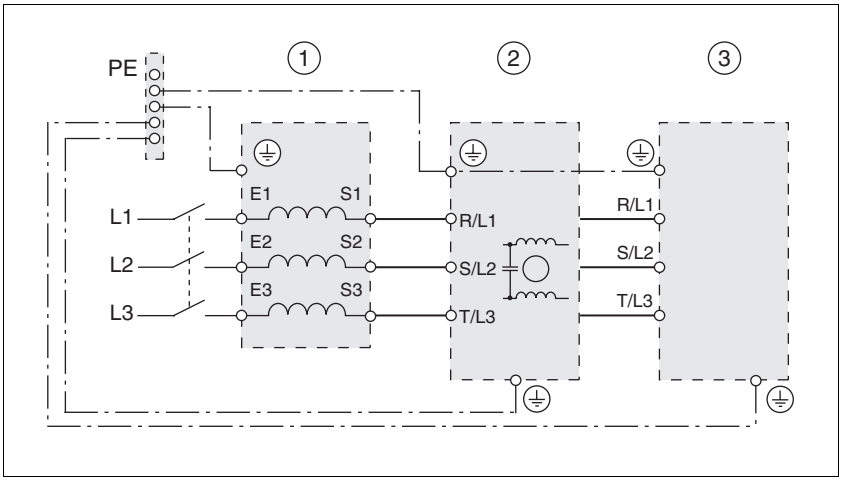

Figure 6.12 Wiring diagram:mains power for 3-phase device

(1) Mains reactor (optional)
(2) Mains filter (optional)
(3) Product

▶ Connect the power cables. Note the exact terminal assignment of your device, see chapter 6.3.2 “Overview of all connections“.

6.3.7 Connection for parallel operation

CAUTION

Destruction of the drive system by incorrect parallel operation.

Operation with a non-approved parallel circuit on the DC bus may destroy the drive systems immediately or after a delay.

- Find out the general conditions and requirements for parallel circuits on the DC bus from your local representative.

Failure to follow these instructions can result in equipment damage.

6.3.8 Connection of motor encoder (CN2)

Function and sensor type

The motor sensor is a Hiperface sensor (SinCos sensor) integrated into the motor. It captures the rotor position of the motor and sends the motor position to the unit both analogue and digitally.

Cable specifications

- Shielded cable
- Twisted pair lines
- Minimum cross section of signal wires: 10*0.25 mm^2 + 2*0.5 mm^2
- Earthing of the shield at both ends
- maximum cable length 100m
- For more information see 3.5.6 “Cable“ on page 3-12.

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Preparing cables

- ▶ Use prefabricated cables to minimise the risk of a wiring error (from page 12-2). Step 5 in Figure 6.13 must be carried out even with prefabricated cable. The dimensions for positioning the shield on the housing are applicable when the included EMC plate is used.
- ▶ If you are not using prefabricated wiring, follow the procedure and the dimensions in Figure 6.13.

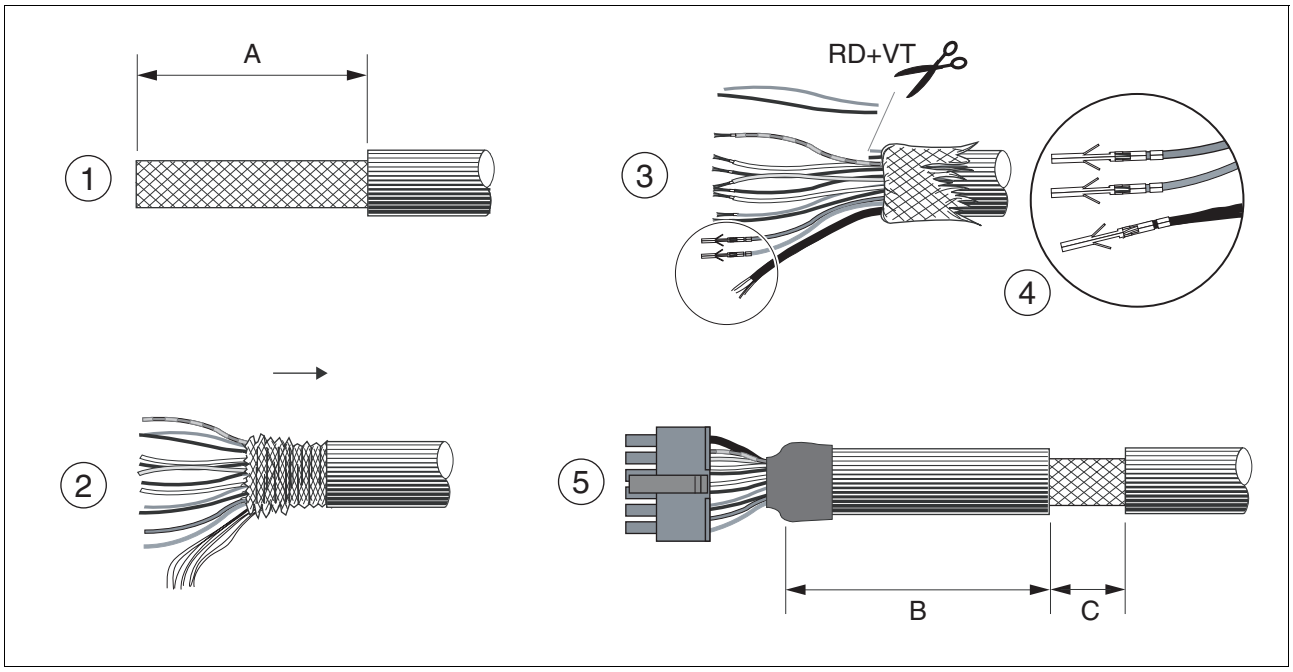

Figure 6.13 Steps (1-5) for fabrication of the sensor cable

LXM05•...		D10•	D14•• D17•••	D2••• D3••• D4•••	D5•••
A	mm	25	25	25	25
B	mm	90	100	130	120
C	mm	15	15	15	15

- ▶ (1) Remove the cable sheath, length A depends on the device, see the table above.
- ▶ (2) Slide the shield braiding back over the cable sheath. The shield braided filler wire is required as the connection.
- ▶ (3) The red and the violet braided wires are not required and can be cut off. Insulate the shield braided wire with shrink wrap.
- ▶ (4) Crimp the plug contacts on the remaining braided wires and on the insulated shield braided wire. Insulate the shield braiding with shrink wrap. Plug the crimp contacts into the connector shell; for the pin assignment see Figure 6.14.
- ▶ (5) Sheath the cable to length C on the position shown, the cable is fastened there at the EMC plate with a clamp (shield-earth connection).

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Wiring diagram

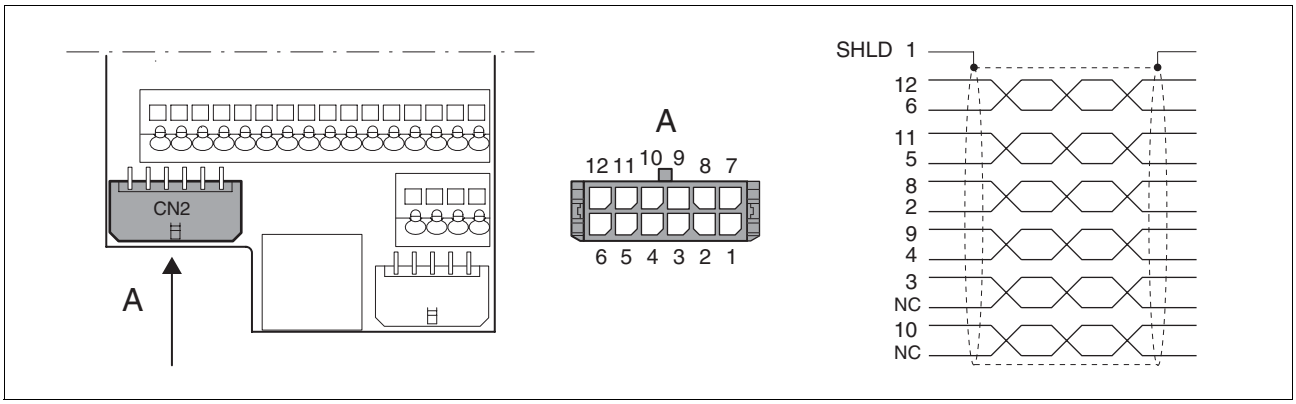

Figure 6.14 Motor sensor wiring diagram

Pin	Signal	Motor, pin	Colour [1)]	Pair	Description	I/O
1	SHLD				Shielding braid	
12	SIN	8	white	1	Sine signal	I
6	REFSIN	4	brown	1	Reference for sine signal, 2.5 V	O
11	COS	9	green	2	Cosine signal	I
5	REFCOS	5	yellow	2	Reference for cosine signal, 2.5 V	O
8	Data	6	grey	3	Receive and transmit data	I/O
2	$\overline{\text{Data}}$	7	pink	3	Receive and transmit data, inverted	I/O
10	ENC_0V	11	blue	4	sensor reference potential (encoder) (0.5mm^2)	O
			red	4	not assigned (0.5mm^2)	
3	TMOT_0V	1	black	5	Reference potential for T_MOT	
			purple	5	not assigned	
9	T_MOT	2	grey/pink	6	temperature sensor PTC	I
4	ENC+10V_OUT	10	red/blue	6	10 V_{DC} power supply for sensor, max. 150 mA	O
7	n.c.				not assigned	

1) Colour data is based on the prefabricated cables

Connecting motor sensor

- ▶ Make sure that the wiring, the cables and the connected interfaces meet the requirements for PELV.
- ▶ Note the EMC specification for motor sensor wiring from page 6-3, and ensure the equipotential bonding over equipotential bonding conductors.
- ▶ Connect the plug to CN2.
- ▶ Fasten the cable to the EMC plate and make sure that the cable shielding is spread over a wide area.

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6.3.9 Connection of holding brake controller (HBC)

⚠ DANGER

Electric shock because of voltage spread

The wiring to the brake in the motor cable generally does not correspond to the PELV requirements.

- Use a holding brake controller.
- Do **not** connect the brake to the controller voltage.

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

Electric shock

High voltages can occur unexpectedly at the motor connection.

- The motor generates voltage when the shaft is rotated. Lock the shaft of the motor to prevent rotation before starting work on the drive system.
- AC voltages may jump over unused wires in the motor cable. Isolate unused wires at both ends of the motor cable.
- The system manufacturer is responsible for compliance with all applicable regulations relevant to earthing the drive system. Extend the earth through the motor cable with an additional earth at the motor housing.

Failure to follow these instructions will result in death or serious injury.

Selection and dimensioning

For a motor with holding brake, we recommend an appropriate start-up logic (HBC) which releases the brake when current is supplied to the motor and which fixes the motor axle quickly when the motor is stopped.

Delay times for the release and the application of the brake can be set by parameters on the device, see page 8-69. For order data for the HBC see accessories from page 12-1.

Note the power requirement of the HBC. It depends on the switching current for the holding brake and is calculated from:
Input current HBC [A] = 0.5 A + switching current [A]

Under certain conditions you can omit a holding brake controller. However, it is imperative that the following points are taken into account:

- A separate power supply is required. This must correspond to the specified brake tolerances.
- The controller supply voltage and the power supply for the brake must be safely electrically isolated.
- The drive power of many motors is reduced if the current reduction to the brake is omitted.
- The unshielded section of the brake wire must not exceed 12 cm because of possible EMC interference.

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Wiring diagram HBC

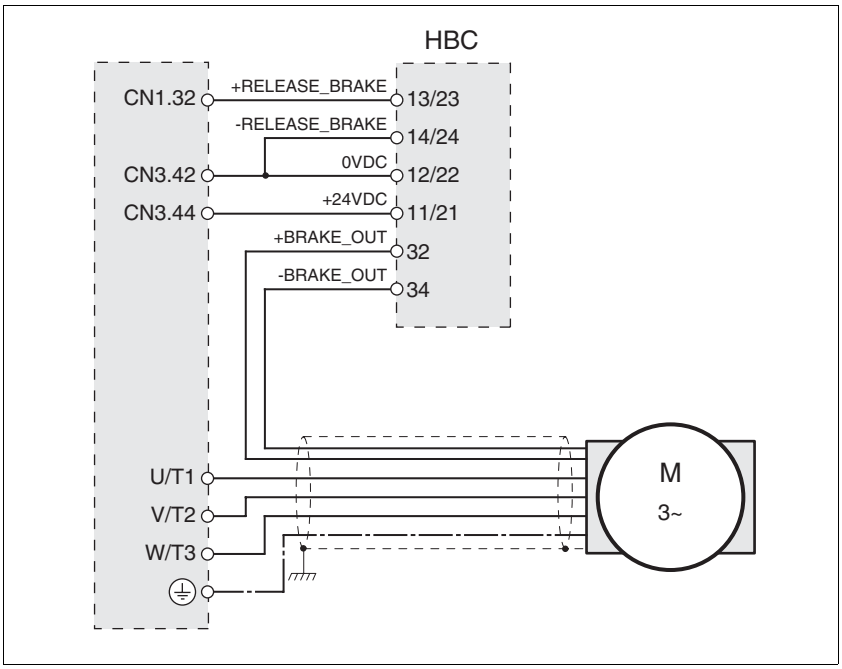

Figure 6.15 Wiring diagram, motor with holding brake and HBC

HBC terminal	HBC connection	Description	Colour
32	+BRAKE_OUT	Brake wire	white (WH)
34	-BRAKE_OUT	Brake wire	grey (GR)
13/23	+RELEASE_BRAKE	Control line ACTIVE1_OUT	
14/24	-RELEASE_BRAKE	Reference potential to ACTIVE1_OUT	
11/21	+24VDC	Supply voltage	
12/22	0VDC	Reference potential for supply voltage	

A maximum motor cable length of 50m is permitted for the BSH motors when using the holding brake controller.

If a greater length is required, a cable with a larger cross section of the brake wires (>1mm^2) is permitted.

Connecting HBC

- ▶ Attach the holding brake controller to the right of the device, see Figure 6.1.
- ▶ Insulate unused leads individually.

The power supply to the holding brake must be insulated from that of the PELV circuit of the device. The insulation is internal in the HBC described in the accessories chapter.

For further information on HBC see page 3-10, 7-28, 12-1.

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6.3.10 Connection of controller supply voltage (24V at CN3)

The controller power supply (+24VDC) must be connected for all operating modes.

⚠ DANGER

Electric shock from incorrect power supply.

The +24VDC supply voltage is connected with many exposed signals in the drive system.

- Use a power supply that meets the requirements for PELV (Protective Extra Low Voltage)
- Connect the negative output of the power supply to PE.

Failure to follow these instructions will result in death or serious injury.

CAUTION

Destruction of contacts.

The connection for the controller power supply at the drive system does not have a make current limit. If the voltage is switched on by switching contacts, the contacts may be destroyed or welded shut.

- Use a power supply that limits the peak value of the output current to a value permissible for the contact.
- Switch the line input of the power supply instead of the output voltage.

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

Destruction of unit components and loss of control!

Excessive currents can be created at the signal connections if the negative connection to the controller supply voltage is interrupted.

- Do not interrupt the negative connection between power supply unit and load with a fuse or switch
- Check for correct connection before switching on.
- Never connect the controller supply voltage or change its wiring while there is supply voltage present.

Failure to follow these instructions can result in injury or equipment damage.

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Wiring diagram

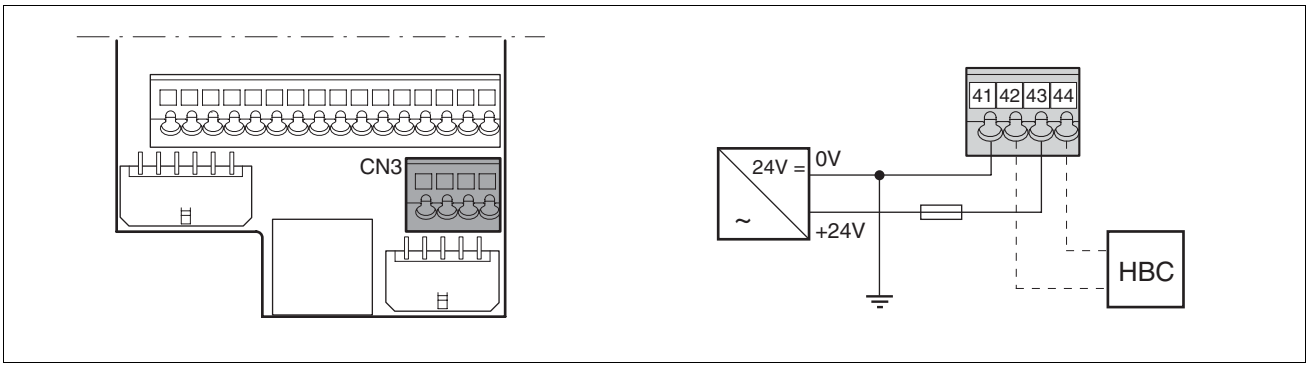

Figure 6.16 Controller supply voltage wiring diagram

Pin	Signal	Description
41	0VDC	Reference potential for 24V voltage
42	0VDC	Reference potential for 24V voltage
43	+24VDC	24V controller supply voltage
44	+24VDC	24V controller supply voltage

Connecting the controller supply voltage

- ▶ Make sure that the cables, the wiring and the connected interfaces meet the requirements for PELV.
- ▶ Feed the controller supply voltage from a power supply unit (PELV) to the device.
- ▶ Earth the negative output at the power supply

Dimensioning

- Terminal CN3, pin 42 and 44 (see Figure 6.16) can be used as a 0V/24V terminal for additional consumers. Note the maximum terminal current, see Technical Data, from page 3-1.
- As long as the controller supply voltage is switched on, the position of the motor will remain the same, even if the power amplifier supply voltage is switched off.

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6.3.11 Connecting encoder signals A, B, I (CN5)

Function At CN5 the setpoint value preset can be made via externally fed A/B signals and index pulse (I) in electronic gear operating mode.

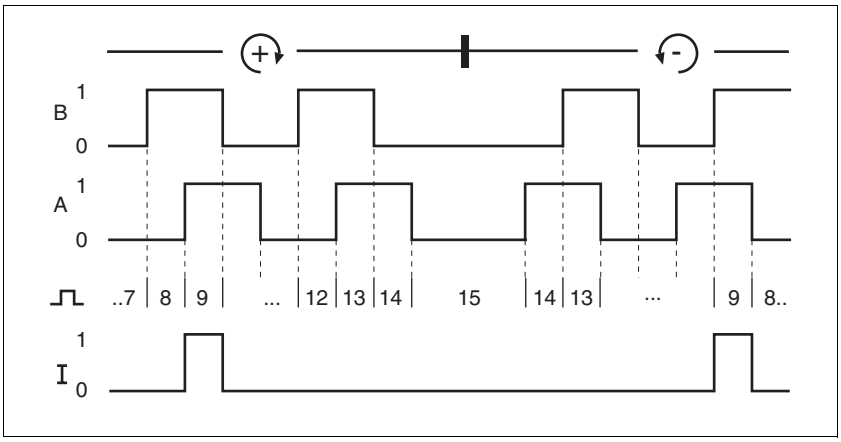

Figure 6.17 Timing diagram with A, B and index pulse signal, counting forwards and backwards

Cable specifications

- Shielded cable
- Twisted pair lines
- Minimum cross section of the signal wires 0.25 mm^2
- Earthing of the shield at both ends
- Maximum cable length 100m

▶ Use equipotential bonding conductors, see page 6-3.

▶ Use prefabricated cables to minimise the risk of a wiring error (from page 12-2).

Connect the sensor

▶ Connect the plug to CN5. If you are not using prefabricated wiring, make sure the pin assignment is correct.

▶ Make the appropriate settings during commissioning. See "First Setup", page 7-13

Wiring diagram

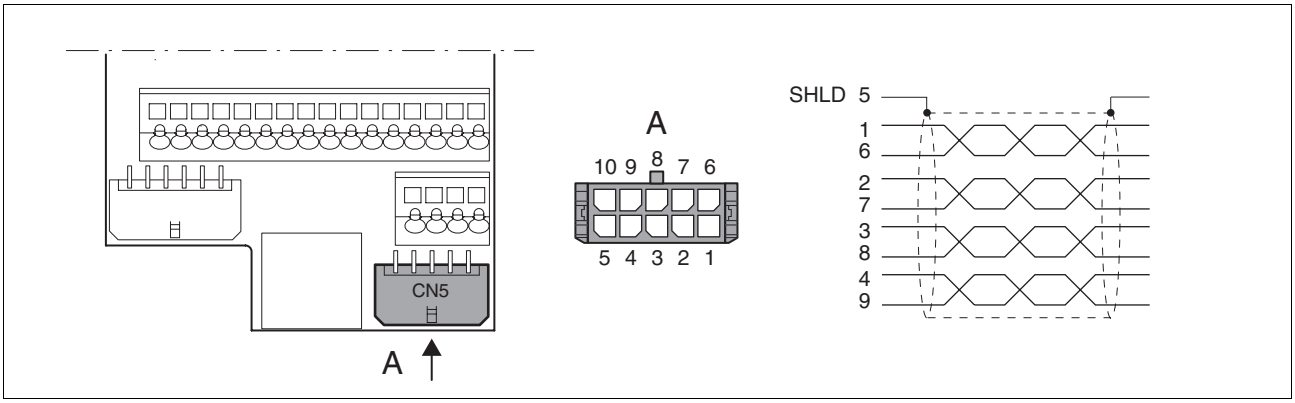

Figure 6.18 Wiring diagram, Encoder to CN5

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Pin	Signal	Colour [1)]	Description	I/O
1	ENC_A	white	Encoder signal channel A	RS422 input signal
6	$\overline{\text{ENC\_A}}$	brown	Channel A, inverted	RS422 input signal
2	ENC_B	green	Encoder signal channel B	RS422 input signal
7	$\overline{\text{ENC\_B}}$	yellow	Channel B, inverted	RS422 input signal
3	ENC_I	grey	Channel index pulse	RS422 input signal
8	$\overline{\text{ENC\_I}}$	pink	Channel index pulse, inverted	RS422 input signal
4	$\overline{\text{ACTIVE2\_OUT}}$	red	Drive ready	Open collector
9	POS_0V	blue	Reference potential	
5	SHLD		Shield	
10	nc		not assigned	

1) Information on colour refers to the wires available as accessories.

6.3.12 PULSE (CN5) connection

⚠ WARNING

Unexpected motion may cause injury and damage to the system.

Incorrect or faulty signals as reference position can trigger unexpected movements.

- Use shielded cables with twisted-pair.
- Operate the interface with push-pull signals.
- Do not use signals without push-pull in critical applications or in an environment subject to interference.
- Do not use signals without push-pull with cable lengths over 3 m and limit the frequency to 50 kHz

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠ CAUTION

Destruction of the product and loss of control!

The PULSE, DIR and ENABLE inputs on this connection are only rated for 5V. Excessive voltage can cause destruction of the product either immediately or at a later time.

- Check the correct connection before switching on.

Failure to follow these instructions can result in injury or equipment damage.

Function

The device is suitable for setpoint value default via externally fed pulse/direction signals. For example, this is required for the electronic gear operating mode.

Pulse-direction signals are used as reference signals for positioning the motor and as a control signal for power amplifier enable . Operation readiness and a possible breakdown are reported.

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PULSE/DIR

The motor executes an angular step on the rising edge of the PULSE signal PULSE. The direction of rotation is controlled by the DIR signal.

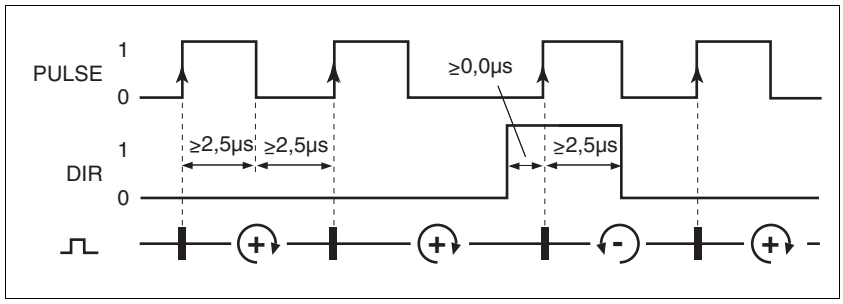

Figure 6.19 Pulse direction signal

Pin	Signal	Value	Function
1	PULSE	0 -> 1	Motor step
2	DIR	0 / open	Clockwise rotation

The maximum frequency of PULSE and DIR is 200 kHz.

ENABLE

If the case of local controller operating mode the ENABLE signal can also be used to enable the power amplifier. A fault message is also acknowledged with a falling edge on the signal input ENABLE.

If there is no breakdown, the output $\overline{\text{ACTIVE2\_OUT}}$ displays operational readiness for approx. 100 ms after the power amplifier is enabled.

$\overline{\text{ACTIVE2\_OUT}}$

$\overline{\text{ACTIVE2\_OUT}}$ is an open collector output and switches against 0 V. The output shows that the unit is ready for operation.

Circuit of the signal inputs

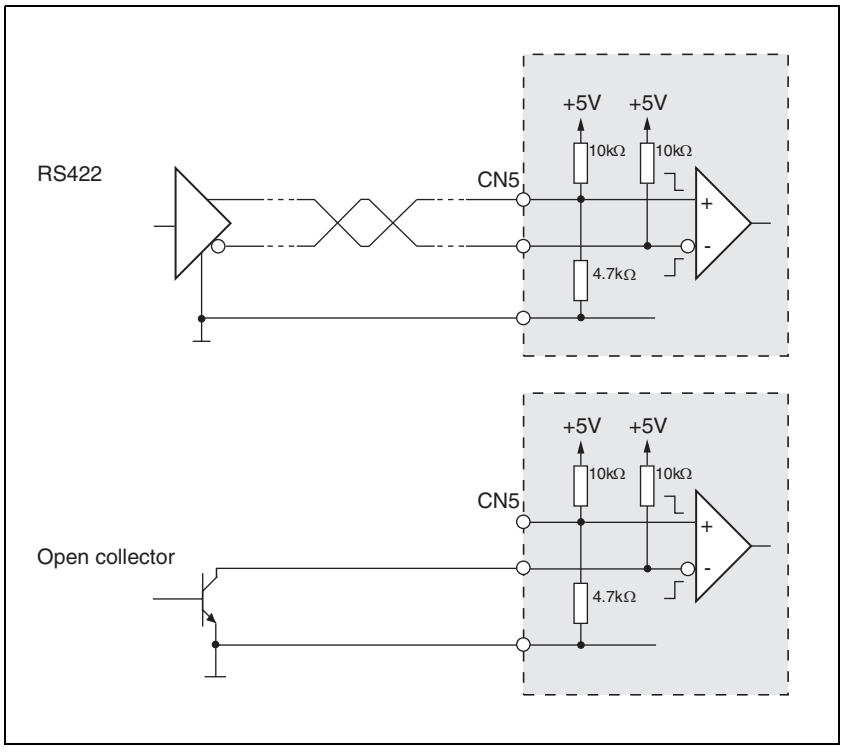

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Figure 6.20 Circuit of the signal inputs PULSE, DIR and ENABLE

Cable specifications

- Shielded cable
- Twisted pair lines
- Minimum cross section of the signal wires 0.14 mm^2
- Earthing of the shield at both ends
- Maximum length 100 m

▶ Use equipotential bonding conductors, see page 6-3.

▶ Use prefabricated cables to minimise the risk of a wiring error (from page 12-1).

Connecting PULSE

▶ Connect the plug to CN5. If you are not using prefabricated wiring, make sure the pin assignment is correct.

▶ Make the appropriate settings during commissioning. See "First Setup", page 7-13

Wiring diagram

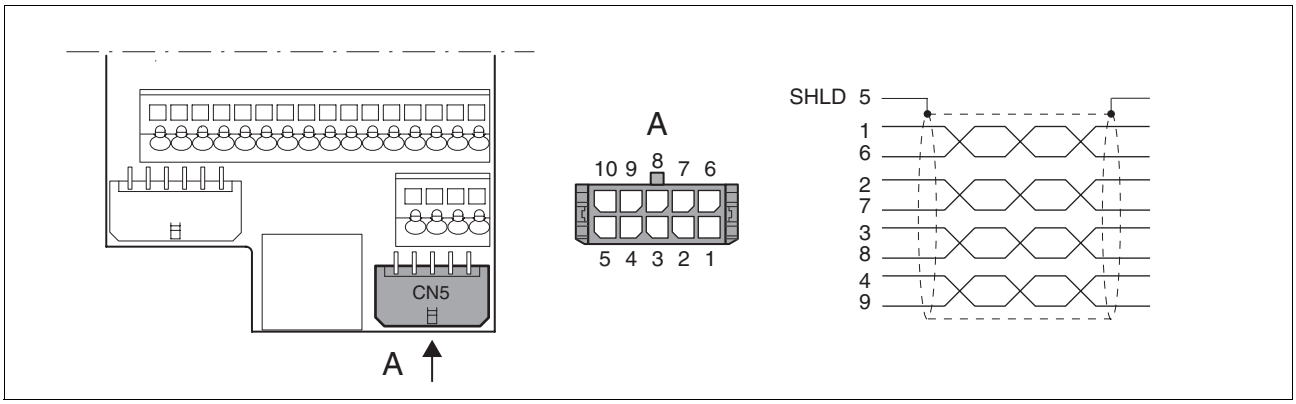

Figure 6.21 Wiring diagram PULSE

Pin	Signal	Colour [1)]	Description	I/O
1	PULSE	white	Motor step "Pulse"	RS422 input signal
6	$\overline{\text{PULSE}}$	brown	Motor step "Pulse", inverted	RS422 input signal
2	DIR	green	direction of rotation "DIR"	RS422 input signal
7	$\overline{\text{DIR}}$	yellow	direction of rotation "Dir", inverted	RS422 input signal
3	ENABLE	grey	Enable signal	RS422 input signal
8	$\overline{\text{ENABLE}}$	pink	Enable signal, inverted	RS422 input signal
4	$\overline{\text{ACTIVE2\_OUT}}$	red	Drive ready	Open collector
9	POS_0V	blue	Reference potential	-
5	SHLD		Shield	
10	nc		not assigned	

1) Information on colour refers to the wires available as accessories.

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6.3.13 Connection of encoder simulation (CN5)

Function The device is suitable for encoder simulation (ESIM). Signals for output of the actual position can be led out at CN5. They are two phase-shifted signals A and B. The A/B signals are generated by the motor encoder signal.

Resolution The basic resolution of the encoder simulation at 4x resolution is 4096 increments per revolution.

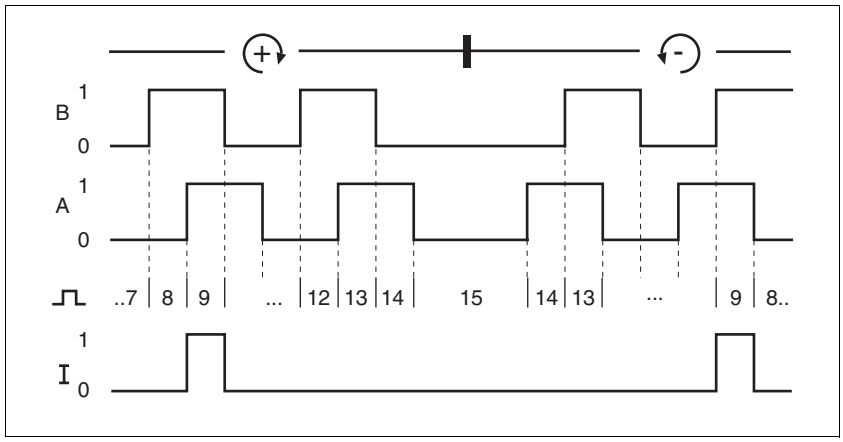

Figure 6.22 Timing diagram with A, B and index pulse signal, counting forwards and backwards

Cable specification

- Shielded cable
- Twisted-pair conductors
- Minimum cross section of the signal wires 0.14 mm^2
- Earthing of the screen at both ends
- Maximum length 100 m

▶ Use equipotential bonding conductors, see page 6-3.

▶ Use prefabricated cables to minimise the risk of a wiring error (from page 12-2).

Connecting ESIM

▶ Connect the plug to CN5. If you are not using prefabricated wiring, make sure the pin assignment is correct.

▶ Make the appropriate settings during commissioning. See "First Setup", page 7-13

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Wiring diagram

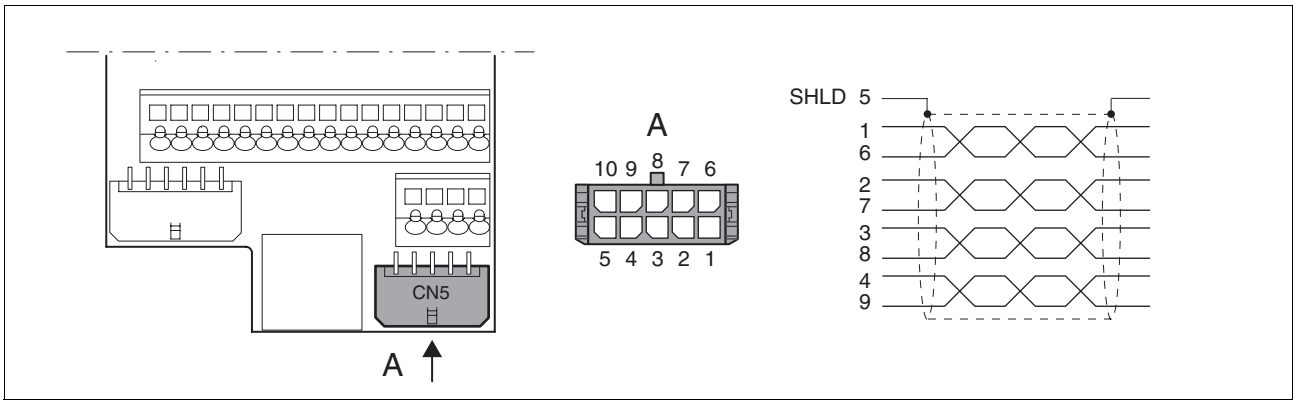

Figure 6.23 ESIM wiring diagram

Pin	Signal	Colour [1)]	Description	I/O
1	ESIM_A	white	Channel A	RS422 output signal
6	$\overline{\text{ESIM\_A}}$	brown	Channel A, inverted	RS422 output signal
2	ESIM_B	green	Channel B	RS422 output signal
7	$\overline{\text{ESIM\_B}}$	yellow	Channel B, inverted	RS422 output signal
3	ESIM_I	grey	Index pulse	RS422 output signal
8	$\overline{\text{ESIM\_I}}$	pink	index pulse, negated	RS422 output signal
4	$\overline{\text{ACTIVE2\_OUT}}$	red	Drive ready	Open collector
9	POS_0V	blue	Reference potential	-
5	SHLD		Shield	
10	nc		not assigned	

1) Information on colour refers to the wires available as accessories.

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6.3.14 CANopen connection (CN1 or CN4)

Function

The device is suitable for connection to CANopen.

In CAN bus multiple network devices can be connected over one bus cable. Up to 32 devices can be addressed in one CAN bus network branch and up to 127 devices in the extended network.

Every network device must be configured before operation on the network. It is given a unique, 7-bit node address (node-ID) between 1 (01_h) and 127 ($7F_h$).

The baud rate must be the same for all devices in the fieldbus.

Address and baud rate are set during commissioning. See "First Setup", page 7-13

For additional in formation see the fieldbus manual, order number, see page 12-4.

Cable specifications

- Shielded cable
- Twisted-pair conductors
- Minimum cross section of the signal wires 0.14 mm^2
- Earthing of the screen at both ends
- Maximum length depends on the number of devices, the baud rate and signal run times. The higher the baud rates the shorter the bus cable must be.

▶ Use equipotential bonding conductors, see page 6-3.

▶ Use prefabricated cables to minimise the risk of a wiring error (from page 12-4).

▶ Make sure that the wiring, the cables and the connected interfaces meet the requirements for PELV.

Maximum bus length

The maximum bus length depends on the selected baud rate. The following table shows the maximum recommended bus lengths for the overall length.

baud rate [kbit/s]	maximum bus length with CANopen [m]
20	2500
125	500
250	250
500	100
800	25
1000	4

Table 6.7 Cable length with CANopen - depending on the baud rate

At a baud rate of 1 Mbit the spur lines are limited to 0.3m.

Terminating resistors

The units at the two ends of a bus cable string must be terminated. This can be achieved with CAN by the using terminating resistances of 120Ω between CAN_L and CAN_H.

A terminating resistor that is enabled with the S1 switch is integrated into the device.

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▶ If the device is at the end of the network, slide the S1 switch for the terminating resistor to the left.

Wiring diagram

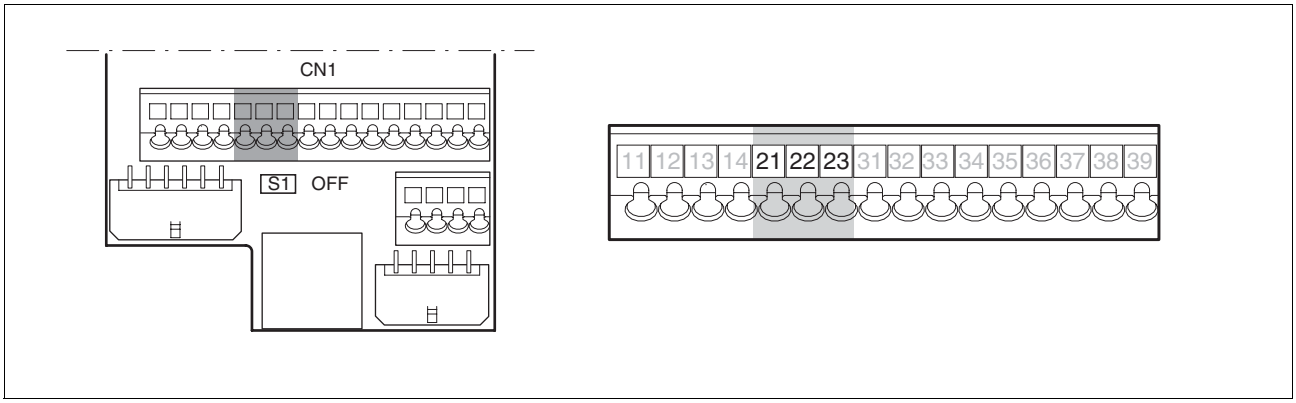

Figure 6.24 Wiring diagram, CANopen at CN1

Pin	Signal	Description	I/O
21	CAN_0V	CAN reference potential	
22	CAN_L	data wire, inverted	CAN level
23	CAN_H	data wire	CAN level

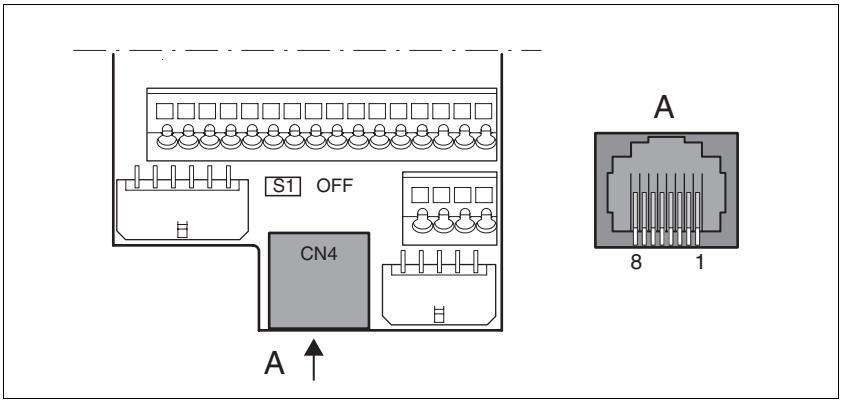

Figure 6.25 CANopen wiring diagram at CN4

Pin	Signal	Description	I/O
1	CAN_H	data wire	CAN level
2	CAN_L	data wire, inverted	CAN level
7	MOD+10V_OUT	10V power supply (different assignment from CANopen)	O
8	MOD_0V	Reference potential forMOD+10V_OUT	O

Connecting CANopen

▶ Connect the CANopen cable to CN1, pin 21, 22 and 23 or to CN4 (pin 1, 2 and 8) with an RJ45 plug.

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6.3.15 Modbus connection (CN4)

Function

The unit is designed for connection to the Modbus

With Modbus, multiple network devices are interconnected by bus cable. Every network device must be configured before operation on the network. Each is given a unique node address.

The baud rate must be the same for all units in the fieldbus.

Address and baud rate are set during commissioning. See "First Setup", page 7-13

For additional in formation see the Modbus manual, order number, see page 12-4.

Cable specifications

The cables used must conform to the following properties:

- Shielded cable
- Twisted-pair conductors
- Minimum cross section of the signal wires 0.14 mm^2
- Earthing of the screen at both ends
- maximum length 400 m.

▶ Use equipotential bonding conductors, see page 6-3.

▶ Use prefabricated cables to minimise the risk of a wiring error (from page 12-4).

Wiring diagram

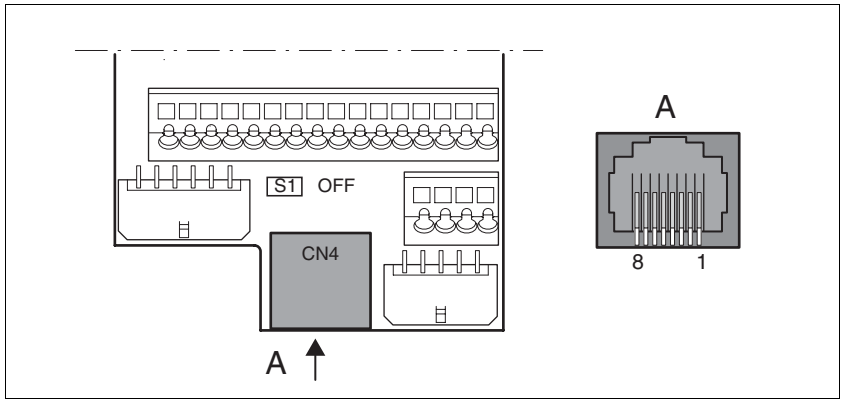

Figure 6.26 Wiring diagram:MODBUS

Pin	Signal	Description	I/O
4	MOD_D1	Bidirectional transmit/receive signal	RS485 level
5	MOD_D0	Bidirectional transmit/receive signal, inverted	RS485 level
7	MOD+10V_OUT	10 V power supply, max. 150 mA	O
8	MOD_0V	Reference potential forMOD+10V_OUT	O

Connecting Modbus

▶ Connect the Modbus cable to CN4 with an RJ45 plug.

6.3.16 Connection of analogue inputs (CN1)

Cable specifications

- Shielded cable

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- Twisted pair lines
- Minimum cross section of signal wires 0.14 mm^2, max. cross section 1.5 mm^2
- maximum length 10 m

Connecting analogue inputs

▶ Attach the cable to the EMC plate, the shield must be attached to the earth potential over a wide area.

Wiring diagram

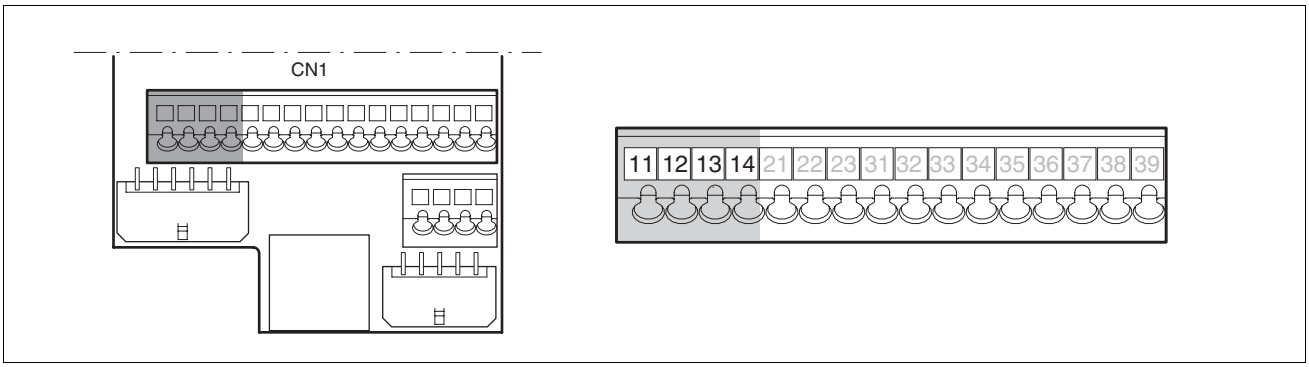

Figure 6.27 Wiring diagram, analogue inputs

Pin	Signal	Description	I/O
11	ANA1+	±10V, e.g. for current or speed reference value; evaluation: 14-bit	I
12	ANA1-	Reference potential forANA1+, pin 11	I
13	ANA2+	±10V, e.g. for current or speed limiting; evaluation: 14-bit	I
14	ANA2-	Reference potential forANA2+, pin 13	I

Reference values and limits

The ±10V scaling of the analogue reference values and analogue limits can be specified for operation, see page 7-21.

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6.3.17 Connection of digital inputs/outputs (CN1)

⚠ CAUTION

Loss of control!

The use of $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$ can offer some protection against hazards (e.g. impact on mechanical stop caused by incorrect motion defaults).

- Use $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$ where possible.
- Check that the external sensors or switches are correctly connected.
- Check the correct functional installation of the limit switches The limit switches must be mounted in a position far enough away from the mechanical stop to allow an adequate braking distance.
- The functions must be enabled to use $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$.
- This function cannot provide protection against faulty functioning of the product or the sensors.

Failure to follow these instructions can result in injury or equipment damage.

Cable specifications

- minimum cross-section 0.14 mm^2, max. cross-section 1.5 mm^2
- Maximum length at minimum cross section 15 m..

Minimum connection assignment

The following signals must always be connected.

Pin	Signal	Remarks
33	$\overline{\text{REF}}$	with fieldbus control mode only
34	$\overline{\text{LIMN}}$	with fieldbus control mode only
35	$\overline{\text{LIMP}}$	with fieldbus control mode only
36	$\overline{\text{HALT}}$	
37 38	$\overline{\text{PWRR\_B}}$ $\overline{\text{PWRR\_A}}$	Two-channel connection, signals are not managed with parameters.

Table 6.8 Minimum connection assignment

If the signals listed in the table are not used, they must be wired with +24VDC. $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$ and $\overline{\text{REF}}$ can also be disabled with corresponding parameters.

Terminal assignment for "Power Removal" function

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⚠ WARNING

Loss of the safety function

Incorrect usage may cause a safety hazard by loss of the safety function.

- Observe the requirements for the safety function.

Failure to follow these instructions can result in death or serious injury.

Notes on the safety signals PWRR_A and PWRR_B can be found in 5.3 “Safety function "Power Removal"“ from page 5-2 and in 3.4.4 “Safety functions“ on page 3-7

Connecting digital inputs/outputs

- ▶ Wire the digital connections to CN1.
  The following functions are defined for pin 33, 34 and 35 depending on the control mode (local or fieldbus) (see Table 6.9). The control mode is specified during commissioning with parameters.
- ▶ Connect the limit switch that restricts the working range for clockwise rotation to LIMP. Connect the switch for the counterclockwise rotation to LIMN.
- ▶ Earth the shield with low resistance and over a wide area at both ends of the cable.

Wiring diagram

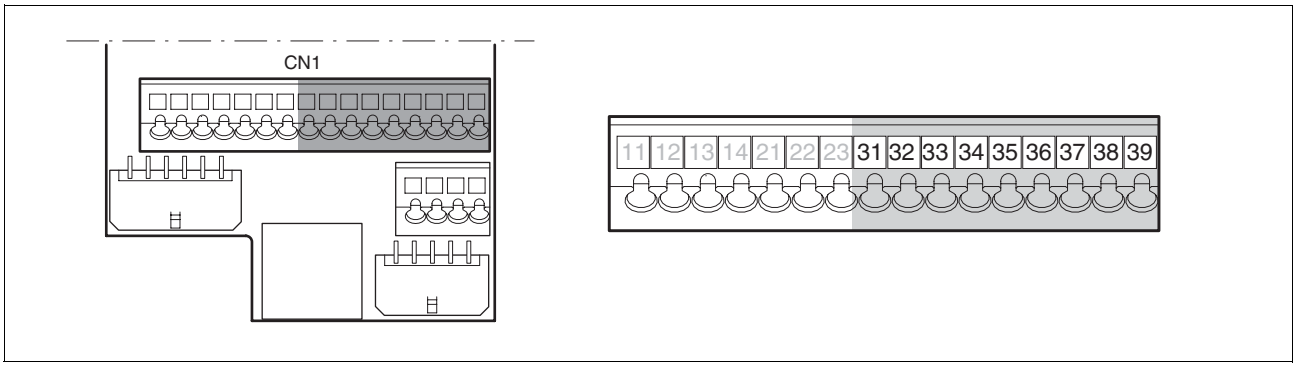

Figure 6.28 Wiring diagram, digital inputs/outputs

Pin	Signal with local control mode	Meaning with local control mode	Signal with fieldbus control mode	Meaning with fieldbus control mode	I/O
31	NO_FAULT_OUT	Fault output	NO_FAULT_OUT	Fault output	24V, O
32	ACTIVE1_OUT	0: motor without current 1: motor under power, control signal for holding brake controller HBC, output max. 400 mA	ACTIVE1_OUT	0: motor without current 1: motor under power, control signal for holding brake controller HBC, output max. 400 mA	24V, O
33	-	-	REF	Reference switch signal (factory setting: disable)	24V, I
34	FAULT_RESET	Reset error	LIMN	Limit switch signal negative	24V, I
34	FAULT_RESET	Reset error	CAP2	fast position capture channel 2	24V, I
35	ENABLE	Enable power amplifier	LIMP	Limit switch signal positive	24V, I

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Pin	Signal with local control mode	Meaning with local control mode	Signal with fieldbus control mode	Meaning with fieldbus control mode	I/O
35	ENABLE	Enable power amplifier	CAP1	fast position capture channel 1	24V, I
36	$\overline{\text{HALT}}$	"Halt" function	$\overline{\text{HALT}}$	"Halt" function	24V, I
37	$\overline{\text{PWRR\_B}}$	"Power Removal" safety function	$\overline{\text{PWRR\_B}}$	"Power Removal" safety function	24V, I
38	$\overline{\text{PWRR\_A}}$	"Power Removal" safety function	$\overline{\text{PWRR\_A}}$	"Power Removal" safety function	24V, I
39	+24VDC	Only for jumpering pin 37 and 38 if "Power Removal" safety function is not used	+24VDC	Only for jumpering pin 37 and 38 if "Power Removal" safety function is not used	-

Table 6.9 Digital signals, connection assignment

6.3.18 Connection to PC or remote terminal (CN4)

CAUTION

Damage to PC!

If the interface connector on the product is directly connected to a Gigabit Ethernet plug on the PC, the interface on the PC may be destroyed.

- Never connect an Ethernet interface directly to this product.

Failure to follow these instructions can result in equipment damage.

Function of the control terminal

The remote terminal with LCD display and keypad can be connected directly to CN4 with the supplied RJ-45 cable, see accessories from page 12-1. This allows the device to be operated at a distance from the system. The functions and display of the control terminal are identical to those of the HMI.

Cable specifications

- Shielded cable
- Twisted pair lines
- Minimum cross section of the signal wires 0.14 mm^2
- Earthing of the shield at both ends
- maximum length 400 m

PC connection

An RS485 to RS232 converter is required for the PC, see accessories from page 12-1. The converter is powered by the device.

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Wiring diagram

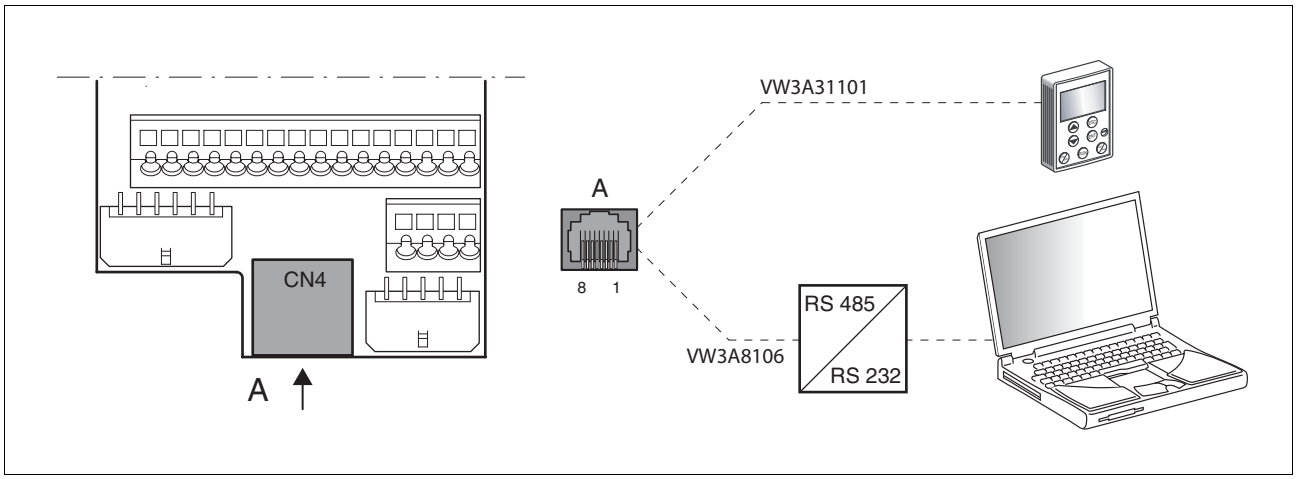

Figure 6.29 Wiring diagram of PC or decentralised operating terminal

Pin	Signal	Description	I/O
4	MOD_D1	Bidirectional transmit/receive signal	RS485 level
5	MOD_D0	Bidirectional transmit/receive signal, inverted	RS485 level
7	MOD+10V_OUT	10 V power supply, max. 150 mA)	O
8	MOD_0V	Reference potential for MOD+10V_OUT	O

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6.3.19 Reference value adapter

Reference value adapter RVA

Reference signals of a master device can be sent simultaneously to up to five devices using the RVA (Reference Value Adapter). This adapter also supplies the supply voltage (5V, monitored with sense wires) for the encoder. The correct power supply is shown by a "5VSE" LED.

An external rotary encoder (A/B signals) or an encoder simulation (ESIM) can be used as a master device. Pulse/direction signals can also be sent from a master controller.

Connecting RVA reference signal adapter

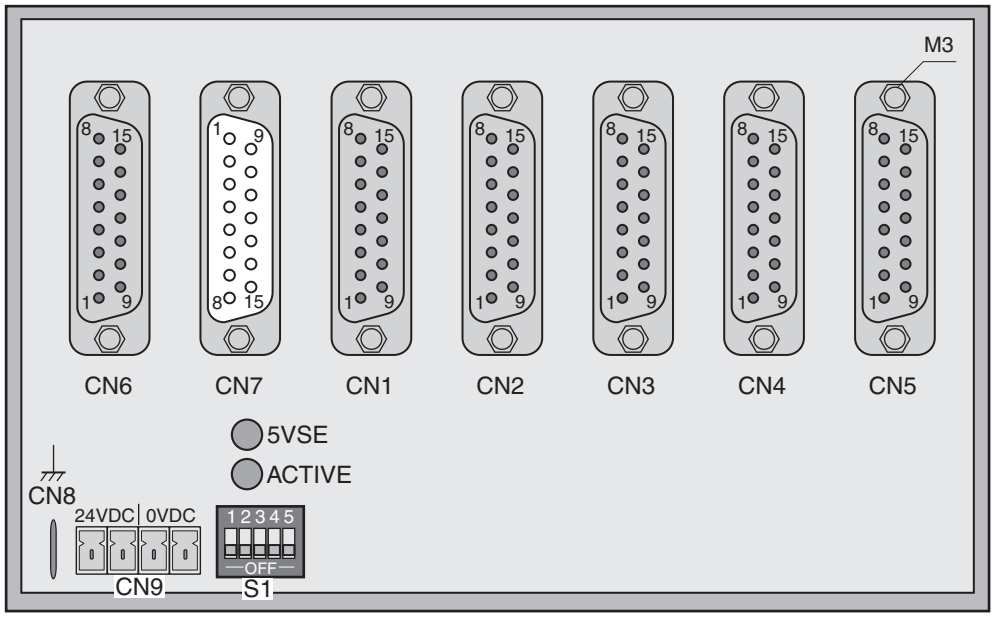
▶ Make sure that the wiring, the cables and the connected interfaces meet the requirements for PELV.

The RVA reference signal adapter is powered by 24 V at the CN9 terminals. A higher level controller (pulse/direction) can be connected to CN6. An external rotary encoder or an ESIM signal can be applied to CN7.

Up to five units for evaluating the specified reference signals can be connected to CN1 to CN5.

▶ Set switch S1 according to the assignment of CN1-CN5 For example, if units are only connected to CN1, CN3 and CN4, S1-1, S1-3 and S1-4 must be set to "off" and S1-2 and S1-5 to "on".

◁ The "active" LED shows that $\overline{\texttt{ACTIVE2\_OUT}}$ has been set on all connected units and the number of connected units complies with the setting.



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Pin	Signal	Description	I/O
1	PULSE_OUT / A_OUT / ESIM_A_OUT	Pulse+, channel A, ESIM_A	O
9	$\overline{\text{PULSE\_OUT}}$ / $\overline{\text{A\_OUT}}$ / $\overline{\text{ESIM\_A\_OUT}}$	Pulse-, channel A inverted, ESIM_A inverted	O
2	DIR_OUT / B_OUT / ESIM_B_OUT	Direction+, channel B, ESIM_B	O
10	$\overline{\text{DIR\_OUT}}$ / $\overline{\text{B\_OUT}}$ / $\overline{\text{ESIM\_B\_OUT}}$	Direction, channel B inverted, ESIM_B inverted	O
3	ENABLE_OUT / I_OUT / ESIM_I_OUT	ENABLE+, index pulse, ESIM_I	O
11	$\overline{\text{ENABLE\_OUT}}$ / $\overline{\text{I\_OUT}}$ / $\overline{\text{ESIM\_I\_OUT}}$	ENABLE-, index pulse inverted, ESIM_I inverted	O
8	$\overline{\text{ACTIVE\_2}}$ / $\overline{\text{READY}}$	Drive ready	I
15	POS_0V	Reference potential	
4 - 7, 12 - 14	nc	not assigned	

Table 6.10 Terminal assignment CN1-CN5

Pin	Signal	Description	I/O
1	PULSE / A / ESIM_A	Pulse+, channel A, ESIM_A	I
9	$\overline{\text{PULSE}}$ / $\overline{\text{A}}$ / $\overline{\text{ESIM\_A}}$	Pulse-, channel A inverted, ESIM_A inverted	I
2	DIR / B / ESIM_B	Direction+, channel B, ESIM_B	I
10	$\overline{\text{DIR}}$ / $\overline{\text{B}}$ / $\overline{\text{ESIM\_B}}$	Direction, channel B inverted, ESIM_B inverted	I
3	ENABLE / I / ESIM_I	ENABLE+, index pulse, ESIM_I	I
11	$\overline{\text{ENABLE}}$ / $\overline{\text{I}}$ / $\overline{\text{ESIM\_I}}$	ENABLE-, index pulse inverted, ESIM_I inverted	I
8	$\overline{\text{ACTIVE2\_OUT}}$ / $\overline{\text{READY\_OUT}}$	Drive ready	O
15	POS_0V	Reference potential	
4...7, 12...14	nc	not assigned	

Table 6.11 Connection assignment CN6

Pin	Signal	Description	I/O
1	A	Channel A	I
9	$\overline{\text{A}}$	Channel A inverted	I
12	B	Channel B	I
5	$\overline{\text{B}}$	Channel B inverted	I
13	I	Index pulse	I
6	$\overline{\text{I}}$	index pulse inverted	I
10	SENSE+	Monitoring motor encoder power supply	I
11	SENSE-	Reference potential to motor encoder monitor	I
2	5VDC_OUT	5V motor encoder power supply	O
3	POS_0V	Reference potential for 5VDC_OUT	
4, 7, 8, 14, 15	nc	not assigned	

Table 6.12 CN7 connection assignment

There are prefabricated cables for the Reference Value Adapter, see chapter 12 “Accessories and spare parts“.

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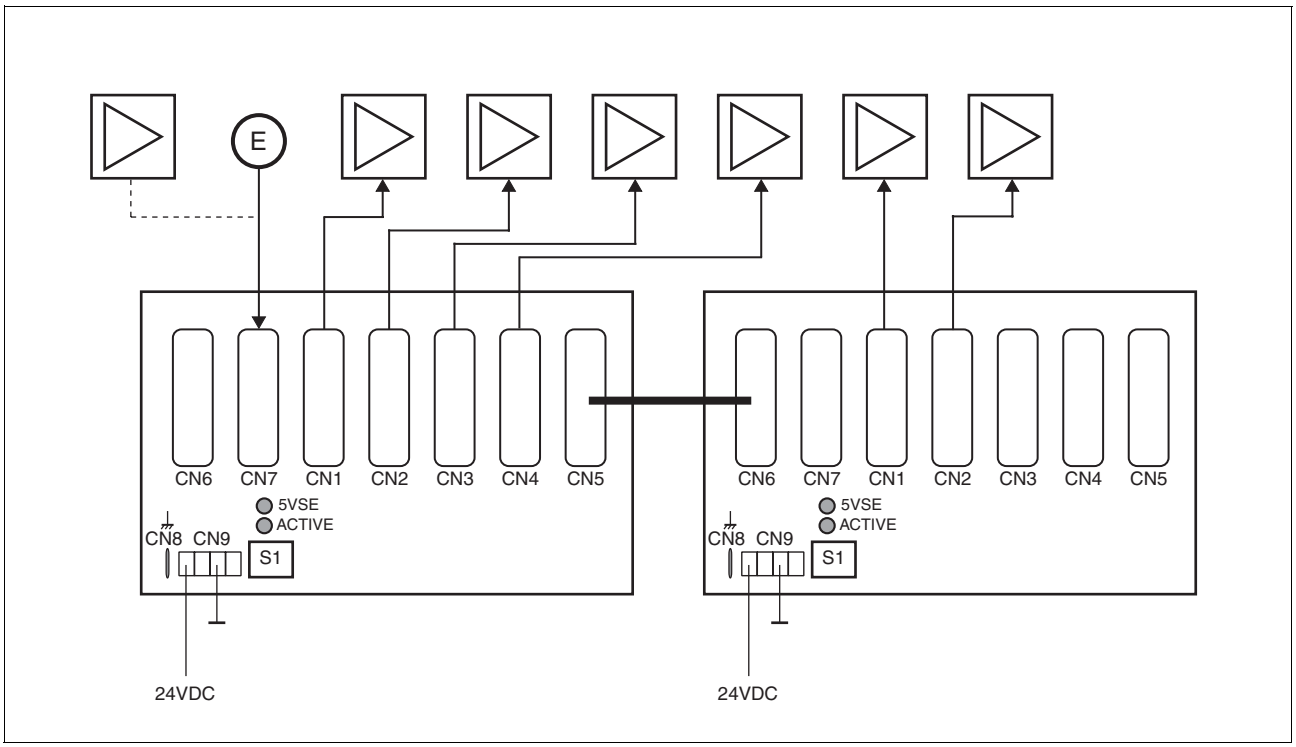

Figure 6.30 Wiring example: encoder signals A/B/I (at CN7) are forwarded to six devices through two cascaded Reference Value Adapters

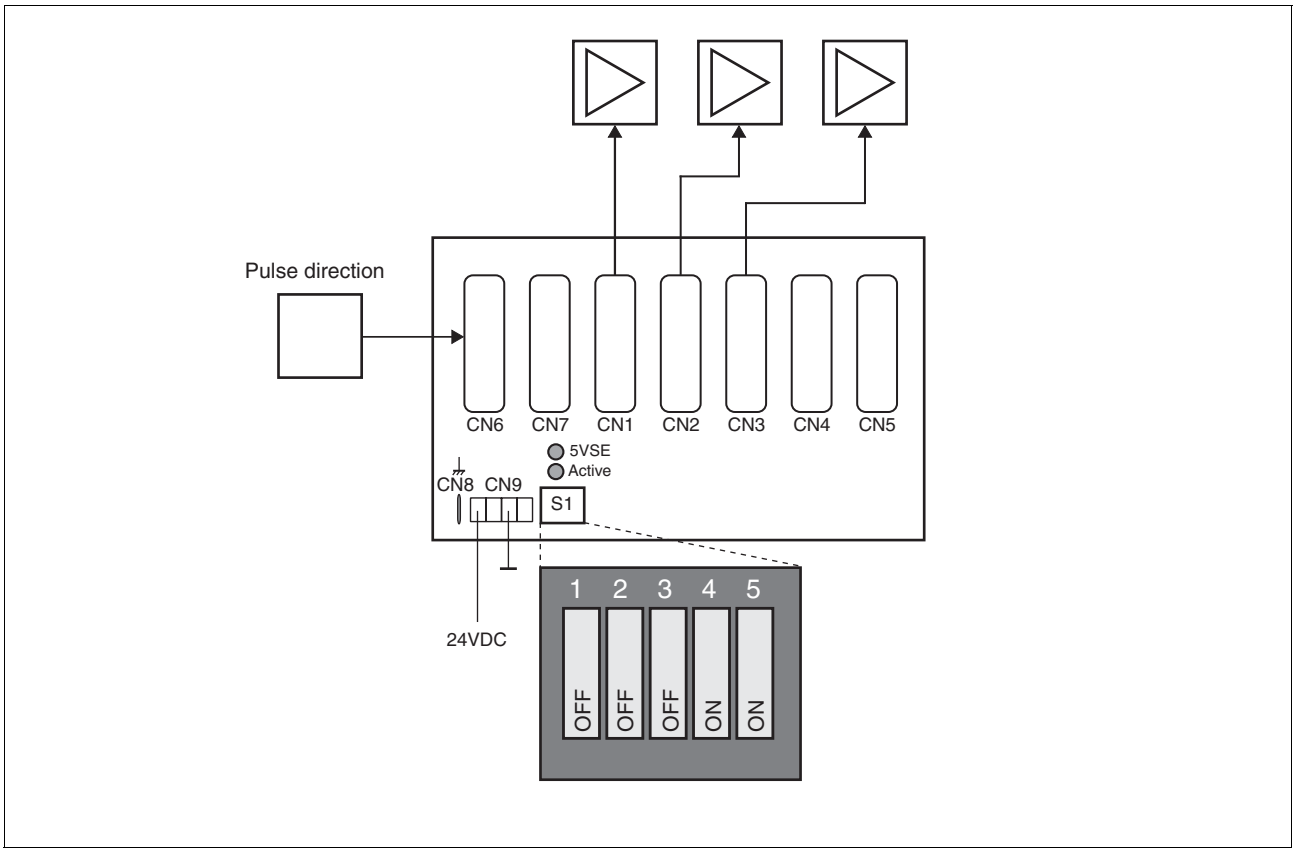

Figure 6.31 Wiring example: pulse direction signals (to CN6) are forwarded to three devices.

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6.4 Checking installation

After completion of all steps we recommend checking the installation to prevent any errors before operation of the system.

▶ Make sure the drive system is correctly installed and wired up. Check in particular basic connections such as mains power and 24V power supply.

▶ Check in detail:

- Are all protective conductors connected?
- Are all fuses correct?
- Are any live cable ends exposed?
- Are all cables and connectors safely installed and connected?
- Are the control lines connected correctly?
- Have all EMC measures been taken?

▶ Check that all seals are fitted and that protection class IP54 is complied with (only when using the "Power Removal" function)

▶ Remove the protective foil as required in accordance with the specifications on page Table 6.1.

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7 Commissioning

*For an overview of **all** parameters can be found alphabetically sorted in the "parameters" section. The application and the function of some parameters are explained in more detail in this section.*

7.1 General safety instructions

⚠ DANGER

Electric shock, fire or explosion

- Only qualified personnel who are familiar with and understand the contents of this manual are authorised to work on and with this drive system.
- The system manufacturer is responsible for compliance with all applicable regulations relevant to earthing the drive system.
- Many components, including printed wiring boards, operate at mains voltage. **Do not touch**. Do **not** touch unshielded components or screws of the terminals with voltage present.
- Install all covers and close the housing doors before applying power.
- The motor generates voltage when the shaft is rotated. Lock the shaft of the motor to prevent rotation before starting work on the drive system.
- Before working on the drive system:
  - Switch off power to all terminals.
  - Place a sign "DO NOT SWITCH ON" on the switch and lock to prevent switching on.
  - **Wait 6 minutes** (for discharge of DC bus capacitors). Do **not** short-circuit DC bus
  - Measure voltage at DC bus and check for <45V. (The DC bus LED is not a safe indication for absence of the DC bus voltage).

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

Electric shock caused by incorrect use!

The "Power Removal" function does not effect any electrical disconnection. The inter circuit voltage is still present.

- Turn off the mains voltage using an appropriate switch to achieve a voltage-free condition.

Failure to follow these instructions will result in death or serious injury.

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⚠ DANGER

Risk of injury by complex system.

When the system is started the drives are generally out of the operator's view and cannot be visually monitored.

- Only start the system if there are no persons in the operating zone of the moving components and the system can be operated safely.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

Unexpected responses may cause injury and damage to the system

The behaviour of the drive system is governed by numerous stored data or settings. Unsuitable settings or data may trigger unexpected movements or reactions to signals and disable monitoring functions.

- Do not operate a drive system with unknown settings or data.
- Check the stored data or settings.
- When commissioning carefully run tests for all operating states and fault cases.
- Check the functions after replacing the product and also after making changes to the settings or data.
- Only start the system if there are no persons or materials in the danger zone and the system can be operated safely.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠ WARNING

Danger of injury and damage to system components by unbraked motor!

Loss of power or faults that result in switching off the power amplifier mean that the motor is no longer actively braked and may run against a mechanical stop at high speed.

- Check the mechanical conditions.
- If necessary, use an absorbent mechanical stop or a suitable brake.

Neglect can result in an accident or damage to the system

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⚠ WARNING

Unexpected motion may cause injury and damage to the system

When the drive is operated for the first time there is a high risk of unexpected motion because of possible wiring faults or unsuitable parameters.

- If possible, run the first test movement without coupled loads.
- Make sure that a functioning button for EMERGENCY STOP is within reach.
- Also anticipate a movement in the incorrect direction or oscillation of the drive.
- Make sure that the system is free and ready for the motion before starting the function.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠ CAUTION

Hot surfaces can cause burns and damage to system components!

The heat sink on the product may heat up to over 100°C depending on the operating mode.

- Prevent contact with the hot heat sink.
- Do not install flammable or heat-sensitive components in the immediate vicinity.
- Follow the actions described for heat dissipation.

Failure to follow these instructions can result in injury or equipment damage.

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7.2 Overview

The following commissioning steps are also required if you are using a configured unit under changed operating conditions.

What must be done

What you need to do...	Info
Checking installation	Page 6-52
Making "First Setup"	Page 7-13
Check and set critical device parameters	Page 7-19
Define ESIM resolution, if used	Page 7-30
Setting, scaling, testing analogue signals	Page 7-21
Set, test digital signals	Page 7-24
Limit switch function, tests the signals $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$	Page 7-26
Check signals $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$, even if the “Power Removal” function is not used	Page 7-27
Check the functioning of the holding brake controller if it is wired for that	Page 7-28
Checking motor direction of rotation	Page 7-29
Run autotuning	Page 7-35
Optimise controller settings manually - speed controller - position controller	Page 7-40 Page 7-41 Page 7-47

Some products of this product family can be operated with different control modes. A distinction is made between local control mode and fieldbus control mode.

- Local control mode Movement specified with analogue signals or with RS422 signals.
- Fieldbus control mode: all communications are made via fieldbus commands or with RS422 signals.

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7.3 Tools for commissioning

7.3.1 Overview

Commissioning and setting parameters and also diagnostic tasks can be carried out with the following tools:

- Integrated HMI
- Peripheral control terminal
- Commissioning software
- fieldbus

Access to the complete list of parameters is only possible with the commissioning software or via fieldbus.

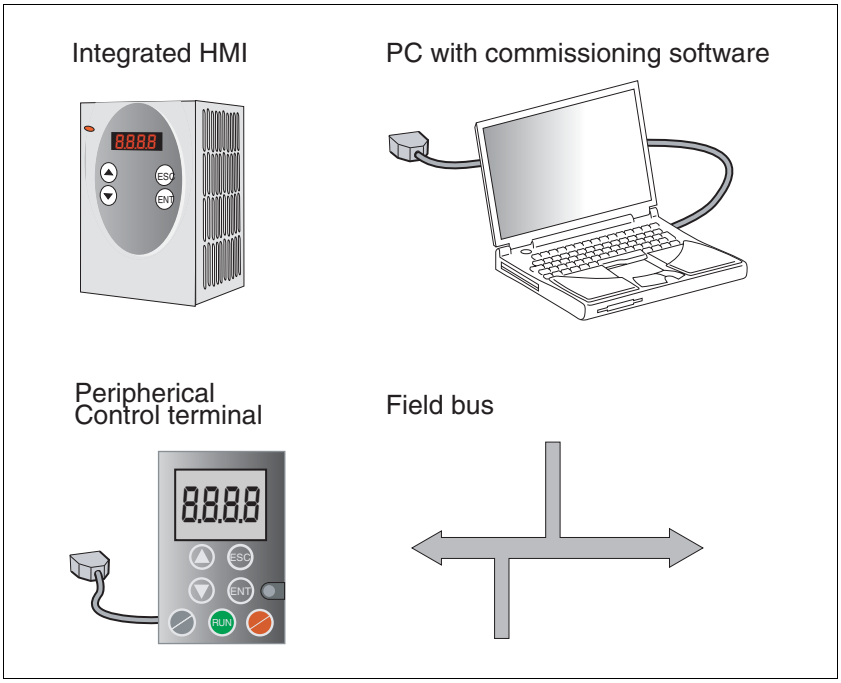

Figure 7.1 Commissioning tools

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7.3.2 HMI: Human-Machine Interface

Function

The unit has the option of editing parameters with the integrated control panel (HMI). Displays for diagnosis are also possible. The sections on commissioning and operation include information on whether a function can be carried out with the HMI or whether the commissioning software must be used.

A brief introduction to the HMI structure and the operation is given below.

Control panel

Figure 7.2 shows the HMI (left) and the decentralised control terminal (right).

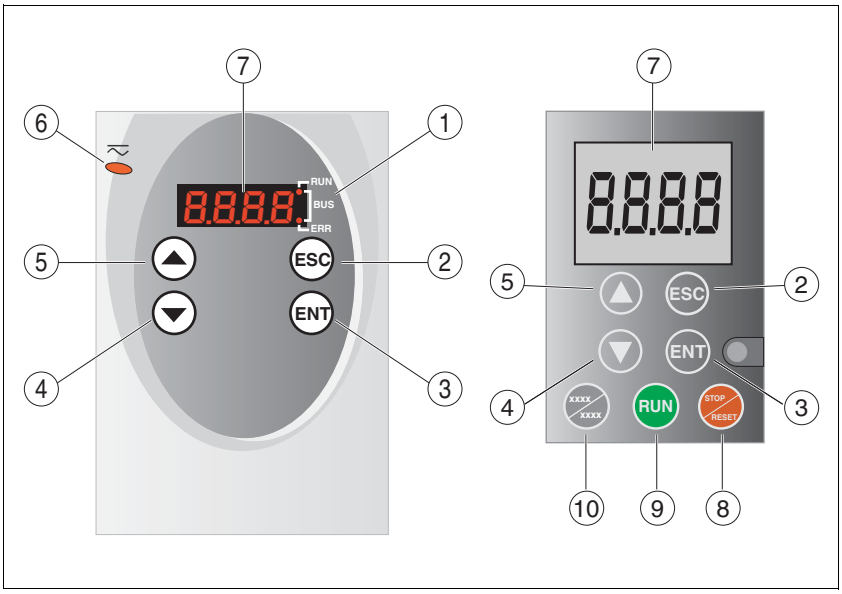

Figure 7.2 HMI and decentralised control terminal

(1) LEDs for fieldbus
(2) ESC:
- exit a menu or parameter
- return from the displayed to the last saved value
(3) ENT:
- call a menu or parameter
- save the displayed value to EEPROM
(4) Down arrow:
- switch to next menu or parameter
- reduce the displayed value
(5) Up arrow:
- switch to previous menu or parameter
- increase the displayed value
(6) Red LED on: DC bus under power
(7) Status display
(8) Quick Stop (Software Stop)
(9) Fault Reset (Continue)
(10) No function

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LEDs for CANopen

2 LEDs show the status of the CANopen status machine as per the CANopen standard DR 303-3.

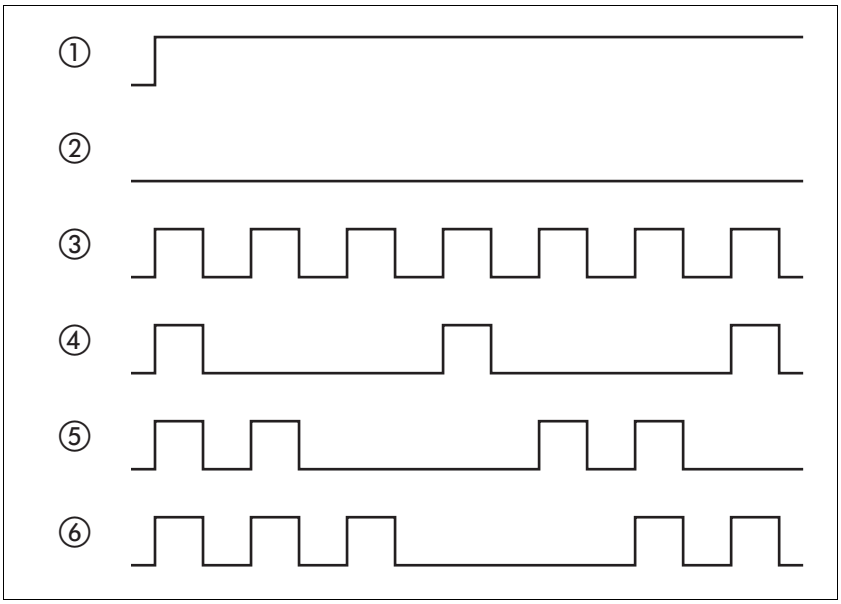

Figure 7.3 Meaning of the LED signals

LED "fieldbus RUN"

(1) device is in the NMT state OPERATIONAL
(3) device is in the NMT state PRE-OPERATIONAL
(4) device is in the NMT state STOPPED

LED "fieldbus ERR"

(1) CAN is BUS-OFF, e.g. after 32 failed transmission attempts.
(2) Device is operating
(4) Warning limit reached e.g. after 16 failed transmission attempts
(5) Monitoring result (node guarding) has occurred
(6) SYNC message was not received within the configured period

Font on HMI display

Table 7.1 shows the assignment of the letters and numbers on the HMI display for the parameter view. Upper and lower case are only distinguished for C.

O	B	C	D	I	F	G	H	I	J	K	L	M	N	O	P	Q	R
A	b	cC	d	E	F	G	h	ı	J	H	L	n	n	o	P	q	r

S	T	U	V	W	X	Y	Z	1	2	3	4	5	6	7	8	9	0
5	t	u	U	b	H	y	2	1	2	3	4	5	6	7	8	9	0

Table 7.1 HMI, available letters and numbers

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Calling parameters via HMI

The parameters belonging to a specific menu item are in the first level below the top menu level for that item. In order to give a better orientation, the table of parameters also shows the overall menu path, e.g. SEt - / nMAX.

Figure 7.4 shows an example of calling a parameter (second level) and input or selection of a parameter value (third level).

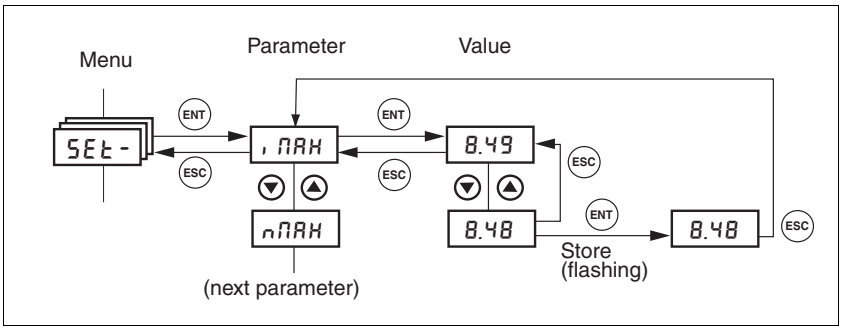

Figure 7.4 HMI, example of parameter setting

The two arrow keys allow setting of the numerical values within the permitted range of values, alphanumeric values are selected from lists.

When you press ENT, the selected value is accepted. Confirmation is indicated by the display flashing once. The modified value is saved in the EEPROM immediately.

If you press ESC, the display jumps back to the original value.

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Menu structure

The HMI is menu-driven. Figure 7.5 shows the top level of the menu structure.

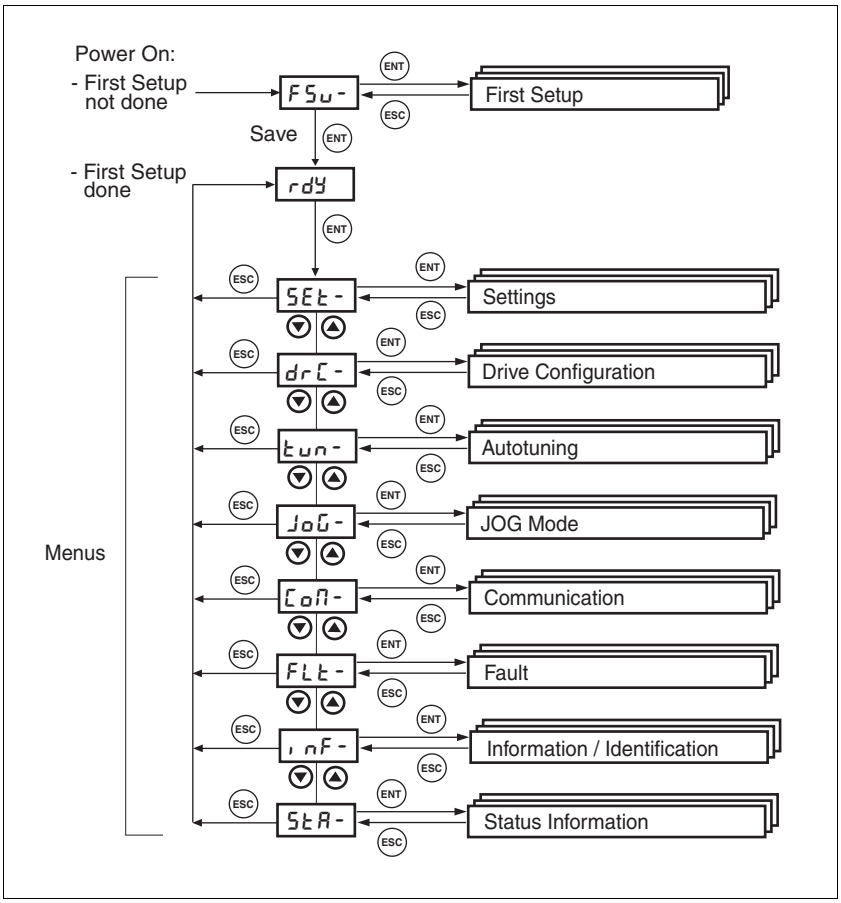

Figure 7.5 HMI menu structure

Status displays such as rdy- (Ready) can be found from page 7-18.

HMI menu		Description
FSU-	FSu-	First setup (**F**irst **S**et**U**p),
	dEUC	Specification of the control mode
	,o-M	Start-up operating mode for "Local Control Mode"
	,oPi	Signal selection position interface ("fieldbus" control mode only)
	CoAd	CANopen address = node number ("fieldbus" control mode only)
	Cobd	CANopen baud rate ("fieldbus" control mode only)
	MbAd	Modbus address ("fieldbus" control mode only)
	Mbbd	Modbus baud rate ("fieldbus" control mode only)
	,oLt	Logic type of the digital inputs/outputs
SET-	SEt-	device settings (**SET**tings)
	A iUn	Zero voltage window on analogue input ANA1
	A i5	Scaling ANA1 for set current at +10V
	A in5	Scaling ANA1 for set current at +10V
	GFAC	Selection of special gear ratios
	,MAX	Current limiting

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HMI menu		Description
	nMAX	Speed limitation
	Li 95	Current limiting for "Quick Stop"
	Li hA	Current limiting for "Halt"
DRC-	drC-	device configuration (**DR**ive **C**onfiguration)
	A2Mo	Selection of limit by ANA2
	A2i M	Scaling for current limiting by ANA2 at +10V
	A2nM	Scaling for speed limiting by ANA2 at +10V
	i oLt	Logic type of the digital inputs/outputs
	i o-M	Start-up operating mode for "Local Control Mode"
	i oPi	Signal selection position interface
	i oAE	Auto. enable at PowerOn if ENABLE input active
	ESSC	Encoder simulation - setting the resolution
	Prot	Definition of direction of rotation
	FCS	Restore factory setting (default values)
	btCL	Time delay when setting the brake
	btrE	Time delay when opening or releasing the brake
	SuPU	HMI display if motor rotating
TUN-	tun-	Autotuning (Auto**TUN**ing)
	Strt	Start Autotuning
	GAi n	Adapting controller parameters (tighter/looser)
	di St	Movement range autotuning
	di r	Direction of rotation autotuning
	MECh	System coupling type
	nrEF	Speed when autotuning
	tAi t	Waiting time between autotuning steps
	rES	Reset controller parameter
JOG-	JoG-	Jog (**JOG** Mode)
	Strt	Start jog
	nSLo	Speed for slow jog
	nFSt	Speed for fast jog
COM-	CoM-	Communication(**COM**munication)
	CoAd	CANopen address (node number)
	Cobd	CANopen baud rate
	MbAd	Modbus address
	Mbbd	Modbus baud rate
	MbFo	Modbus data format
	Mbwo	Modbus word sequence for double words (32 bit values)
FLT-	FLt-	Error display(**F**au**LT**)
	StPF	Fault number of the last interruption cause
INF-	i nF-	Information/identification (**INF**ormation / Identification)

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HMI menu		Description
	dEUC	Current selection of control mode
	-nAM	product name
	-Pnr	Firmware program number
	-PUr	Firmware version
	PoUo	Number of turn-on processes
	P, no	Nominal current of power amplifier
	P, MA	Maximum current of power amplifier
	M, no	Nominal motor current
	M, MA	Motor maximum current
STA-	StA-	Observation/monitoring of device, motor and travel data (**STA**tus Information)
	, oAC	Status of digital inputs and outputs
	A 1AC	Voltage value analogue input ANA1
	A2AC	Voltage value analogue input ANA2
	nACt	Actual speed of motor
	PACu	Actual position of the motor in user-defined units
	Pd, F	Current regulation variation of the position controller
	, ACt	Total motor current (vector sum of d and q components
	, qrF	Set motor current q component (torque-creating)
	udCA	DC bus voltage of the power amplifier supply voltage
	tdEU	Device temperature
	tPA	Temperature of power amplifier
	Wrn5	Stored warnings bit-coded
	S, GS	Stored state of the monitoring signals
	oPh	Operating hours counter
	, 2tr	Load factor braking resistor
	, 2tP	Loading factor power amplifier
	, 2tM	Loading factor motor

Status display

The status display in its default setting shows the current operating status, see page 8-4. You can specify the following with the menu item drC- / SuPU:

- StAt shows the current operating status by default
- nAct shows the current motor speed by default
- , Act shows the current motor current by default

A change is only imported with the power amplifier disabled.

7.3.3 Commissioning software (PowerSuite)

Features

The Windows-based commissioning software simplifies commissioning, setting parameters, simulation and diagnosis.

Compared to the HMI the commissioning software offers further options such as:

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- Setting the controller parameters in a graphic interface
- Extensive diagnostic tools for optimisation and maintenance
- Long-term recording as an aid to assessing operating behaviour
- Testing input and output signals
- Tracking signal sequences on the monitor
- Interactive optimisation of controller behaviour
- Archiving all device settings and recordings with export functions for data processing

System requirements You will need a PC or laptop with a free serial port and an operating system with Windows 2000 or newer.

To connect the PC to the device see page 6-47.

Online help The commissioning software offers comprehensive help functions, which can be accessed via "? - Help Topics" or by pressing F1.

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7.4 Commissioning procedure

⚠ WARNING

Unsuitable parameters may cause injury and damage to the system.

If unsuitable parameters are used, safety functions may fail, unexpected motions or responses to signals may occur.

- Prepare a list with the parameters required for the functions in use.
- Check the parameters before operation.
- Start the system only if there are no persons or materials in the danger zone and the system can be operated safely.

Failure to follow these instructions can result in death, serious injury or equipment damage.

7.4.1 "First Setup"

"First Setup" must be made when the controller supply voltage is switched on for the first time or when the factory settings have been loaded.

Preparation

- A PC with the commissioning software must be connected to the unit unless the commissioning is conducted exclusively through the HMI.
- ▶ During commissioning disconnect the connection to the fieldbus to avoid conflicts caused by simultaneous access.
- ▶ Switch on the controller power supply.

Automatic read-in of the motor data set

When the unit is switched on for the first time with the motor connected, the unit reads the motor data set automatically from the Hiperface sensor (motor sensor). The data set is checked for completeness and saved in the EEPROM.

The motor data set contains technical information about the motor such as the nominal and peak torque, the nominal current and speed and the pole-pair number. It cannot be modified by the user. The unit cannot be switched ready for operation without this information

"First Setup" via HMI

The following diagram shows the sequence using HMI.

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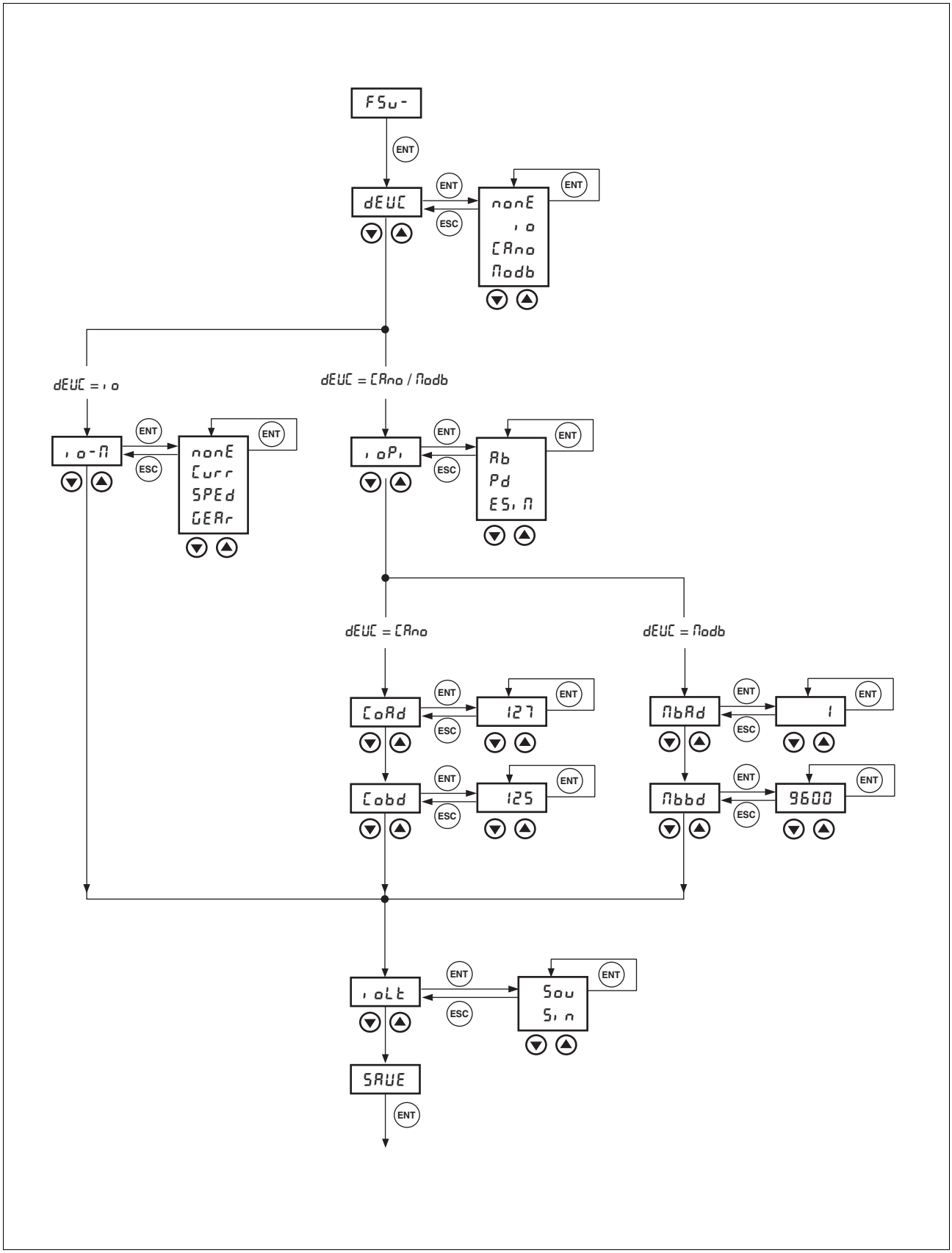

Figure 7.6 "First Setup" via HMI

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Unit controller

▶ Specify how the unit will be controlled with the parameter DEVcmdinterf (dEUC).

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
DEVcmdinterf DEVC NONEdEUC	Specification of device control(7-13) **0 / none**: undefined (default)) **1 / IODevice / IO**: Local control mode **2 / CANopenDevice / CanO** CANopen **3 / ModbusDevice / Modb**: Modbus CAUTION: A change of the setting is not activated until the unit is switched on again (exception: Change of the value 0, at "First setup").	- 0 0 4	UINT16 R/W per. -	CANopen 3005:1$_h$ Modbus 1282

Default operating mode

■ DEVcmdinerf = IODevice (dEUC = IO)

▶ Specify the operating mode in which the unit will start by default every time it is switched on with the parameter IOdefaultMode (IO-M).

The operating modes are described from page 8-12.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOdefaultMode IO-M DRC-IO-M	Start-up of operating mode for 'local control mode'(7-13) **0 / none / none** : none (default) **1 / CurrentControl / Curr**: Current controller (reference value from ANA1) **2 / SpeedControl / Sped**: Speed controller (reference value from ANA1) **3 / GearMode / Gear**: electronic gear The operating mode is activated automatically as soon as the drive switches to the 'OperationEnable' state and 'IODevice/IO' in DEVcmdinterf is set.	- 0 0 3	UINT16 R/W per. -	CANopen 3005:3$_h$ Modbus 1286

Function of the RS422 interface

■ DEVcmdinerf = CANopenDevice / ModbusDevice (dEUC = CAno / Modb)

▶ Set the assignment for the RS422 interface with the IOposInterfac (IOPI) parameter.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOposInterfac IOPI DRC-oPi	Signal selection at position interface(7-13) RS422 IO interface (Pos) as: **0 / ABinput / AB**: input ENC_A, ENC_B, ENC_I (index pulse) 4x evaluation **1 / PDinput /PD**: input PULSE, DIR, ENABLE2 **2 / ESIMoutput / ESIM**: output: ESIM_A, ESIM_B, ESIM_I CAUTION: A change of the setting is not activated until the unit is switched on again.	- 0 0 2	UINT16 R/W per. -	CANopen 3005:2h Modbus 1284

Fieldbus CANopen

- DEVcmdinerf = CANopenDevice (dEUC = CAno)

▶ Specify the node address with the parameter CANadr (CoAd) and the baud rate with the parameter CANbaud (Cobd).

Every unit must have its own unique node address, which must be assigned only once in the network.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CANadr COAD COM-CoAd	CANopen address (node number)(7-13) valid addresses (node numbers) : 1 to 127 CAUTION: A change of the setting is not activated until the unit is switched on again or after an NMT reset command	- 1 127 127	UINT16 R/W per. -	CANopen 3017:2h Modbus 5892
CANbaud COBD COM-Cobd	CANopen baud rate(7-13) valid baud rates in kbaud : 50 125 250 500 1000 CAUTION: A change of the setting is not activated until the unit is switched on again.	- 50 125 1000	UINT16 R/W per. -	CANopen 3017:3h Modbus 5894

Fieldbus Modbus

- DEVcmdinerf = ModbusDevice (dEUC = Modb)

▶ Specify the node address with the parameter MBadr (MbAd) and the baud rate with the parameter MBbaud (Mbbd).

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MBadr MBAD COM-MbAd	Modbus address(7-13) valid addresses : 1 to 247	- 1 1 247	UINT16 R/W per. -	CANopen 3016:4$_h$ Modbus 5640
MBbaud MBBD COM-Mbbd	Modbus baud rate(7-13) Allowed baud rates: 9600 19200 38400 CAUTION: A change of the setting is not activated until the unit is switched on again.	- 9600 19200 38400	UINT16 R/W per. -	CANopen 3016:3$_h$ Modbus 5638

Select logic type

▶ Specify the logic type with the parameter `IOLogicType` (I-O LLt). For more information see chapter 5-1.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOLogicType IOLT DRC-I-O LLt	Logic type of the digital inputs/outputs(7-13) **0 / source / sou**: for current supply outputs (default) **1 / sink / sin**: for current draw outputs WARNING: A change of the setting is not activated until the device is switched on again.	- 0 0 1	UINT16 R/W per. -	CANopen 3005:4$_h$ Modbus 1288

Data back-up

▶ Back up all inputs on completion.
HMI: Save your settings with SAVE
Commissioning software: Save your settings with the menu path "Configuration - Save in EEPROM"

◁ The device saves all set values in the EEPROM and displays the status nrdY, rdY or di S on the HMI.

A restart of the device is required to allow the changes to be accepted.

Further steps

▶ Stick a label on the unit with all important information required in case of service,e.g. fieldbus type, address and baud rate.

▶ Make the settings described below for commissioning.

Note that you can only return to the "Initial Setup" by restoring the factory settings, see 8.6.10.2 “Restore factory settings“ page 8-73.

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7.4.2 Operating status (state diagram)

After switching on and at the start of an operating mode, a sequence of operating states is progressed through.

The relationship between the operating states and the state transitions is shown in the state diagram (state machine).

The operating states are internally monitored and influenced by monitoring and system functions, such as temperature and current monitoring

Graphic representation The state diagram is shown graphically as a flow chart.

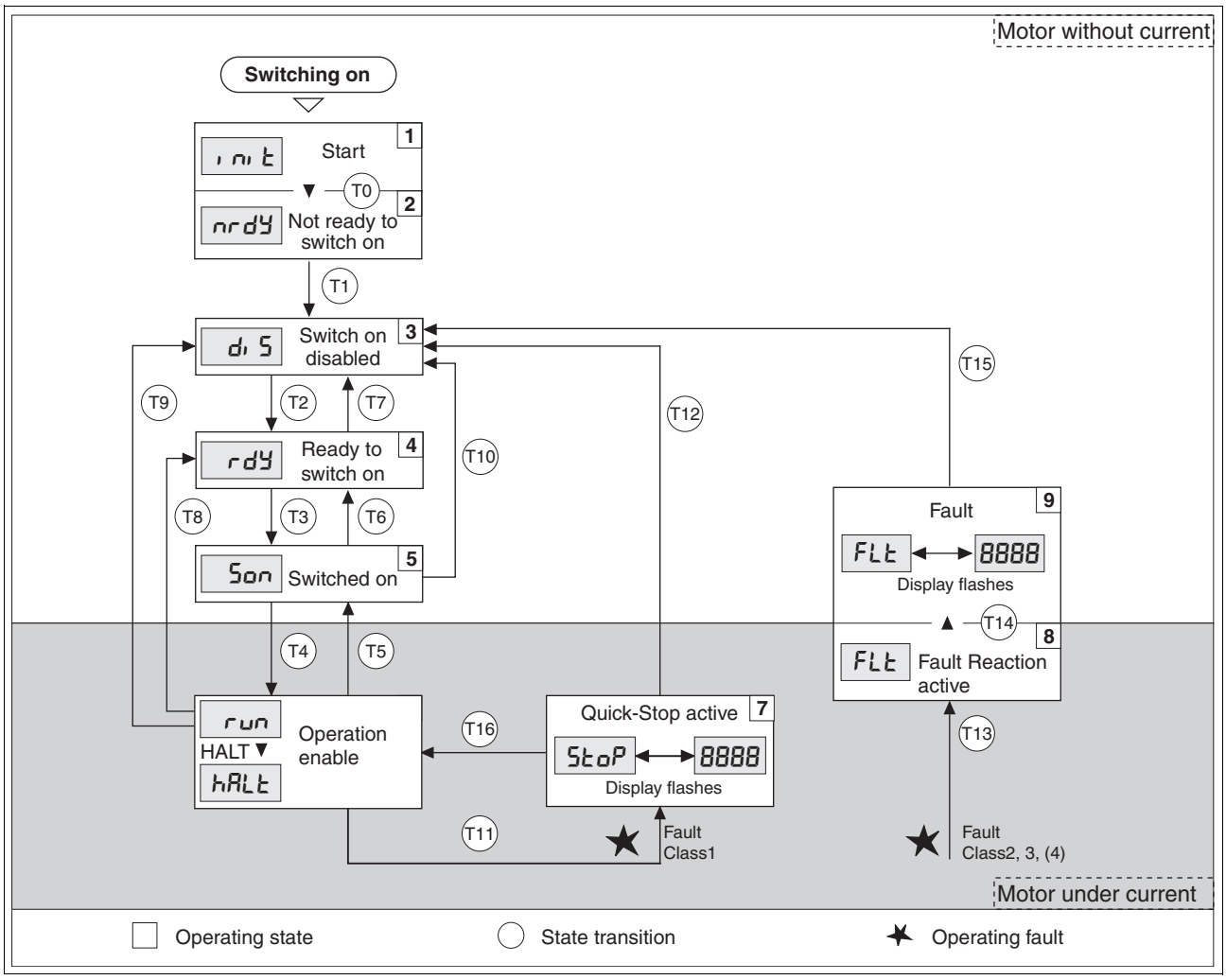

Figure 7.7 Status diagram

Operating states and mode transitions For detailed information on operating states and mode transitions see page 8-4.

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7.4.3 Setting basic parameters and limit values

⚠ WARNING

Unsuitable parameters may cause injury and damage to the system.

If unsuitable parameters are used, safety functions may fail, unexpected motions or responses to signals may occur.

- Prepare a list with the parameters required for the functions in use.
- Check the parameters before operation.
- Start the system only if there are no persons or materials in the danger zone and the system can be operated safely.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Setting thresholds

Suitable thresholds must be calculated from the system configuration and motor characteristics. So long as the motor is operated without external loads you will not need to change the default settings.

The maximum motor current must for example be reduced as a determining factor of the torque if the permissible torque of a system component will otherwise be exceeded.

Current limiting

To protect the drive system, the maximum current flowing can be modified with the `CTRL_I_max` parameter. The maximum current for the "Quick Stop" function can be limited with the `LIM_I_maxQSTP` parameter and for the "Halt" function with the `LIM_I_maxHalt` parameter.

Acceleration and deceleration are limited with ramp functions in the point-to-point , speed profile and referencing modes.

▶ Specify the maximum motor current with the `CTRL_I_max` parameter.

▶ Specify the maximum current for "Quick Stop" with the `LIM_I_maxQSTP` parameter.

▶ Specify the maximum current for "Halt" with the `LIM_I_maxHalt` parameter.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_I_max IMAX SET-, ΠRH	Current limiting(7-19) Value must not exceed max. permissible current of motor or power amplifier. Default is the smallest value of M_I_max and PA_I_max	A_{pk} 0.00 - 299.99 **Fieldbus** 0 29999	UINT16 R/W per. -	CANopen 3012:1$_h$ Modbus 4610

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
LIM_I_maxQSTP LIQS SET-L, 95	Current limiting for Quick Stop(8-63) Max. current during braking via torque ramp resulting from an error with error class 1 or 2, and when a software stop is triggered Maximum and default value setting depend on motor and power amplifier in 0.01Apk steps	A_{pk} - - -	UINT16 R/W per. -	CANopen 3011:5$_h$ Modbus 4362
LIM_I_maxHalt LIHA SET-L, hA	Current limiting for Halt(8-64) Max. current during braking after Halt or termination of an operating mode. Maximum and default value settings depend on motor and power amplifier in 0.01Apk steps	A_{pk} - - -	UINT16 R/W per. -	CANopen 3011:6$_h$ Modbus 4364

Speed limitation

The maximum speed can be limited with the parameter CTRL_n_max to protect the drive system.

▶ Specify the maximum motor speed with the parameter CTRL_n_max.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_n_max NMAX SET-nMAX	Speed limitation(7-19) Max. speed of rotation motor must not be exceeded Default is the maximum speed of the motor (see M_n_max)	1/min 0 - 13200	UINT16 R/W per. -	CANopen 3012:2$_h$ Modbus 4612

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7.4.4 Analogue inputs

Analog inputs

The analogue inputs allow analogue input voltages between -10V and +10V to be read in. The current voltage value on ANA1+ can be read using the parameter ANA1_act

- Power amplifier power is switched off.
  Controller power supply is switched on.
- ▶ At the analogue input ANA1or ANA2 apply a voltage in the range of $\pm 10V_{DC}$.
- ▶ Check the applied voltage with the parameter ANA1_act or ANA2_act.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
ANA1_act A1AC STA-AIAC	Voltage value analogue input ANA1()	mV -10000 - 10000	INT16 R/- - -	CANopen 3009:1$_h$ Modbus 2306
ANA2_act A2AC STA-A2AC	Voltage value analogue input ANA2(8-2)	mV -10000 - 10000	INT16 R/- - -	CANopen 3009:5$_h$ Modbus 2314

Reference value

An input voltage at ANA1 can be used as a reference value for the operating mode current control or speed control. The reference value for a voltage of +10V can be set over the parameter ANA1_I_scale or ANA1_n_scale.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
ANA1_I_scale A1IS SET-AI.S	Setpoint current in current control operating mode at 10V on ANA1(7-21) An inversion of the evaluation of the analogue signal can be run with a neg. advance sign	A_{pk} -300.00 3.00 300.00 **Fieldbus** -30000 300 30000	INT16 R/W per. -	CANopen 3020:3$_h$ Modbus 8198
ANA1_n_scale A1NS SET-AInS	Setpoint speed in speed control operating mode at 10V on ANA1() The internal maximum speed is limited to the current setting in CTRL_n_max A preceding negative sign can be used to effect an inversion of the evaluation of the analogue signal	1/min -30000 3000 30000	INT16 R/W per. -	CANopen 3021:3$_h$ Modbus 8454

Offset and the zero voltage window

An offset can be parameterized for the input voltage at ANA1 over the parameter ANA1_offset and a zero voltage window can be parameterized over the parameter ANA1_win.

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This corrected input voltage gives the voltage for the operating modes current control and speed control as well as the reading value for parameters ANA1_act.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
ANA1_offset A1OF SET-A IoF	Offset at analogue input ANA1() The ANA1 analogue input is corrected/relocated by the offset. A defined zero-voltage window acts in the range of the zero crossing of the corrected ANA1 analogue input.	mV -5000 0 5000	INT16 R/W per. -	CANopen 3009:B_h Modbus 2326
ANA1_win A1WN SET-A IWn	Zero voltage window on analogue input ANA1() Value up to which an input voltage is interpreted as 0V Example: Setting 20mV ->range from -20 .. +20mV is interpreted as 0mV	mV 0 0 1000	UINT16 R/W per. -	CANopen 3009:9_h Modbus 2322

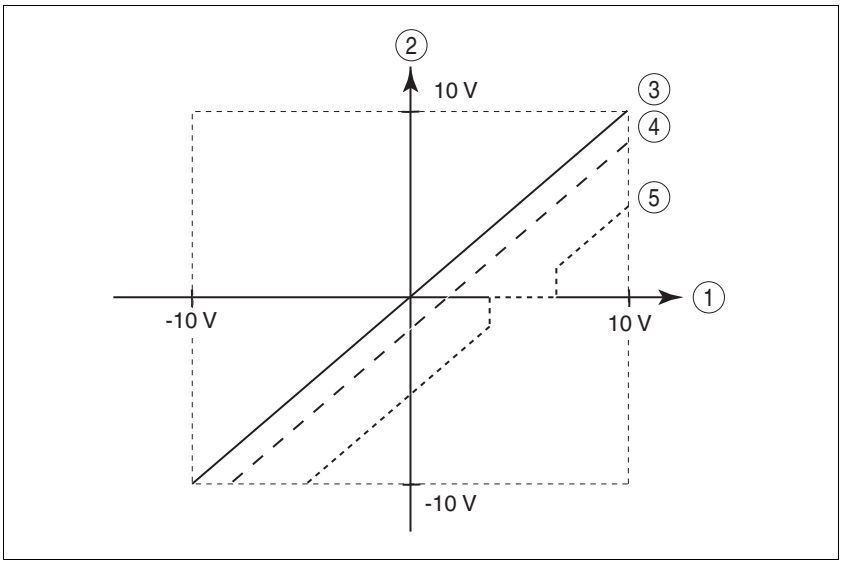

Figure 7.8 Offset and zero voltage window

(1) Input voltage at ANA1
(2) Voltage value for current control and speed control operating modes as well as reading value of parameter ANA1_act
(3) Input voltage without processing
(4) Input voltage with offset
(5) Input voltage with offset and zero voltage window

Limitations A current limitation or speed limitation can be activated over the analogue input ANA2.

- ▶ Specify the limit type with the parameter ANA2LimMode.
- ▶ Specify the scaling of the limit at +10V with the parameter ANA2_I_max or ANA2_n_max.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
ANA2LimMode A2MO DRC-A2Mo	Selection of limit by ANA2() **0 / none**: no limit **1 / Current Limitation / CURR**: Limit reference current value at current controller (Limit value at 10V in ANA2_I_max) **2 / Speed Limitation / SPED**: Limit speed reference value at speed controller (Limit value at 10V in ANA2_n_max)	- 0 0 2	UINT16 R/W per. -	CANopen 3012:B_h Modbus 4630
ANA2_I_max A2IM DRC-A2, M	Current limiting at 10 V input voltage on ANA2() The maximum limiting value is the lesser value of ImaxM and ImaxPA	A_{pk} 0.00 3.00 300.00 **Fieldbus** 0 300 30000	UINT16 R/W per. -	CANopen 3012:C_h Modbus 4632
ANA2_n_max A2NM DRC-A2nM	Speed limiting at 10 V input voltage on ANA2() The minimum limiting speed is set to 100 rpm, i.e. analogue values that implement a lower speed of rotation have no effect. The max. speed of rotation is also limited by the setting value in CTRL_n_max.	1/min 500 3000 30000	UINT16 R/W per. -	CANopen 3012:D_h Modbus 4634

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7.4.5 Digital inputs/outputs

The switching states of the digital inputs and outputs can be displayed on the HMI and displayed and modified using the commissioning software or the fieldbus.

HMI The signal states can be displayed with the HMI, but they cannot be modified.

▶ Call up the menu point StA / I/O Act.

◁ You will see the digital inputs (Bit 0-7) bit-coded.

▶ Press the "up arrow".

◁ You will see the digital inputs (Bit 8, 9) bit-coded.

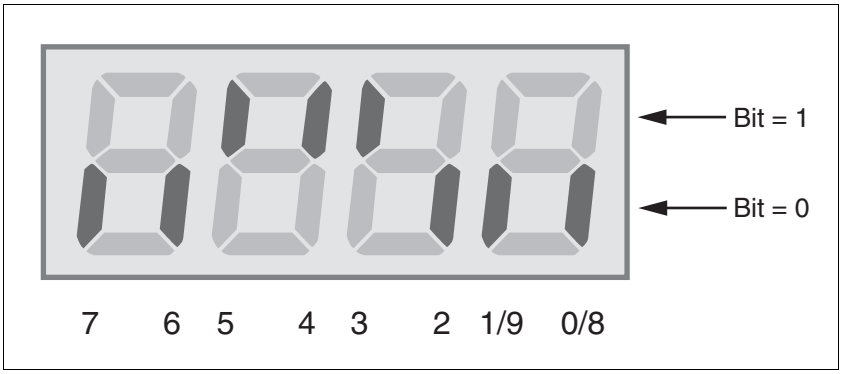

Figure 7.9 HMI, status display of the digital inputs/outputs

Bit	Local controller operating mode	Fieldbus control mode	I/O
0	-	$\overline{\text{REF}}$	I
1	FAULT_RES	$\overline{\text{LIMN}}$	I
2	ENABLE	$\overline{\text{LIMP}}$	I
3	$\overline{\text{HALT}}$	$\overline{\text{HALT}}$	I
4	$\overline{\text{PWRR\_B}}$	$\overline{\text{PWRR\_B}}$	I
5	$\overline{\text{PWRR\_A}}$	$\overline{\text{PWRR\_A}}$	I
6	ENABLE2 [1)]	-	I
7	-	-	I
8	NO_FAULT	NO_FAULT	O
9	ACTIVE1_OUT	ACTIVE1_OUT	O

1) only with IOposInterfac = PDinput

Fieldbus The current switching states are displayed bit-coded in the parameter _IO_act. The values 1 and 0 indicate whether an input or output is active.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_IO_act IOAC STA-, oRC	Status of digital inputs and outputs(7-24) Assignment of 24V inputs: (Local control mode) Bit 0: - Bit 1: FAULT_RESET Bit 2: ENABLE Bit 3: HALT Bit 4: PWRR_B Bit 5: PWRR_A Bit 6: ENABLE2 Bit 7: reserved Bit 6 forms the ENABLE only under the following conditions: DEVcmdinterf = IODevice and IOposInterfac = Pdinput (fieldbus control mode) Bit 0: REF Bit 1: LIMN,CAP2 Bit 2: LIMP,CAP1 Bit 3: HALT Bit 4: PWRR_B Bit 5: PWRR_A Bit 6: - Bit 7: reserved assignment 24V outputs: Bit 8: NO_FAULT Bit 9: ACTIVE	- - 	UINT16 R/- - -	CANopen 3008:1$_h$ Modbus 2050

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7.4.6 Testing limit switches signals in fieldbus devices

⚠ CAUTION

Loss of control!

The use of LIMP and LIMN can offer some protection against hazards (e.g. impact on mechanical stop caused by incorrect motion defaults).

- Use LIMP and LIMN where possible.
- Check that the external sensors or switches are correctly connected.
- Check the correct functional installation of the limit switches The limit switches must be mounted in a position far enough away from the mechanical stop to allow an adequate braking distance.
- The functions must be enabled to use LIMP and LIMN.
- This function cannot provide protection against faulty functioning of the product or the sensors.

Failure to follow these instructions can result in injury or equipment damage.

▶ Set up the limit switches so the drive cannot traverse through the limit switch.

▶ Trigger the limit switches manually.

◁ The HMI shows an error message, see Diagnostics from page 10-3

The release of the input signals LIMP, LIMN and REF and the evaluation at active 0 or active 1 can be changed with the parameters of the same name, see page 8-45.

Use the active 0 monitoring signals if possible, because they are proof against wire breakage.

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7.4.7 Testing safety functions

Operation with "Power Removal"

If you wish to use the "Power Removal" safety function , carry out the following steps:

- Power amplifier supply voltage is switched off.
  Controller supply voltage is switched off.
- ▶ Check that the inputs $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ are insulated from each other. The two signals must not be connected.
- Power amplifier supply voltage is switched on.
  Controller supply voltage is switched on.
- ▶ Start the jog operating mode (without motor movement).
  (see page 8-15)
- ▶ Trigger the safety disconnection. $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ must be switched off simultaneously.
- ◁ The power amplifier is switched off and error message 1300 is displayed. (CAUTION: error message 1301 displays a wiring error.)
- ▶ Check that the parameter `IO_AutoEnable` (HMI: drC-/oRE) is set to "off" for protection against unexpected restart.
- ▶ Check the behaviour of the drive in error states.
- ▶ Record all tests of the safety function in the acceptance record.

Operation without "Power Removal"

If you do not wish to use the "Power Removal" safety function:

- ▶ Check that the inputs $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ are connected to +24VDC.

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7.4.8 Checking holding brake

⚠ WARNING

Unexpected motion may cause injury and damage to the system

For example, if the brake is released with vertical axes an unexpected motion may be triggered in the system.

- Make sure that no damage will be caused by the load dropping.
- Run the test only if there are no persons or materials in the danger zone of the moving system components.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Testing from HBC to brake

■ Supply voltage is present at HBC, LED '"24 V on"' is lit up.

▶ Switch off the power amplifier supply voltage.

◁ The unit switches to the operating status "Switch on disabled"

▶ Press the "Release brake" button on the HBC several times to release and close the brake alternately.

◁ The LED '"Brake released"' on the HBC flashes if there is brake voltage present and the brake is released by the button.

▶ Test that the axle can be moved manually with the brake lifted (take gearbox into account, if applicable).

Testing from device to HBC

■ The device is in operating status "Ready to switch on" and the parameters for the holding brake must be set, see chapter 8.6.8 “Braking function with HBC“ page 8-69.

▶ Start jog operating mode
(HMI: JoG- / Strt)

◁ The HMI displays JG. The brake is released. The LED "Brake released" on the HBC is lit up if there is brake voltage present and the brake is released.

For more information on the HBC see page 3-10, 6-31 and 12-1.

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7.4.9 Check direction of rotation

Direction of rotation

Rotation of the motor shaft in a positive or negative direction of rotation. A positive direction of rotation is defined as the motor shaft rotating clockwise as the observer faces the end of the protruding shaft.

The initial setting of the controller parameters may result in an unstable closed-loop control at inertia ratios of "J ext" to "J motor" >10.

- ▶ Start jog operating mode (HMI: JoG- / Strt)
- ◁ The HMI displays JG.
- ▶ Start a movement in clockwise rotation (HMI: "up arrow")
- ◁ The motor rotates in clockwise rotation. The HMI shows JG-
- ▶ Start a movement in the counterclockwise rotation (HMI: "down arrow")
- ◁ The motor rotates in counterclockwise rotation. The HMI shows -JG

⚠ WARNING

Unexpected movement if motor phases are reversed!

Reversal of the motor phases can cause unexpected movements at high acceleration.

- Use the parameter `POSdirOfRotat` to reverse the direction of rotation, if required.
- Do not reverse the motor phases.

Failure to follow these instructions can result in death, serious injury or equipment damage.

- ▶ If the arrow and direction of rotation do not match, correct this with the parameter `POSdirOfRotat`, see 8.6.9 “Reversal of direction of rotation“ page 8-71.

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7.4.10 Setting parameters for encoder simulation

Defining resolution for encoder simulation

The resolution for the encoder simulation can be scaled with the parameter ESIMscale.

- The functionality is only active if the parameter IOposInterfac is set to "ESIM".

▶ Specify the resolution with the parameter ESIMscale.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
ESIMscale ESSC DRC-ESSC	Encoder simulation - setting the resolution() Software version 1.102: The following resolutions are adjustable: 128 256 512 1024 2048 4096 from software version 1.103: the complete value range is available for the resolution. For resolutions that can be divided by 4 the index pulse must be at A=high and B=high. CAUTION: the values are not enabled until the controller is restarted. After the write access a wait of at least 1 second is required until the controller is switched off.	Inc 8 4096 65535	UINT16 R/W per. -	CANopen 3005:15$_h$ Modbus 1322

The index pulse can be defined by setting the absolute position encoder, see chapter 7.4.11 “Setting parameters for encoder“.

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7.4.11 Setting parameters for encoder

Setting an encoder absolute position

When starting up the device reads the absolute position of the motor from the encoder. The current absolute position can be shown with the parameter _p_absENCusr.

At motor standstill the new absolute position of the motor can be defined at the current mechanical motor position with the parameter ENC_pabsusr. The value can be transferred with the power amplifier active and inactive. Setting the absolute position also shifts the position of the index pulse of the encoder and the index pulse of the encoder simulation.

In the commissioning software you will find the parameter via the menu "Display - Specific panels".

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_p_absENCusr -	Absolute position based on motor encoder working range in user-defined units(7-31) Value range is set by sensor type With Singleturn motor encoders the value is set with reference to one motor revolution, with multiturn motor encoders with reference to the total working range of the sensor (e.g. 4096 revs.) Caution! Position is only valid after determination of the motor absolute position. With invalid motor absolute position : _WarnLatched _WarnActive Bit 13=1: absolute position of motor not yet detected	usr -	UINT32 R/- - -	CANopen 301E:F_h Modbus 7710
ENC_pabsusr -	Setting position of the motor encoder directly(7-31) Value range depends on the sensor type. SRS: Sincos single turn: 0..max_pos_usr/rev. - 1 SRM: Sincos multiturn: 0 .. (4096 * max_pos_usr/rev.) -1 max_pos_usr/rev.: maximum user position for one motor revolution, with default position scaling this value is 16384. !!!Important: * If the process is to be conducted with direction inversion function, it must be set before setting the motor encoder position * The setting value will only be active when the controller is switched on the next time. After the write access a wait of at least 1 second is required until the controller is switched off. * Changing the value also changes the position of the virtual index pulse and the index pulse displaced at ESIM function.	usr 0 - 2147483647	UINT32 R/W - -	CANopen 3005:16_h Modbus 1324

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If the device or the motor is replaced, a new adjustment will be required.

Position processing with SinCos single turn

With the SinCos Singleturn the position of the index pulse of the encoder and the position of the index pulse of the encoder simulation can be shifted by setting a new absolute position. At position value 0 the index pulse is defined at the current mechanical motor position.

Position processing with SinCos Multiturn

With the SinCos Multiturn the mechanical working range of the motor can be shifted to the continuous range of the sensor by setting a new absolute position.

If the motor is moved anticlockwise from the absolute position 0, the SinCos multiturn receives an underrun of its absolute position. In contrast, the internal actual position counts mathematically forward and sends a negative position value. After switching off and on the internal actual position would no longer show the anticlockwise position value but the absolute position of the sensor.

To prevent these jumps caused by underrun or overrun - i.e. unsteady positions in the area of travel, the absolute position in the sensor must be set so the mechanical limits are within the continuous range of the sensor.

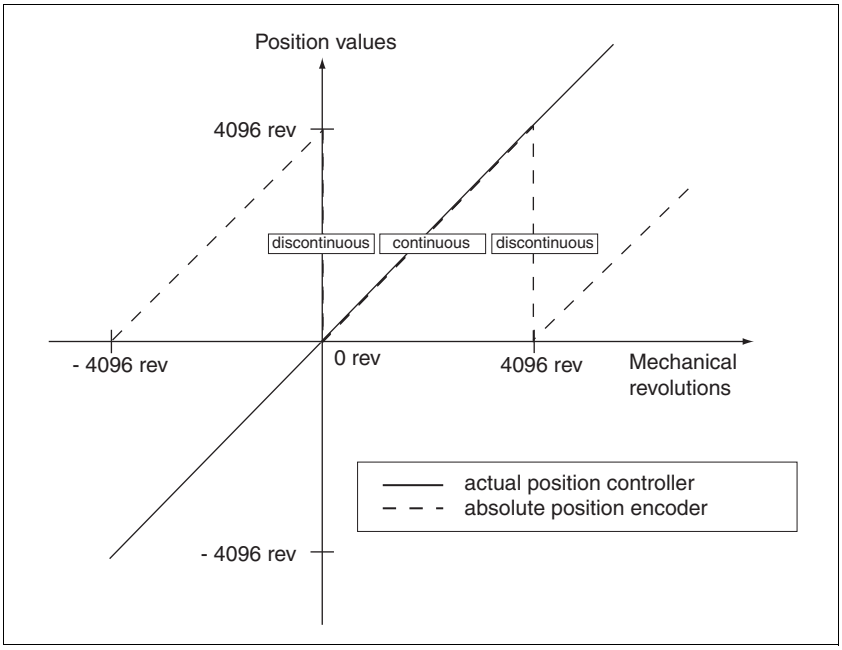

Figure 7.10 SinCos Multiturn position values

▶ When setting the absolute position at the mechanical limit set a position value >0. This ensures that when the drive is moved within the mechanical limits of the system the resulting sensor position is always within the continuous range of the sensor.

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7.4.12 Setting parameters for braking resistor

⚠ WARNING

Risk of injury and damage to system components by unbraked motor!

An insufficient braking resistor causes overvoltage on the DC bus and switches off the power amplifier. The motor is no longer actively braked.

- Make sure that the braking resistor is sufficiently dimensioned.
- Check the setting of the parameter for the braking resistor.
- Check the temperature of the braking resistor by conducting a test run under the most critical conditions.
- During the test make sure that at higher mains voltage there is less reserve in the capacitors on the DC bus.

Failure to follow these instructions can result in death, serious injury or equipment damage.

If an external braking resistor is connected, the parameter `RESint_ext` must be set to "external".

The values of the external braking resistor must be set in the parameters `RESext_P`, `RESext_R` and `RESext_ton`, see chapter 3.5.1 “External braking resistors“ page 3-10.

If the actual brake output exceeds the maximum allowable brake output, the device will output an error message and the power amplifier will be switched off.

⚠ WARNING

Hot surfaces can cause burns, fire and damage to system components.

The braking resistor may heat up to over 250°C depending on the operating mode.

- Prevent contact with the hot braking resistor.
- Do not place flammable or heat-sensitive components in the immediate vicinity of the braking resistor.
- Ensure good heat dissipation.
- Check the temperature of the braking resistor by conducting a test run under the most critical conditions.

Failure to follow these instructions can result in death, serious injury or equipment damage.

▶ Test the function of the braking resistor under realistic conditions.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RESint_ext -	Control of braking resistor(7-19) **0 / internal**: internal braking resistor **1 / external**: external braking resistor	- 0 0 1	UINT16 R/W per. -	CANopen 3005:9$_h$ Modbus 1298
RESext_P -	Nominal power of external braking resistor(7-19)	W 1 10 32767	UINT16 R/W per. -	CANopen 3005:12$_h$ Modbus 1316
RESext_R -	Resistance value of external braking resistor(7-19)	Ω 0.01 100.00 327.67 **Fieldbus** 1 10000 32767	UINT16 R/W per. -	CANopen 3005:13$_h$ Modbus 1318
RESext_ton -	max. permissible switch-in time for external braking resistor(7-19)	ms 1 1 30000	UINT16 R/W per. -	CANopen 3005:11$_h$ Modbus 1314

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7.4.13 Run autotuning

Autotuning determines the friction torque, an ever present load torque, and considers it in the calculation of the mass moment of inertia of the total system.

External factors, such as a load on the motor, are taken into account. Autotuning optimises the parameters for the controller settings see chapter 7.5 “Controller optimisation with step response“.

Autotuning also supports typical vertical axes.

Autotuning is not suitable for inertia ratios of "J ext" to "J motor" >10.

⚠ WARNING

Unexpected movement may cause injury and damage to the system.

Autotuning moves the motor to set the drive controller. If incorrect parameters are input unexpected movements may occur or monitoring functions may be disabled.

- Check the parameters AT_dir and AT_dismax. The travel for the braking ramp in case of error must also be taken into account.
- Check that the parameter LIM_I_maxQSTP for Quick-Stop is correctly set.
- If possible, use the limit switches $\overline{\text{LIMN}}$ and $\overline{\text{LIMP}}$.
- Make sure that a functioning button for EMERGENCY STOP is within reach.
- Make sure that the system is free and ready for the motion before starting the function.

Failure to follow these instructions can result in death, serious injury or equipment damage.

▶ Select the setting for the AT_mechanics parameter corresponding to your mechanical system. If in doubt, select a softer coupling (less rigid mechanism, see Figure 7.12).

▶ Start the Autotuning with the commissioning software with the menu path "Operating Mode - Automatic optimisation". Also note additional settings in the "Display - Specific Displays" menu.

Autotuning can also be started from the HMI (tun- / Strt).

The calculated values are accepted immediately without an additional save.

If the Autotuning is interrupted with an error message, the default values are imported. Change the mechanical position and start the Autotuning again. If you want to check the plausibility of the calculated values, they can be displayed, see also 7.4.14 “Extended settings for autotuning“ from page 7-37.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
AT_dir DIR TUN-dir	Direction of rotation autotuning(7-35) **1 / pos-neg-home / pnh**: first positive direction, then negative direction with return to initial position**2 / neg-pos-home / nph**: first negative direction, then positive direction with return to initial position **3 / pos-home / p-h**: only positive direction with return to initial position **4 / pos / p--**: only positive direction without return to initial position **5 / neg-home / n-h**: only negative direction with return to initial position **6 / neg / n--**: only negative direction without return to initial position	- 1 1 6	UINT16 R/W - -	CANopen 302F:4_h Modbus 12040
AT_dismax DIST TUN-dist	Movement range autotuning(7-35) Range in which the automatic optimisation processes of the controller parameters are run. The range is input relative to the current position. Caution with "movement in only one direction" (parameter AT_dir), it corresponds to the actual movement of a multiple of this specified range. It is used for every optimisation level.	revolution 1.0 1.0 999.9 **Fieldbus** 10 10 9999	UINT32 R/W - -	CANopen 302F:3_h Modbus 12038
AT_mechanics MECH TUN-MECH	System coupling type(7-35) 1: direct coupling (J ext. to J motor <3:1) 2: medium coupling () 3: medium coupling (short toothed belt) 4: medium coupling () 5: soft coupling (J ext. to J motor between 5:1 and 10:1, linear axis)	- 1 1 5	UINT16 R/W - -	CANopen 302F:E_h Modbus 12060
AT_start -	Start Autotuning(7-35) 0: End 1: Activate	- 0 - 1	UINT16 R/W - -	CANopen 302F:1_h Modbus 12034

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7.4.14 Extended settings for autotuning

For most applications the procedure described is sufficient for autotuning. The following parameters can be used to monitor or even influence the autotuning.

The parameters AT_state and AT_progress can be used to monitor the percentage progress and the status of the Autotuning.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
AT_state - 	Autotuning status(7-37) Bit15: auto_tune_err Bit14: auto_tune_end Bit13: auto_tune_process Bit 10..0: last processing step	- -	UINT16 R/- - -	CANopen 302F:2_h Modbus 12036
AT_progress -	Autotuning progress(7-37)	% 0 0 100	UINT16 R/- - -	CANopen 302F:B_h Modbus 12054

If you are conducting a test operation and want to check how a harder or softer setting affects the control parameters on your system, you can change the settings found during autotuning by writing the parameter AT_gain. A value of 100% is generally not possible, because this value is at the stability limit. The available value is typically 70%-80%.
The parameter AT_J can be used to read out the mass moment of inertia of the entire system calculated during the autotuning.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
AT_gain GAIN TUN-GAIN	Adapting controller parameters (tighter/looser)(7-37) Measure of the degree of tightness of the regulation. The value 100 represents the theoretical optimum. Values larger than 100 mean that the regulation is tighter and smaller values mean that the regulation is looser.	% -	UINT16 R/W - -	CANopen 302F:A_h Modbus 12052
AT_J - 	Inertia of the entire system(7-37) is automatically calculated during the autotuning process in 0.1 kgcm^2 steps	kg cm^2 0.0 - 0.0	UINT16 R/W per. -	CANopen 302F:C_h Modbus 12056

The parameter AT_wait can be changed to set a wait time between the single steps during the autotuning process. It only makes sense to set a wait time if a very flexible coupling is used, and particularly if the next automatic autotuning step (change of hardness) is carried out while the system is still oscillating.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
AT_wait WAIT TUN-ωR, t	Waiting time between autotuning steps(7-37)	ms 300 1200 10000	UINT16 R/W - -	CANopen 302F:9$_h$ Modbus 12050

Malfunctions during optimisation

High-frequency resonances in mechanical components may interfere with controller optimisation. The values for CTRL_KPn and CTRL_TNn cannot be set satisfactorily if this occurs.

The reference value filter of the current controller suppresses high-frequency resonance (>500Hz). However, if high-frequency resonance does interfere with controller optimisation, it may be necessary to increase the time constant with the parameter CTRL_TAUiref.

In most cases the default setting suppresses the high-frequency resonance.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_TAUiref -	Filter time constant reference value filter of the reference current value()	ms 0.00 1.20 4.00 **Fieldbus** 0 120 400	UINT16 R/W per. -	CANopen 3012:10$_h$ Modbus 4640

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7.5 Controller optimisation with step response

7.5.1 Controller structure

The controller structure corresponds to the classical cascade control of a closed positioning loop with current controller, speed controller and position controller. The reference value of the speed controller can also be smoothed by an upstream filter.

The controllers are set from "inside" to "outside" in the sequence current, speed and position controller. The higher-level control loop in each case stays switched out.

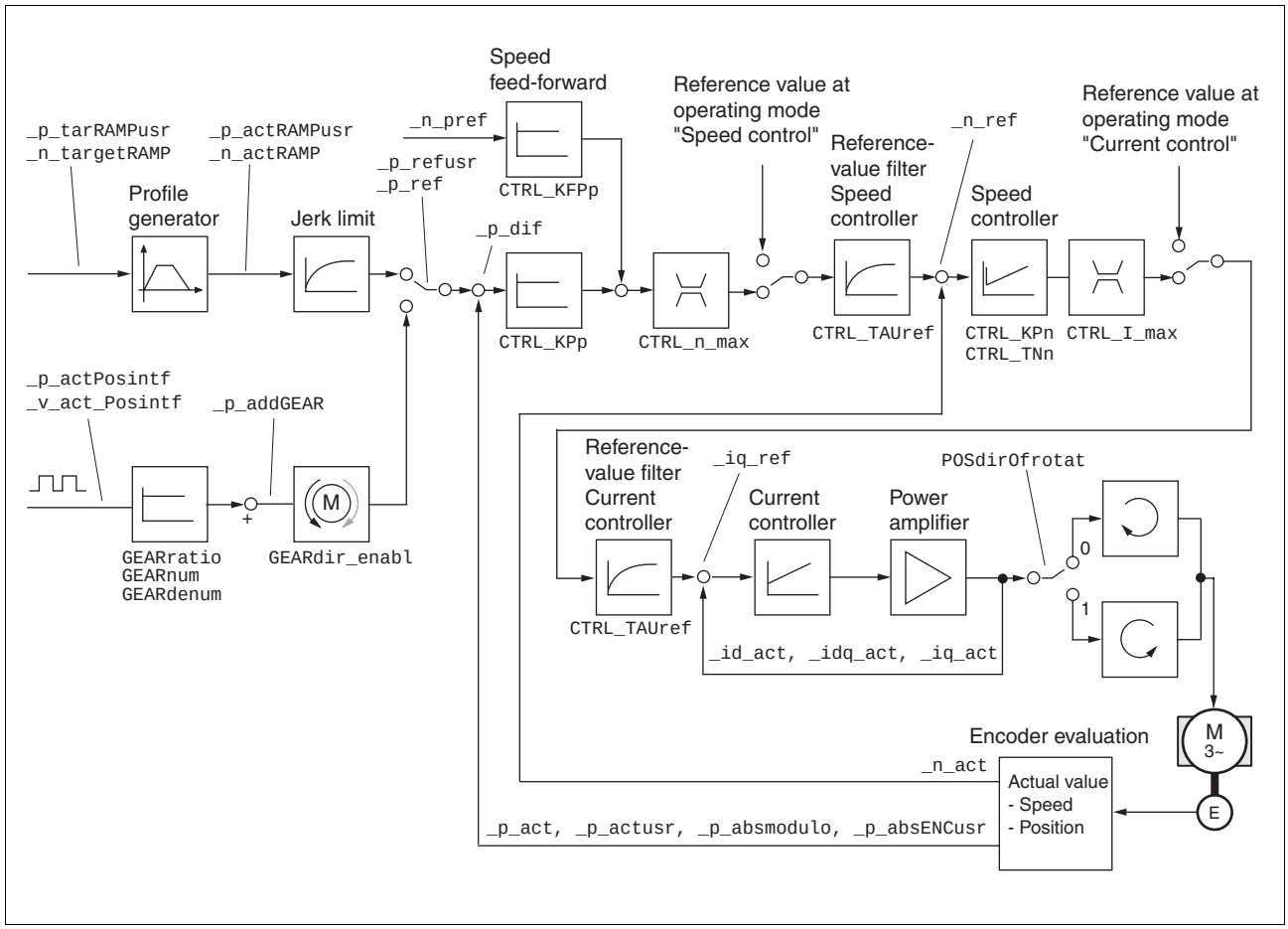

Figure 7.11 Controller structure for encoder evaluation via CN2

Current controller The motor's drive torque is determined by the current controller. The current controller has been optimised automatically using the stored motor data.

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Speed controller

The speed controller maintains the required motor speed by varying the output motor torque depending on the load situation. It exerts a decisive influence on the speed with which the drive reacts. The dynamics of the speed controller depend on

- the moments of inertia of the drive and the control distance
- the torque of the motor
- the stiffness and elasticity of the components in the power flow
- the backlash of the mechanical drive components
- the friction

Position controller

The position controller reduces the difference between setpoint and actual motor position (tracking error) to a minimum. At motor standstill the tracking error is virtually zero with a well-adjusted position controller. In movement mode a speed-dependent tracking error occurs. The setpoint position for the closed positioning loop is generated by the internal travel profile generator during the profile position, profile velocity, homing and jog operating modes. In the electronic gear operating mode the setpoint position for the closed positioning loop is generated by external A/B or pulse/direction input signals.

A requirement for good amplification of the position controller is an optimised speed control loop.

7.5.2 Optimisation

The drive optimisation function matches the unit to the operating conditions. The following options are available:

- Selecting control loops. Higher level control loops are automatically disconnected.
- Defining reference signal: signal form, height, frequency and starting point
- Testing control response with the signal generator.
- Recording and assessing the control behaviour on the monitor with the commissioning software.

Setting reference signals

▶ Start the controller optimisation with the commissioning software with the menu path "Command - Manual tuning".

▶ Set the following values for the reference signal:

- Signal form: 'Positive jump'
- Amplitude: 100 1/min
- Period duration: 100 ms
- Number of repetitions: 1

▶ Highlight the field "Autoscope".

▶ Also note additional settings in the menu "Display - Specific panels".

The total dynamic behaviour of a control loop can be only understood with the signal forms 'Jump' and 'Square wave'. Refer to the manual for all signal paths for the signal form 'Jump'.

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Inputting controller values

Control parameters must also be input for the individual optimisation steps described over the following pages. These parameters must be tested by initiating a jump function.

A jump function is triggered as soon as a recording is started in the commissioning software tool bar with the “Start” button (arrow icon).

You can enter controller values for optimisation in the parameters window in the "Control" group.

7.5.3 Optimising the speed controller

The optimum setting for complex mechanical control systems requires practical experience with setting and adjustment procedures for control equipment. This includes the ability to calculate control parameters and to apply identification procedures.

Less complex mechanical systems can generally be successfully optimised with the experimental adjustment procedure using the aperiodic limiting case method. Here the following two parameters are set:

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_KPn -	Speed controller P-factor(7-41) Default value is calculated from motor parameters	A/(1/min) 0.0001 - 1.2700 **Fieldbus** 1 12700	UINT16 R/W per. -	CANopen 3012:3_h Modbus 4614
CTRL_TNn -	Speed controller integral time(7-41)	ms 0.00 9.00 327.67 **Fieldbus** 0 900 32767	UINT16 R/W per. -	CANopen 3012:4_h Modbus 4616

Check and optimise the calculated values in a second step, as described from page 7-45.

Determining the mechanics of the system

Decide which one of the following two systems fits the mechanics of your set-up to assess and optimise its transient response behaviour.

- System with rigid mechanism
- System with less rigid mechanism

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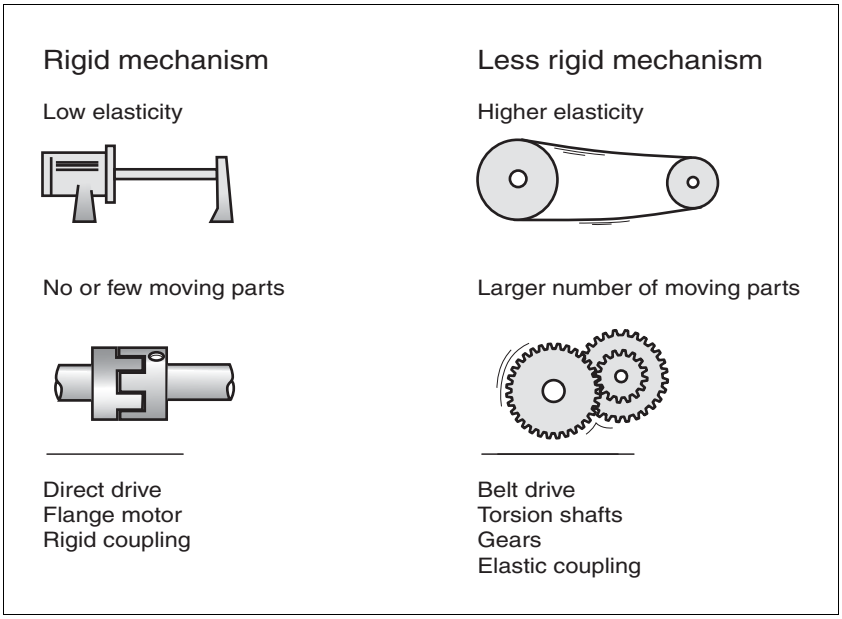

Figure 7.12 Mechanical systems with rigid and less rigid mechanisms

▶ Connect the motor to your system's mechanism.

▶ Test the limit switch function after installing the motor if limit switches are used.

Switch off reference value filter of speed controller

With the reference variable filter you can improve the response behaviour under optimised speed control. The reference value filter must be switched off when setting the speed controller for the first time.

▶ Disable the reference value filter of the speed controller. Set the parameter `CTRL_TAUnref` to the bottom limit value "0".

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_TAUnref -	Filter time constant reference value filter of the speed reference value(7-41)	ms 0.00 9.00 327.67 **Fieldbus** 0 900 32767	UINT16 R/W per. -	CANopen 3012:9$_h$ Modbus 4626

The procedure for optimisation of the settings described is only a suggested setting. It is responsibility of the user to decide whether the method is suitable for the actual application.

Determining controller values with rigid mechanics

Requirements for setting the control behaviour as per the table are:

- a known and constant inertia of load and motor
- a rigid mechanism

The P-factor `CTRL_KPn` and the correction time `CTRL_TNn` depend on:

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- J_L: Mass moment of inertia of the load
- J_M Mass moment of inertia of the motor

▶ Determine the controller values based on Table 7.2:

	$J_L=J_M$		$J_L=5 * J_M$		$J_L=10 * J_M$	
J_L[kgcm^2]	KPn	TNn	KPn	TNn	KPn	TNn
1	0.0125	8	0.008	12	0.007	16
2	0.0250	8	0.015	12	0.014	16
5	0.0625	8	0.038	12	0.034	16
10	0.125	8	0.075	12	0.069	16
20	0.250	8	0.150	12	0.138	16

Table 7.2 Determining controller values

Determining controller values with less rigid mechanics

For optimisation purposes the P-factor of the speed controller at which the controller adjusts the speed _n_act as quickly as possible without overshooting is determined.

▶ Set the correction time CTRL_TNn to infinite.
CTRL_TNn = 0 ms.

If a load torque is acting on the stationary motor, the correction time must be set just high enough to prevent an uncontrolled change of the motor position.

In drive systems in which the motor is loaded while stationary, e.g. with vertical axis operation, the correction time "infinite" may result in unwanted position deviations, thereby requiring the value to be reduced. However, this can adversely affect optimisation results.

⚠ WARNING

Unexpected motion may cause injury and damage to the system

The jump function moves the motor in speed mode at constant speed until the specified time has expired.

- Check that the selected values for speed and time do not exceed the available distance.
- If possible, use limit switches or stop as well.
- Make sure that a functioning button for EMERGENCY STOP is within reach.
- Make sure that the system is free and ready for motion before starting the function.

Failure to follow these instructions can result in death, serious injury or equipment damage.

▶ Initiate a jump function.

▶ After the first test check the maximum amplitude for the current setpoint _Iq_ref.

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Set the amplitude of the reference value – default was 100 rpm – just high enough so the current setpoint _Iq_ref remains below the maximum value CTRL_I_max. On the other hand, the value selected should not be too low, otherwise friction effects of the mechanism will determine control loop response.

- ▶ Trigger a jump function again if you need to modify _n_ref and check the amplitude of _Iq_ref.
- ▶ Increase or decrease the P-factor in small steps until _n_act adjusts as fast as possible. The following diagram shows the adjustment response required on the left. Overshooting - as shown on the right - is reduced by reducing CTRL_KPn.

Deviations from _n_ref and _n_act result from setting CTRL_TNn to "infinite".

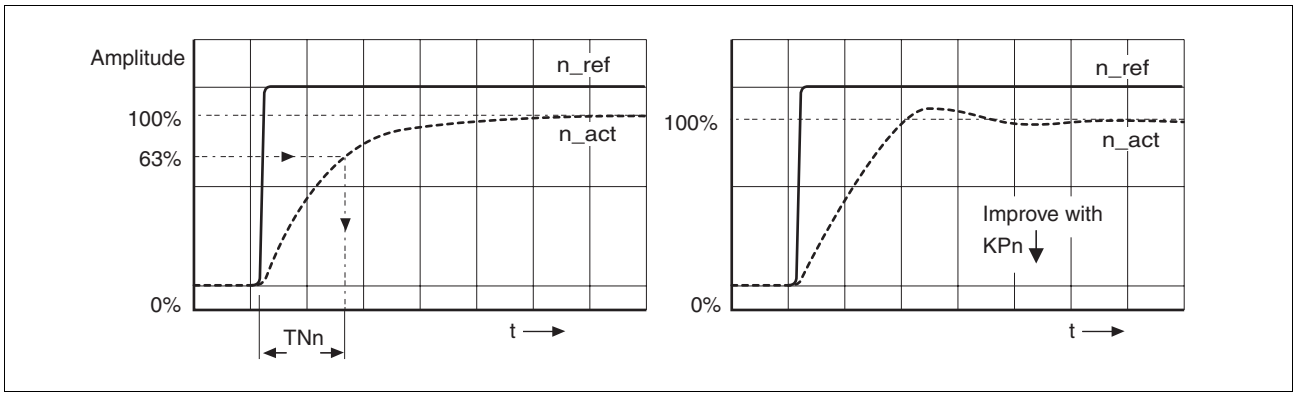

Figure 7.13 Determining 'TNn' in the aperiodic limiting case

For drive systems in which oscillations occur before the aperiodic limiting case is reached, the P-factor "KPn" must be reduced to the exact point where oscillations can no longer be detected. This occurs frequently with linear axes with a toothed belt drive.

Graphical calculation of the 63% value

Determine graphically the point at which the actual speed _n_act reaches 63% of the final value. The correction time CTRL_TNn is then shown as a value on the time axis. The commissioning software will help you with the evaluation:

Malfunctions during optimisation

High-frequency resonances in mechanical components may interfere with controller optimisation. The values for CTRL_KPn and CTRL_TNn cannot be set satisfactorily if this occurs.

The reference value filter of the current controller suppresses high-frequency resonance (>500Hz). However, if high-frequency resonance does interfere with controller optimisation, it may be necessary to increase the time constant with the parameter CTRL_TAUiref.

In most cases the default setting suppresses the high-frequency resonance.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_TAUiref -	Filter time constant reference value filter of the reference current value()	ms 0.00 1.20 4.00 **Fieldbus** 0 120 400	UINT16 R/W per. -	CANopen 3012:10$_h$ Modbus 4640

7.5.4 Checking and optimising default settings

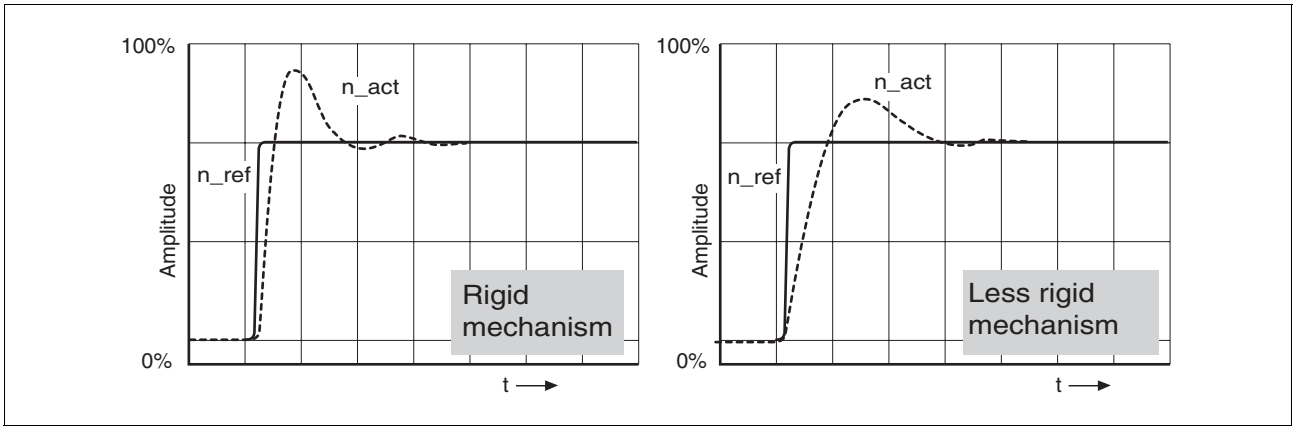

Figure 7.14 Step responses with good control behaviour

The controller is properly set when the jump response is approximately identical to the signal path shown. Good control response can be recognised by

- Fast adjustment
- Overshooting up to a maximum of 40% - 20% is recommended.

If the control response does not correspond to the curve shown, change CTRL_KPn´ in steps of about 10% and then initiate a jump function once again:

- If the controller is too slow: select CTRL_KPn greater.
- If the controller tends to oscillate: select CTRL_KPn smaller.

You can recognise an oscillation by the motor continuously accelerating and decelerating.

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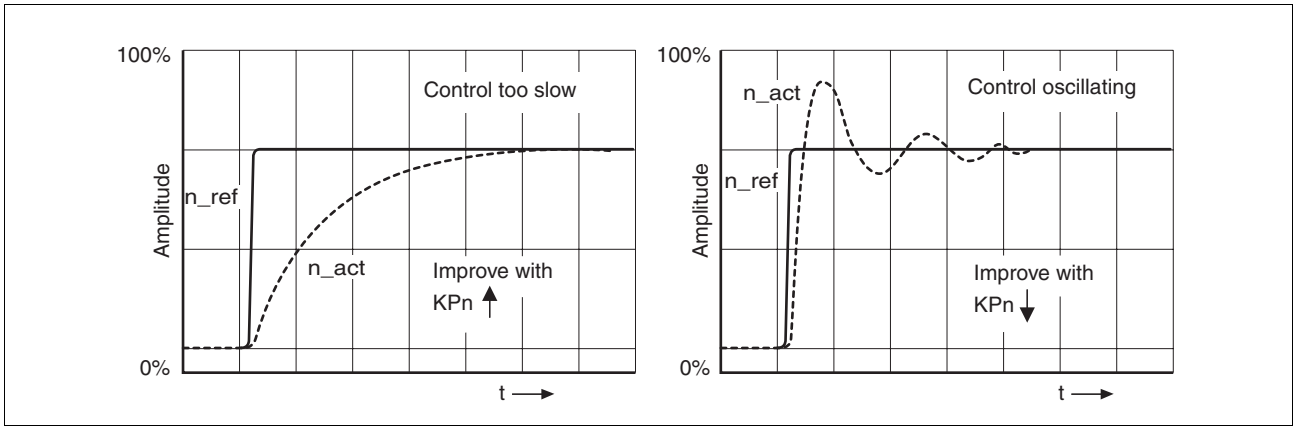

Figure 7.15 Optimise inadequate settings of the speed regulator

If you cannot achieve sufficiently satisfactory controller properties in spite of optimisation, contact your local dealer.

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7.5.5 Optimising the position controller

Optimisation requires a good control response in the lower-ranking speed control circuit.

When setting the position control the P-factor of the position controller CTRL_KPp must be optimised in two limits:

- CTRL_KPp too great: overshooting of the mechanism, instability of the controller
- CTRL_KPp too small: Large following error

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_KPp -	Position controller P-factor(7-47) Default value is calculated	1/s 2.0 - 495.0 **Fieldbus** 20 4950	UINT16 R/W per. -	CANopen 3012:6_h Modbus 4620

⚠ WARNING

Unexpected motion may cause injury and damage to the system

The jump function moves the motor in speed mode at constant speed until the specified time has expired.

- Check that the selected values for speed and time do not exceed the available distance.
- If possible, use limit switches or stop as well.
- Make sure that a functioning button for EMERGENCY STOP is within reach.
- Make sure that the system is free and ready for motion before starting the function.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Setting the reference signal

▶ Select the position controller reference value in the commissioning software.

▶ Set the reference signal:

- Signal form: 'Jump'
- Set amplitude for about 1/10 motor revolution.
  The amplitude is input in user-defined units. At default scaling the resolution is 16384 usr per motor revolution.

Selecting recording signals

▶ Select the values in General Recording Parameters:

- Setpoint of the position controller _p_refusr (_p_ref)
- Actual position of the position controller _p_actusr (_p_act)

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- actual speed _n_act
- current motor current _Iq_ref

Controller values for the position controller can be changed in the same parameter group used for the speed controller.

Optimising the position control value

▶ Start a jump function with the default controller values.

▶ After the first test check the achieved values _n_act and _Iq_ref for current and speed control. The values must not cross into the range of current and speed limiting.

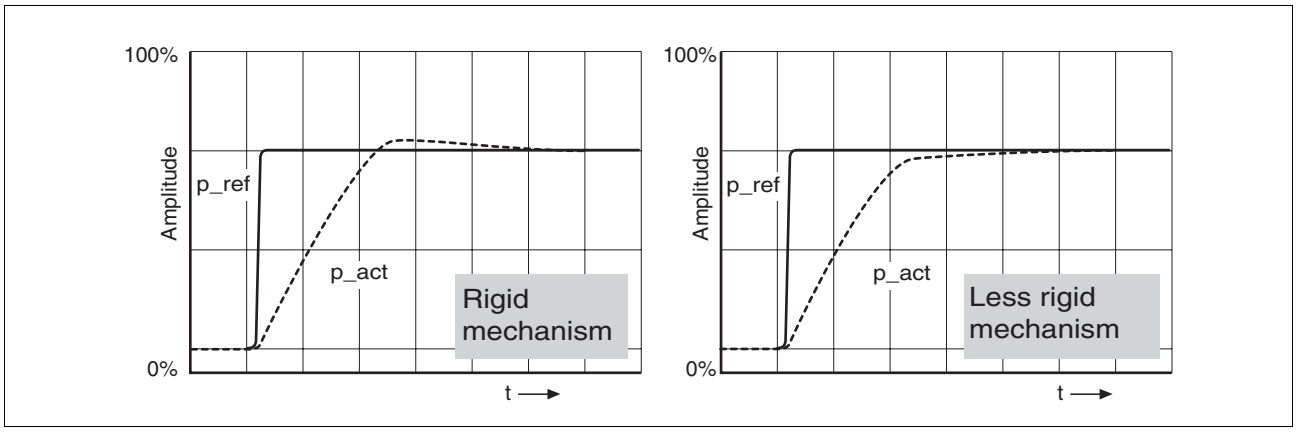

Figure 7.16 Step responses of a position controller with a good control behaviour

The proportional factor CTRL_KPp is at its optimum setting when the motor reaches its target position rapidly and with little or no overshooting.

If the control behaviour does not correspond to the curve shown, change the P-factor CTRL_KPp in steps of about 10% and then initiate a jump function once again.

- If the closed-loop control tends to oscillate: select CTRL_KPp smaller.
- If the actual value is too slow following the reference value: select CTRL_KPp larger.

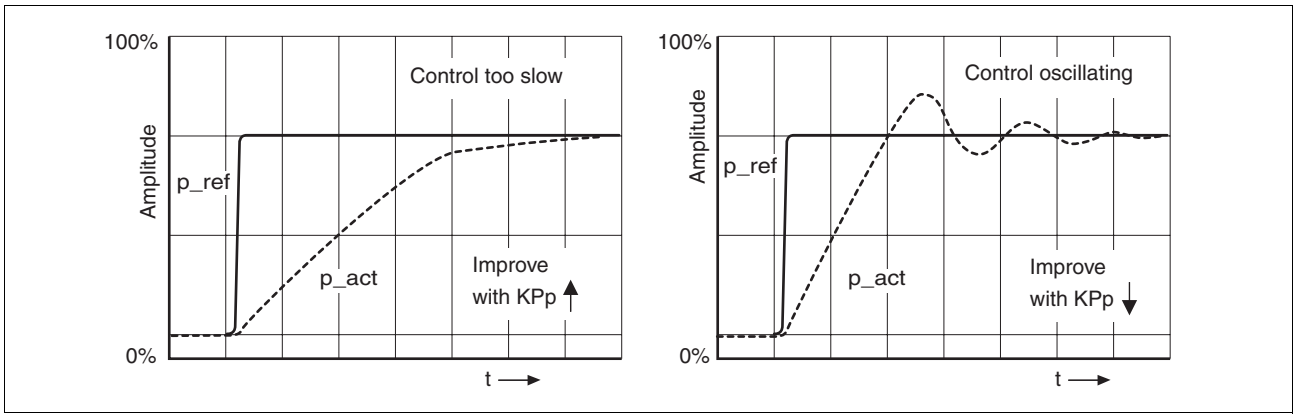

Figure 7.17 Optimising improper settings of the position controller

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8 Operation

The "Operation" section describes the basic operating states, operating modes and functions of the device.

*For an overview of **all** parameters can be found alphabetically sorted in the "parameters" section. The application and the function of some parameters are explained in more detail in this section.*

8.1 Control mode and operating mode management

During initial commissioning, you will have determined during "First Setup", amongst other things, whether the device is to be operated under local control mode or via fieldbus control mode. This determination cannot be altered in running operation.

The operating modes can be changed at any time after ending an operating mode and motor standstill. The choice of operating modes is dependent upon the "First Setup".

Reference value interface

The following table shows the correspondance of operating mode, control mode and reference value interface.

Operating mode	in local control mode	in fieldbus control mode.	Description
Jog	HMI	Fieldbus commands or HMI	Page 8-15
Current control	ANA_IN1	Fieldbus command or ANA_IN1	Page 8-17
Speed control	ANA_IN1	Fieldbus command or ANA_IN1	Page 8-19
Electronic gear	P/D or A/B	P/D or A/B	Page 8-21
Profile position	-	Fieldbus commands	Page 8-25
Profile velocity	-	Fieldbus commands	Page 8-29
Homing	-	Fieldbus commands	Page 8-31

In the case of local control mode, the motion can be initiated using analogue signals (±10V) or with RS422 signals (pulse/direction or A/B)

In the case of fieldbus control mode, the movement can be initiated using analogue signals (±10V) or RS422 signals (pulse/direction or A/B) or fieldbus commands.

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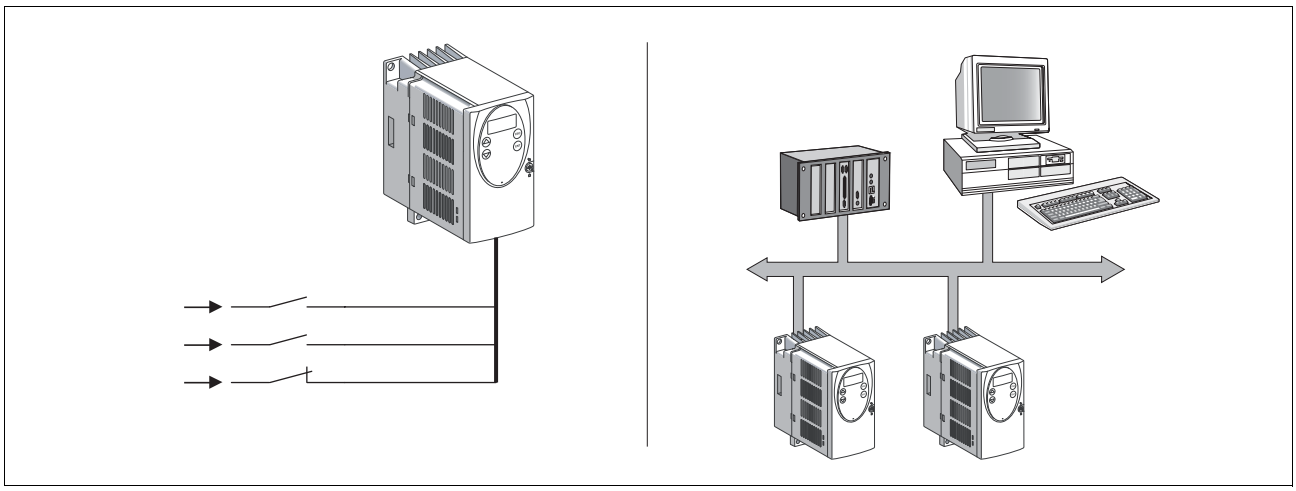

Figure 8.1 Local control mode and fieldbus control mode

Reference value to control loop

The following table shows the correspondance of operating mode, control loop and usage of the profile generator.

Operating mode	Control loop	Profile generator
Jog	position controller	X
Current control	current controller	-
Speed control	speed controller	-
Electronic gear	position controller	-
Profile position	position controller	X
Profile velocity	position controller	X
Homing	position controller	X

8.2 Access monitor

8.2.1 via HMI

The HMI receives the access monitoring when starting the jog operating mode or when starting Autotuning. Control via the commissioning software or by the fieldbus is then not possible.

In addition, the HMI can be locked using the parameter `HMIlocked` This means that control via the HMI is no longer possible.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMIlocked -	Block HMI(8-2) 0: HMI not blocked 1: HMI blocked When the HMI is blocked the following actions are no longer possible: - Change parameters - Manual operation (Jog) - Autotuning - FaultReset	- 0 0 1	UINT16 R/W per. -	CANopen 303A:1_h Modbus 14850

8.2.2 via fieldbus

Local control mode Access monitoring via fieldbus is not possible when in local control mode. It is, however, possible to enter parameters via the fieldbus .

Fieldbus control mode In the case of fieldbus control mode, the parameter AccessLock can be used to limit the access monitoring to the fieldbus .

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
AccessLock -	Blocking of other access channels(8-2) 0: Other access channels enabled 1: Other access channels blocked This parameter allows the fieldbus to block active access to the device for the following access channels: - Commissioning tool - HMI - a second fieldbus The processing of the input signals (e.g. Stop-input) cannot be blocked.	- 0 - 1	UINT16 R/W - -	CANopen 3001:$1E_h$ Modbus 316

8.2.3 via commissioning software

The commissioning software receives the access monitor via the "Activate" button. Access via HMI or fieldbus is then not possible.

8.2.4 via hardware input signals

In the local control mode the digital input signals $\overline{\text{HALT}}$, FAULT_RESET, ENABLE, $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ are always effective, even if the HMI or the commissioning software control the access.

In fieldbus control mode the digital input signals $\overline{\text{HALT}}$, $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ are always effective, even if the HMI or the commissioning software control the access.

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8.3 Operating states

8.3.1 Status diagram

After switching on and at the start of an operating mode, a sequence of operating states is progressed through.

The relationship between the operating states and the state transitions is shown in the state diagram (state machine).

The operating states are internally monitored and influenced by monitoring and system functions, such as temperature and current monitoring

Graphic representation The state diagram is shown graphically as a flow chart.

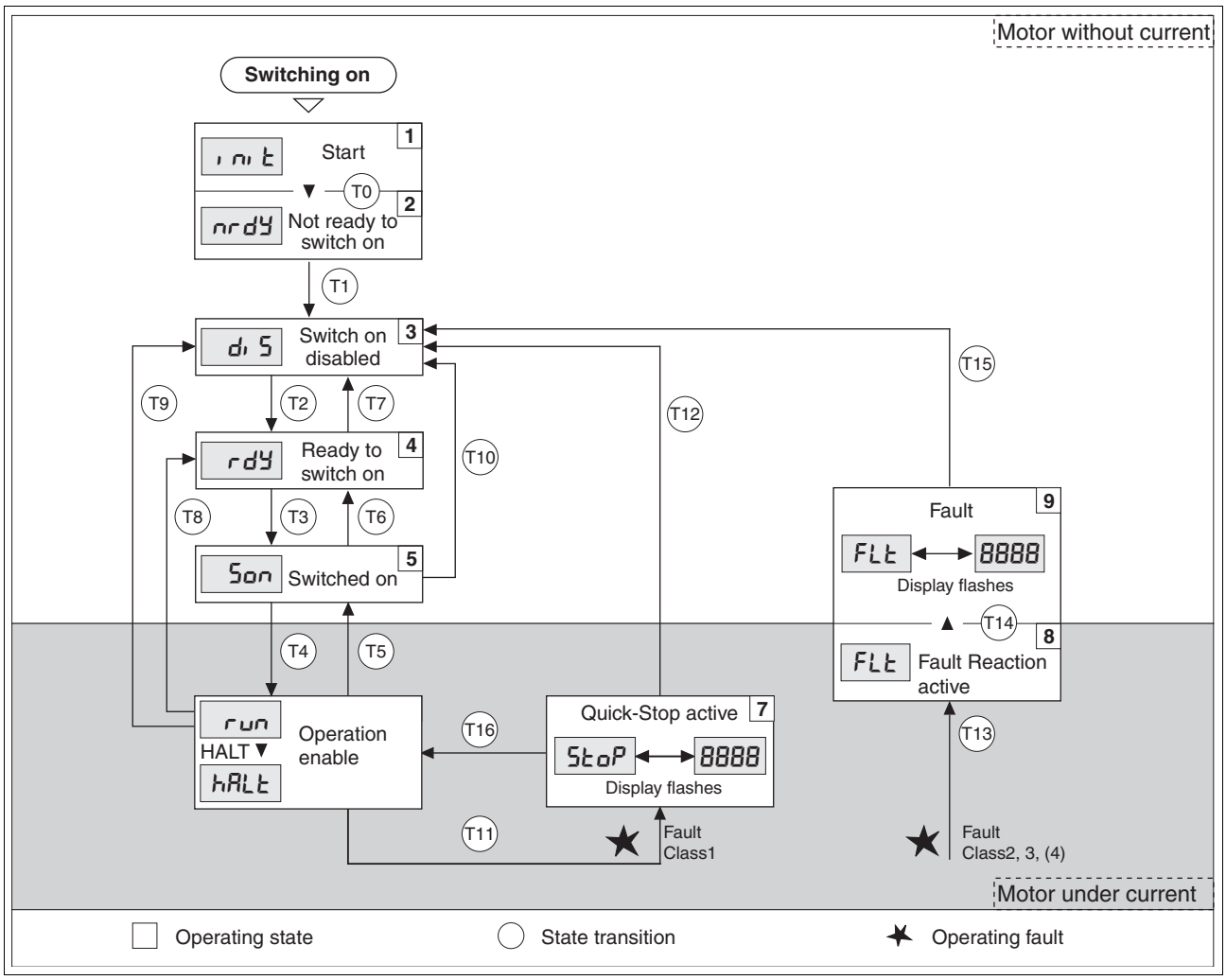

Figure 8.2 Status diagram

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Operating states

The operating states are displayed as standard by the HMI and the commissioning software.

Display	Status	State description
init	**1** Start	Controller supply voltage, electronics is initialised
nrdy	**2** Not ready to switch on	The power amplifier is not ready to switch on
di S	**3** Switch on disabled	Switching on the power amplifier is disabled
rdy	**4** Ready to switch on	The power amplifier is ready to switch on
Son	**5** Switched on	Motor not under current Power amplifier ready No operating mode active
run hALt	**6** Operation enable	RUN: device running in the selected operating mode HALT: The motor is stopped with active power amplifier
StoP	**7** Quick Stop active	"Quick Stop" is executed
FLt	**8** Fault Reaction active	Error detected, error response is enabled
FLt	**9** Fault	device is in error condition

Error response

The state transition T13 initiates an error response as soon as an internal occurrence indicates an operation error to which the device must react. The description of the error classification can be seen in the diagnostics chapter.

Error class	Statusfrom -> to	Response
2	**x** -> **8**	Braking with "Quick Stop" Brake is closed Power amplifier is switched off
3.4 or "Power Removal"	**x** -> **8 -> 9**	Power amplifier is switched off immediately, even if "Quick Stop" is still active

Table 8.1 Error response at state transition T13

An operating error can be indicated by, for example, a temperature sensor. The device interrupts the travel command and carries out an error response e.g. braking and stopping with "Quick Stop" or switching off the power amplifier. Subsequently the operating status changes to "Fault".

To leave the operating status "Fault" the cause of the error must be corrected and a "Fault Reset"run with the input signal FAULT_RESET or the parameter DCOMcontrol.

*In the case of a "Quick Stop" triggered by errors of class 1 (operating status **7**), a "Fault Reset" triggers a direct return to the operating status **6**.*

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State transitions Status transitions are triggered by an input signal, a fieldbus command (with fieldbus control mode only) or as a response to a monitoring signal.

Transition	Operating status	Condition / result [1]	Response
T0	**1** -> **2**	• Motor speed below switch-on limit • Device electronics successfully initialised	Check motor encoder
T1	**2** -> **3**	• First commissioning is completed	-
T2	**3** -> **4**	• Motor encoder successfully checked, DC bus voltage active, $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ = +24V, actual speed: <1000 rpm fieldbus command: Shutdown [2]	-
T3	**4** -> **5**	• Fieldbus command Switch On • Input signal ENABLE0 -> 1	
T4	**5** -> **6**	• Fieldbus command Enable Operation	Switch on power amplifier. Motor phases, earthing, user parameters are checked Release brake
T5	**6** -> **5**	• Fieldbus command Disable Operation • Input signal ENABLE0 -> 1	Interrupt travel command with "Halt" Apply brake Switch off power amplifier
T6	**5** -> **4**	• Fieldbus command Shutdown	
T7	**4** -> **3**	• DC BUS undervoltage • $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ = 0V • Actual speed: >1000 rpm (e.g. by auxiliary drive) • Fieldbus command Disable Voltage	-
T8	**6** -> **4**	• Fieldbus command Shutdown	Switch off power amplifier immediately
T9	**6** -> **3**	• Fieldbus command Disable Voltage	Switch off power amplifier immediately
T10	**5** -> **3**	• Fieldbus command Disable Voltage	
T11	**6** -> **7**	• Class 1 error • Fieldbus command Quick Stop	Interrupt travel command with "Quick Stop"
T12	**7** -> **3**	• Fieldbus command Disable Voltage	Switch off power amplifier immediately, even if "Quick Stop" still active
T13	**x** -> **8**	• Errors Class 2, 3 or 4	Error response is carried out, see "error response"
T14	**8** -> **9**	• Error response completed • Errors Class , 3 or 4	
T15	**9** -> **3**	• Fieldbus command Fault Reset [3] • Input signal FAULT_RESET0 -> 1 [3]	Error is reset
T16	**7** -> **6**	• Fieldbus command Fault Reset [3] • Input signal FAULT_RESET0 -> 1 [3] • Fieldbus command Enable Operation [4]	Local control mode specified operating mode is automatically continued

1) It is sufficient to fulfil one point to trigger the status transition
2) Only required with fieldbus control mode, fieldbus CANopen and parameter DCOMcompatib = 1

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3) Cause of error must be corrected
4) Only possible if operating status was triggered via fieldbus

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8.3.2 Changing operating states

Local controller operating mode

In local controller operating mode, the change of operating state takes place either via the commissioning software, the signal inputs or automatically.

Input signal	State transitions	State change to
ENABLE 0 -> 1	T3, T4	**6**: Operation enable
ENABLE 1 -> 0	T5, T6	**4**: Ready to switch on
FAULT_RESET 0 -> 1	T15 T16	**4**: Ready to switch on **6**: Operation enable

Fieldbus control mode

In the case of fieldbus control mode, the operating states are set either by the commissioning software or by the parameter `DCOMcontrol`. Bits 0 to 3 and Bit 7 are relevant for a state change

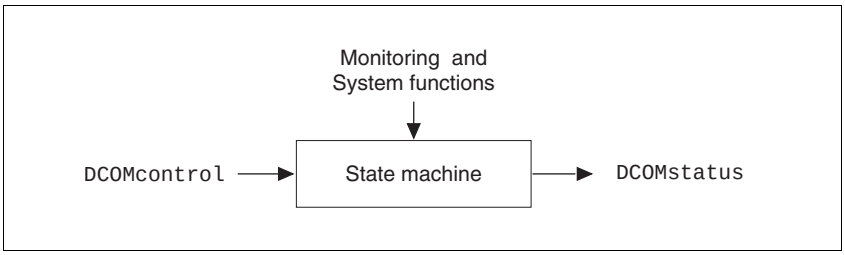

Figure 8.3 Changing and monitoring the operating status via parameters

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
DCOMcontrol -	Drivecom control word(8-8) For bit coding see chapter on operation, operating states 0: Switch On 1 Enable Voltage 2: QuickStop 3: Enable Operation 4..6: op. mode specific 7: Fault Reset 8: Halt 9..15: reserved (must be 0)	- - 	UINT16 R/W - -	CANopen 6040:0$_h$ Modbus 6914

Bit 0 to 3 and 7

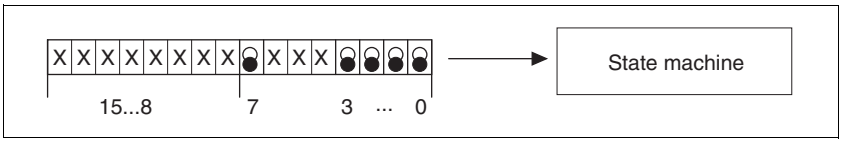

Figure 8.4 Changing the operating status

Fieldbus command	state transitions	Change of state to	Bit 7, Reset Fault	Bit 3, Enable operation	Bit 2, Quick Stop	Bit 1, Enable Voltage	Bit 0, Switch On
Shutdown	T2, T6, T8	**4**: Ready to switch on	X	X	1	1	0
Switch On	T3	**5**: Switched on	X	X	1	1	1

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Fieldbus command	state transitions	Change of state to	Bit 7, Reset Fault	Bit 3, Enable operation	Bit 2, Quick Stop	Bit 1, Enable Voltage	Bit 0, Switch On
Disable Voltage	T7, T9, T10, T12	**3**: Switch on disabled	X	X	X	0	X
Quick Stop	T7, T10T11	**3**: Switch on disabled**7**: Quick Stop active	X	X	0	1	X
Disable Operation	T5	**5**: Switched on	X	0	1	1	1
Enable operation	T4, T16	**6**: Operation enable	X	1	1	1	1
Fault Reset	T15	**3**: Switch on disabled	0 -> 1	X	X	X	X

The bit states in the fields marked with "X" have no meaning that particular status change.

Bit 4 to 6 Bits 4 to 6 are used for the operating mode specific settings. Details can be found in the description of the individual operating modes in this chapter.

Bit 8, Halt Bit 8=1 can initiate a "Halt".

Bit 9 to 15 reserved

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8.3.3 Displaying the operating states

Local control mode

In local control mode the operating status is displayed via the signal outputs, the HMI or the commissioning software.

Status	NO_FAULT_OUT	ACTIVE1_OUT
2: Not ready to switch on	0	0
3: Switch on disabled	0	0
4: Ready to switch on	1	0
5: Switched on	1	0
6: Operation enable	1	1
7: Quick Stop active	0	1
9: Fault	0	0

Fieldbus control mode

In fieldbus control mode the operating status is displayed via the signal inputs, the fieldbus , the HMI or the commissioning software.

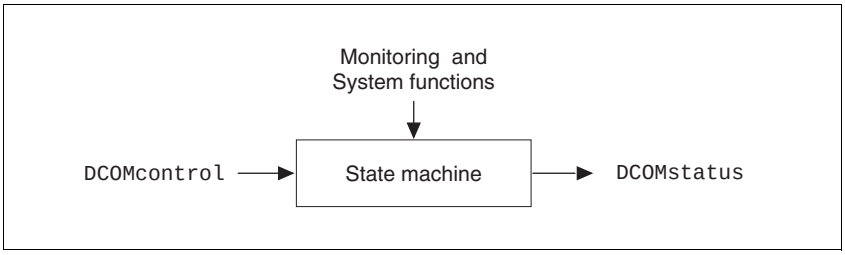

Figure 8.5 Changing and monitoring the operating status via parameters

Status information

The parameter `DCOMstatus` provides global information on the operating state of the unit and the processing state.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
DCOMstatus -	Drivecom status word(8-10) For bit coding see chapter on operation, status machine 0-3,5,6: Status bits 4: Voltage enabled 7: Warning 8: HALT request active 9: Remote 10: Target reached 11: reserved 12: op. mode specific 13: x_err 14 x_15err ref_ok	- - 	UINT16 R/- - -	CANopen 6041:0$_h$ Modbus 6916

Bit 0 to 3, 5 and 6

The status of the state diagram is displayed by bits 0 to 3, 5 and 6 of the parameter `DCOMstatus`.

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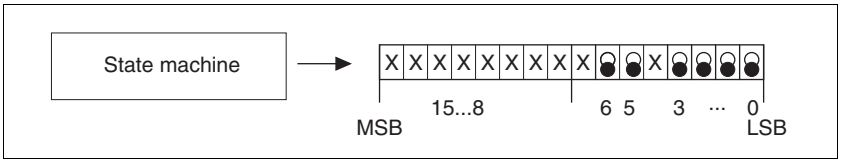

Figure 8.6 Display of operating status

Status	Bit 6,Switch Ondisable	Bit 5, Quick Stop	Bit 3,Fault	Bit 2, OperationE-NABLE	Bit 1, Switch On	Bit 0, Ready toSwitch On
2: Not ready to switch on	0	X	0	0	0	0
3: Switch on disabled	1	X	0	0	0	0
4: Ready to switch on	0	1	0	0	0	1
5: Switched on	0	1	0	0	1	1
6: Operation enable	0	1	0	1	1	1
7: Quick Stop active	0	0	0	1	1	1
9: Fault	0	X	1	1	1	1

Bit 4, Voltage enabled Bit 4=1 indicates whether the DC bus voltage is correct. If the voltage is missing or is too low, then the device does not change from state 3 to state 4.

Bit 7, Warning Bit 7 becomes 1 if a warning message is pending in parameter `_WarnActive`. The movement mode is not interrupted. The bit remains set so long as a warning message is pending in parameter `_WarnActive`. The bit remains set for at least 100ms, even if a warning message is pending for a shorter time. The bit is reset immediately at a "Fault Reset".

Bit 8, Halt request active Bit 8=1 indicates that a "Halt" is active.

Bit 9, Remote If Bit 9 is set, then the device carries out commands via the fieldbus bus. If Bit 9 is set, then the device is controlled from a different interface. The fieldbus then allows other parameters to be read and written.

Bit 10, Target reached Bit 10 only becomes "1“, if the operating mode is completed successfully and the motor stops. Bit 10 has the value “0”, as long as the motor is running, if the operating mode is interrupted by a "Halt" or discontinued because of an error.

Bit 11 reserved

Bit 12 Bit 12 is used for the monitoring the current operating mode. Details can be found in the chapter for the individual operating mode.

Bit 13, x_err Bit 13 only becomes "1“ in the case of an error which needs to be rectified by the further processing. The device responds corresponding to an error class, see page 10-2.

Bit 14, x_end Bit 14 changes to "0“, if an operating mode is started. When the process is complete or if the process is discontinued e.g. by a "Halt", Bit 14 changes back to "1" when the motor is at a standstill.
Bit 14's signal change to '1' is suppressed if one process is followed immediately by a new process in a different operating mode.

Bit 15, ref_ok Bit 15 is "1" if the motor or the axis has a valid reference point, e.g. by a reference movement.

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8.4 Starting and changing operating modes

⚠ WARNING

Danger of personal injury and damage to system parts by uncontrolled system operation!

- Note that inputs to these parameters are executed by the drive controller immediately on receipt of the data set.
- Make sure that the system is free and ready for movement before changing these parameters

Failure to follow these instructions can result in death, serious injury or equipment damage.

Requirements

To start an operating mode the unit must be ready to start and correctly initialised.

An operating mode cannot be carried out in parallel with another operating mode. If an operating mode is active, then you can only change to a different operating mode if the current operating mode is completed or is discontinued.

An operating mode is completed if the drive is at a standstill, e.g. if the target position of a positioning process is reached or if the drive is stopped by a "Quick Stop" or "Halt". If a fault occurs during the process which leads to the discontinuation of a current operating mode, then, after the cause of the fault has been removed, the traverse operation can be resumed, or you can change to a different operating mode.

8.4.1 Start operating mode

Local control mode

In the case of local control mode, after starting, the device changes to the operating mode set using the parameter `IOdefaultMode`

The motor is placed under current by setting the input signal `ENABLE` and the set operating mode is started.

In addition, a "jog" or "Autotuning" can be started with the HMI.

Fieldbus control mode

In the case of fieldbus control mode, the operating mode is started using the parameter `DCOMopmode` .

The following table shows the sequence of parameters for starting an operating mode with the example of the current control operating mode.

	Parameter	Description
1	CUR_I_target	Transmission of the reference value
2	CURreference	Setting the reference quantity
3	DCOMopmode	Calling up the operating mode (-3)

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CUR_I_target -	Set current in operating mode current control(8-17)	A_{pk} -300.00 0.00 300.00 **Fieldbus** -30000 0 30000	INT16 R/W - -	CANopen 3020:4_h Modbus 8200
CURreference -	Selection of preset source for current control operating mode() 0: no 1: Reference value via +/-10V-interface ANA1 2: Reference value via parameter CUR_I_target	- 0 0 2	UINT16 R/W - -	CANopen 301B:10_h Modbus 6944
DCOMopmode -	Operating mode() DSP402-operating modes 1: Profile position 3 Profile velocity 6 : Homing ---------- Manufacturer operating modes: -1: jog -2: electronic gear -3: current control -4 : speed control -7 : oscillator mode	- -6 - 6	INT16 R/W - -	CANopen 6060:0_h Modbus 6918

In the case of the Profile Position and Homing mode, the device receives the instruction to start the set operating mode by Bit 4 in the parameter `DCOMcontrol`.

For all other operating modes, the Bits 4 to 6 are not occupied.

8.4.2 Change operating mode

Local control mode

When the drive is at a standstill, the default operating mode can be changed using the parameter `IOdefaultMode`. The operating modes cannot be changed whilst the operation is in process.

Fieldbus control mode

The operating modes can be changed whilst the operation is in process. For this purpose, the current process must be completed or explicitly discontinued. The drive must be at a standstill. Proceed then as shown under "Starting the Operating Mode".

Exceptions to this are the operating modes current control and speed control. The motor need not be at a standstill to change between these two operating modes

Two parameters are available for displaying the current operating mode and for switching the operating modes.

- Parameter for display: `_DCOMopmd_act`
- Parameter for change: `DCOMopmode`

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_DCOMopmd_act -	active operating mode(8-13) Coding see: DCOMopmode	- -6 - 6	INT16 R/- - -	CANopen 6061:0_h Modbus 6920
DCOMopmode -	Operating mode(8-12) DSP402-operating modes 1: Profile position 3 Profile velocity 6 : Homing ---------- Manufacturer operating modes: -1: jog -2: electronic gear -3: current control -4 : speed control -7 : oscillator mode	- -6 - 6	INT16 R/W - -	CANopen 6060:0_h Modbus 6918

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8.5 Operating modes

8.5.1 Jog operation mode

⚠ WARNING

Danger of personal injury and damage to system parts by uncontrolled system operation!

- Note that inputs to these parameters are executed by the drive controller immediately on receipt of the data set.
- Make sure that the system is free and ready for movement before changing these parameters

Failure to follow these instructions can result in death, serious injury or equipment damage.

Description

The motor traverses by one traverse unit or at constant speed in continuous running. The length of the traverse unit, the speed steps and the change-over time in continuous running can be adjusted.

The current axis position is the start position for the jog operating mode. Position and speed values are input in user-defined units.

Start operating mode

The operating mode can be started via the HMI. The power amplifier becomes active and the motor is under current by calling up the JoG- / Strt. The motor runs by pushing the "up arrow" or "down arrow" buttons. You can change between slow and fast movement by simultaneously pushing the ENT-button.

With fieldbus control mode the operating mode must be set in parameter DCOMopmode. The writing of the parameter value simultaneously causes the start of the operating mode. With the start signal for the jog the motor first moves over a defined travel JOGstepusr. If the start signal is still pending after a specified delay time JOGtime, the device switches to continuous operation until the start signal is cancelled.

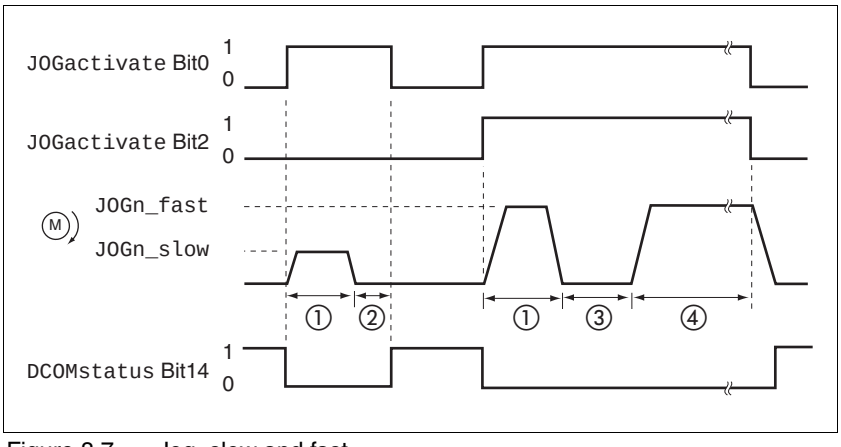

Figure 8.7 Jog, slow and fast

(1) JOGstepusr
(2) t < JOGtime
(3) t > JOGtime
(4) Continuous operation

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The inching distance, delay and jog speeds can be set. If the inching distance is zero, jog starts directly with continuous movement irrespective of the delay.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
JOGactivate -	Activation of jog(8-15) Bit0: clockwise rotation Bit1 : counterclockwise rotation Bit2 : 0=slow 1=fast	- 0 - 7	UINT16 R/W - -	CANopen 301B:9_h Modbus 6930
JOGn_slow NSLW JOG-nSLL	Speed for slow jog(8-15) The setting value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 60 13200	UINT16 R/W per. -	CANopen 3029:4_h Modbus 10504
JOGn_fast NFST JOG-nFSt	Speed for fast jog(8-15) The setting value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 180 13200	UINT16 R/W per. -	CANopen 3029:5_h Modbus 10506
JOGstepusr -	inching distance before continuous operation(8-15) 0: direct activation of continuous operation >0: positioning section per inching cycle	usr 0 20	INT32 R/W per. -	CANopen 3029:7_h Modbus 10510
JOGtime -	Waiting time before continuous operation(8-15) Time is only effective if an inching distance not equal to 0 has been set, otherwise direct transition to continuous operation.	ms 1 500 32767	UINT16 R/W per. -	CANopen 3029:8_h Modbus 10512

End operating mode Jog is finished when the motor has stopped and

- the directional signal is inactive.
- the operating mode has been interrupted by "Halt" or an error

Further possibilities For further setting possibilities and functions for the operating mode see from page 8-45.

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8.5.2 Current control operating mode

Overview of current control

In the operating mode current control the reference value of the motor current is specified by the ±10V analogue input or by parameters.

The following overview shows the effectivity of the parameters which can be set for the operating mode.

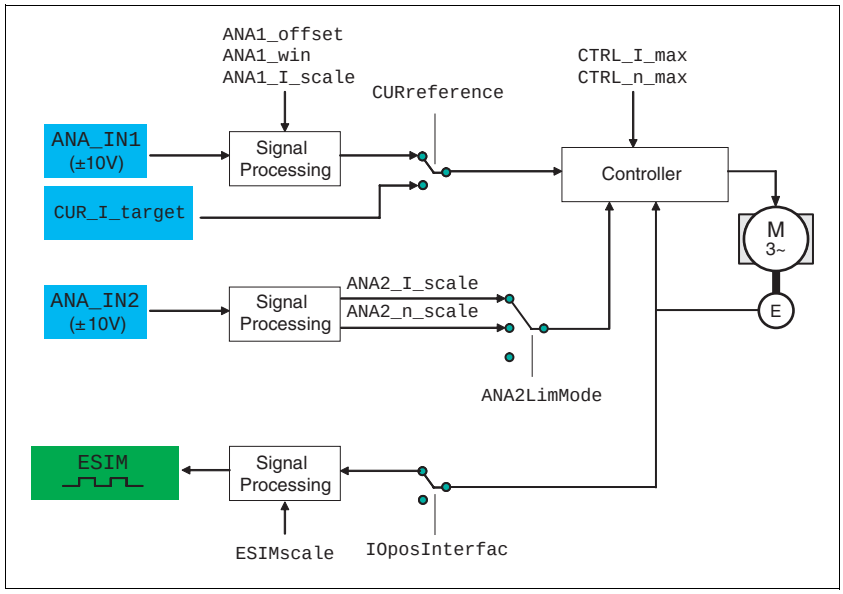

Figure 8.8 Operating mode current control, effects of settable parameters

Start operating mode

In the case of local control mode, the operating mode must be set using the parameter `IOdefaultMode` . The power amplifier becomes active, the motor receives current and the inputs are evaluated in accordance with the setting by setting the input signal `ENABLE`.

In the case of fieldbus control mode, the operating mode must be set using the parameter `DCOMopmode` . The writing of the parameter value simultaneously causes the start of the operating mode.

Setting thresholds

For setting current limiting and speed limiting see 7.4.3 “Setting basic parameters and limit values“.

⚠ WARNING

Unexpected acceleration may cause injury and damage to the system.

The drive in current regulation mode can reach extreme speeds when operated without limits or load.

- Check the configured speed limiter.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Setting to the set value

In the case of local controlmode, the analogue input `ANA1` is automatically evaluated.

In the case of fieldbus control mode, the parameter `CURreference` determines whether the analogue input `ANA1` or the parameter `CUR_I_target` is to be evaluated.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CURreference -	Selection of preset source for current control operating mode(8-17) 0: no 1: Reference value via +/-10V-interface ANA1 2: Reference value via parameter CUR_I_target	- 0 0 2	UINT16 R/W - -	CANopen 301B:10_h Modbus 6944
CUR_I_target -	Set current in operating mode current control(8-17)	A_{pk} -300.00 0.00 300.00 **Fieldbus** -30000 0 30000	INT16 R/W - -	CANopen 3020:4_h Modbus 8200

Reference value at +10V input signal

The progress of the reference value in relation to the ±10V input value can be altered:

- Setting the reference value at +10V
- Setting parameters for a zero voltage window
- Setting parameters for a voltage offset

For setting options for the analogue inputs see 7.4.4 “Analogue inputs“.

The device calculates a current value, with which the motor accelerates to a speed which is limited by the load moment, from the ±10 V analogue value preset. Without a load the motor therefore accelerates to the variable speed limit.

Example local controller operating mode

An example of setting by parameters in the case of local controller operating mode can be found on page 9-3.

End operating mode

The processing in the operating mode is completed if the operating mode has been "deactivated" and the drive is at a standstill, or if the motor speed has taken the value = 0 as a result of a fault.

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8.5.3 Speed control operating mode

Description

In the operating mode speed regulation, the set reference value of the motor speed is provided either via the ±10V analogue input or by parameter.

Transitions between two speeds can only take place in relation to the set control parameters. Compare this to the operating mode velocity profile, where the transitions are defined by a profile generator.

The following overview shows the effectivity of the parameters which can be set for the operating mode.

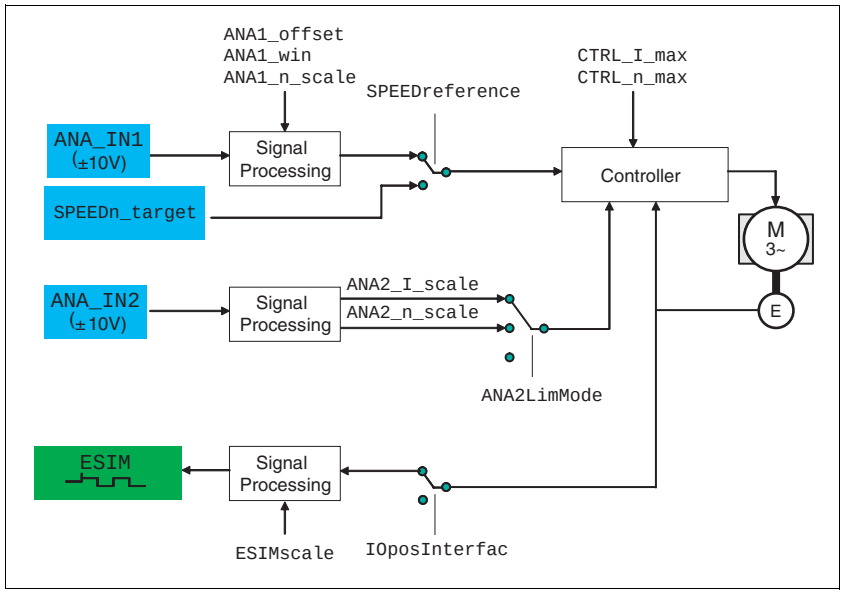

Figure 8.9 Operating mode speed control , effect of settable parameters

Start operating mode

In the case of local control mode, the operating mode must be set using the parameter `IOdefaultMode` . The power amplifier becomes active, the motor receives current and the inputs are evaluated in accordance with the setting by setting the input signal ENABLE.

In the case of fieldbus control mode, the operating mode must be set using the parameter `DCOMopmode` . The writing of the parameter value simultaneously causes the start of the operating mode.

Setting thresholds

For setting current limiting and speed limiting see 7.4.3 “Setting basic parameters and limit values“.

Setting to the set value

In the case of local control mode, the analogue input ANA1 is automatically evaluated.

In the case of fieldbus control mode, the parameter `SPEEDreference` determines whether the analogue input ANA1 or the parameter `SPEEDn_target` is to be evaluated.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPEEDreference -	Selection of preset source for speed control operating mode(8-19) 0: no 1: Reference value via +/-10V-interface ANA1 2: Reference value via parameter SPEEDn_target	- 0 0 2	UINT16 R/W - -	CANopen 301B:11$_h$ Modbus 6946
SPEEDn_target -	Set speed in operating mode speed control(8-19) The internal maximum speed is limited by the current setting in CTRL_n_max	1/min -30000 0 30000	INT16 R/W - -	CANopen 3021:4$_h$ Modbus 8456

Reference value at +10V input signal

The progress of the reference value in relation to the ±10V input value can be altered:

- Setting the reference value at +10V
- Setting parameters for a zero voltage window
- Setting parameters for a voltage offset

For setting options for the analogue inputs see 7.4.4 “Analogue inputs“.

Example local controller operating mode

An example of setting by parameters in the case of local controller operating mode can be found on page 9-3.

End operating mode

The processing in the operating mode is completed if the operating mode has been "deactivated" and the drive is at a standstill, or if the motor speed has taken the value = 0 as a result of a fault.

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8.5.4 Electronic gear operation mode

⚠ WARNING

Danger of personal injury and damage to system parts by uncontrolled system operation!

- Note that inputs to these parameters are executed by the drive controller immediately on receipt of the data set.
- Make sure that the system is free and ready for movement before changing these parameters

Failure to follow these instructions can result in death, serious injury or equipment damage.

Description In the electronic gear operating mode reference signals are fed in as A/B signals or as pulse/direction signals. They are offset to a new position preset with an adjustable gear ratio.

The specification whether A/B signals or pulse/direction signals should processed depends on the setting of the parameter `IOposInterfac`.

Example An NC control provides reference signals to two units. The motors execute different, proportional positioning movements in accordance with the gear ratios.

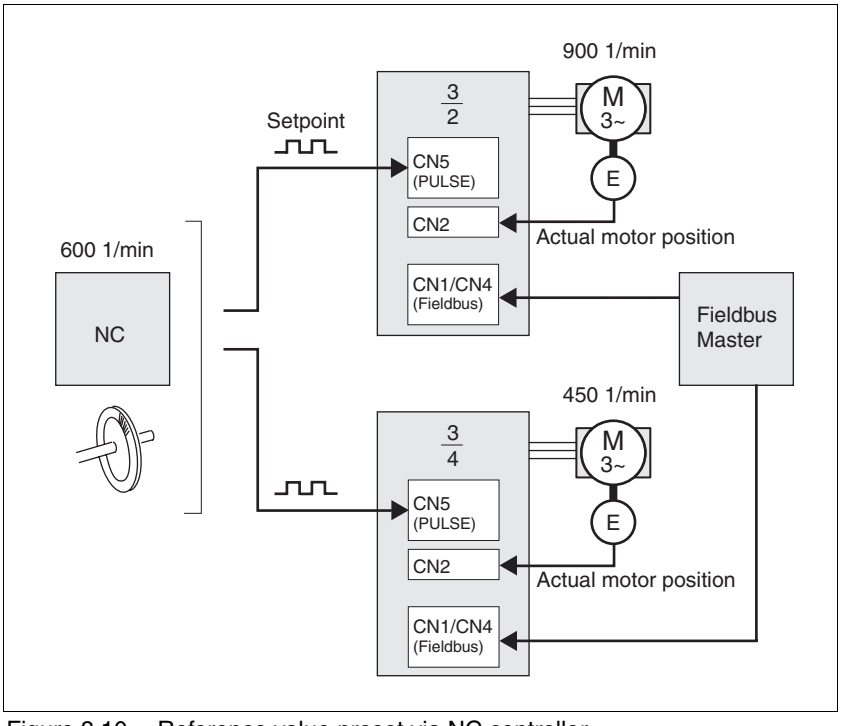

Figure 8.10 Reference value preset via NC controller

Start operating mode In the case of local control mode, the operating mode must be set using the parameter `IOdefaultMode` . The power amplifier becomes active, the motor receives current and the inputs are evaluated in accordance with the setting by setting the input signal ENABLE.

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In the case of fieldbus control mode, the operating mode must be set using the parameter DCOMopmode . The writing of the parameter value simultaneously causes the start of the operating mode.

The type of synchronisation is set and the gear processing is started by a write command on the parameter GEARreference . If positioning changes at the reference signals are stored, then the unit computes these with the gear factor and positions the motor to the new set position.

Positioning values are given in internal units. The unit performs the changes immediately.

End operating mode

The process is ended by:

- disabling the operating mode and motor at standstill
- motor standstill by "Halt" or by an error

8.5.4.1 Setting parameters

Example local controller operating mode

An example of setting by parameters in the case of local controller operating mode can be found on page 9-3.

Overview

The following overview shows the effectiveness of the parameters which can be set for the operating mode electronic gear.

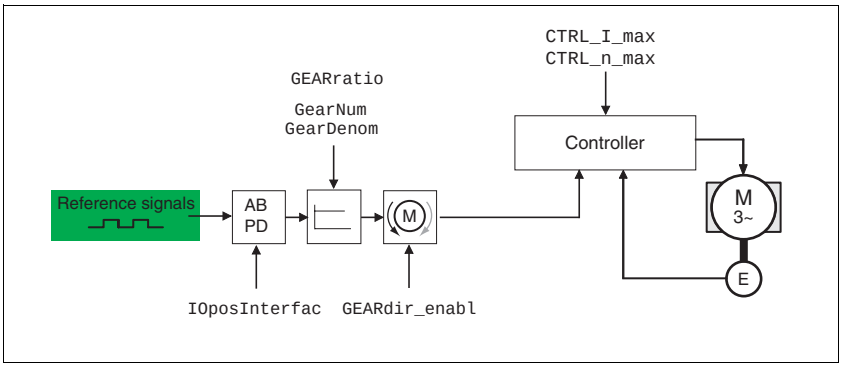

Figure 8.11 Operating mode electronic gear, effect of settable parameters

The resulting positioning movement is dependent upon the current motor resolution. It amounts to 131072 motor increments per revolution.

The setting values for the electronic gear, independent of the type of synchronisation, are:

- Gear factor (predefined value or intrinsic gear factor)
- size of following error
- Release of the direction of rotation

Setting thresholds

For setting current limiting and speed limiting see 7-19.

Synchronisation

In the case of the operating mode electronic gear, the device operates synchronously in interconnected gears, e.g. with other drives. If the device leaves the gear processing for a short period of time, then the synchronous run with other drives is lost.

- With local control mode position changes are not evaluated at the reference signals that occur during the interruption. When restarting gear processing the device tracks the reference signal from the time at which the gear processing was enabled again.

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- With fieldbus control mode position changes are internally counted at the reference signals that occur during the interruption. The parameter GEARreference can be used to set whether these positioning changes are to be processed or ignored when the gear processing is resumed.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
GEARreference -	Operating mode electronic gear processing(8-21) 0: disabled 1: Real-time synchronisation 2: Synchronisation with compensation movement	- 0 0 2	UINT16 R/W - -	CANopen 301B:12$_h$ Modbus 6948

Gear ratio The gear ratio is the relationship between the motor increments and the externally inputted guide increments for the movement of the motor.

$$\text{Gear factor} = \frac{\text{Motor increments}}{\text{Reference increments}} = \frac{\text{Gear factor numerator}}{\text{Gear factor denominator}}$$

The parameter GEARratio serves to set the predefined gear ratio. Alternatively, an intrinsic gear ratio can be selected.

The intrinsic gear ratio is determined with the parameters count and name. A negative numerator value reverses the motor's direction of rotation. The gear ratio is preset to 1:1.

Example At a setting of 1000 reference increments the motor should rotate 2000 motor increments. This yields a gear ratio of 2.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
GEARratio GFAC SET-GFAC	Selection of special gear ratios(8-21) 0: Use of the specified gear ratio from GEARnum/GEARdenom 1 : 200 2 : 400 3: 500 4 : 1000 5 : 2000 6 : 4000 7 : 5000 8: 10000 9 : 4096 10 : 8192 11 : 16384 Changing the reference variable by the stated value causes the motor to make one revolution.	- 0 0 11	UINT16 R/W per. -	CANopen 3026:6$_h$ Modbus 9740

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
GEARnum -	Gear ratio numerator(8-21) $\text{Gear ratio} = \frac{\text{GEARnum}}{\text{GEARdenom}}$ The new gear ratio is enabled when the numerator value is transferred.	- -2147483648 1 2147483647	INT32 R/W per. -	CANopen 3026:4_h Modbus 9736
GEARdenom -	Gear ratio denominator(8-21) see description GEARnum	- 1 1 2147483647	INT32 R/W per. -	CANopen 3026:3_h Modbus 9734

Direction enabling The direction enabling allows restriction of the movement to positive or negative direction of rotation. Direction enabling is set with the parameter `GEARdir_enabl`.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
GEARdir_enabl -	Enabled direction of motion of the gear processing(8-21) **1 / positive** : pos. direction **2 / negative**: neg. direction **3 / both**: both directions (default) This can be used to enable a return motion lock.	- 1 3 3	UINT16 R/W per. -	CANopen 3026:5_h Modbus 9738

Further possibilities For further setting possibilities and functions for the operating mode see from page 8-45.

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8.5.5 Profile position operating mode

The operating mode can only be used with fieldbus control mode and can only be executed via fieldbus.

⚠ WARNING

Danger of personal injury and damage to system parts by uncontrolled system operation!

- Note that inputs to these parameters are executed by the drive controller immediately on receipt of the data set.
- Make sure that the system is free and ready for movement before changing these parameters

Failure to follow these instructions can result in death, serious injury or equipment damage.

In profile position operating mode a movement with an adjustable travel profile is run from a start position to a target position. The value of the target position can be given as either a relative or an absolute position.

A movement profile can be set with values for acceleration and deceleration ramps and final speed.

Relative and absolute positioning,

At an absolute positioning the positioning path is specified absolutely with reference to the zero point of the axis. A zero point must be defined with the homing operating mode before the first absolute positioning.

At a relative positioning the positioning path is specified relative to the momentary axis position or the target position.

An absolute positioning or relative positioning is set with bit 6 via the parameter `DCOMcontrol`.

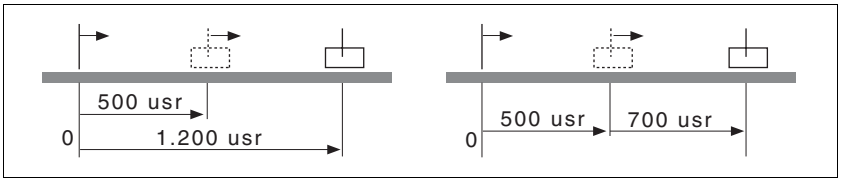

Figure 8.12 Absolute positioning (left) and relative positioning (right)

Requirements

The unit must be in the "Operation status" operating mode.

See chapter 8.4 “Starting and changing operating modes“.

Trigger positioning

Parameter value	Description
Bit 4: New setpoint	0->1: Start positioning or prepare next positioning
Bit 5: Change set immediately (applicable only with new setpoint 0->1)	0: enable new positioning values when target position is reached 1: enable new positioning values immediately
Bit 6: Absolute / relative	0: Absolute positioning 1: Relative positioning

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A positioning of rising edge is started by bit 4 in parameter DCOMcontrol. The positioning can be triggered in two ways depending on bit 5.

- Bit 5=0:

  Positioning values (PPp_targetusr, PPn_target, RAMPacc and RAMPdecel), that are transferred during a positioning, are saved temporarily. The target position of the current positioning is approached. The new positioning values are executed only when the target position is reached.

  If new positioning values are transferred again, the temporarily saved positioning values are overwritten again.

- Bit 5=1:

  Positioning values (PPp_targetusr, PPn_target, RAMPacc and RAMPdecel), that are transferred during a positioning, are executed immediately. The target position of the new positioning is directly approached.

Status messages

The drive provides information concerning positioning via Bits 10 and 12 to 15 in the parameter DCOMstatus.

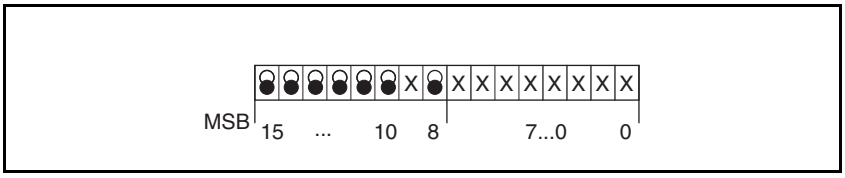

Figure 8.13 Status message for operating mode

Parameter value	Description
Bit 10: Target reached :	0: Target position not reached (also with "Halt" or error) 1: Target position reached
Bit 12: setpoint acknowledge	0: Transfer of new position possible 1: New target position accepted
Bit 13: x_err	1: Error arisen
Bit 14: x_end	1: Positioning completed, motor at a standstill
Bit 15: ref_ok	1: drive has valid reference point

Positioning finished

Bit 14 indicates whether positioning is complete. If this includes reaching the target position, then Bit 10 changes to 1. If the positioning has been interrupted by a "Halt" or a fault, Bit 10 remains at 0.

8.5.5.1 Setting parameters

The profile position operating mode can be set and executed with parameters.

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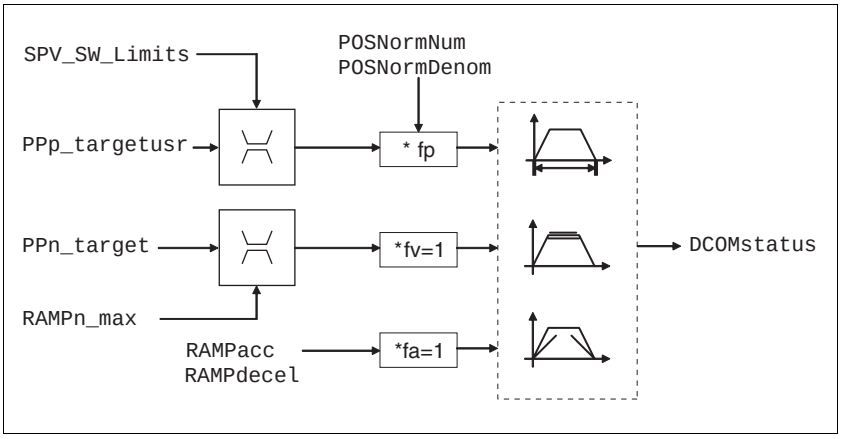

Figure 8.14 Profile position operating mode, effect of settable parameters

PZD2	corresponds to parameterPPn_target
PZD3 + PZD4	Absolute: corresponds to parameter PPp_absusr Relative: corresponds to parameter PPp_relprefusr or parameter PPp_relpactusr

At an absolute positioning the positioning path is specified absolutely with reference to the zero point of the axis.

At a relative positioning the positioning path is specified relative to the momentary axis position or the target position.

Target position

A new position value is transferred with the parameter PPp_targetusr .

At an absolute positioning the positioning path is specified absolutely with reference to the zero point of the axis.

At a relative positioning the positioning path is specified relative to the momentary axis position or the target position. This depends on the setting in parameter PPoption.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PPn_target -	Speed setpoint for profile position mode(8-25) Maximum value is limited to the current setting in CTRL_n_max The setting value is internally limited to the current parameter setting in RAMPn_max.	1/min 0 60	UINT32 R/W - -	CANopen 6081:0$_h$ Modbus 6942
PPoption - from Version 1.120	Options for operating mode profile position() Determines the reference position for a relative positioning: 0: relative to the previous target position of the travel profile generator 1: not supported 2: relative to the current actual position of the motor	- 0 0 2	UINT16 R/W - -	CANopen 60F2:0$_h$ Modbus 6960

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PPp_targetusr -	Target position of profile position operating mode(8-25) Min/Max values are dependent upon: - Scaling factor - software limit switch (if this is activated)	usr -	INT32 R/W - -	CANopen 607A:0_h Modbus 6940

Current Position The current position is determined by using the 2 parameters `_p_actusr` and `_p_actRAMPusr` .

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_p_actusr PACU STA-PRCU	Actual position of the motor in user-defined units(8-45) Caution! Actual position of motor is only valid after determination of the motor absolute position. With invalid motor absolute position : _WarnLatched _WarnActive Bit 13=1: absolute position of motor not yet detected	usr -	INT32 R/- - -	CANopen 6064:0_h Modbus 7706
_p_actRAMPusr -	Actual position of the travel profile generator(8-45) in user-defined units	usr -	INT32 R/- - -	CANopen 301F:2_h Modbus 7940

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8.5.6 Operation mode Profile velocity

The operating mode can only be used with fieldbus control mode and can only be executed via fieldbus.

⚠ WARNING

Danger of personal injury and damage to system parts by uncontrolled system operation!

- Note that inputs to these parameters are executed by the drive controller immediately on receipt of the data set.
- Make sure that the system is free and ready for movement before changing these parameters

Failure to follow these instructions can result in death, serious injury or equipment damage.

In the profile velocity operating mode it is accelerated to an adjustable setpoint speed. A movement profile can be set with values for acceleration and deceleration.

Requirements The unit must be in the "Operation status" operating mode.

See chapter 8.4 “Starting and changing operating modes“.

Velocity operation trigger If the type of operation, the operating state and the parameter values are set, the operating mode can be started by transfer of a set velocity in the parameter `PVn_target` .

Status messages The drive provides information concerning positioning via Bits 10 and 12 to 15 in the parameter `DCOMstatus`.

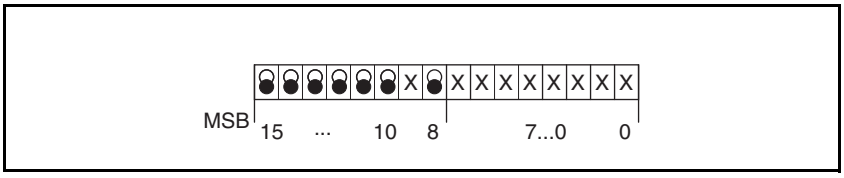

Figure 8.15 Status messages for operating mode

Parameter/ Signal	Description
Bit 10: Target reached :	0: Set speed not reached 1: Set speed reached (also with motor at standstill by "Halt")
Bit 12: speed=0	0: Motor is moving 1: Motor stopped
Bit 13: x_err	1: Error arisen
Bit 14: x_end	1: Operating mode finished
Bit 15: ref_ok	1: drive has valid reference point

Operating mode finished The operating mode is completed and motor standstill achieved by "Halt", by an error or after a preset default = 0.

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8.5.6.1 Setting parameters

Overview The following overview shows the effect of the parameters which can be set for the velocity profile operating mode.

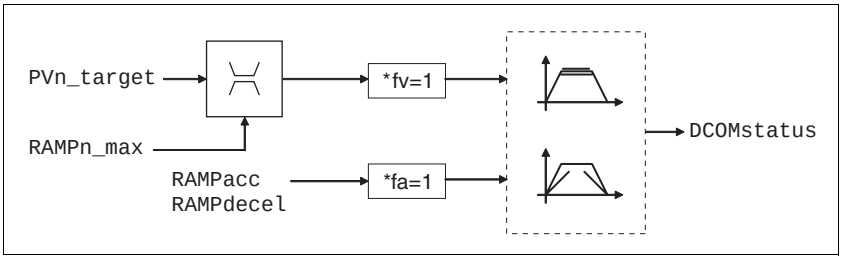

Figure 8.16 Operating mode velocity profile, effect of settable parameters

Set speed The set speed is transferred via the parameter PVn_target in rpm and can be changed during the movement. The operating mode is not limited by range limits of the positioning. New speed values are accepted immediately during a travel command.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PVn_target	Setpoint velocity profile velocity operating mode(8-29)	1/min	INT32 R/W	CANopen 60FF:0_h Modbus 6938
-	Maximum value is limited to the current setting in CTRL_n_max. The setting value is internally limited to the current parameter setting in RAMPn_max.	0	- -	

Current speed The current speed is determined by using the 2 parameters _n_act and _n_actRAMP .

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_n_act NACT STA-nACt	Actual speed of motor(8-45)	1/min -	INT16 R/- - -	CANopen 606C:0_h Modbus 7696
_n_actRAMP -	Actual speed of the movement profile generator(8-45)	1/min -	INT32 R/- - -	CANopen 606B:0_h Modbus 7948

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8.5.7 Operation mode Homing

The operating mode can only be used with fieldbus control mode and can only be executed via fieldbus.

⚠ WARNING

Danger of personal injury and damage to system parts by uncontrolled system operation!

- Note that inputs to these parameters are executed by the drive controller immediately on receipt of the data set.
- Make sure that the system is free and ready for movement before changing these parameters

Failure to follow these instructions can result in death, serious injury or equipment damage.

Overview of homing

In homing mode, an absolute scale reference of the motor position at a defined axis position is established. Referencing can be carried out by a homing movement or by dimension setting.

- A reference movement performs movement to a defined point, the reference point, on the axis, in order to create the absolute measurement reference of the motor position. The reference point simultaneously defines the zero point that is used for all subsequent absolute positionings as a reference point. Displacement of the zero point can be set by parameters.

  The reference movement must be carried out completely to ensure that the new zero point is valid. If it is interrupted, then the reference movement has to be started again. Unlike the other operating modes a reference movement must be completed before you can switch to a new operating mode.

  The signals $\overline{\text{LIMN}}$, $\overline{\text{LIMP}}$ and $\overline{\text{REF}}$ required for the reference movement must be wired. Monitoring signals that are not used should be deactivated.

- Set dimensions provides the option of setting the current motor position to a desired position value to which the subsequent position specifications will refer.

A homing is not required for motors with SinCos Multiturn encoders, because it sends a valid absolute position after startup.

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Types of reference movements

4 standard reference movements are available

- Movement to negative limit switch $\overline{\texttt{LIMN}}$
- Movement to positive limit switch $\overline{\texttt{LIMP}}$
- Movement to reference switch $\overline{\texttt{REF}}$ with movement in negative direction of rotation
- Movement to reference switch $\overline{\texttt{REF}}$ with movement in positive direction of rotation

A reference movement can be conducted with or without index pulse.

- Reference movement without index pulse
  Movement from the edge of the switch to a distance set by parameters from the edge of the switch.
- Reference movement with index pulse (SinCos Singleturn encoder) movement from switch edge to the next motor index pulse. The current motor position can be read out with the parameter `_p_absENCusr`. The index pulse is at position value 0.

Trigger homing

Homing via Bit 4=1 in parameter `DCOMcontrol` is triggered.

Status messages

The drive provides information concerning positioning via Bits 10 and 12 to 15 in the parameter `DCOMstatus`.

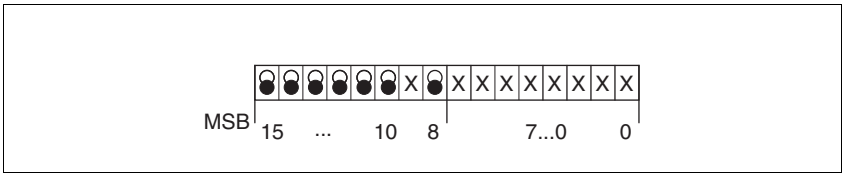

Figure 8.17 Status messages for operating mode

Parameter/ Signal	Description
Bit 10: Target reached :	0: Homing not finished 1: Homing finished (also when interrupted by "Halt")
Bit 12: Homing attained	1: Homing successfully completed
Bit 13: x_err	1: Error arisen
Bit 14: x_end	1: Homing completed, motor at a standstill
Bit 15: ref_ok	1: drive has valid reference point

8.5.7.1 Setting by parameters, general

There are various methods of homing which can be selected via the parameters `HMmethod`.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMmethod -	Reference movement method(8-31) 1: LIMN with index pulse 2 : LIMP with index pulse 7 : REF+ with index pulse, inv., outside 8: REF+ with index pulse, inv., inside 9: REF+ with index pulse, not inv., inside 10: REF+ with index pulse, not inv., outside 11: REF- with index pulse, inv., outside 12: REF- with index pulse, inv., inside 13: REF- with index pulse, not inv., inside 14: REF- with index pulse, not inv., outside 17: LIMN 18: LIMP 23: REF+, inv., outside 24: REF+, inv., inside 25: REF+, not inv., inside 26: REF+, not inv., outside 27: REF-, inv., outside 28: REF-, inv., inside 29: REF-, not inv., inside 30: REF-, not inv., outside 33 : index pulse neg. direction 34: index pulse pos. direction 35: set dimensions Explanation of abbreviations: REF+: search movement in pos. direction REF-: search movement in neg. direction inv.: invert direction in switch not inv.: direction in switch not invert. outside: index pulse/distance outside switch inside: index pulse/distance inside switch	- 1 18 35	INT16 R/W - -	CANopen 6098:0_h Modbus 6936

The evaluation at active_0 or active_1 of the reference switch $\overline{\text{REF}}$ can be set in parameter `IOsigREF`. A release of the switch is not required.

The evaluation is set to active_0 or active_1 and the release of the limit switch is set with the parameters `IOsigLimN` and `IOsigLimP`.

Use the active 0 monitoring signals if possible, because they are proof against wire breakage.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOsigRef -	REF signal evaluation(8-45) **1 / normally closed**: normally closed contact **2 / normally open**: normally open contact The reference switch is only enabled while processing the reference movement to REF.	- 1 1 2	UINT16 R/W per. -	CANopen 3006:E_h Modbus 1564

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOsigLimN -	LIMN signal evaluation(8-45) **0 / none**: inactive **1 / normally closed**: normally closed contact **2 / normally open**: normally open contact	- 0 1 2	UINT16 R/W per. -	CANopen 3006:F_h Modbus 1566
IOsigLimP -	LIMP signal evaluation(8-45) **0 / none**: inactive **1 / normally closed**: normally closed contact **2 / normally open**: normally open contact	- 0 1 2	UINT16 R/W per. -	CANopen 3006:10_h Modbus 1568

The parameters `HMn` and `HMn_out` are used for setting the speeds for the reference movement.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMn -	Set speed for search for the switch(8-31) The setting value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 60 13200	UINT16 R/W per. -	CANopen 6099:1_h Modbus 10248
HMn_out -	Set speed for release movement from switch(8-31) The setting value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 6 3000	UINT16 R/W per. -	CANopen 6099:2_h Modbus 10250

The parameter `HMp_homeusr` can be used to specify a desired position value, which is set at the reference point after a successful reference movement. This position value defines the current motor position at the reference point. This also defines the zero point.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMp_homeusr -	Position on reference point(8-31) After successful reference movement this position value is automatically set at the reference point.	usr -2147483648 0 2147483647	INT32 R/W per. -	CANopen 3028:B_h Modbus 10262

The parameters `HMoutdisusr` and `HMsrchdisusr` can be used for activation of the monitoring of the switch function.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMoutdisusr -	Maximum run-off(8-31) 0: run-off check inactive >0: run-off in user-defined units The switch must be disabled again inside this run-off, otherwise the reference movement is aborted	usr 0 0 2147483647	INT32 R/W per. -	CANopen 3028:6_h Modbus 10252
HMsrchdisusr -	Maximum search distance after traversing over the switch(8-31) 0: search distance processing inactive >0: search distance in user-defined units The switch must be disabled again inside this search distance, otherwise the reference movement is aborted	usr 0 0 2147483647	INT32 R/W per. -	CANopen 3028:D_h Modbus 10266

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8.5.7.2 Reference movement without index pulse

Description

A reference movement without index pulse is set with the parameter HMmethod = 17 to 30, see page 8-32.

The distance to the switching edge can be specified with the parameter HMdisusr.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMdisusr -	Distance between the switching edge and the reference point(8-36) After leaving the switch, the drive is still positioned in the working range for a defined path and this position is defined as a reference point. The parameters are only effective with reference movements without index pulse searching.	usr 1 200 2147483647	INT32 R/W per. -	CANopen 3028:7$_h$ Modbus 10254

Reference movement towards limit switch

A reference movement to the negative limit switch is shown below with the distance to the switch edge (HMmethod = 17).

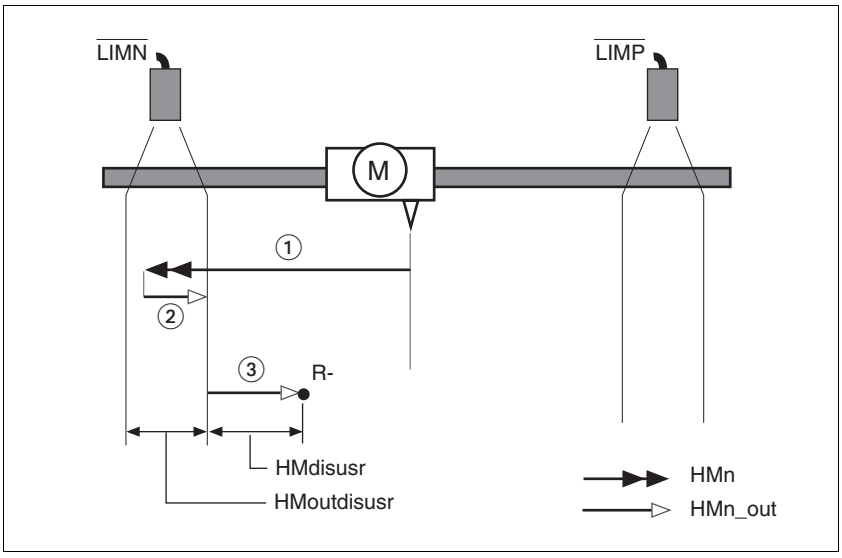

Figure 8.18 Reference movement to the negative limit switch

(1) Movement to limit switch at search speed
(2) Movement to switching edge with clearance speed
(3) Movement at the distance to switching edge with clearance speed

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Reference movement to reference switch

Reference movements to the reference switch with the distance to the switch edge are shown below (`HMmethod` = 27 to 30).

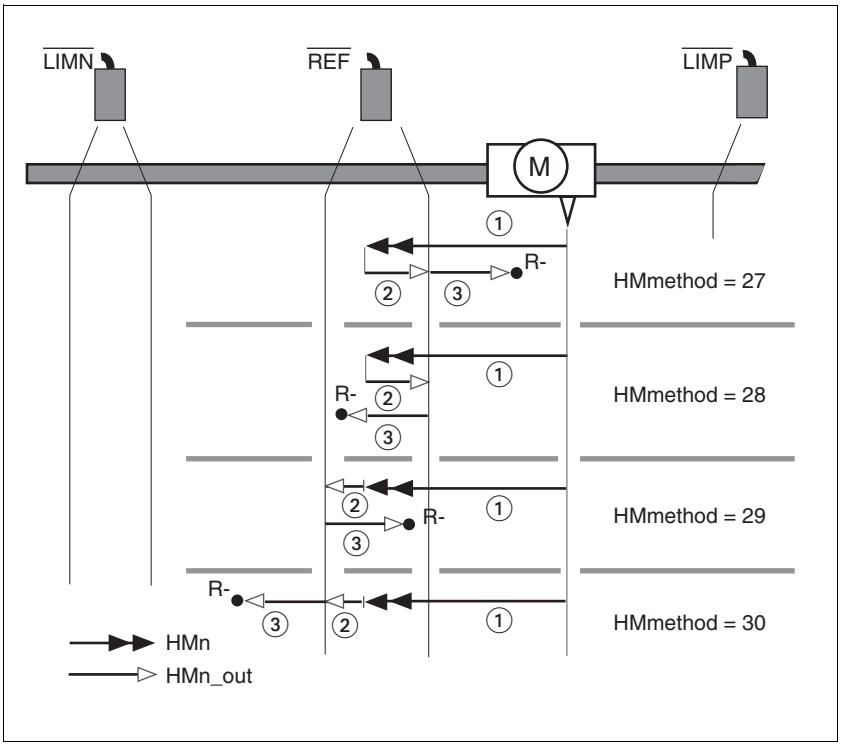

Figure 8.19 Reference movements to the reference switch

(1) Movement to reference switch at search speed
(2) Movement to switching edge with clearance speed
(3) Movement at the distance to switching edge with clearance speed

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Examples Reference movements to the reference switch with the distance to the switch edge are shown below (`HMmethod` = 27). Various responses at different search speeds and start positions are shown.

- Movement to the reference switch with first movement in the negative direction, reference switch is once before (A1, A2) and once behind the start point (B1, B2).
- Additional movement when traversing through the switching window (A2, B2).

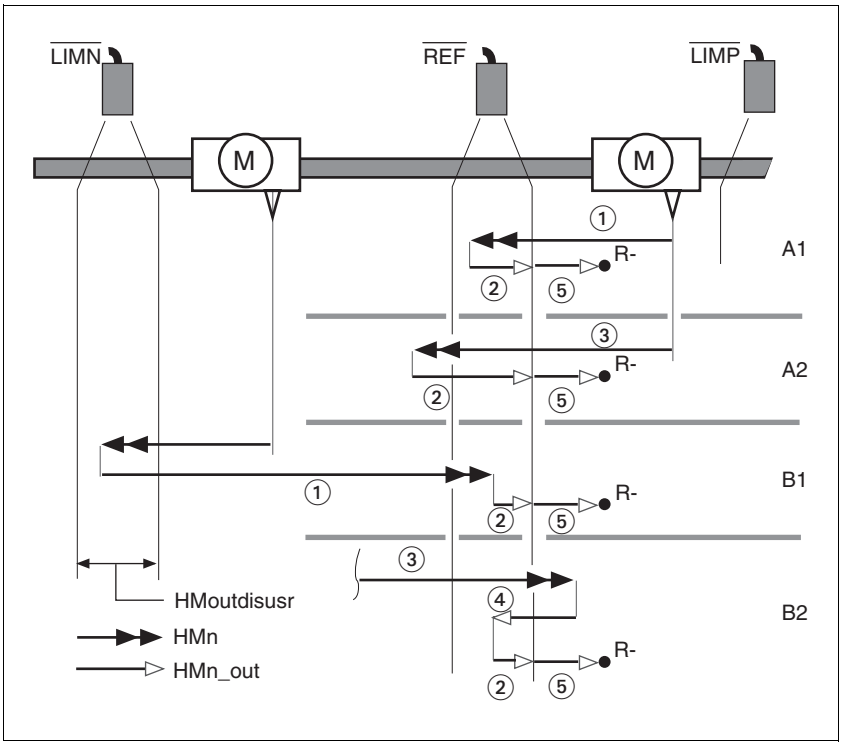

Figure 8.20 Reference movements to the reference switch

(1) Movement to reference switch at search speed
(2) Movement to switching edge with clearance speed
(3) Excessively fast movement to reference switch with search speed
(4) Return movement to switch area at clearance speed
(5) Movement at the distance to switching edge with clearance speed

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8.5.7.3 Reference movement with index pulse

Description

A reference movement with index pulse is set with the parameter HMmethod = 1 to 14, see page 8-32.

First, the defined reference switch is approached and finally a search movement is made to the nearest index pulse.

Parameter possibilities

The position distance between switching edge and index pulse can be calculated with the parameter HMdisREFtoIDX.
The value should be >0.05 revolutions.

If the index pulse is too close to the switching edge, the limit switch or reference switch can be moved mechanically. Otherwise the position of the index pulse can be moved with the parameter ENC_pabsusr, see Chapter 7.4.11 “Setting parameters for encoder“ page 7-31. This ensures that a reference movement with index pulse can be reproduced at any time.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMdisREFtoIDX	Distance switch - index pulse after reference movement(8-39)	revolution 0.0000 -	INT32 R/- -	CANopen 3028:C_h Modbus 10264
-	Reading value provides the value of the difference between the index pulse position and the position on the switching flank of the limit or reference switch. Used to check how far the index pulse is from the switching edge and is used as a criterion for whether the reference movement can be correctly reproduced with index pulse processing in steps of 1/10000 revolutions	0.0000	-	

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Reference movement towards limit switch

A reference movement to the positive limit switch with movement to the first index pulse is shown below (`HMmethod` = 2).

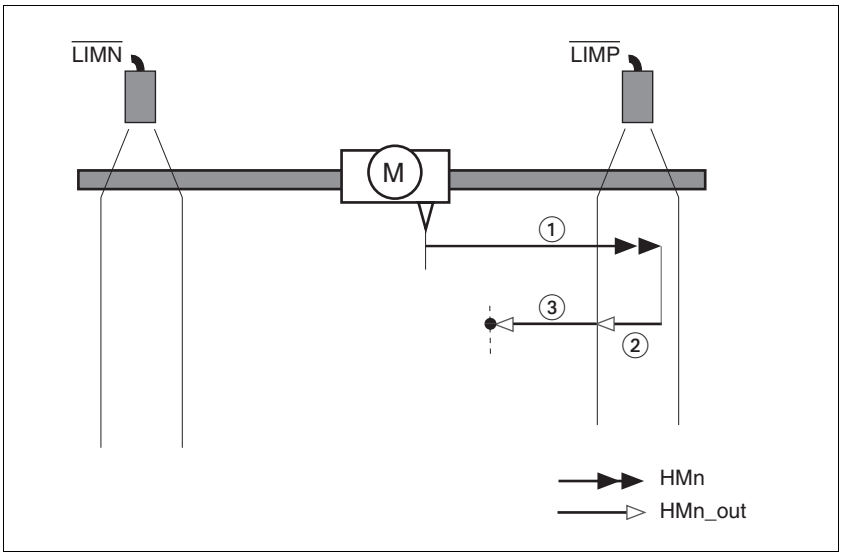

Figure 8.21 Reference movement to the positive limit switch

(1) Movement to limit switch at search speed
(2) Movement to switching edge with clearance speed
(3) Movement to index pulse with clearance speed

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Reference movement to reference switch

Reference movements to the reference switch with movement to the first index pulse are shown below (`HMmethod` = 11 to 14).

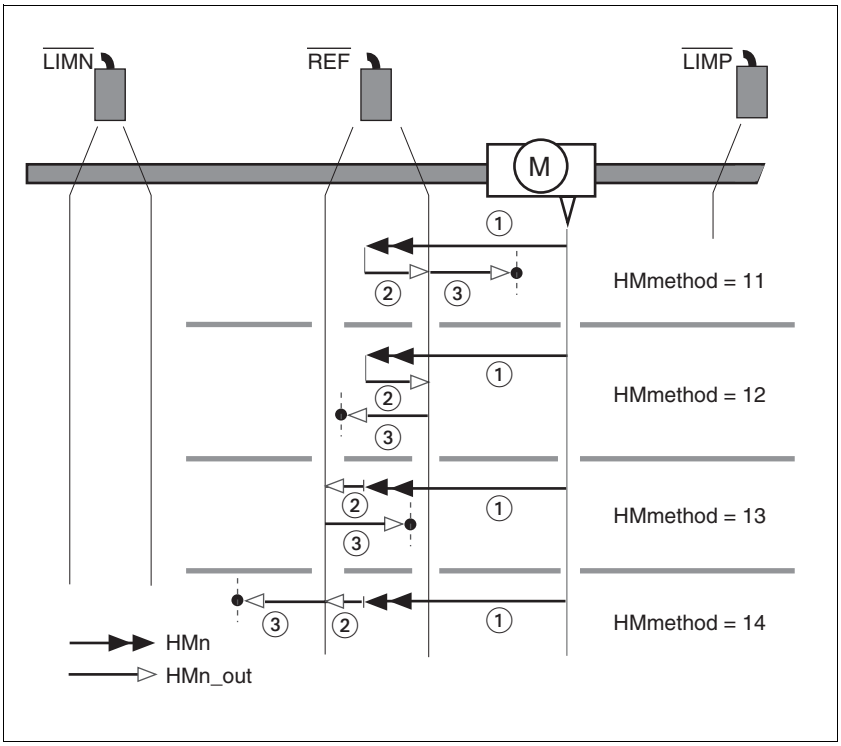

Figure 8.22 Reference movements to the reference switch

(1) Movement to reference switch at search speed
(2) Movement to switching edge with clearance speed
(3) Movement to index pulse with clearance speed

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Examples Reference movements to the reference switch with movement to the first index pulse are shown below (`HMmethod` = 11). Various responses at different search speeds and start positions are shown.

- Movement to the reference switch with first movement in the negative direction, reference switch is once before (A1, A2) and once behind the start point (B1, B2).
- Additional movements when travelling through switching window (A2, B2).

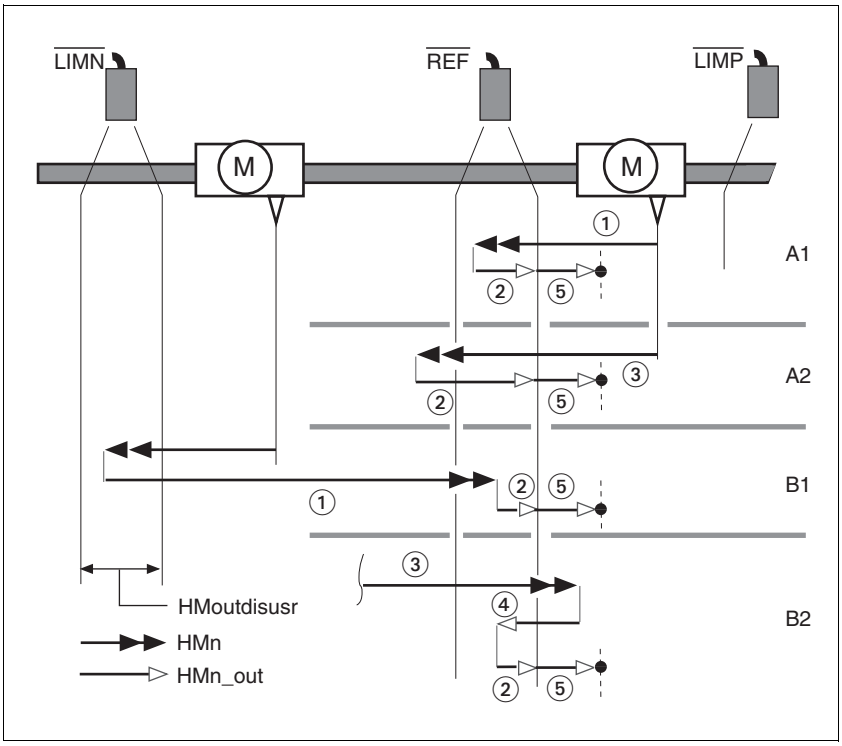

Figure 8.23 Reference movements to the reference switch

(1) Movement to reference switch at search speed
(2) Movement to switching edge with clearance speed
(3) Excessively fast movement to reference switch with search speed
(4) Return movement to switch area at clearance speed
(5) Movement to index pulse with clearance speed

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8.5.7.4 Reference movement to the index pulse

Description A reference movement on the index pulse is set using the parameters HMmethod = 33 and 34, see page 8-32.

Reference movement on index pulse In the following descriptions the reference movements are shown on the index pulse (HMmethod = 33 and 34).

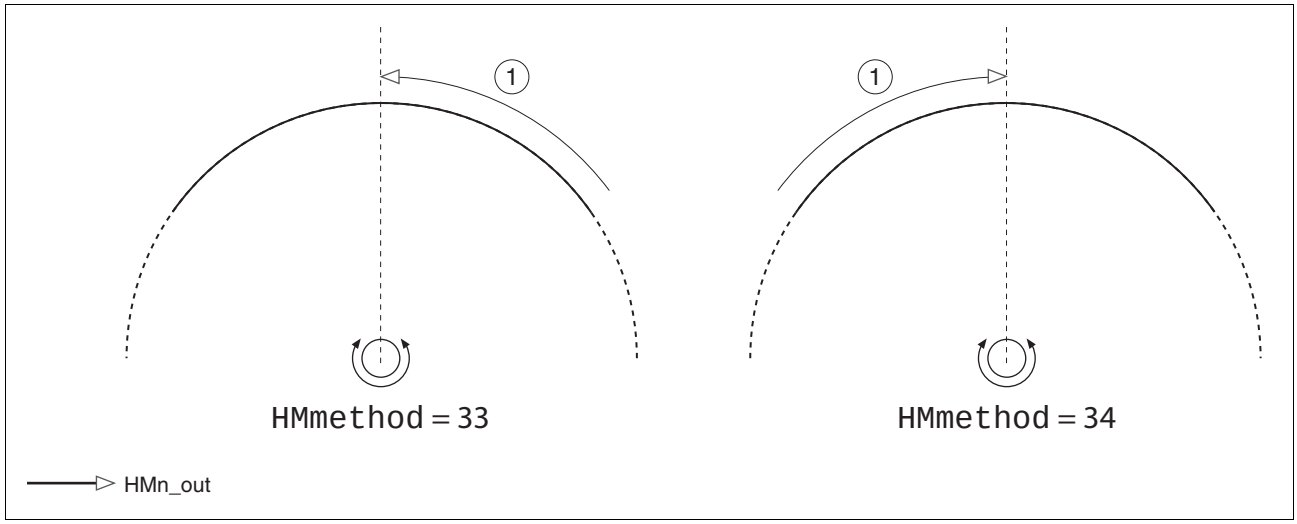

Figure 8.24 Reference movement on index pulse

(1) Movement on index pulse with clearance speed

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8.5.7.5 Homing by dimension setting

Description A homing by set dimensions is set with the parameter HMmethod = 35, see page 8-32.

The current motor position is set at the position value in the parameter HMp_setpusr by set dimensions. This also defines the zero point.

Homing by dimension setting can only be carried out when the motor is at a standstill. Any active position deviation is retained and can still be compensated by the position controller after dimension setting has taken place.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMp_setpusr	Position for dimension setting(8-44)		INT32 R/W	CANopen 301B:16$_h$ Modbus 6956
	Dimension setting position for homing method 35	0	-	
-		usr	-	

Example Dimension setting can be used to carry out a continuous motor movement without exceeding positioning limits.

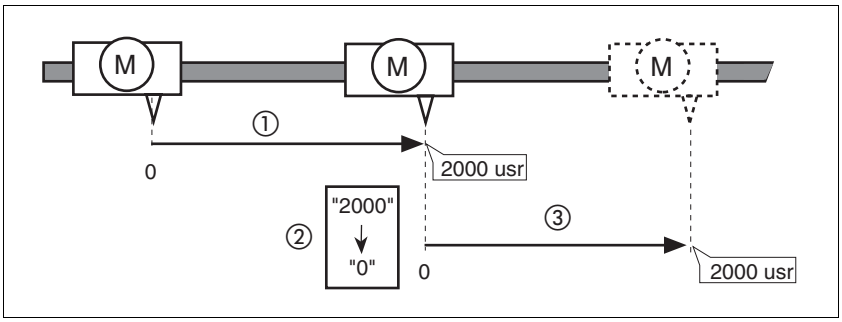

Figure 8.25 Positioning by 4000 usr units with dimension setting

(1) The motor is positioned by 2000 usr.
(2) By setting dimensions to 0 the current motor position is set to position value 0 and the new zero point is simultaneously defined.
(3) After triggering a new travel command of 2000 usr, the new target position is 2000 usr.

This method avoids crossing absolute position limits during a positioning operation because the zero point is continuously tracked.

The read out of the setpoint is by the parameter _p_refusr.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_p_refusr	Setpoint of the position controller in user-defined units()	usr	INT32 R/-	CANopen 301E:C$_h$ Modbus 7704
		-	-	
-			-	

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8.6 Functions

8.6.1 Monitoring functions

8.6.1.1 Status monitoring in movement mode

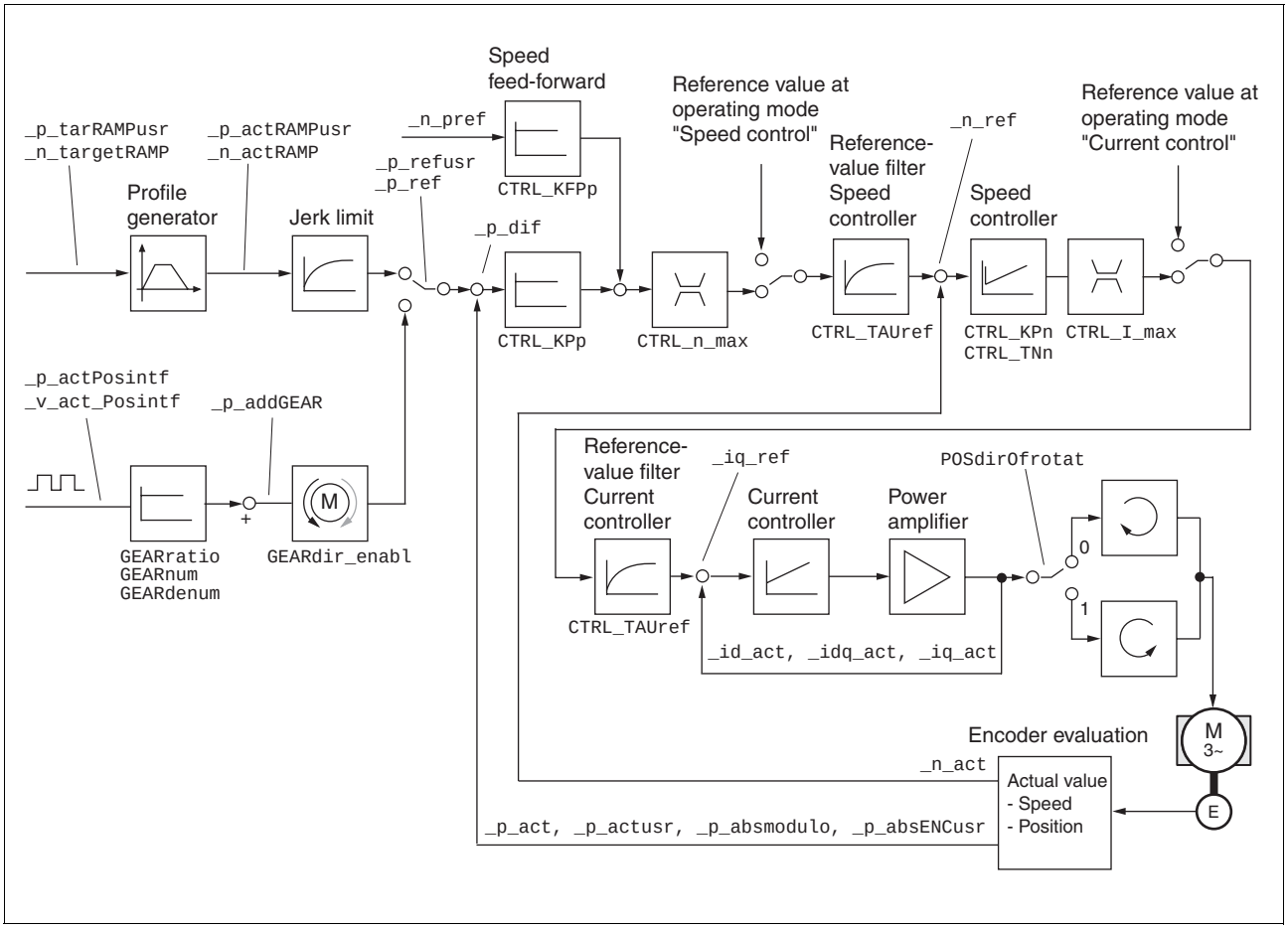

Figure 8.26 Status monitoring of the control loops

8.6.1.2 Positioning range

Positioning range (only fieldbus)

The motor can be moved to any point on the axis within the axis positioning range by specifying an absolute positioning process.

The current position of the motor can be read out using the parameter `_p_actusr`.

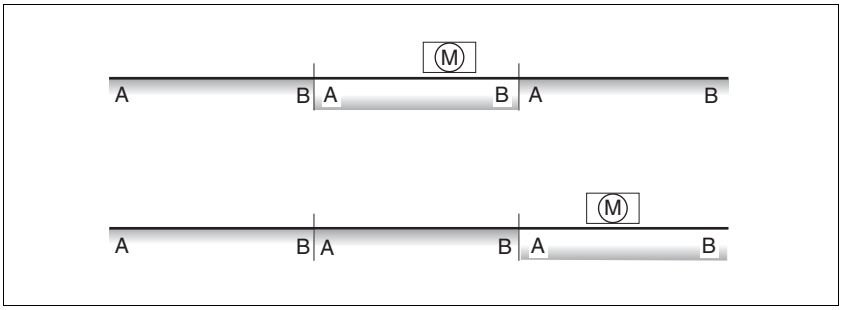

Figure 8.27 Positioning range

The positioning limits, with default scaling, are:

(A) -286435456 usr
(B) 286435455 usr

An overshoot of the positioning limits is possible in all operating modes, except during an absolute positioning in profile position mode.

Overshoot of motor at a positioning limit loses the reference point.

During a relative position in profile position mode a check of whether the absolute positioning limits will be overshot is made before starting the movement. If yes, an internal dimension setting to 0 is made before starting the movement. The reference point is lost (ref_ok = 1->0).

Software limit switches

The positioning range can be limited by software limit switch. This is possible as soon as the drive has a valid zero point (ref_ok = 1). The positioning values are quoted relative to the zero point. The software limit switches are set using the parameters `SPVswLimPusr` and `SPVswLimNusr` are activated using `SPV_SW_Limits` .

The determining factor for position monitoring of the software limit switch range is the setpoint of the position controller. Depending on the controller setting, therefore, the motor can stop before it reaches the limit switch position. Bit 2 of parameter `_SigLatched` signals the triggering of a software limit switch

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPVswLimPusr -	positive position limit for software limit switch(8-45) If a user-defined value outside the permissible user-defined area is set, the limit switch limits are automatically limited internally to the maximum user-defined value.	 2147483647 usr	INT32 R/W per. -	CANopen 607D:2_h Modbus 1544
SPVswLimNusr -	negative position limit for software limit switch(8-45) see description of 'SPVswLimPusr'	 -2147483648 usr	INT32 R/W per. -	CANopen 607D:1_h Modbus 1546

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPV_SW_Limits -	Monitoring the SW-limit switch(8-45) **0 / none**: none (default) **1 / SWLIMP**: Activating SW limit switch pos. direction **2 / SWLIMN**: Activating SW limit switch neg. direction **3 / SWLIMP+SWLIMN**: Activating SW limit switch both. directions The software limit switch is only monitored after a successful homing (ref_ok = 1)	- 0 0 3	UINT16 R/W per. -	CANopen 3006:3$_h$ Modbus 1542

Limit switch

⚠ CAUTION

Loss of control!

The use of $\overline{\texttt{LIMP}}$ and $\overline{\texttt{LIMN}}$ can offer some protection against hazards (e.g. impact on mechanical stop caused by incorrect motion defaults).

- Use $\overline{\texttt{LIMP}}$ and $\overline{\texttt{LIMN}}$ where possible.
- Check that the external sensors or switches are correctly connected.
- Check the correct functional installation of the limit switches The limit switches must be mounted in a position far enough away from the mechanical stop to allow an adequate braking distance.
- The functions must be enabled to use $\overline{\texttt{LIMP}}$ and $\overline{\texttt{LIMN}}$.
- This function cannot provide protection against faulty functioning of the product or the sensors.

Failure to follow these instructions can result in injury or equipment damage.

During the movement the two limit switches are monitored with the input signals $\overline{\texttt{LIMP}}$ and $\overline{\texttt{LIMN}}$. If the drive moves to a limit switch, the motor stops. The triggering of the limit switch is signalled.

The release of the input signals $\overline{\texttt{LIMP}}$ and $\overline{\texttt{LIMN}}$ and the evaluation at active 0 or active 1 can be changed with parameters `IOsigLimP` and `IOsigLimN`.

Use the active 0 monitoring signals if possible, because they are proof against wire breakage.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOsigLimN -	LIMN signal evaluation(8-45) **0 / none**: inactive **1 / normally closed**: normally closed contact **2 / normally open**: normally open contact	- 0 1 2	UINT16 R/W per. -	CANopen 3006:F_h Modbus 1566
IOsigLimP -	LIMP signal evaluation(8-45) **0 / none**: inactive **1 / normally closed**: normally closed contact **2 / normally open**: normally open contact	- 0 1 2	UINT16 R/W per. -	CANopen 3006:10_h Modbus 1568
IOsigRef -	REF signal evaluation(8-45) **1 / normally closed**: normally closed contact **2 / normally open**: normally open contact The reference switch is only enabled while processing the reference movement to REF.	- 1 1 2	UINT16 R/W per. -	CANopen 3006:E_h Modbus 1564

Moving drive out The drive can be moved back from the limit switch area to the movement area by using manual movement.

If the drive does not go back to the movement area, check whether the manual drive is activated and that the correct direction of movement has been selected.

8.6.1.3 Monitoring internal signals

Monitoring systems protect the motor, the power amplifier and the braking resistor from overheating and contribute to the functional and operational safety. A list of all the safety equipment can be seen from page 2-3.

Temperature monitoring Sensors monitor the temperature of motor, power amplifier and braking resistor. All temperature limits are permanently set. If the temperature of a component approaches its permissible temperature limit, the device creates a warning signal. If the temperature exceeds the limit value for more than 5 seconds, then the power amplifier and the regulation switches off. The device signals a temperature error.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_Temp_act_DEV TDEV STA-tdEU	Device temperature(8-47)	°C - 	INT16 R/- - -	CANopen 301C:12_h Modbus 7204
_Temp_act_M -	Temperature motor(8-47) reasonable display is not possible for switching temperature sensors (for type of temperature sensor see parameter M_TempType)	°C -	INT16 R/- - -	CANopen 301C:11_h Modbus 7202

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_Temp_act_PA TPA STA-tPR	Temperature of power amplifier(8-47)	°C -	INT16 R/- - -	CANopen 301C:10$_h$ Modbus 7200
M_T_max -	max. motor temperature(8-47)	°C	INT16 R/- - -	CANopen 300D:10$_h$ Modbus 3360
PA_T_max -	maximum permissible temperature of the power amplifier(8-47)	°C	INT16 R/- per. -	CANopen 3010:7$_h$ Modbus 4110
PA_T_warn -	Temperature limit of the power amplifier(8-47)	°C	INT16 R/- per. -	CANopen 3010:6$_h$ Modbus 4108

I^2t monitoring

If the device operates with high peak currents, then temperature monitoring with sensors can be too sluggish. With I^2t monitoring the closed-loop control anticipates a rise in temperature in time and if the I^2t threshold is exceeded, it reduces the motor, power amplifier or braking resistor current to their nominal value.

If the limit value is not reached, the individual components can be taken to the output limit again.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_I2tl_act_RES -	Actual overload braking resistor(8-47)	% -	INT16 R/- - -	CANopen 301C:13$_h$ Modbus 7206
_I2tl_mean_RES I2TR STA-, 2tr	Load factor braking resistor(8-47)	% -	INT16 R/- - -	CANopen 301C:14$_h$ Modbus 7208
_I2t_peak_RES -	Overload braking resistor maximum value(8-47) Maximum overload braking resistor that has occurred in the last 10 sec.	% -	INT16 R/- - -	CANopen 301C:15$_h$ Modbus 7210
_I2t_act_PA -	Overload power amplifier current(8-47)	% -	INT16 R/- - -	CANopen 301C:16$_h$ Modbus 7212
_I2t_mean_PA I2TP STA-, 2tP	Loading factor power amplifier(8-47)	% -	INT16 R/- - -	CANopen 301C:17$_h$ Modbus 7214

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_I2t_peak_PA	Overload power amplifier maximum value(8-47)	% -	INT16 R/-	CANopen 301C:18$_h$ Modbus 7216
-	Maximum overload power amplifier that has occurred in the last 10 sec.		- -	
_I2t_act_M	Overload motor current(8-47)	% -	INT16 R/-	CANopen 301C:19$_h$ Modbus 7218
-			- -	
_I2t_mean_M I2TM STA-, 2tM	Loading factor motor(8-47)	% -	INT16 R/- - -	CANopen 301C:1A$_h$ Modbus 7220
_I2t_peak_M	Overload motor maximum value(8-47)	% -	INT16 R/-	CANopen 301C:1B$_h$ Modbus 7222
-	Maximum overload motor that has occurred in the last 10 sec.		- -	

Tracking error monitoring

The drive monitors the following error at 1ms intervals. The tracking error is the difference between the current setpoint and the actual position. If the difference exceeds the limit value set by the parameter SPV_P_maxDiff, it will immediately cause an interruption of movement (tracking error) with configurable error class.

Select the limit value in parameter SPV_P_maxDiff significantly higher than the maximum possible following error in error-free operation. This will ensure that a shutdown as a result of tracking error will only occur in case of error, e.g. with illegally increased external load torque, faulty position encoder etc.

The maximum control deviation occurring during operation can be determined with the parameter _p_DifPeakand compared with the maximum permissible following error. This allows the actual distance to the shut-off limit to be detected.

The error class for a tracking error can also be changed, see also8.6.1 “Monitoring functions“.

Calculating the tracking error

The tracking error monitoring considers the dynamic tracking error and tracking error reduced by the speed pilot control (KFPp). Only the tracking error actually required for generating torque is compared with the specified tracking error limit. The lower limit value at which the tracking error must be set as a minimum is derived with the following formula. The change of P-intervals is calculated without considering the dynamic I-intervals and D-intervals from the tracking error to the current reference value input. The current limit I_{max} is used as the current reference value.

Because the units of KPn[A/(rpm)] and p_dif[10000usr/rev] are not SI units, a correction factor of 10000(usr/rev)/(60(s/min)) must be used.

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$$\_p\_dif = \frac{CTRL\_I\_max}{CTRL\_KPp \cdot CTRL\_KPn} \cdot \frac{10000 \frac{usr}{U}}{60s/min}$$

Example of a tracking error calculation

The following values are used in the example:
I_{max}=10A, KPp=100/s, KPn=0.04A (rpm)

This yields the following:

$$\_p\_dif = \frac{10A}{100 \frac{1}{s} \cdot 0{,}04A \frac{min}{U}} \cdot \frac{10000 \frac{usr}{U}}{60s/min} = 416usr$$

The calculated value is the actual tracking error that immediately results in a tracking error with shutdown. Enter five times the calculated value in the parameter SPV_P_maxDiff to give an appropriate safety distance; for the example it would be 2080 usr.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_p_DifPeak -	Value of max. reached tracking error of the position controller(8-47) The tracking error is the current position regulation offset minus the speed-dependent position regulation offset. For further information see SPV_p_maxDiff. A write operation resets the value again.	revolution 0.0000 - 429496.7295 **Fieldbus** 0 4294967295	UINT32 R/W - -	CANopen 3011:F_h Modbus 4382
_p_dif PDIF STA-Pdi, F	Current regulation variation of the position controller(8-47) Actual rule deviation between setpoint and actual position, i.e. without consideration of any dynamic components. Note: Different from SPV_p_maxDiff	revolution -214748.3648 - 214748.3647 **Fieldbus** -2147483648 2147483647	INT32 R/- - -	CANopen 60F4:0_h Modbus 7716
SPV_p_maxDiff -	Max. permissible tracking error of the position controller(8-47) The tracking error is the current position regulation offset minus the speed-dependent position regulation offset. Actually, only the position offset caused by the moment requirements is still referred to for tracking error monitoring.	revolution 0.0001 1.0000 200.0000 **Fieldbus** 1 10000 2000000	UINT32 R/W per. -	CANopen 6065:0_h Modbus 4636

Monitoring parameters The unit and operating status can be monitored with various objects.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_SigActive -	Current status of monitoring signals(8-47) Meaning see _SigLatched	- -	UINT32 R/- - -	CANopen 301C:7_h Modbus 7182
_SigLatched SIGS STA-5, 65	Stored state of the monitoring signals(8-47) Signal state: 0: not enabled 1: activated Bit assignment Bit0: general fault Bit1: limit switch (LIMP/LIMN/REF) Bit2: area of travel exceeded (SW limit switch, tuning range) Bit3: Quick Stop via fieldbus Bit4: inputs PWRR are 0 Bit6: error RS485 Bit7: error CAN Bit9: frequency of reference signal too high Bit10: error current operating mode Bit12: Profibus error Bit14: undervoltage DC bus Bit15: overvoltage DC bus Bit16: no mains phase Bit17: connection to motor faulty Bit18. motor overcurrent/short circuit Bit19. error motor encoder or connection to encoder Bit20: undervoltage 24V power supply Bit21: temperature too high (power amplifier, motor) Bit22: tracking error Bit23: max. speed exceeded Bit24: PWRR inputs different Bit29: error in EEPROM Bit30: error in system startup (hardware or parameter error) Bit31: internal system fault such as Watch-dog) Note: assignment depends on control mode	- -	UINT32 R/- - -	CANopen 301C:8_h Modbus 7184
_WarnActive -	Active warnings bit-coded(8-47) Meaning of Bits see _WarnLatched	- -	UINT16 R/- - -	CANopen 301C:B_h Modbus 7190

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_WarnLatched WRNS STA-wrn5	Stored warnings bit-coded(8-47) Stored warning bits are erased in the event of a FaultReset. Bits 10,11,13 are automatically deleted. Signal state: 0: not enabled 1: activated Bit assignment Bit 0: general warning (see _LastWarning) Bit 1: power amplifier temperature high Bit 2: motor temperature high Bit 3: reserved Bit 4: overload (I^2t) power amplifier Bit 5: overload (I^2t) motor Bit 6: overload (I^2t) braking resistor Bit 7: CAN warning Bit 8: Motor Encoder warning Bit 9: RS485 protocol warning Bit 10: PWRR_A and/or PWRR_B Bit 11: DC bus undervoltage, faulty mains phase Bit 12: Profibus warning Bit 13: Position not yet valid (position detection continuing) Bit 14: reserved Bit 15: reserved Note: assignment depends on control mode	- - -	UINT16 R/- - -	CANopen 301C:C$_h$ Modbus 7192
_actionStatus -	Action word(8-47) Signal state: 0: not enabled 1: activated Bit0: Class 0 error Bit1 Class 1 error Class 2 error Bit3 Class 3 error Bit4 Class 4 error Bit5 reserved Bit6: drive stopped (actual speed _n_act < 9U/min) Bit7: drive rotates in positive direction Bit8: drive rotates in negative direction Bit9: Drive within position window (pwin) Bit10: reserved Bit11: profile generator stopped (setpoint speed is 0) Bit12: Profile generator decelerating Bit13: Profile generator accelerating Bit14: Profile generator moves in constant mode Bit15: reserved	- - -	UINT16 R/- - -	CANopen 301C:4$_h$ Modbus 7176
_StopFault STPF FLT-StPF	Fault number of the last interruption cause(8-47)	- - -	UINT16 R/- - -	CANopen 603F:0$_h$ Modbus 7178

Set fault response The response of the unit to a fault is classified into error classes, and can be set for certain monitoring functions. This allows the error response of the unit to be matched to the operational requirements.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPV_Flt_pDiff -	Error response to tracking error(8-47) **1 / ErrorClass1**error class 1 **2 / ErrorClass2**: error class 2 **3 / ErrorClass3**: error class 3	- 1 3 3	UINT16 R/W per. -	CANopen 3005:B_h Modbus 1302
SPV_Flt_AC -	Error response to power failure on one phase(8-47) **1 / ErrorClass1**error class 1 **2 / ErrorClass2**: error class 2 **3 / ErrorClass3**: error class 3	- 1 2 3	UINT16 R/W per. -	CANopen 3005:A_h Modbus 1300

8.6.1.4 Commutation monitoring

Functional principle

The unit continuously checks the plausibility of motor acceleration and effective motor moment, in order to recognise uncontrolled motor movements and to stop them if required. The monitoring function is referred to as commutation monitoring.

If the motor accelerates for a time period of more than 5 to 10ms, the commutation monitoring signals an uncontrolled motor movement, even though the drive regulation delays the motor with the set current value.

The unit shows flashing on HMI `5603` (error class 4)

Causes of error

Uncontrolled motor movements can be traced back to the following causes:

- The motor phases U, V, W are connected to the unit incorrectly, i.e. each offset by 120° , e.g. U with V, V with W, W with U.
- Faulty or interfered evaluation of the rotor position by a faulty position encoder on the motor, interfered sensor signals or defective position acquisition in the unit.

In addition, the unit can recognise a commutation error in the following cases, since the above-mentioned plausibility conditions could equally apply:

- The motor receives an external torque that is greater than the specified maximum torque. The external force causes it to accelerate.
- The motor is manually moved either in the direction of the motor moment or in the opposite direction, whilst the drive regulation is active.
- The motor is moved to a mechanical stop.
- Speed and position control loop are set to be extremely unstable.

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Setting parameters

⚠ WARNING

Danger of injury and damage to system components by unexpected movement!

Disabling monitoring functions increases the risk of an unexpected movement.

- Use the monitoring functions.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPVcommutat -	Monitoring commutation(8-54) **0 / off**: off **1 / on**: on (default)	- 0 1 1	UINT16 R/W per. -	CANopen 3005:5$_h$ Modbus 1290

8.6.1.5 Earth fault monitoring

Functional principle

The device continuously checks the motor phases for earth fault with the power amplifier enabled. An earth fault of one or more motor phases is detected. An earth fault of the DC bus or the braking resistor is not detected.

Setting parameters

⚠ WARNING

Danger of injury and damage to system components by unexpected movement!

Disabling monitoring functions increases the risk of an unexpected movement.

- Use the monitoring functions.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPV_EarthFlt -	Earth fault monitoring(8-55) **0 / off**: off **1 / on**: On (default) In exceptional cases deactivation may be required, e.g.: - parallel connection of multiple devices - operation on an IT mains - long motor lines Disable the monitoring only if it responds when not wanted	- 0 1 1	UINT16 R/W per. expert	CANopen 3005:10$_h$ Modbus 1312

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8.6.1.6 Mains phase monitoring

Functional principle

If a mains phase fails and under high load the device may become overloaded. The failure of a mains phase is detected with 3-phase devices. An error response can be set with the parameter SPV_Flt_AC.

Setting parameters

⚠ WARNING

Danger of injury and damage to system components by unexpected movement!

Disabling monitoring functions increases the risk of an unexpected movement.

- Use the monitoring functions.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPV_MainsVolt -	Monitor mains phases(8-56) **0 / off**: off **1 / on**: default 3-phase devices must only be connected and operated on 3-phase mains. In exceptional cases it may be necessary to disable it, e.g.: - supply via the DC bus	- 0 1 1	UINT16 R/W per. expert	CANopen 3005:F_h Modbus 1310

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8.6.2 Scaling

Description Scaling translates user units to internal units of the device, and vice versa. The device saves position values in user-defined units.

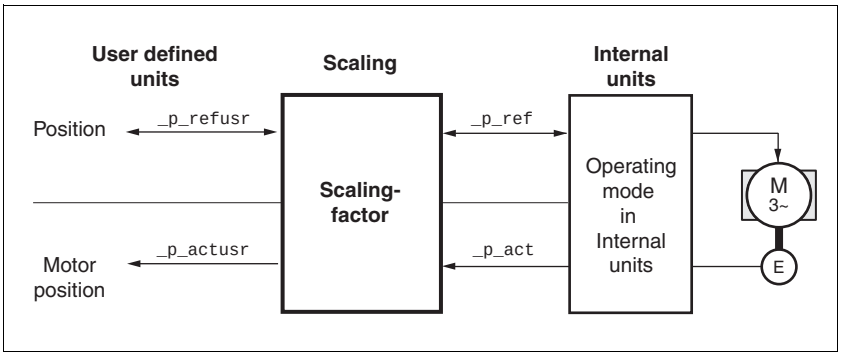

Figure 8.28 Scaling

Scaling factor The scaling factor creates the relationship between the number of motor rotations and the required user units [usr] needed for this. It is specified in [rev/usr].

$$\text{Scaling factor} = \frac{\text{Motor revolution [rev]}}{\text{Change of the user position [usr]}}$$

Figure 8.29 Calculation of the scaling factor

Default scaling A value of 16384 user-defined units per motor revolution is set as the default scaling.

⚠ WARNING

Unexpected motion may cause injury and damage to the system

Changing the scaling changes the effect of the values in user-defined units. The same movement jobs can therefore cause different motions.

- Note that the scaling affects all relationships between the defaults and the drive motion.
- Check the corresponding usr parameters and defaults of the system in user-defined units.

Failure to follow these instructions can result in death, serious injury or equipment damage.

The scaling factor is set using the parameters `POSscaleNum` and `POSscaleDenom` . A new scaling factor is activated by transfer of the numerator value.

When quoting the scaling factor, take care that the relationship can be completely represented by a fraction.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
POSscaleNum -	Numerator of the position scaling factor(8-57) :Definition of scaling factor Motor revolutions[U] ---------- Change in user position [usr] Acceptance of a new scaling factor takes place on the entry of the numerator User limits can be reduced when internal system factors are taken into account	revolution 1 1 2147483647	INT32 R/W per. -	CANopen 3006:8$_h$ Modbus 1552
POSscaleDenom -	Denominator of the position scaling factor(8-57) Description see numerator (POSscaleNum) Acceptance of a new scaling factor is by transfer of the numerator	usr 1 16384 2147483647	INT32 R/W per. -	CANopen 3006:7$_h$ Modbus 1550

If the existing unit is replaced by this unit, and if the same positioning orders are to be used, then the scaling is to be set in accordance with the settings used previously.

Value change of the scaling factor is only possible with inactive output stage. Value statements in user units are transformed to internal units when activating the output stage, simultaneously checking the value range.

Examples There are 3 cases for the setting of the user units.

- Scaling corresponds to default scaling
  1 motor revolution = 16384 user-defined units

  => every 8th motor position can be approached.

- Scaling corresponds to motor resolution (most minimal scaling)
  1 motor revolution = 131072 user-defined units

  => every motor position can be approached.

- Scaling is less than the default scaling
  1 motor revolution = 4096 user-defined units

  => every 32nd motor position can be approached.

To retain the same positioning movement of the motor after changing the scaling factor, the following persistent parameters must be adapted in addition to the user-defined values: `HMoutdisusr`, `HMdisusr`, `HMp_homeusr`, `HMsrchdisusr`, `JOGstepusr`, `SPVswLimPusr` *and* `SPVswLimNusr`.

If the parameters are not adjusted, this can cause problems such an error during the reference movement, because the distance to the swit-

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ching edge of the limit or reference switch is no longer sufficient for safely leaving the switching range.

Example 1 Positioning of 1111 user-defined units is to correspond to 3 motor revolutions. This gives:

$$\text{Scaling factor} = \frac{3\ \text{rev}}{1111\ \text{usr}}$$

If you carry out a relative positioning operation of 900 user-defined units now, the motor will move 900 usr * 3/1111 rev/usr = 2.4302 motor revolutions.

Example 2 Calculation of the scaling factor in length units: 1 motor revolution corresponds to a path of 100 mm. Every user-defined unit [usr] should correspond to one 0.01 mm step.

This gives: 1 usr = 0.01 mm * 1 rev/100 mm = 1/10000 rev.

$$\text{Scaling factor} = \frac{1\ \text{rev}}{10000\ \text{usr}}$$

Example 3 Setting the positioning in 1/1000 rad
1rad = 1 U/(2*π)
π = 3.1416 (rounded)

User value = 1 usr

device value = 1/(2*π*1000) U

$$\text{Scaling factor} = \frac{1\ \text{rev}}{2*3{,}1416*1000\ \text{usr}} = \frac{1\ \text{rev}}{6283{,}2\ \text{usr}} = \frac{10\ \text{rev}}{62832\ \text{usr}}$$

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8.6.3 Movement profile

Profile generator

Target position and final speed are input values to be entered by the user. The profile generator uses these values to calculate a motion profile dependent on the selected operating mode.

The initial values of the profile generator and the addable jolt limiting are transformed into a motor movement by the drive regulator.

The acceleration and deceleration behaviour of the motor can be described by the ramp function of the profile generator. The nominal sizes of the ramp functions are the ramp shape and the ramp steepness.

Ramp shape

A linear ramp for the acceleration and deceleration phases is available as the ramp shape. The profile settings are valid for both directions of movement of the drive.

Ramp steepness

The steepness of the ramp determines the speed changes of the motor per unit time. It can be set, for the acceleration ramp, by using the parameter RAMPacc and the deceleration ramp by using RAMPdecel.

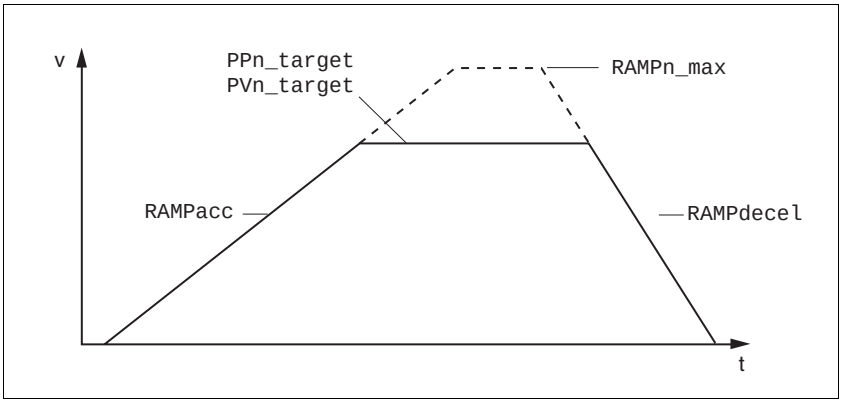

Figure 8.30 Acceleration and deceleration ramps

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMPacc -	Profile generator acceleration(8-60)	(1/min)/s 30 600 3000000	UINT32 R/W per. -	CANopen 6083:0_h Modbus 1556
RAMPdecel -	Deceleration of the profile generator(8-60)	(1/min)/s 750 750 3000000	UINT32 R/W per. -	CANopen 6084:0_h Modbus 1558

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMPn_max -	Limiting set speed with operating modes with profile generation(8-60) The parameters are effective in the following operating modes: - profile positioning - profile velocity - homing - jog - oscillator If a higher setpoint speed is set in one of these operating modes a limit to RAMPn_max is automatically set. This makes it simple to conduct a commissioning with limited speed.	1/min 60 13200 13200	UINT16 R/W per. -	CANopen 607F:0_h Modbus 1554

Jolt limiting The jolt limiting removes the jump-like acceleration changes to create a smooth, soft virtually jolt-free speed change.

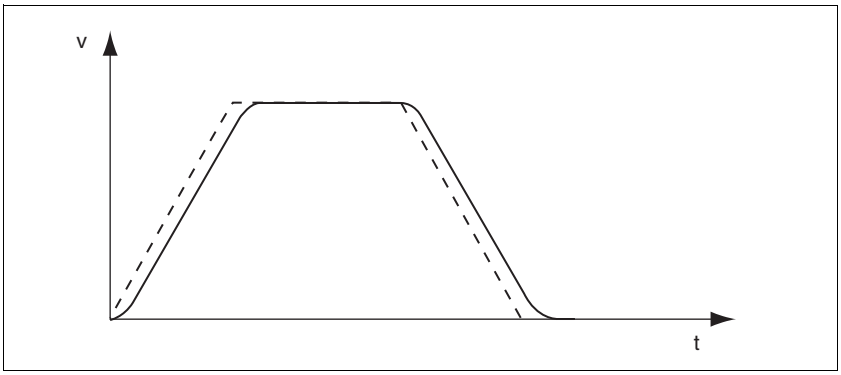

Figure 8.31 Speed curve with and dotted without jolt limitation

The jolt limitation is set and switched on using the parameter `RAMP_TAUjerk`.

The end of travel (x_end = 1) is not reported until the target position at the output of the jerk limiting has been reached.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMP_TAUjerk -	Jolt limiting() **0**: off **>0**: Setting for filter processing time The following values can be set: 0: inactive 1 2 4 8 16 32 64 128 Limits the acceleration change (jerk) of the setpoint position generation during the positioning transitions: Standstill - acceleration acceleration - constant movement constant movement - deceleration deceleration - standstill Processing in the following operating modes: - speed control - profile positioning - jog - homing Setting can only be made with inactive operating mode (x_end=1). Not active with braking process via moment ramp ("Halt" or "Quick Stop")	ms 0 0 128	UINT16 R/W per. -	CANopen 3006:D_h Modbus 1562

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8.6.4 Quick Stop

⚠ WARNING

Risk of injury and damage to system components by unbraked motor!

An insufficient braking resistor causes overvoltage on the DC bus and switches off the power amplifier. The motor is no longer actively braked.

- Make sure that the braking resistor is sufficiently dimensioned.
- Check the setting of the parameter for the braking resistor.
- Check the temperature of the braking resistor by conducting a test run under the most critical conditions.
- During the test make sure that at higher mains voltage there is less reserve in the capacitors on the DC bus.

Failure to follow these instructions can result in death, serious injury or equipment damage.

"Quick Stop" is a fast braking function which stops the motor as a result of a fault of error class 1 and 2 or by a software stop.

In the event of a fault category 1 fault response, the power amplifier remains on. In the case of error class 2, the output stage switches off after the drive is at a standstill.

Maximum current

The unit absorbs the excess braking energy. If the DC bus voltage exceeds the permissible limit the output stage switches off and the unit signals "DC bus overvoltage". The motor runs down without braking.

The current for the moment ramp should be set so that the drive comes to a standstill with the required delay.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
LIM_I_maxQSTP LIQS SET-L, 95	Current limiting for Quick Stop(8-63) Max. current during braking via torque ramp resulting from an error with error class 1 or 2, and when a software stop is triggered Maximum and default value setting depend on motor and power amplifier in 0.01Apk steps	A_{pk} - - -	UINT16 R/W per. -	CANopen 3011:5$_h$ Modbus 4362

If the device switches off frequently with "Quick Stop" with "DC bus overvoltage", then the maximum braking current should be reduced, the drive load should be reduced or an external braking resistor should be installed.

Quick Stop reset

A "Quick Stop" must be acknowledged with the error confirmation.

If the "Quick Stop" is actuated by the limit switch signals $\overline{\text{LIMN}}$ or $\overline{\text{LIMP}}$, the drive can be moved back into the movement area by the jog operation, see page 8-15.

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8.6.5 Halt

The "Halt" function can be set from any desired source (commissioning software, fieldbus, input signal $\overline{\text{HALT}}$). This is independent of the control mode that was set at "First Setup".

The "Halt" function brakes the motor with a moment ramp The parameter `LIM_I_maxHalt` specifies the current for the moment ramp.

After drive standstill an internal position compensation is run, the position control is enabled and the motor is stopped with the power amplifier active.

After cancellation of all "Halt" requests the interrupted movement is continued. If the $\overline{\text{HALT}}$ signal is cancelled during the braking procedure, the drive still runs down to standstill and only then accelerates again.

Maximum current

The unit absorbs the excess braking energy. If the DC bus voltage exceeds the permissible limit the output stage switches off and the unit signals "DC bus overvoltage". The motor runs down without braking.

The current for the moment ramp should be set so that the drive comes to a standstill with the required delay.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
LIM_I_maxHalt LIHA SET-L, hR	Current limiting for Halt(8-64) Max. current during braking after Halt or termination of an operating mode. Maximum and default value settings depend on motor and power amplifier in 0.01Apk steps	A_{pk} - - -	UINT16 R/W per. -	CANopen 3011:6_h Modbus 4364

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8.6.6 Fast position capture

The "fast position capture" function captures the current motor position at the time of receipt of a digital 24V signal at one of the two capture inputs. The operating function can, for example, be used for detection of a print mark.

Setting options

Two independent capture inputs are available for the "fast position capture" operating function.

- ENABLE/$\overline{\text{LIMP}}$/CAP1 (CAP1)
- FAULT_RESET/$\overline{\text{LIMN}}$/CAP2 (CAP2)

One of two possible functions for capture can be selected for each capture input:

- Position capture at rising or falling edge at the capture input, adjustable with parameters CAP1CONFIG and CAP2CONFIG.
- One-time or continuous position capture with multiple change of edge at the capture input with parameters CAP1ACTIVATE and CAP2ACTIVATE.

Continuous capture means that the motor position is captured anew at every defined edge while the former captured value is lost.

The CAP1 and CAP2 capture inputs have a time constant of t = 2 µs.

The jitter is less than 2 µs, since the following applies at a resolution of 32768Inc/rev.: 3662rpm = 2 inc/µs.

The captured motor position is not exact during the acceleration phase and the deceleration phase.

Enable fast position capture

Enable single position capture

- For CAP1: write value 1 to parameter Cap1Activate
- For CAP2: write value 1 to parameter Cap2Activate

Enable continuous position capture

- For CAP1: write value 2 to parameter Cap1Activate
- For CAP2: write value 2 to parameter Cap2Activate

End position capture

With single position capture the "fast position capture " function is ended when the first signal edge is detected.

With continuous position capture or no signal edge the capture can be stopped by writing the parameter Cap1Activate, value 0 or Cap2Activate, value 0.

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Cap1Activate -	Capture unit 1 Start/Stop(8-65) Value 0 : abort capture function Value 1: start capture once Value 2: start capture continuously With one-time capture the function is terminated at the first captured value. The capture continues endlessly with continuous capture. Position capture can only be enabled with the "fieldbus" device setting.	- 0 - 2	UINT16 R/W - -	CANopen 300A:4_h Modbus 2568
Cap1Config -	Configuration of capture unit 1(8-65) 0 = position capture at 1->0 switch 1 = position capture at 0->1 switch	- 0 0 1	UINT16 R/W - -	CANopen 300A:2_h Modbus 2564
Cap1Count -	Capture unit 1 event counter(8-65) Counts the capture events. Counter is reset when the capture unit 1 is enabled.	- -	UINT16 R/- - -	CANopen 300A:8_h Modbus 2576
Cap1Pos -	Capture unit 1 captured position(8-65) Captured position at the time of the "capture signal". The captured position is recalculated after "set dimensions" or after a "homing".	usr -	INT32 R/- - -	CANopen 300A:6_h Modbus 2572
Cap2Activate -	Capture unit 2 Start/Stop(8-65) Value 0 : abort capture function Value 1: start capture once Value 2: start capture continuously With one-time capture the function is terminated at the first captured value. The capture continues endlessly with continuous capture. Position capture can only be enabled with the "fieldbus" device setting.	- 0 - 2	UINT16 R/W - -	CANopen 300A:5_h Modbus 2570
Cap2Config -	Configuration of capture unit 2(8-65) 0 = position capture at 1->0 switch 1 = position capture at 0->1 switch	- 0 0 1	UINT16 R/W - -	CANopen 300A:3_h Modbus 2566
Cap2Count -	Capture unit 2 event counter(8-65) Counts the capture events. Counter is reset when the capture unit 2 is enabled.	- -	UINT16 R/- - -	CANopen 300A:9_h Modbus 2578
Cap2Pos -	Capture unit 2 captured position(8-65) Captured position at the time of the "capture signal". The captured position is recalculated after "set dimensions" or after a "homing".	usr -	INT32 R/- - -	CANopen 300A:7_h Modbus 2574

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CapStatus -	Status of capture units(8-65) Read access: Bit 0: position capture by CAP1 is complete Bit 1: Position captured via CAP2	- - 	UINT16 R/- - -	CANopen 300A:1_h Modbus 2562

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8.6.7 Standstill window

The standstill window can be used to check whether the drive has reached the setpoint position.

If the control deviation _p_dif of the position controller remains in the standstill window after the end of the positioning for time STANDpwinTime, the device reports the end of the process (x_end = 0->1).

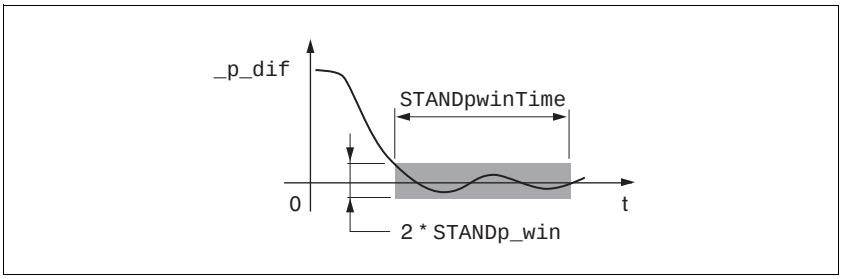

Figure 8.32 Standstill window

The parameters STANDp_win and STANDpwinTime define the size of the window.

The parameter STANDpwinTout can be used to set the period after which an error is reported if the standstill window was not reached.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
STANDp_win -	Standstill window, permissible control deviation(8-68) The offset for the standstill window time must lie in this range of values to allow recognition of the standstill of the drive. Info: The processing of the standstill window must be activated via the STANDpwinTime parameter.	revolution 0.0000 0.0010 3.2767 **Fieldbus** 0 10 32767	UINT16 R/W per. -	CANopen 6067:0_h Modbus 4370
STANDpwinTime -	Standstill window, time(8-68) 0: Standstill window monitoring deactivated >0 : Time in ms within which the offset must lie in the standstill window	ms 0 0 32767	UINT16 R/W per. -	CANopen 6068:0_h Modbus 4372
STANDpwinTout -	Timeout for the standstill window monitor(8-68) 0: timeout monitor deactivated >0 : Timeout in ms Setting the standstill window processing is accomplished via STANDp_win and STANDpwinTime The time monitoring begins at the moment the target position is reached (position controller setpoint) or at the end of the profile generator processing.	ms 0 0 16000	UINT16 R/W per. -	CANopen 3011:B_h Modbus 4374

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8.6.8 Braking function with HBC

Inadvertent movement of the motor without current is prevented by the use of a holding brake motor. The holding brake requires a holding brake control system HBC, see chapter "Accessories"

Holding brake controller

The holding brake control HBC amplifies the digital output signal ACTIVE1_OUT of the unit and controls the brake in such a way to allow fast switching with a minimum of heat generation. In addition, the brake connection, which is located in a cable with the wiring connections to the motor, safely disconnects the signal connections on the unit in the event of a breakdown of the insulation of the motor cable.

The function of the HBC and the holding brake can be tested, see 7.4.8 “Checking holding brake“ page 7-28.

Settable parameters

ACTIVE1_OUT changes to 1 as soon as the output stage is released and the motor has a holding moment applied to it. A time delay for release (BRK_trelease) and application (BRK_tclose) can be set by parameters.

Signal	Function	Value
ACTIVE1_OUT	Brake is or will be released	1
	Brake is or will be applied	0

Delayed release

When releasing the brake (opening) the parameter BRK_trelease effects a delayed response of the drive with respect to the enable command.

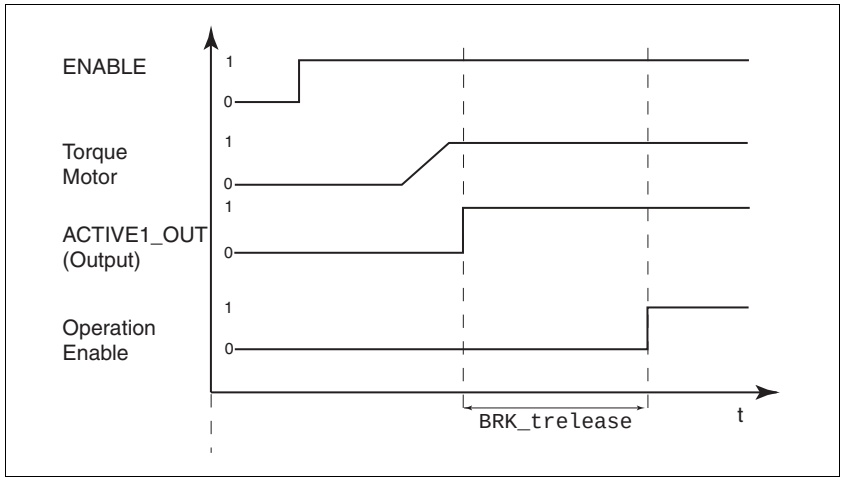

Figure 8.33 Releasing the holding brake

The setting of the parameter BRK_trelease depends on the motor type and can be found in the motor data sheet.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
BRK_trelease BTRE DRC-btrE	Time delay when opening or releasing the brake(8-69)	ms 0 0 1000	UINT16 R/W per. -	CANopen 3005:7$_h$ Modbus 1294

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Delayed application

Once `Enable` is removed, the `ACTIVE1_OUT` signal changes to 0 and the brake is applied. The motor remains under current, however, for the time set on the parameter `BRK_tclose`.

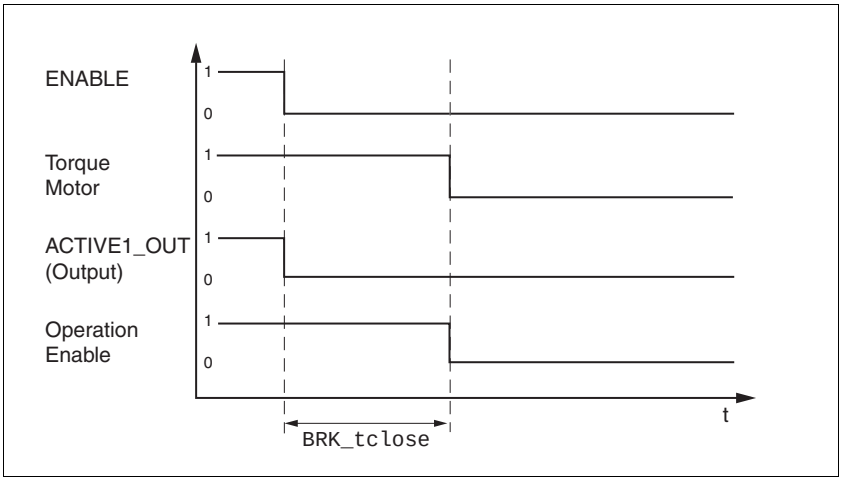

Figure 8.34 Applying the holding brake

The setting of the parameter `BRK_tclose` depends on the motor type and can be found in the motor data sheet.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
BRK_tclose BTCL DRC-bECL	Time delay when setting the brake(8-69)	ms 0 0 1000	UINT16 R/W per. -	CANopen 3005:8$_h$ Modbus 1296

Voltage reduction

If the voltage reduction on the HBC is activated, the start-up voltage of the brake is reduced after a time delay.

The voltage reduction must be set via the "Voltage reduction" switch depending on the motor type:
on: voltage reduction on, e.g. for SER motors
off: voltage reduction off, e.g. for BSH motors
Note the defaults in the motor manual.

When switching on the supply voltage, the holding brake control and the function of the HBC button are reset. There is no voltage at the control terminals of the brake, the LED "Brake released" of the HBC is off.

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8.6.9 Reversal of direction of rotation

The parameter POSdirOfRotat can be used to reverse the direction of rotation of the motor. Note that changing the parameter value will only be effective after switching the device off and on again.

The limit switch that limits the working range with clockwise rotation must be connected to $\overline{\text{LIMP}}$. The limit switch that limits the working range with anti-clockwise rotation must be connected to $\overline{\text{LIMN}}$.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
POSdirOfRotat PROT DRC-Prot	Definition of direction of rotation(8-71) **0 / clockwise / clw**: Clockwise **1 / counter clockwise / cclw**: Counterclockwise Interpretation: The drive rotates clockwise with positive speeds, looking onto the motor shaft at the flange. CAUTION: A change of the setting is not activated until the unit is switched on again CAUTION: When using limit switches, after changing the setting, the limit switch connections must be changed over. The limit switch which is actuated by moving in jog mode in clockwise direction must be connected to the LIMP input, and vice versa.	- 0 0 1	UINT16 R/W per. -	CANopen 3006:C_h Modbus 1560

If the direction of rotation of the motor must be reversed, all parameter values can be imported unchanged except for the parameters for position processing with SinCos Multiturn.

By reversing the direction of rotation, the absolute position of the motor _p_absworkusr changes, which is read from the rotary encoder, and also the actual position evaluated by the device _p_actusr.

The direction of rotation should therefore be set at commissioning to the state which will be required later for the operation of this motor.

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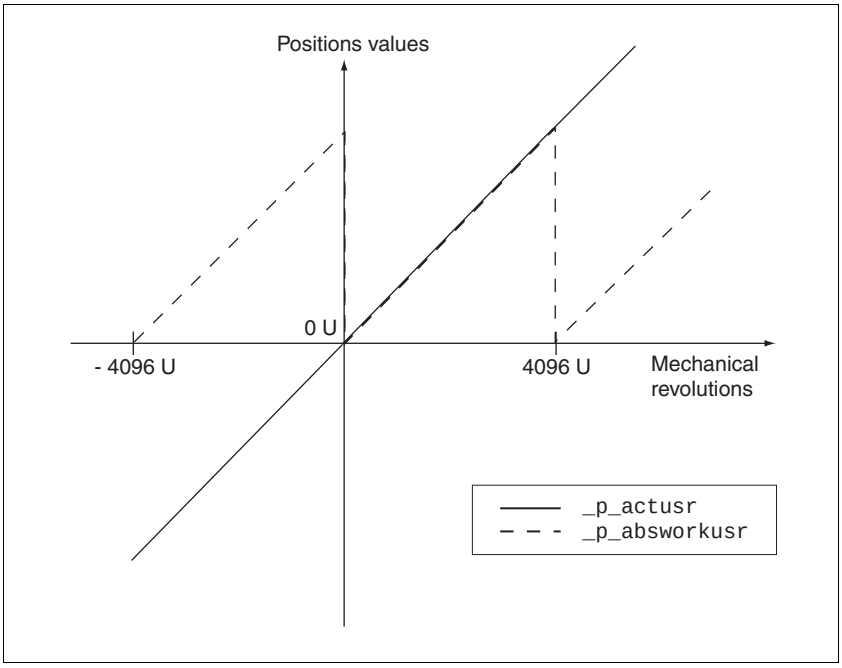

Figure 8.35 Position values without direction reversal

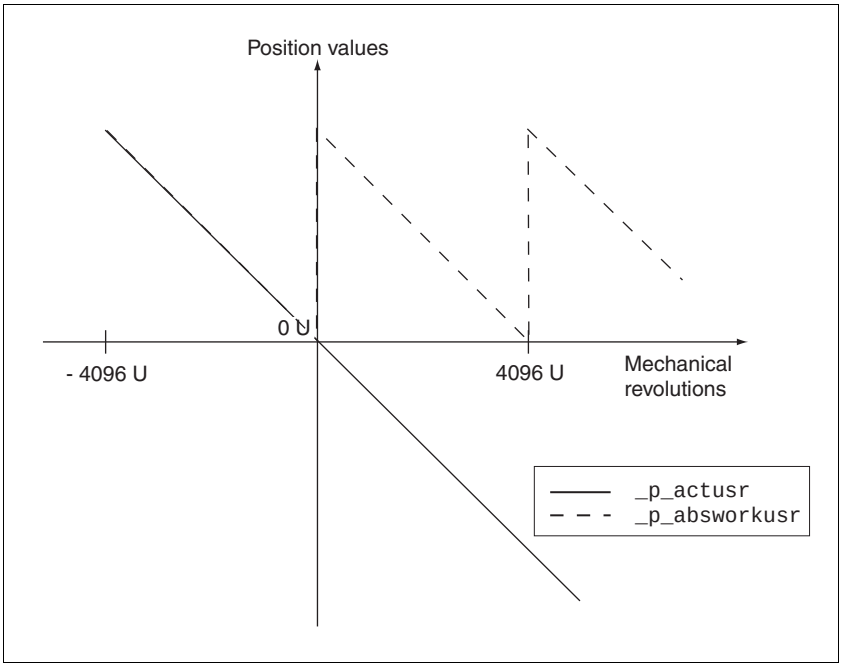

Figure 8.36 Position values with direction reversal

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8.6.10 Restoring default values

8.6.10.1 Restore status after "First Setup"

The parameter PARuserReset is used to restore the status after "First Setup".All parameter values are reset to default values, with the exception of the communication parameters, the control mode and the logic type.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PARuserReset -	Resetting the user parameters(8-73) 1: Set the user parameters to default values. All parameters are reset, with the exception of: - communication parameters - device control - logic type	- 0 - 1	UINT16 R/W - -	CANopen 3004:8_h Modbus 1040

All parameter values set by the user are lost during this process.
It is possible at any time to save all parameter values set for a device as a configuration using the commissioning software.

8.6.10.2 Restore factory settings

The parameter PARfactorySet is used to restore the factory settings. All parameter values are reset to the default values.

▶ Remove the connection to the fieldbus in order to avoid conflicts by simultaneous access.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PARfactorySet FCS DRC-FCS	Restore factory setting (default values)(8-73) 1: Set all parameters to default values and back up in the EEPROM. The factory setting can be triggered via HMI or PowerSuite. CAUTION: The default state only becomes active at the next start-up.	- 0 - 3	UINT16 R/W - -	

Factory setting via HMI

▶ Set drC and then FCS on the HMI and confirm your selection with YES.

All parameter values are reset to the default values. See "First Setup", page 7-13
The new settings only become effective after switching off and switching on the device again.

Factory settings via commissioning software

The factory settings are set via the menu points Configuration => Factory Settings. All parameter values are reset to the default values. See

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"First Setup", page 7-13
The new settings only become effective after switching off and switching on the device again.

All parameter values set by the user are lost during this process.
It is possible at any time to save all parameter values set for a device as a configuration using the commissioning software.

8.6.10.3 Duplicate existing device settings

Application and advantage

- Multiple devices should have the same settings, e.g. when devices are replaced.
- "First setup" does not need to be carried out using the HMI.

Requirements

Device type, motor type and device firmware must be identical. The tool is the Windows-based commissioning software PowerSuite. The controller power supply must be switched on at the device.

Export device settings

The commissioning software installed on a PC can apply the settings of a device as configuration.

▶ Load the configuration if the device into the commissioning software with "Action Transfers".

▶ Highlight the configuration and select "File - Export".

Import device settings

A stored configuration can be imported into a device of the same type. Please note that the fieldbus address is also copied with this information.

▶ In the commissioning software select the menu item "File - Import" and load the desired configuration.

▶ Highlight the configuration and select "Action - Configure".

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9 Examples

9.1 Wiring of local control mode

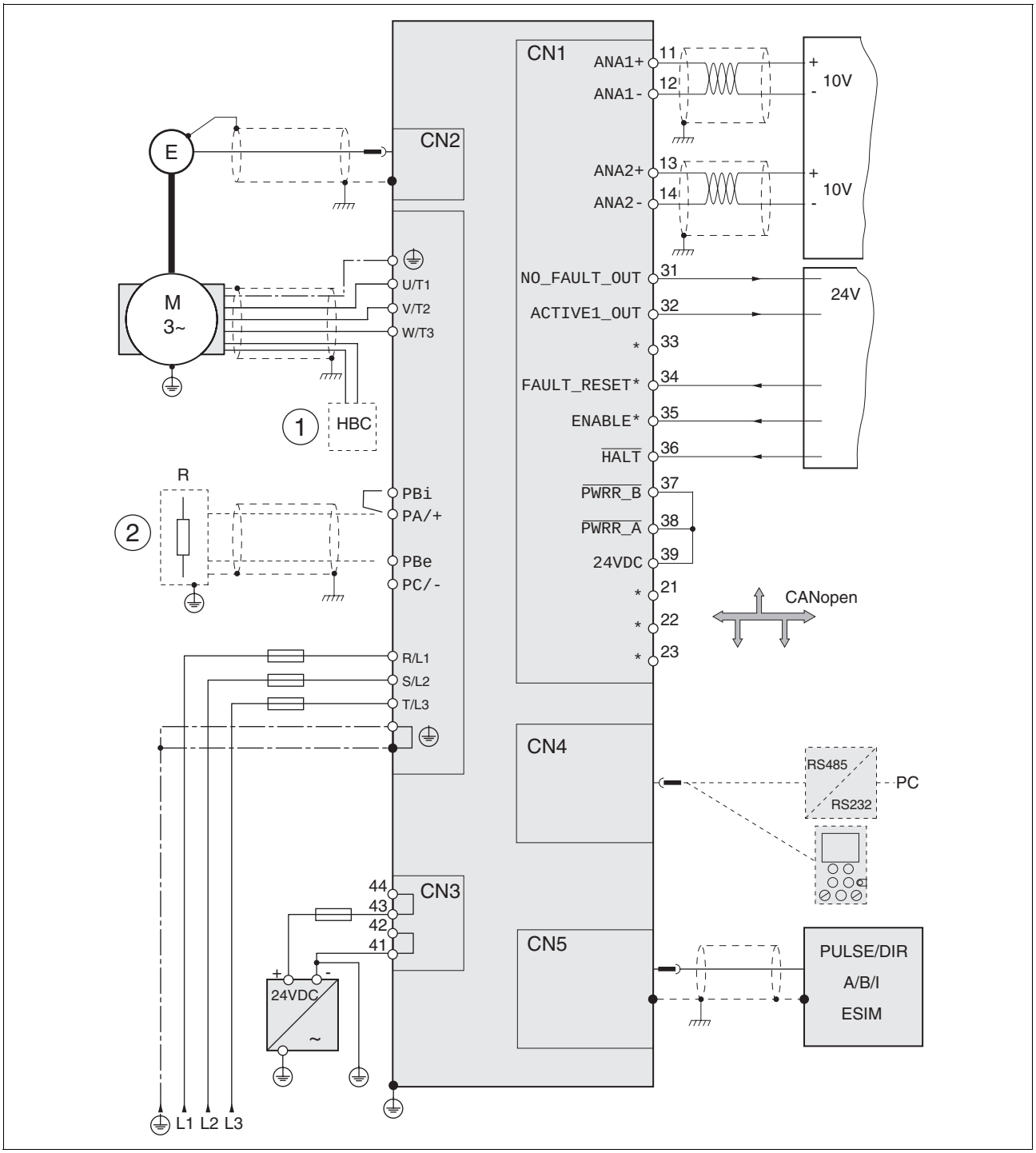

Figure 9.1 Wiring example

(1) Optional: Holding brake controller
(2) Optional: external braking resistor

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9.2 Wiring of fieldbus control mode

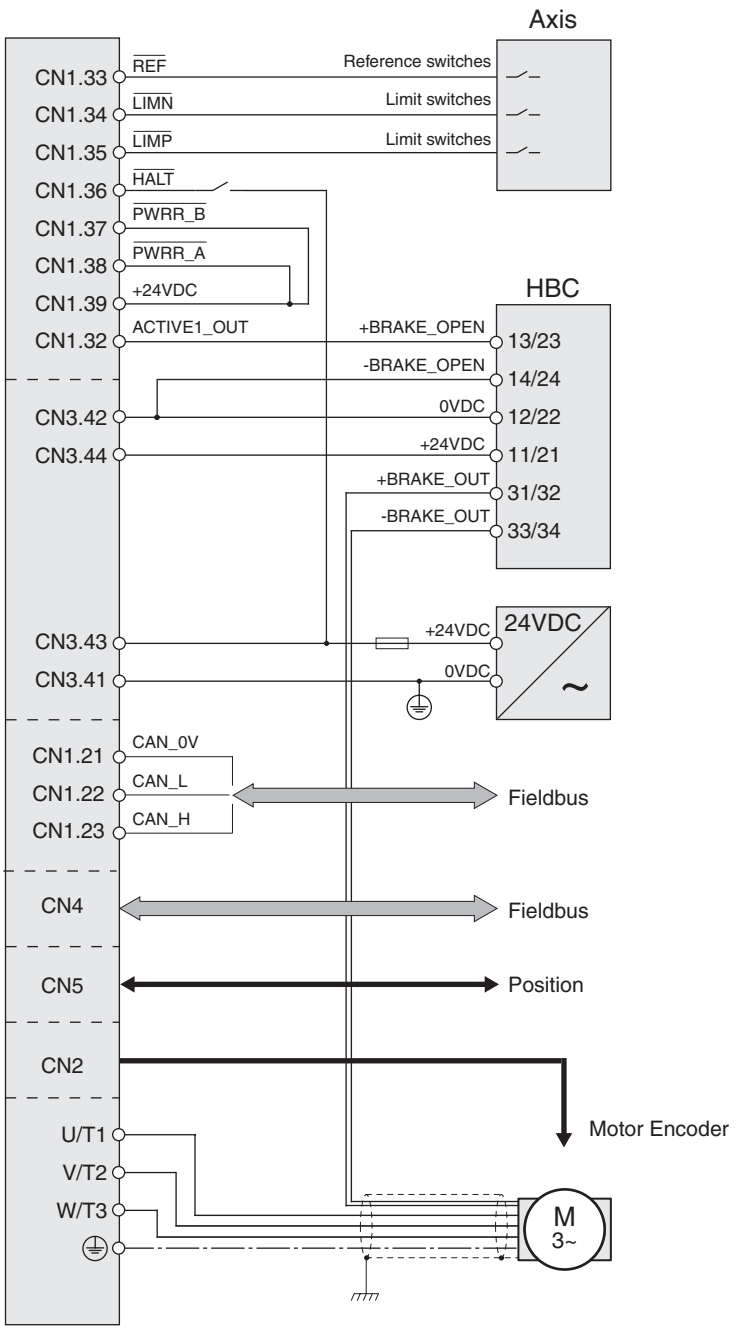

Figure 9.2 Wiring example

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9.3 "Power Removal" wiring

Using the safety functions integrated in this product requires careful planning. For more information see 5.3 “Safety function "Power Removal"“ on page 5-2.

9.4 Parameterisation of local control mode

The following examples show settings for the current control, speed control and electronic gear modes. The control is local (I/O Mode), the reference value preselection via the analogue inputs.

The parameter setting is performed on the HMI in the following examples.

Requirements:

- The motor shaft should not yet be coupled with the system mechanism.
- The analogue inputs are already wired up.
- The "First Setup" and the settings for the basic parameters and limiting values have been carried out during commissioning.
- The power amplifier is ready to switch on, i.e the status display on the HMI shows rdY.

Example A: Current control

▶ Set the default operating mode to current control. Under drC- / IoM select the entry Curr.

▶ The set current should be preset to 200 mA at 10V using ANA1+ . Select under SEt- / A1S the value 0.20.

▶ The motor speed should be limited using ANA2+ . Under drC- / A2Mo select the entry SPEd.

▶ The limit value of the motor speed should be 6000 rpm at 10 V. Under drC- / A2nM select the value 6000.

▶ Check the speed limiter.

Start the motor for this (input signal $\overline{\text{ENABLE}}$). Set ANA1+ to maximum and limit it using ANA2+. Read off the speed value under StA- / nACt.

▶ Check the actual current value. Read off the value under StA- / IACt.

Example B: Speed control

▶ Set the default operating mode to speed control . Under drC- / IoM select the entry SPEd.

▶ The motor speed should be preset to 1500 r.p.m. at 10V using ANA1+ . Select under SEt- / A1nS the value 1500.

▶ The motor current should be limited using ANA2+ . Under drC- / A2Mo select the entry Curr.

▶ The limit value of the motor current should be 0.5 A at 10 V. Under drC- / A2IM select the value 5.00.

▶ Check the current limiter

Start the motor for this (input signal $\overline{\text{ENABLE}}$). Set ANA1+ to maximum and limit it using ANA2+. Read off the current value under StA- / IACt.

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▶ Check the current speed. Read off the value under 5tA- / nACt.

Example C: Electronic gear

▶ Set the default operating mode to electronic gear. Under drC- / ,o-M select the entry GEAr

▶ The gear ratio should be selected from a list of presets and should be 2000. Under 5Et- / GFAC select the value 2000.

▶ Check the current speed. Start the motor for this (input signal $\overline{\text{ENABLE}}$). Read off the value under 5tA- / nACt.

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10 Diagnostics and troubleshooting

⚠ DANGER

Electric shock, fire or explosion

- Only qualified personnel who are familiar with and understand the contents of this manual are authorised to work on and with this drive system.
- The system manufacturer is responsible for compliance with all applicable regulations relevant to earthing the drive system.
- Many components, including printed wiring boards, operate at mains voltage. **Do not touch**. Do **not** touch unshielded components or screws of the terminals with voltage present.
- Install all covers and close the housing doors before applying power.
- The motor generates voltage when the shaft is rotated. Lock the shaft of the motor to prevent rotation before starting work on the drive system.
- Before working on the drive system:
  - Switch off power to all terminals.
  - Place a sign "DO NOT SWITCH ON" on the switch and lock to prevent switching on.
  - **Wait 6 minutes** (for discharge of DC bus capacitors). Do **not** short-circuit DC bus
  - Measure voltage at DC bus and check for <45V. (The DC bus LED is not a safe indication for absence of the DC bus voltage).

Failure to follow these instructions will result in death or serious injury.

10.1 Service

If you cannot resolve the fault yourself please contact your appointed sales partner. Have the following details available:

- Type, identification number and serial number of the product (type plate)
- Type of fault (possibly with fault number)
- Previous and concurrent conditions
- Your own ideas regarding the cause of the fault

Include this information if you return the product for inspection or repair.

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10.2 Error responses and error classes

Error response

The product triggers an error response in the event of a fault. Depending upon the gravity of the fault, the unit responds in accordance with one of the following error classes:

Error class	Response	Description
0	Warning	Message only, no interruption of movement mode.
1	Quick Stop	Motor stops with "Quick Stop", power amplifier and controller remain switched on and active.
2	Quick Stop with switch-off	Motor stops with "Quick Stop", power amplifier and controller switch off when at standstill.
3	Fatal error	Power amplifier and controller switch off immediately, without stopping the motor first.
4	Uncontrolled operation	Power amplifier and controller switch off immediately, without stopping the motor first. Error response can only be reset by switching the unit off.

The occurrence of an event is signalled by the device as follows:

Event	Status	HMI-display	Entry for last interruption cause (_StopFault)	Entry in error memory
Halt	Operation Enabled	hALt	-	-
Software-Stop	Quick Stop active	StoP A306	E A306	-
Hardware limit switch (e.g.LIMP)	Quick Stop active	StoP A302	E A302	E A302
Error with error class 1, e.g. tracking error with error class 1	Quick Stop active	StoP A320	E A320	E A320
Error with error class>1, e.g. tracking error with error class 3	Fault	FLt A320	E A320	E A320

HMI, commissioning software and fieldbus indicate whether the safety function was triggered by $\overline{\text{PWRR\_A}}$ or $\overline{\text{PWRR\_B}}$. Neither signal can be configured via parameters.

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10.3 Error display

The last cause of interruption and the last 10 error messages are stored. The HMI allows the last cause of interruption to be displayed; the commissioning software and the fieldbus allow, in addition to the last cause of interruption, the last 10 error messages also to be displayed. A description of all the error numbers can be seen from page 10-13.

10.3.1 Status diagram

After switching on and at the start of an operating mode, a sequence of operating states is progressed through.

The relationship between the operating states and the state transitions is shown in the state diagram (state machine).

The operating states are internally monitored and influenced by monitoring and system functions, such as temperature and current monitoring

Graphic representation The state diagram is shown graphically as a flow chart.

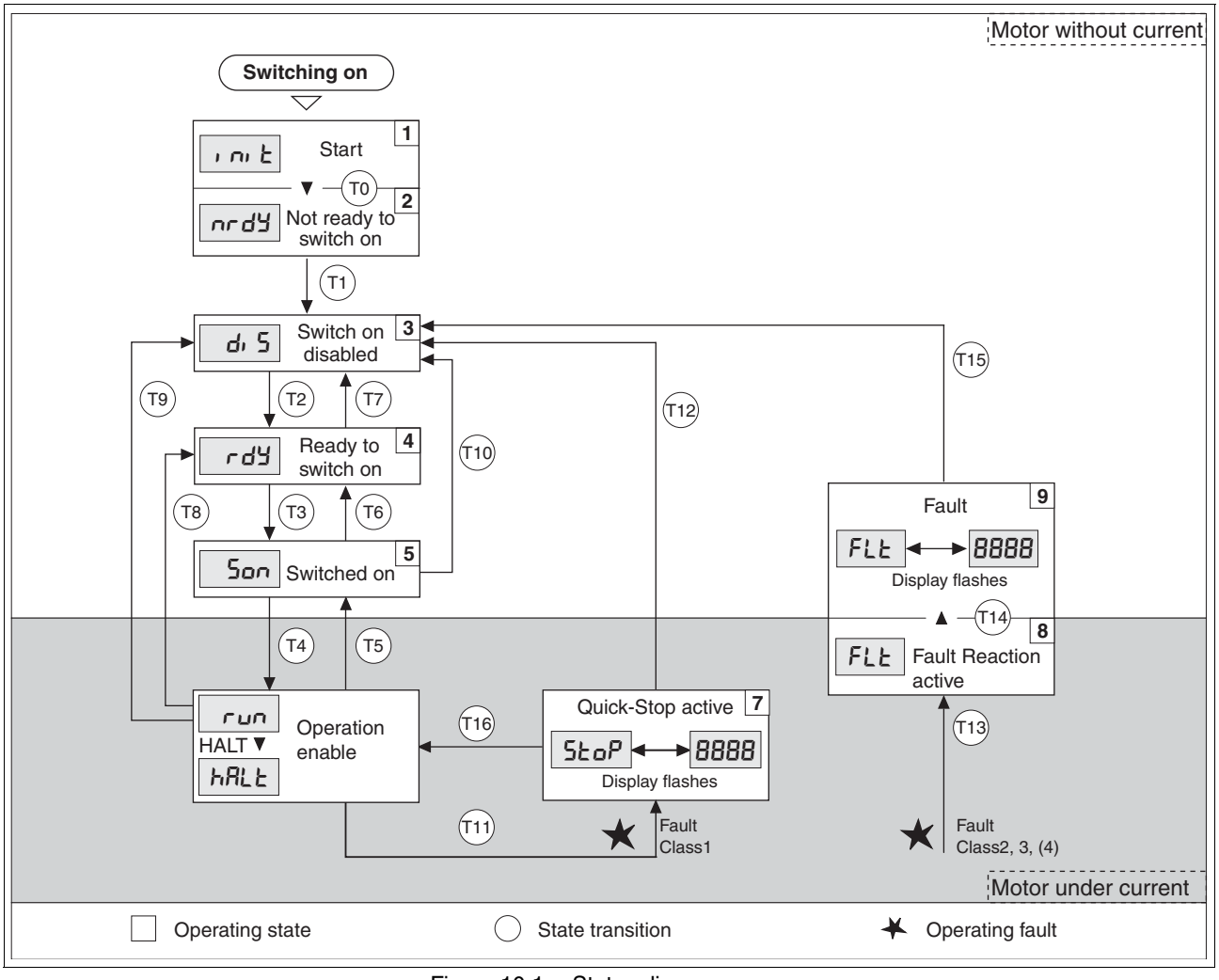

Figure 10.1 Status diagram

Operating states The operating states are displayed as standard by the HMI and the commissioning software.

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Display	Status	State description
init	**1** Start	Controller supply voltage, electronics is initialised
nrdy	**2** Not ready to switch on	The power amplifier is not ready to switch on
dis	**3** Switch on disabled	Switching on the power amplifier is disabled
rdy	**4** Ready to switch on	The power amplifier is ready to switch on
Son	**5** Switched on	Motor not under current Power amplifier ready No operating mode active
run hALt	**6** Operation enable	RUN: device running in the selected operating mode HALT: The motor is stopped with active power amplifier
StoP	**7** Quick Stop active	"Quick Stop" is executed
Flt	**8** Fault Reaction active	Error detected, error response is enabled
Flt	**9** Fault	device is in error condition

State transitions Status transitions are triggered by an input signal, a fieldbus command (with fieldbus control mode only) or as a response to a monitoring signal.

Trans-ition	Operating status	Condition / result [1]	Response
T0	**1** -> **2**	• Motor speed below switch-on limit • Device electronics successfully initialised	Check motor encoder
T1	**2** -> **3**	• First commissioning is completed	-
T2	**3** -> **4**	• Motor encoder successfully checked, DC bus voltage active, $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ = +24V, actual speed: <1000 rpm fieldbus command: Shutdown [2]	-
T3	**4** -> **5**	• Fieldbus command Switch On • Input signal ENABLE0 -> 1	
T4	**5** -> **6**	• Fieldbus command Enable Operation	Switch on power amplifier. Motor phases, earthing, user parameters are checked Release brake
T5	**6** -> **5**	• Fieldbus command Disable Operation • Input signal ENABLE0 -> 1	Interrupt travel command with "Halt" Apply brake Switch off power amplifier
T6	**5** -> **4**	• Fieldbus command Shutdown	
T7	**4** -> **3**	• DC BUS undervoltage • $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ = 0V • Actual speed: >1000 rpm (e.g. by auxiliary drive) • Fieldbus command Disable Voltage	-
T8	**6** -> **4**	• Fieldbus command Shutdown	Switch off power amplifier immediately
T9	**6** -> **3**	• Fieldbus command Disable Voltage	Switch off power amplifier immediately
T10	**5** -> **3**	• Fieldbus command Disable Voltage	
T11	**6** -> **7**	• Class 1 error • Fieldbus command Quick Stop	Interrupt travel command with "Quick Stop"

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Transition	Operating status	Condition / result [1]	Response
T12	**7** -> **3**	• Fieldbus command Disable Voltage	Switch off power amplifier immediately, even if "Quick Stop" still active
T13	**x** -> **8**	• Errors Class 2, 3 or 4	Error response is carried out, see "error response"
T14	**8** -> **9**	• Error response completed • Errors Class , 3 or 4	
T15	**9** -> **3**	• Fieldbus command Fault Reset [3] • Input signal FAULT_RESET0 -> 1 [3]	Error is reset
T16	**7** -> **6**	• Fieldbus command Fault Reset [3] • Input signal FAULT_RESET0 -> 1 [3] • Fieldbus command Enable Operation [4]	Local control mode specified operating mode is automatically continued

1) It is sufficient to fulfil one point to trigger the status transition
2) Only required with fieldbus control mode, fieldbus CANopen and parameter DCOMcompatib = 1
3) Cause of error must be corrected
4) Only possible if operating status was triggered via fieldbus

10.3.2 Error display on HMI

State display uLoU The display shows uLoU (ULOW) when initialised. The voltage of the control supply is too low .

▶ Check the control supply.

State display nrdY The product persists in switch-on state nrdY (NRDY).

▶ After "First Setup", you need to switch the unit off and switch it on again.

▶ Check the installation.
If the installation is correct, then there is an internal fault. To diagnose, read the error memory using the commissioning software.
If you cannot resolve the fault yourself please contact your local sales partner.

Status display di 5 If the product comes to a stop in status di 5 (DIS), the DC bus voltage has failed or the $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ safety inputs have no power.

▶ Check the following:

- Are the $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ safety inputs enabled? If not required, these two inputs should be set to +24V.
- Check the installation of the analogue and digital signal connections. Pay particular attention to the minimum assignment, see page 6.3.17 “Connection of digital inputs/outputs (CN1)“.
- Is the mains supply to the power amplifier switched on and does the voltage correspond to the details in the technical data?

Special condition for devices with CANopen fieldbus: For devices with fieldbus control mode and CANopen note the setting of the DCOMcompatib parameter. Depending on the setting of this parameter the device remains in status di 5 after being switched on.

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State display FLt

The display flashes alternately with FLt (FLT) and a 4 digit error number. The error number can also be found in the error memory list.

▶ Check especially:

- Is a suitable motor connected?
- Is the motor encoder cable correctly wired and connected? The unit cannot correctly start up the motor without a motor encoder signal.

Status display StoP

The HMI displays StoP (STOP) when a "Quick Stop" has been triggered. This can be caused by a software stop, a hardware limit switch or by an error of error class 1.

▶ Remove the cause of the error and reset the error message.

StAtE di SPLAY Ldog

The display shows Ldog (WDOG) when initialised. The internal monitor has sensed a fault by means of the Watchdog.

▶ Contact the Technical Support of your local sales partner. Advise the peripheral conditions (operating mode, application event) when the fault occurs:

▶ The error can be reset by switching the unit off and on again.

Cause of the last interruption

▶ Press the ENT button on the HMI to acknowledge the current error message.

▶ Change to the FLt menu. The last cause of interruption (Parameter _StopFault) is shown as an error number, see chapter 10.5.

10.3.3 Error display with commissioning software

■ You will need a PC with the commissioning software and a functional connection to the product, see 6.3.18 “Connection to PC or remote terminal (CN4)“ from page 6-47.

▶ Select “Diagnosis error memory“. A dialogue box which displays the error messages appears.

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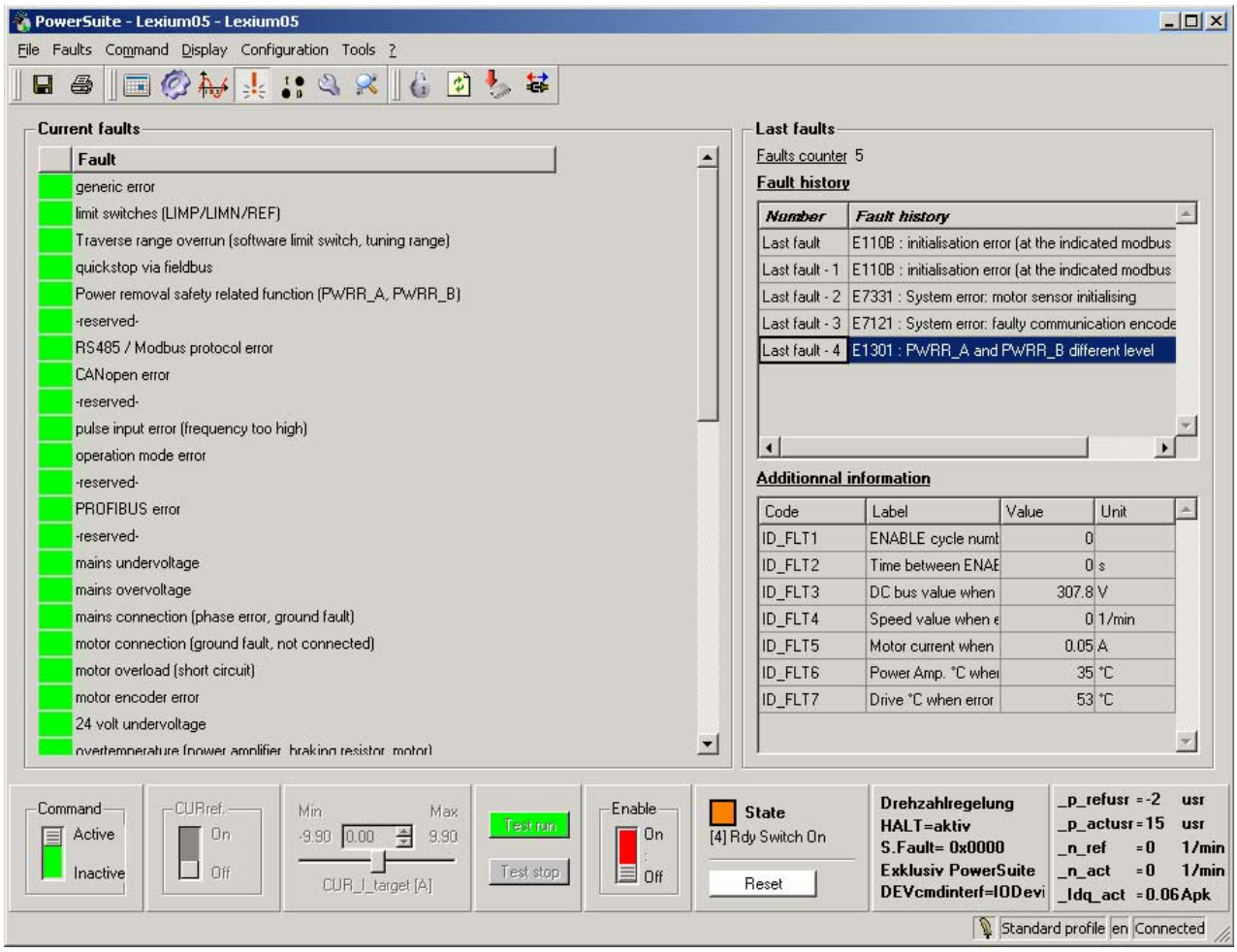

Figure 10.2 Error messages

The commissioning software shows a 4 digit error number in the list of the error memory with an "E" in front.

Error messages are displayed showing status, error class, time when error occurred and a short description. Under "additional information "you can verify the exact conditions when the error occurred.

▶ Resolve the error and reset the current error message with the "reset "button in the command bar of the program.
In the case of class 4 errors, you will need to switch off the controller supply voltage and switch it on again.

10.3.4 Error display over the fieldbus

Error display by status word

The error is first displayed via the parameter `DCOMstatus` . The display takes place by changing the operating status and setting the error bit Bit 13 x_err.

cause of last interruption

The parameter `_StopFault` allows read out of the error number and the last cause of interruption. As long as there is no error present, the value of this parameter will be 0. If an error occurs, the error, together with the further status information, is written to the error memory. In the case of subsequent errors, only the triggering cause of error is stored.

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Error memory

The error memory is an error history of the last 10 errors and is maintained even if the device is switched off. The following parameters allow the error memory to be controlled:

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
FLT_del_err -	Erase error memory(10-7) 1: Erases all entries in the error memory The erasing process is complete when a 0 is returned when reading.	- 0 - 1	UINT16 R/W - -	CANopen 303B:4_h Modbus 15112
FLT_MemReset -	Reset the error memory read pointer(10-7) 1: Set error memory read pointer to oldest error entry.	- 0 - 1	UINT16 R/W - -	CANopen 303B:5_h Modbus 15114

The error memory can only be read sequentially. The parameter `FLT_MemReset` must be used to reset the read pointer. Then the first error entry can be read. The read pointer is automatically moved on to the next entry, re-reading selects the next error entry. If the error number 0 is returned there is no error entry present.

Position of the entry	Description
1	1. error entry, oldest message
2	2. error entry, later message, if present
...	...
10	10. error entry. In the case of 10 error entries the most current error value is shown here

An individual error entry consists of several pieces of information which are read out using various parameters. When reading out an error entry, the error number must always be read out first with the parameter `FLT_err_num`.

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
FLT_err_num -	Error number(10-7) Reading this parameter brings the complete error entry (error class, time of error ...) into an intermediate memory from which all components of the error can be read. In addition, the read indicator of the error memory is automatically switched forward to the next error entry.	- 0 - 65535	UINT16 R/- - -	CANopen 303C:1_h Modbus 15362
FLT_class -	Error class(10-7) 0: Warning (no reaction) 1: error (Quick Stop -> status 7) 2: error (Quick Stop -> status 8.9) 3: Fatal error (state 9) 4: Fatal error (state 9, not resettable)	- 0 - 4	UINT16 R/- - -	CANopen 303C:2_h Modbus 15364

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
FLT_Time -	Error time(10-7) referenced to the operating hours counter	s 0 - 536870911	UINT32 R/- - -	CANopen 303C:3_h Modbus 15366
FLT_Qual -	Error additional information(10-7) This entry contains additional information about the error, depending on the error number. Example: a parameter address	- 0 - 65535	UINT16 R/- - -	CANopen 303C:4_h Modbus 15368

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10.4 Troubleshooting

10.4.1 Resolution of malfunctions

Malfunction	Cause	Correction
Motor not turning	Motor blocked by brake	Release holding brake, check wiring
Break in the motor cable	Check motor cable and connection. One or more motor phases are not connected.	
No torque	Set the parameters for max. current, max. speed to greater than zero	
Incorrect operating mode selected	Set the input signal and parameters for the operating mode you want	
Drive system switched off	Switch on drive system, generate release signal	
Analogue reference value is missing	PLC program and wiring to be checked	
Motor phases reversed	Correct the sequence of the motor phases	
Motor mechanically blocked	Check ancillary devices	
Current limiting activated (analogue input or parameter)	Correct the current limit	
The motor jerks briefly	Motor phases reversed	Check motor cable and connection: connect motor phases U, V and W in the same way on the motor and device sides
Motor vibrating	Amplification factor KP too high	reduce KP (speed controller)
Fault in the motor encoder system	Check motor encoder	
Reference potential for analogue signal missing	Connect reference potential of analogue signal to the reference value source.	
Motor running too soft	Integration time TNn too high	Reduce Tn (speed controller)
Amplification factor KPn too low	Increase KPn (speed controller)	
Motor running too rough	Integration time TNn too low	Increase TNn (speed controller)
Amplification factor KPn too high	Reduce KPn (speed controller)	
Error message communication error	Drive system switched off	Switch on the drive system
Wiring error	Check wiring	
Wrong PC interface selected	Select correct interface	

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10.4.2 Error resolution sorted by error bit

To provide improved visibility when troubleshooting, all error numbers are categorised with so-called error bits. The error bits can be read using the parameter _SigLatched . The signal state "1" marks an error or warning message.

Error bit	Description	Error class	Cause	Troubleshooting
0	General error	0		
1	Limit switch (LIMP/LIMN/ REF)	1	Limit switch is or was activated, wire interrupted	Traverse drive into movement range, match positioning data to axis range, special message in error memory
2	Area of travel exceeded (software limit switch, tuning range)	1	Motor outside area of travel	Check area of travel, re-reference the drive
3	"Quick Stop" by fieldbus	1	fieldbus command	
4	$\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ inputs are "0"	3	"Power Removal" has been triggered	Check safety guard, wiring
5	reserved			
6	Error in fieldbus RS485, Modbus		Interruption of the fieldbus communication, only with RS485, such as Modbus	Check communication cable, check fieldbus, check communication parameters, see also fieldbus manual
7	Error in fieldbus CANopen		Interruption in fieldbus communication, only with CANopen	Check communication cable, check fieldbus, check communication parameters, see also fieldbus manual
8	reserved			
9	Reference signals faulty (frequency too high)		frequency too high, error	EMC measures, maintain maximum frequency (technical data)
10	Error in processing of the current operating mode	2	Processing error in electronic gear, reference movement or jog mode.	Detailed information see under additional information in the error memory
11	reserved			
13	reserved			
14	DC BUS undervoltage	2	DC bus voltage under threshold value for "Quick Stop"	Check or increase mains voltage
		3	DC bus voltage under threshold value for switch-off of the drive	Check for power failure
15	DC bus overvoltage	3	DC bus overvoltage, braking too fast	Extend braking process, use external braking resistor
16	Power supply faulty (phase fault, earth fault)	par. [1)]	Short circuit or earth fault	Check fuse and installation
			Supply voltage connected incorrectly (e.g. 1-phase instead of 3-phase)	
17	Connection to motor (motor phase interrupted, earth fault, commutation)	3	Short circuit or earth fault in the motor wiring or encoder wiring. Motor faulty.	Check connections, change motor cable or encoder cable.
			External moment exceeds the motor moment (preset motor current too low).	Change motor. Reduce external moment or increase the setting of the motor current.
18	Motor overload (phase current too high)	3	I^2t monitoring for motor	Reduce load, use a motor with a higher nominal power

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Error bit	Description	Error class	Cause	Troubleshooting
19	Encoder in motor signals error or connection to encoder faulty	3-4	No signal from the motor encoder, encoder faulty	Check encoder cable and encoder, replace cable
20	undervoltage from controller supply		Controller supply voltage has fallen below the minimum value	Secure control supply. Check short-term voltage failures during load changes
21	Temperature too high (power amplifier, braking resistor or motor)	3	The power amplifier is overheating	Ventilator faulty or blocked, switch on time for peak current, reduce load or peak torque
			Motor is overheating Temperature sensor not connected	Allow motor to cool down, reduce load, use motor with greater nominal power, temperature sensor faulty, check/change motor and encoder cables
22	Tracking error	par. [1)] 1-3	Tracking error	Reduce external load or acceleration, error response is adjustable via "Flt_pDiff“
23	Maximum speed exceeded		Exceeding the maximum motor speed under shift operation	Reduce vertical loading
24	Inputs $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ different	4	Interruption of the signal wiring	Signal cable/connection to be checked, check signal encoder or change
25..28	reserved			
29	error in EEPROM	3-4	Checksum in EEPROM incorrect	"Initial setting "to be carried out, user parameters to be stored in the EEPROM, consult your local sales partner
30	system run-up faulty (hardware or parameter error)	3-4	Cause of error in accordance with error display	Resolution dependent upon error display
31	Internal system error such as Watchdog)	4	Internal system error	Switch device off and on, replace device
			System fault such as division by 0 or time-out checks, inadequate EMC	Comply with EMC protective measures, switch device off and on, contact your local service representative

1) par. = configurable

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10.5 Table of error numbers

The cause of error for each error message is coded as an error number and stored in the parameter FLT_err_num . The following table shows all the error numbers and their meaning If "par. "is shown under the error class, then the error class is can be set as a parameter. Please note that in the HMI, the error number is shown without the preceding "E".

The error numbers are structured:

Error number	Error in area
E 1xxx	General errors
E 2xxx	Excess current error
E 3xxx	Voltage error
E 4xxx	Temperature error
E 5xxx	Hardware error
E 6xxx	Software error
E 7xxx	Interface error, wiring error
E 8xxx	Fieldbus error CANopen
E Axxx	Drive error, movement error
E Bxxx	Communication error

Information on error class can be found on page 10-2.
Information on error bits and measures for correcting errors can be found on page 10-11.

Error number	Class	Bit	Description
E 1100	0	0	parameter out of permissible range
E 1101	0	0	parameter does not exist
E 1102	0	0	parameter does not exist
E 1103	0	0	parameter write not permissible (READ only)
E 1104	0	0	write access denied (no access authorisations)
E 1106	0	0	Command not allowed while power amplifier is active
E 1107	0	0	Access via other interface blocked
E 1108	0	0	parameter not readable (Block Upload)
E 1109	1	0	Data that are saved following a power failure are invalid
E 110A	0	0	System error: boot loader not present
E 110B	3	30	Initialisation error (additional info=modbus register address)
E 1300	3	4	Power Removal tripped (PWRR_A, PWRR_B)
E 1301	4	24	PWRR_A and PWRR_B different level
E 1310	3	9	Reference signal frequency too high
E 1603	0	0	Capture memory occupied by other function
E 1606	0	0	Capture still active
E 1607	0	0	Recording: no trigger defined
E 1608	0	0	Recording: trigger option not permissible
E 1609	0	0	Recording: no channel defined

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Error number	Class	Bit	Description
E 160A	0	0	Recording: no data present
E 160B	0	0	parameter not recordable
E 160C	1	0	Autotuning: moment of inertia outside permissible range
E 160D	1	0	Autotuning: the value of parameter 'AT_n_tolerance' may be too low for the identified mechanical system
E 160E	1	0	Autotuning: Test movement could not be started
E 160F	1	0	Autotuning: Power amplifier cannot be activated
E 1610	1	0	Autotuning: Processing discontinued
E 1611	1	0	System error: Autotuning internal write access
E 1612	1	0	System error: Autotuning internal write access
E 1613	1	0	Autotuning: max. permissible positioning range exceeded
E 1614	0	0	Autotuning: already active
E 1615	0	0	Autotuning: this parameter cannot be changed while autotuning is active
E 1616	1	0	Autotuning: static friction for selected speed jump height 'AT_n_ref' too high
E 1617	1	0	Autotuning: Frictional or load moment too great
E 1618	1	0	Autotuning: optimisation aborted
E 1619	0	0	Autotuning: the speed of rotation jump height 'AT_n_ref' is too low compared to 'AT_n_tolerance'
E 1A00	0	0	System error: FIFO memory overflow
E 1A01	3	19	motor has been changed
E 1A02	3	19	motor has been changed
E 1B00	4	31	System error: faulty parameter for motor or power amplifier
E 1B01	3	30	User parameter max. speed of rotation too high
E 1B02	3	30	User parameter max. current, holding current or Quick Stop current too high
E 1B03	4	30	Encoder is not supported by current operating system
E 1B04	3	30	ESIM resolution too high with selected n_max
E 2300	3	18	power amplifier overcurrent
E 2301	3	18	braking resistor overcurrent
E 3100	par.	16	mains power supply phase fault
E 3200	3	15	DC bus overvoltage
E 3201	3	14	DC bus undervoltage (switch-off threshold)
E 3202	2	14	DC bus undervoltage (Quick Stop threshold)
E 3203	4	19	Motor encoder supply voltage
E 3206	0	11	DC bus undervoltage, no mains phase (warning)
E 4100	3	21	Power amplifier overtemperature
E 4101	0	1	warning power amplifier overtemperature
E 4102	0	4	Power amplifier overload (I^2t) warning
E 4200	3	21	device overtemperature
E 4300	3	21	motor overtemperature
E 4301	0	2	warning motor overtemperature
E 4302	0	5	Motor overload (I^2t) warning

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Error number	Class	Bit	Description
E 4402	0	6	Braking resistors resistor overload (I^2t) warning
E 5200	4	19	Fault in connection to motor encoder
E 5201	4	19	errors in motor encoder communication
E 5202	4	19	Motor encoder is not supported
E 5203	4	19	Fault in connection to motor encoder
E 5204	3	19	Connection to motor encoder lost
E 5205	4	19	Connected motor (motor family) is not supported
E 5430	4	29	System error: EEPROM read error
E 5431	3	29	System error: EEPROM write error
E 5435	4	29	System error: EEPROM not formatted
E 5437	4	29	System error: EEPROM checksum error in manufacturer data
E 5438	3	29	System error: EEPROM checksum error in user-defined parameter
E 5439	3	29	System error: EEPROM checksum error CAN parameter
E 543A	4	29	System error: EEPROM HardwareInfo invalid
E 543B	4	29	System error: EEPROM Manufacturer data invalid
E 543C	3	29	System error: EEPROM CAN-data invalid
E 543D	3	29	System error: EEPROM user parameter invalid
E 543E	3	29	System error: EEPROM checksum error NoInit parameter
E 5600	3	17	motor connection phase error
E 5601	4	19	Interruption or faulty encoder signals
E 5602	4	19	Interruption or faulty encoder signals
E 5603	4	17	Commutation error
E 6107	0	0	Parameters outside value range (calculation error)
E 6108	0	0	Function not available
E 610D	0	0	Error in selection parameter
E 610F	4	30	System error: Internal time base failed (Timer0)
E 7120	4	19	Invalid motor data
E 7121	2	19	System error: errors in motor encoder communication
E 7122	4	30	Motor data not acceptable
E 7123	4	30	motor current offset outside permissible range
E 7124	4	19	System error: encoder is defective
E 7126	0	19	No answer has been received yet
E 7200	4	30	System error: calibration of analogue/digital converter
E 7201	4	30	System error: motor encoder initialising (quadrant evaluation)
E 7327	4	19	System error: position sensor not ready
E 7328	4	19	Motor encoder sends: position capture errors
E 7329	0	8	Motor encoder sends: Warning
E 7330	4	19	System error: motor encoder (Hiperface)
E 7331	4	30	System error: Motor encoder initialisation
E 7333	4	30	System error: Discrepancy during calibration of analogue/digital converter

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Error number	Class	Bit	Description
E 7334	0	0	System error: Analogue/digital converter offset too big
E 7335	0	8	Communication to motor encoder occupied
E 7336	3	0	Offset with Sincos drift compensation too high
E 7337	1	8	Offset could not be successfully written
E 7338	0	13	No valid motor absolute position
E 7400	0	31	System error: illegal interrupt (XINT2)
E 7500	0	9	RS485/Modbus: overrun error
E 7501	0	9	RS485/Modbus: framing error
E 7502	0	9	RS485/Modbus: Parity-error
E 7503	0	9	RS485/Modbus: receive error
E 8110	0	7	CANopen: CAN overflow (message lost)
E 8120	0	7	CANopen: CAN Controller in Error Passive
E 8130	2	7	CANopen: Heartbeat or Life Guard error
E 8140	0	0	CANopen: CAN Controller was in Busoff, communication possible again
E 8141	2	7	CANopen: CAN Controller in Busoff
E 8201	0	7	CANopen: RxPdo1 could not be processed
E 8202	0	7	CANopen: RxPdo2 could not be processed
E 8203	0	7	CANopen: RxPdo3 could not be processed
E 8204	0	7	CANopen: RxPdo4 could not be processed
E 8205	0	7	CANopen: TxPdo could not be processed
E 8206	0	7	CANopen: Internal queue overflow message lost
E A060	2	10	Calculation error with electronic gearbox
E A061	2	10	Change in reference value with electronic gearbox too great
E A300	0	0	Torque ramp with HALT current active
E A301	0	0	Drive in status 'QuickStopActive'
E A302	1	1	Interruption by LIMP
E A303	1	1	Interruption by LIMN
E A304	1	1	Interruption by REF
E A305	0	0	Power amplifier cannot be activated in current operating status of status machine
E A306	1	3	Interruption by user initiated software stop
E A307	0	0	Interruption by internal software stop
E A308	0	0	Drive in state 'Fault'
E A309	0	0	Drive not in state 'OperationEnable'
E A310	0	0	Power amplifier not active
E A312	0	0	Profile generation interrupted
E A313	0	0	Position overrun (pos_over=1), reference point is therefore no longer defined (ref_ok=0)
E A314	0	0	No reference position
E A315	0	0	Homing active
E A316	0	0	Overrun on acceleration calculation
E A317	0	0	Drive not at standstill

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Error number	Class	Bit	Description
E A318	0	0	Operating mode active (x_end = 0)
E A319	1	2	Manual/Autotuning: distance range overflow
E A31A	0	0	Manual/Autotuning: amplitude/offset set too high
E A31B	0	0	HALT requested
E A31C	0	0	Illegal position setting with software limit switch
E A31D	0	0	Speed range exceeded (CTRL_n_max)
E A31E	1	2	Interruption by pos. software limit switch
E A31F	1	2	Interruption by neg. software limit switch
E A320	par.	22	position tracking error
E A321	0	0	RS422 position interface not defined as input signal
E A324	1	10	Error when homing (additional info = detailed error number)
E A325	1	10	Approach limit switch not activated
E A326	1	10	REF switch not found between LIMP and LIMN
E A327	1	10	Reference movement to REF without direction reversal, improper activation of limit switch LIM"
E A328	1	10	Reference movement to REF without direction reversal, overrun of LIM or REF not permissible
E A329	1	10	More than one signal LIMP/LIMN/REF active
E A32A	1	10	Ext. monitoring signal LIMP with counterclockwise rotation
E A32B	1	10	Ext. monitoring signal LIMN with clockwise rotation
E A32C	1	10	Error with REF (switch signal enabled briefly or switch overrun)
E A32D	1	10	Error with LIMP (switch signal enabled briefly or switch overrun)
E A32E	1	10	Error with LIMN (switch signal enabled briefly or switch overrun)
E A32F	1	10	index pulse not found
E A330	0	0	Reproducibility of the index pulse movement uncertain, index pulse too close to the switch
E A331	3	0	No run-up operating mode with local control mode selected
E A332	1	10	Error with jog (additional info = detailed error number)
E A334	2	0	Timeout at Standstill window monitor
E A335	1	10	Processing only possible in fieldbus operation
E A337	0	10	Operating mode cannot be continued
E B100	0	9	RS485/Modbus: unknown service
E B200	0	9	RS485/Modbus: Protocol error
E B201	2	6	RS485/Modbus: Nodeguard error
E B202	0	9	RS485/Modbus: Nodeguard Warning
E B203	0	9	RS485/Modbus: number of monitor objects incorrect
E B204	0	9	RS485/Modbus: service too long

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11 Parameters

This section contains an overview of all parameters that can be addressed for operation of the product.

11.1 Layout of parameters

The parameter display contains, on the one hand, information which is needed for positive identification of a parameter. On the other hand, the parameter display can also provide information on setting options, presets and parameter properties.

A parameter display has the following features:

Parameter Name **Code** **HMI menu, Code**	**Description**	**Unit** **Minimum value** **Default value** **Maximum value**	**Data type** **R/W** **persistent** **Expert**	**Parameter address via fieldbus**
Example_Name BSPI MENUE-bSP-	Example parameter (cross-reference) Details and selection values **1 / selection value1 / WRT1**: declaration 1 **2 / selection value2 / WRT2**: declaration 2	A_{pk} 0.00 3.00 300.00 **Fieldbus** 0 300 30000	UINT16 R/W per. -	CANopen 1234:5$_h$ Modbus 1234

The most important terms in the heading line of a parameter table are explained in the following.

Parameter Name The parameter name is displayed with the commissioning software in the "Designation" column.

Code and HMI Code The Code is represented on a 7 segment display on the HMI (HMI-Code).

Cross reference If there is more information available for these parameters you can find this under this cross-reference.

Selection values In the case of parameters which offer a selection of settings, the selection number via fieldbus and the designation of the values when inputting with commissioning software and HMI are quoted.

1	Selection value over the fieldbus
Selection value 1	Commissioning tool display
WRT1	HMI display

Default value Factory settings.

Data type The data type determines the valid range of values, especially when a parameter does not have explicit minimum and maximum values.

Data type	**Byte**	**Min value**	**Max value**
INT16	2 Byte / 16 Bit	-32768	32767
UINT16	2 Byte / 16 Bit	0	65535

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Data type	Byte	Min value	Max value
INT32	4 Byte / 32 Bit	-2147483648	2147483647
UINT32	4 Byte / 32 Bit	0	4294967295

R/W Note on reading and writing the values
"R/-" values are read-only
"R/W" values are read and write.

persistent Designation of whether the value of the parameter is persistent, i.e. after switching off the unit it is retained in the memory. When changing a value via commissioning software or fieldbus, the user must explicitly store the value change in the persistent memory. When entering via HMI the unit stores the value of the parameter automatically at each change.

Instructions on inputting values Use these specifications with the various parameter setting options:

Setting parameters with	Specifications
Fieldbus	Parameter name
HMI	HMI code
Commissioning software	Code

Please note that parameter values via the fieldbus are shown without a decimal point, e.g.

- For HMI and commissioning software:
  Max. value = 327.67
- For fieldbus (in list of parameters under "Fieldbus"):
  Max. value = 32767

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11.2 List of all parameters

Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_acc_pref -	Acceleration of reference value generation() Advance sign corresponding to the change of the value for speed: Increase in speed: pos. advance sign Reduction in speed: neg. advance sign	(1/min)/s -	INT32 R/- - -	CANopen 301F:9$_h$ Modbus 7954
_AccessInfo -	Current access channels for action objects(8-2) Lowbyte: 0: Occupied by the channel in Highbyte 1 : Exclusively occupied by channel in Highbyte Highbyte: Current assignment of the access channel 0: reserved 1: IO 2: HMI 3: Modbus 4: CANopen 5: CANopen via second SDO channel 6: Profibus	- -	UINT16 R/- - -	CANopen 3001:C$_h$ Modbus 280
_actionStatus -	Action word(8-47) Signal state: 0: not enabled 1: activated Bit0: Class 0 error Bit1 Class 1 error Class 2 error Bit3 Class 3 error Bit4 Class 4 error Bit5 reserved Bit6: drive stopped (actual speed _n_act < 9U/min) Bit7: drive rotates in positive direction Bit8: drive rotates in negative direction Bit9: Drive within position window (pwin) Bit10: reserved Bit11: profile generator stopped (setpoint speed is 0) Bit12: Profile generator decelerating Bit13: Profile generator accelerating Bit14: Profile generator moves in constant mode Bit15: reserved	- -	UINT16 R/- - -	CANopen 301C:4$_h$ Modbus 7176
_DCOMopmd_act -	active operating mode(8-13) Coding see: DCOMopmode	- -6 - 6	INT16 R/- - -	CANopen 6061:0$_h$ Modbus 6920
_I2t_act_M -	Overload motor current(8-47)	% -	INT16 R/- - -	CANopen 301C:19$_h$ Modbus 7218
_I2t_act_PA -	Overload power amplifier current(8-47)	% -	INT16 R/- - -	CANopen 301C:16$_h$ Modbus 7212

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_I2t_mean_M I2TM STA-, 2tM	Loading factor motor(8-47)	% - 	INT16 R/- - -	CANopen 301C:1A$_h$ Modbus 7220
_I2t_mean_PA I2TP STA-, 2tP	Loading factor power amplifier(8-47)	% - 	INT16 R/- - -	CANopen 301C:17$_h$ Modbus 7214
_I2t_peak_RES -	Overload braking resistor maximum value(8-47) Maximum overload braking resistor that has occurred in the last 10 sec.	% - 	INT16 R/- - -	CANopen 301C:15$_h$ Modbus 7210
_I2t_peak_M -	Overload motor maximum value(8-47) Maximum overload motor that has occurred in the last 10 sec.	% - 	INT16 R/- - -	CANopen 301C:1B$_h$ Modbus 7222
_I2t_peak_PA -	Overload power amplifier maximum value(8-47) Maximum overload power amplifier that has occurred in the last 10 sec.	% - 	INT16 R/- - -	CANopen 301C:18$_h$ Modbus 7216
_I2tl_act_RES -	Actual overload braking resistor(8-47)	% - 	INT16 R/- - -	CANopen 301C:13$_h$ Modbus 7206
_I2tl_mean_RES I2TR STA-, 2tr	Load factor braking resistor(8-47)	% - 	INT16 R/- - -	CANopen 301C:14$_h$ Modbus 7208
_Id_act -	current motor current d-components() in 0.01 Apk steps	A_{pk} 0.00 - 0.00	INT16 R/- - -	CANopen 301E:2$_h$ Modbus 7684
_Id_ref -	Set motor current d component (field weakening)() in 0.01 Apk steps	A_{pk} 0.00 - 0.00	INT16 R/- - -	CANopen 301E:11$_h$ Modbus 7714
_Idq_act IACT STA-, ACt	Total motor current (vector sum of d and q components() in 0.01 Apk steps	A_{pk} 0.00 - 0.00	INT16 R/- - -	CANopen 301E:3$_h$ Modbus 7686

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_IO_act IOAC STA-, oRC	Status of digital inputs and outputs(7-24) Assignment of 24V inputs: (Local control mode) Bit 0: - Bit 1: FAULT_RESET Bit 2: ENABLE Bit 3: HALT Bit 4: PWRR_B Bit 5: PWRR_A Bit 6: ENABLE2 Bit 7: reserved Bit 6 forms the ENABLE only under the following conditions: DEVcmdinterf = IODevice and IOposInterfac = Pdinput (fieldbus control mode) Bit 0: REF Bit 1: LIMN,CAP2 Bit 2: LIMP,CAP1 Bit 3: HALT Bit 4: PWRR_B Bit 5: PWRR_A Bit 6: - Bit 7: reserved assignment 24V outputs: Bit 8: NO_FAULT Bit 9: ACTIVE	- -	UINT16 R/- - -	CANopen 3008:1$_h$ Modbus 2050
_Iq_act - -	current motor current q-components() in 0.01 Apk steps	A_{pk} 0.00 - 0.00	INT16 R/- - -	CANopen 301E:1$_h$ Modbus 7682
_Iq_ref IQRF STA-, qrF	Set motor current q component (torque-creating)() in 0.01 Apk steps	A_{pk} 0.00 - 0.00	INT16 R/- - -	CANopen 301E:10$_h$ Modbus 7712
_LastWarning - -	Last warning as number() Number of the last warning generated. If the warning becomes inactive again, the number is retained until the next fault reset. Value 0 : No warning generated	- -	UINT16 R/- - -	CANopen 301C:9$_h$ Modbus 7186
_n_act NACT STA-nRCt	Actual speed of motor(8-45)	1/min - -	INT16 R/- - -	CANopen 606C:0$_h$ Modbus 7696
_n_actRAMP - -	Actual speed of the movement profile generator(8-45)	1/min - -	INT32 R/- - -	CANopen 606B:0$_h$ Modbus 7948
_n_pref - -	Speed of reference value generation()	1/min - -	INT32 R/- - -	CANopen 301F:7$_h$ Modbus 7950

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_n_ref -	Reference speed of the speed controller()	1/min - 	INT16 R/- - -	CANopen 301E:7_h Modbus 7694
_n_targetRAMP -	Target speed of the travel profile generator()	1/min - 	INT32 R/- - -	CANopen 301F:5_h Modbus 7946
_OpHours OPH STA-oPh	Operating hours counter()	s - 	UINT32 R/- - -	CANopen 301C:A_h Modbus 7188
_p_absENCusr -	Absolute position based on motor encoder working range in user-defined units(7-31) Value range is set by sensor type With Singleturn motor encoders the value is set with reference to one motor revolution, with multiturn motor encoders with reference to the total working range of the sensor (e.g. 4096 revs.) Caution! Position is only valid after determination of the motor absolute position. With invalid motor absolute position : _WarnLatched _WarnActive Bit 13=1: absolute position of motor not yet detected	usr - 	UINT32 R/- - -	CANopen 301E:F_h Modbus 7710
_p_absmodulo -	Absolute position based on one motor revolution in internal units() Caution! Position is only valid after determination of the motor absolute position. With invalid motor absolute position : _WarnLatched _WarnActive Bit 13=1: absolute position of motor not yet detected	Inc 	UINT32 R/- - -	CANopen 301E:E_h Modbus 7708
_p_act -	Actual position of motor in internal units() Caution! Actual position of motor is only valid after determination of the motor absolute position. With invalid motor absolute position : _WarnLatched _WarnActive Bit 13=1: absolute position of motor not yet detected	Inc 	INT32 R/- - -	CANopen 6063:0_h Modbus 7700
_p_actPosintf -	Actual position at position interface() Counted increments at pulse input. Condition: IOposInterfac = Pdinput or Abinput	Inc -2147483648 - 2147483647	INT32 R/- - -	CANopen 3008:5_h Modbus 2058

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_p_actusr PACU STA-PRCu	Actual position of the motor in user-defined units(8-45) Caution! Actual position of motor is only valid after determination of the motor absolute position. With invalid motor absolute position : _WarnLatched _WarnActive Bit 13=1: absolute position of motor not yet detected	usr - -	INT32 R/- - -	CANopen 6064:0$_h$ Modbus 7706
_p_actRAMPusr -	Actual position of the travel profile generator(8-45) in user-defined units	usr - -	INT32 R/- - -	CANopen 301F:2$_h$ Modbus 7940
_p_addGEAR -	Start position of electronic gearbox() With an inactive gearbox the setpoint position can be calculated here at the position controller that was set when the gearbox was enabled with the selection 'Synchronisation with compensation movement'.	Inc	INT32 R/- - -	CANopen 301F:3$_h$ Modbus 7942
_p_dif PDIF STA-Pdi F	Current regulation variation of the position controller(8-47) Actual rule deviation between setpoint and actual position, i.e. without consideration of any dynamic components. Note: Different from SPV_p_maxDiff	revolution -214748.3648 - 214748.3647 **Fieldbus** -2147483648 2147483647	INT32 R/- - -	CANopen 60F4:0$_h$ Modbus 7716
_p_DifPeak -	Value of max. reached tracking error of the position controller(8-47) The tracking error is the current position regulation offset minus the speed-dependent position regulation offset. For further information see SPV_p_maxDiff. A write operation resets the value again.	revolution 0.0000 - 429496.7295 **Fieldbus** 0 4294967295	UINT32 R/W - -	CANopen 3011:F$_h$ Modbus 4382
_p_ref -	Setpoint position of the position controller in internal units()	Inc	INT32 R/- - -	CANopen 301E:9$_h$ Modbus 7698
_p_refusr -	Setpoint of the position controller in user-defined units()	usr -	INT32 R/- - -	CANopen 301E:C$_h$ Modbus 7704
_p_tarRAMPusr -	Target position of the travel profile generator() Absolute position value of the profile generator calculated from transferred relative and absolute position values. in user-defined units	usr -	INT32 R/- - -	CANopen 301F:1$_h$ Modbus 7938

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_Power_act -	current output power()	W - 	INT16 R/- - -	CANopen 301C:D_h Modbus 7194
_Power_mean -	average output power()	W - 	INT16 R/- - -	CANopen 301C:E_h Modbus 7196
_prgNoDEV _PNR INF--Pnr	Firmware program number() Example: PR840.1 Value is entered decimally as: 8401	- 0.0 - 0.0	UINT16 R/- - -	CANopen 3001:1_h Modbus 258
_prgVerDEV _PVR INF--PVr	Firmware version() Example: V4.201 Value is entered decimally: 4201	- - - -	UINT16 R/- - -	CANopen 3001:2_h Modbus 260
_serialNoDEV -	Device serial number() Serial number: Unique number for identification of the product	- 0 - 4294967295	UINT32 R/- per. -	CANopen 3001:17_h Modbus 302
_SigActive -	Current status of monitoring signals(8-47) Meaning see _SigLatched	- - 	UINT32 R/- - -	CANopen 301C:7_h Modbus 7182

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_SigLatched SIGS STA-SI, GS	Stored state of the monitoring signals(8-47) Signal state: 0: not enabled 1: activated Bit assignment Bit0: general fault Bit1: limit switch (LIMP/LIMN/REF) Bit2: area of travel exceeded (SW limit switch, tuning range) Bit3: Quick Stop via fieldbus Bit4: inputs PWRR are 0 Bit6: error RS485 Bit7: error CAN Bit9: frequency of reference signal too high Bit10: error current operating mode Bit12: Profibus error Bit14: undervoltage DC bus Bit15: overvoltage DC bus Bit16: no mains phase Bit17: connection to motor faulty Bit18. motor overcurrent/short circuit Bit19. error motor encoder or connection to encoder Bit20: undervoltage 24V power supply Bit21: temperature too high (power amplifier, motor) Bit22: tracking error Bit23: max. speed exceeded Bit24: PWRR inputs different Bit29: error in EEPROM Bit30: error in system startup (hardware or parameter error) Bit31: internal system fault such as Watch-dog) Note: assignment depends on control mode	- -	UINT32 R/- - -	CANopen 301C:8$_h$ Modbus 7184
_StopFault STPF FLT-STPF	Fault number of the last interruption cause(8-47)	- -	UINT16 R/- - -	CANopen 603F:0$_h$ Modbus 7178
_Temp_act_DEV TDEV STA-TDEU	Device temperature(8-47)	°C -	INT16 R/- - -	CANopen 301C:12$_h$ Modbus 7204
_Temp_act_M -	Temperature motor(8-47) reasonable display is not possible for switching temperature sensors (for type of temperature sensor see parameter M_TempType)	°C -	INT16 R/- - -	CANopen 301C:11$_h$ Modbus 7202
_Temp_act_PA TPA STA-TPR	Temperature of power amplifier(8-47)	°C -	INT16 R/- - -	CANopen 301C:10$_h$ Modbus 7200

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_Ud_ref -	Set motor voltage d-components() in 0.1V steps	V 0.0 - 0.0	INT16 R/- - -	CANopen 301E:5_h Modbus 7690
_UDC_act UDCA STA-udCR	DC bus voltage() in 0.1V steps	V 0.0 - 0.0	UINT16 R/- - -	CANopen 301C:F_h Modbus 7198
_Udq_ref - 	Total motor voltage (vector sum of d and q components() Root from (_Uq_ref^2 + _Ud_ref^2) in 0.1 V steps	V 0.0 - 0.0	INT16 R/- - -	CANopen 301E:6_h Modbus 7692
_Uq_ref -	Set motor voltage q-components() in 0.1V steps	V 0.0 - 0.0	INT16 R/- - -	CANopen 301E:4_h Modbus 7688
_v_act_Posintf -	Actual speed at position interface() Corresponds to frequency of the signal at the pulse input. Condition: IOposInterfac = Pdinput or Abinput	Inc/s -2147483648 - 2147483647	INT32 R/- - -	CANopen 3008:6_h Modbus 2060
_VoltUtil - 	Power/space ratio of DC bus voltage() 100% means that the drive is at the voltage limit. _VoltUtil = (_Udq_ref / _Udq_ref) * 100%	% -	INT16 R/- - -	CANopen 301E:13_h Modbus 7718
_WarnActive -	Active warnings bit-coded(8-47) Meaning of Bits see _WarnLatched	- -	UINT16 R/- - -	CANopen 301C:B_h Modbus 7190

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_WarnLatched WRNS STA-wrnS	Stored warnings bit-coded(8-47) Stored warning bits are erased in the event of a FaultReset. Bits 10,11,13 are automatically deleted. Signal state: 0: not enabled 1: activated Bit assignment Bit 0: general warning (see _LastWarning) Bit 1: power amplifier temperature high Bit 2: motor temperature high Bit 3: reserved Bit 4: overload (I^2t) power amplifier Bit 5: overload (I^2t) motor Bit 6: overload (I^2t) braking resistor Bit 7: CAN warning Bit 8: Motor Encoder warning Bit 9: RS485 protocol warning Bit 10: PWRR_A and/or PWRR_B Bit 11: DC bus undervoltage, faulty mains phase Bit 12: Profibus warning Bit 13: Position not yet valid (position detection continuing) Bit 14: reserved Bit 15: reserved Note: assignment depends on control mode	- - - -	UINT16 R/- - -	CANopen $301C:C_h$ Modbus 7192
AccessLock - -	Blocking of other access channels(8-2) 0: Other access channels enabled 1: Other access channels blocked This parameter allows the fieldbus to block active access to the device for the following access channels: - Commissioning tool - HMI - a second fieldbus The processing of the input signals (e.g. Stop-input) cannot be blocked.	- 0 - 1	UINT16 R/W - -	CANopen $3001:1E_h$ Modbus 316
ANA1_act A1AC STA-A1AC	Voltage value analogue input ANA1(7-21)	mV -10000 - 10000	INT16 R/- - -	CANopen $3009:1_h$ Modbus 2306
ANA1_I_scale A1IS SET-A1iS	Setpoint current in current control operating mode at 10V on ANA1(7-21) An inversion of the evaluation of the analogue signal can be run with a neg. advance sign	A_{pk} -300.00 3.00 300.00 **Fieldbus** -30000 300 30000	INT16 R/W per. -	CANopen $3020:3_h$ Modbus 8198

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
ANA1_n_scale A1NS SET-R in5	Setpoint speed in speed control operating mode at 10V on ANA1(7-21) The internal maximum speed is limited to the current setting in CTRL_n_max A preceding negative sign can be used to effect an inversion of the evaluation of the analogue signal	1/min -30000 3000 30000	INT16 R/W per. -	CANopen 3021:3_h Modbus 8454
ANA1_offset A1OF SET-R ioF	Offset at analogue input ANA1(7-21) The ANA1 analogue input is corrected/relocated by the offset. A defined zero-voltage window acts in the range of the zero crossing of the corrected ANA1 analogue input.	mV -5000 0 5000	INT16 R/W per. -	CANopen 3009:B_h Modbus 2326
ANA1_win A1WN SET-R iUn	Zero voltage window on analogue input ANA1(7-21) Value up to which an input voltage is interpreted as 0V Example: Setting 20mV ->range from -20 .. +20mV is interpreted as 0mV	mV 0 0 1000	UINT16 R/W per. -	CANopen 3009:9_h Modbus 2322
ANA2_act A2AC STA-R2AC	Voltage value analogue input ANA2(7-21)	mV -10000 - 10000	INT16 R/- - -	CANopen 3009:5_h Modbus 2314
ANA2_I_max A2IM DRC-R2i M	Current limiting at 10 V input voltage on ANA2(7-21) The maximum limiting value is the lesser value of ImaxM and ImaxPA	A_{pk} 0.00 3.00 300.00 **Fieldbus** 0 300 30000	UINT16 R/W per. -	CANopen 3012:C_h Modbus 4632
ANA2_n_max A2NM DRC-R2nM	Speed limiting at 10 V input voltage on ANA2(7-21) The minimum limiting speed is set to 100 rpm, i.e. analogue values that implement a lower speed of rotation have no effect. The max. speed of rotation is also limited by the setting value in CTRL_n_max.	1/min 500 3000 30000	UINT16 R/W per. -	CANopen 3012:D_h Modbus 4634
ANA2LimMode A2MO DRC-R2Mo	Selection of limit by ANA2(7-21) **0 / none**: no limit **1 / Current Limitation / CURR**: Limit reference current value at current controller (Limit value at 10V in ANA2_I_max) **2 / Speed Limitation / SPED**: Limit speed reference value at speed controller (Limit value at 10V in ANA2_n_max)	- 0 0 2	UINT16 R/W per. -	CANopen 3012:B_h Modbus 4630

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
AT_dir DIR TUN-dir	Direction of rotation autotuning(7-35) **1 / pos-neg-home / pnh**: first positive direction, then negative direction with return to initial position**2 / neg-pos-home / nph**: first negative direction, then positive direction with return to initial position **3 / pos-home / p-h**: only positive direction with return to initial position **4 / pos / p--**: only positive direction without return to initial position **5 / neg-home / n-h**: only negative direction with return to initial position **6 / neg / n--**: only negative direction without return to initial position	- 1 1 6	UINT16 R/W - -	CANopen 302F:4_h Modbus 12040
AT_dismax DIST TUN-dis	Movement range autotuning(7-35) Range in which the automatic optimisation processes of the controller parameters are run. The range is input relative to the current position. Caution with "movement in only one direction" (parameter AT_dir), it corresponds to the actual movement of a multiple of this specified range. It is used for every optimisation level.	revolution 1.0 1.0 999.9 **Fieldbus** 10 10 9999	UINT32 R/W - -	CANopen 302F:3_h Modbus 12038
AT_gain GAIN TUN-GAIn	Adapting controller parameters (tighter/looser)(7-37) Measure of the degree of tightness of the regulation. The value 100 represents the theoretical optimum. Values larger than 100 mean that the regulation is tighter and smaller values mean that the regulation is looser.	% - 	UINT16 R/W - -	CANopen 302F:A_h Modbus 12052
AT_J - 	Inertia of the entire system(7-37) is automatically calculated during the autotuning process in 0.1 kgcm^2 steps	kg cm^2 0.0 - 0.0	UINT16 R/W per. -	CANopen 302F:C_h Modbus 12056
AT_M_friction - 	System friction moment() is determined during the autotuning process in 0.01Apk steps	A_{pk} 0.00 - 0.00	UINT16 R/- - -	CANopen 302F:7_h Modbus 12046
AT_M_load - 	Constant load torque() is determined during the autotuning process in 0.01Apk steps	A_{pk} 0.00 - 0.00	INT16 R/- - -	CANopen 302F:8_h Modbus 12048
AT_mechanics MECH TUN-MECH	System coupling type(7-35) 1: direct coupling (J ext. to J motor <3:1) 2: medium coupling () 3: medium coupling (short toothed belt) 4: medium coupling () 5: soft coupling (J ext. to J motor between 5:1 and 10:1, linear axis)	- 1 1 5	UINT16 R/W - -	CANopen 302F:E_h Modbus 12060

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
AT_n_ref NREF TUN-nrEF	Speed jump for motor starting()	1/min 10 100 1000	UINT16 R/W - -	CANopen 302F:6_h Modbus 12044
AT_progress -	Autotuning progress(7-37)	% 0 0 100	UINT16 R/- - -	CANopen 302F:B_h Modbus 12054
AT_start -	Start Autotuning(7-35) 0: End 1: Activate	- 0 - 1	UINT16 R/W - -	CANopen 302F:1_h Modbus 12034
AT_state -	Autotuning status(7-37) Bit15: auto_tune_err Bit14: auto_tune_end Bit13: auto_tune_process Bit 10..0: last processing step	- -	UINT16 R/- - -	CANopen 302F:2_h Modbus 12036
AT_wait WAIT TUN-uRi t	Waiting time between autotuning steps(7-37)	ms 300 1200 10000	UINT16 R/W - -	CANopen 302F:9_h Modbus 12050
BRK_trelease BTRE DRC-btrE	Time delay when opening or releasing the brake(8-69)	ms 0 0 1000	UINT16 R/W per. -	CANopen 3005:7_h Modbus 1294
BRK_tclose BTCL DRC-btCL	Time delay when setting the brake(8-69)	ms 0 0 1000	UINT16 R/W per. -	CANopen 3005:8_h Modbus 1296
CANadr COAD COM-CoAd	CANopen address (node number)(7-13) valid addresses (node numbers) : 1 to 127 CAUTION: A change of the setting is not activated until the unit is switched on again or after an NMT reset command	- 1 127 127	UINT16 R/W per. -	CANopen 3017:2_h Modbus 5892
CANbaud COBD COM-Cobd	CANopen baud rate(7-13) valid baud rates in kbaud : 50 125 250 500 1000 CAUTION: A change of the setting is not activated until the unit is switched on again.	- 50 125 1000	UINT16 R/W per. -	CANopen 3017:3_h Modbus 5894

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CanDiag ERCO ErCo	CANopen diagnosis word() 0x0001 pms read error for TxPdo 0x0002 pms write error for RxPdo1 0x0004 pms write error for RxPdo2 0x0008 pms write error for RxPdo3 0x0010 pms write error for RxPdo4 0x0020 heartbeat or lifeguard error (timer expired) 0x0040 heartbeat msg with wrong state received 0x0080 CAN warning level set 0x0100 CAN message lost 0x0200 CAN in busoff 0x0400 software queue rx/tx overrun 0x0800 CPD error indication from stopfault	- -	UINT16 R/- - -	CANopen 3017:6$_h$ Modbus 5900
CANpdo4Event - 	PDO4 event mask() Value changes in the object trigger event: Bit 0=1: first PDO4 object Bit 1 = 1: second PDO4 object Bit 2 = 1: third PDO4 object Bit 3 = 1: fourth PDO4 object Bit 4..15 : reserved	- 0 15 15	UINT16 R/W - -	CANopen 3017:5$_h$ Modbus 5898
Cap1Activate - 	Capture unit 1 Start/Stop(8-65) Value 0 : abort capture function Value 1: start capture once Value 2: start capture continuously With one-time capture the function is terminated at the first captured value. The capture continues endlessly with continuous capture. Position capture can only be enabled with the "fieldbus" device setting.	- 0 - 2	UINT16 R/W - -	CANopen 300A:4$_h$ Modbus 2568
Cap1Config - 	Configuration of capture unit 1(8-65) 0 = position capture at 1->0 switch 1 = position capture at 0->1 switch	- 0 0 1	UINT16 R/W - -	CANopen 300A:2$_h$ Modbus 2564
Cap1Count - 	Capture unit 1 event counter(8-65) Counts the capture events. Counter is reset when the capture unit 1 is enabled.	- -	UINT16 R/- - -	CANopen 300A:8$_h$ Modbus 2576
Cap1Pos - 	Capture unit 1 captured position(8-65) Captured position at the time of the "capture signal". The captured position is recalculated after "set dimensions" or after a "homing".	usr -	INT32 R/- - -	CANopen 300A:6$_h$ Modbus 2572

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Cap2Activate -	Capture unit 2 Start/Stop(8-65) Value 0 : abort capture function Value 1: start capture once Value 2: start capture continuously With one-time capture the function is terminated at the first captured value. The capture continues endlessly with continuous capture. Position capture can only be enabled with the "fieldbus" device setting.	- 0 - 2	UINT16 R/W - -	CANopen 300A:5_h Modbus 2570
Cap2Config -	Configuration of capture unit 2(8-65) 0 = position capture at 1->0 switch 1 = position capture at 0->1 switch	- 0 0 1	UINT16 R/W - -	CANopen 300A:3_h Modbus 2566
Cap2Count -	Capture unit 2 event counter(8-65) Counts the capture events. Counter is reset when the capture unit 2 is enabled.	- -	UINT16 R/- - -	CANopen 300A:9_h Modbus 2578
Cap2Pos -	Capture unit 2 captured position(8-65) Captured position at the time of the "capture signal". The captured position is recalculated after "set dimensions" or after a "homing".	usr -	INT32 R/- - -	CANopen 300A:7_h Modbus 2574
CapStatus -	Status of capture units(8-65) Read access: Bit 0: position capture by CAP1 is complete Bit 1: Position captured via CAP2	- -	UINT16 R/- - -	CANopen 300A:1_h Modbus 2562
CTRL_I_max IMAX SET-I MAX	Current limiting(7-19) Value must not exceed max. permissible current of motor or power amplifier. Default is the smallest value of M_I_max and PA_I_max	A_{pk} 0.00 - 299.99 **Fieldbus** 0 29999	UINT16 R/W per. -	CANopen 3012:1_h Modbus 4610
CTRL_I_max_fw -	Field-shunting control max. field current() maximum value is approx. half of the lower value of the nominal current of the power amplifier and the motor.	A_{pk} 0.00 0.00 327.67 **Fieldbus** 0 0 32767	UINT16 R/W per. expert	CANopen 3011:C_h Modbus 4376
CTRL_KFDn -	Speed regulator pilot control D factor()	- 0 0 3175	UINT16 R/W per. expert	CANopen 3012:5_h Modbus 4618

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_KFPp -	Position controller feed pilot control speed() Over-control up to 110% possible.	% 0.0 0.0 110.0 **Fieldbus** 0 0 1100	UINT16 R/W per. -	CANopen 3012:8_h Modbus 4624
CTRL_KPid -	Current controller longitudinal (d) P factor() Is calculated from motor parameters. In 0.1V/A steps	V/A 0.5 - 1270.0 **Fieldbus** 5 12700	UINT16 R/- per. -	CANopen 3011:1_h Modbus 4354
CTRL_KPiq -	Current controller transverse (q) P factor() Value is calculated from motor parameters in 0.1 V/A steps	V/A 0.5 - 1270.0 **Fieldbus** 5 12700	UINT16 R/- per. -	CANopen 3011:3_h Modbus 4358
CTRL_KPn -	Speed controller P-factor(7-41) Default value is calculated from motor parameters	A/(1/min) 0.0001 - 1.2700 **Fieldbus** 1 12700	UINT16 R/W per. -	CANopen 3012:3_h Modbus 4614
CTRL_KPp -	Position controller P-factor(7-47) Default value is calculated	1/s 2.0 - 495.0 **Fieldbus** 20 4950	UINT16 R/W per. -	CANopen 3012:6_h Modbus 4620
CTRL_n_max NMAX SET-nMAX	Speed limitation(7-19) Max. speed of rotation motor must not be exceeded Default is the maximum speed of the motor (see M_n_max)	1/min 0 - 13200	UINT16 R/W per. -	CANopen 3012:2_h Modbus 4612
CTRL_Nfbandw -	Bandwidth notch filter current() The bandwidth is defined as follows: Fb/F0	% 10 30 99	UINT16 R/W per. expert	CANopen 3012:13_h Modbus 4646

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_Nfdamp -	Damping notch filter current()	% 1.0 10.0 45.0 **Fieldbus** 10 100 450	UINT16 R/W per. expert	CANopen 3012:12$_h$ Modbus 4644
CTRL_Nffreq -	Frequency notch filter current() The filter is disabled at the value of 15000.	Hz 50.0 1500.0 1500.0 **Fieldbus** 500 15000 15000	UINT16 R/W per. expert	CANopen 3012:11$_h$ Modbus 4642
CTRL_Pcdamp -	Damping Posicast filter speed() The filter is disabled at the value of 1000.	% 50.0 100.0 100.0 **Fieldbus** 500 1000 1000	UINT16 R/W per. expert	CANopen 3012:14$_h$ Modbus 4648
CTRL_Pcdelay -	Time delay Posicast filter speed() The filter is disabled at the value of 0.	ms 0.00 0.00 25.00 **Fieldbus** 0 0 2500	UINT16 R/W per. expert	CANopen 3012:15$_h$ Modbus 4650
CTRL_TAUiref -	Filter time constant reference value filter of the reference current value()	ms 0.00 1.20 4.00 **Fieldbus** 0 120 400	UINT16 R/W per. -	CANopen 3012:10$_h$ Modbus 4640
CTRL_TAUnref -	Filter time constant reference value filter of the speed reference value(7-41)	ms 0.00 9.00 327.67 **Fieldbus** 0 900 32767	UINT16 R/W per. -	CANopen 3012:9$_h$ Modbus 4626

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_TNid -	Current controller longitudinal (d) setting time() Value is calculated from motor parameters in 0.01ms steps	ms 0.13 - 327.67 **Fieldbus** 13 32767	UINT16 R/- per. -	CANopen 3011:2_h Modbus 4356
CTRL_TNiq -	Current controller lateral (q) setting time() Value is calculated from motor parameters in 0.01ms steps	ms 0.13 - 327.67 **Fieldbus** 13 32767	UINT16 R/- per. -	CANopen 3011:4_h Modbus 4360
CTRL_TNn -	Speed controller integral time(7-41)	ms 0.00 9.00 327.67 **Fieldbus** 0 900 32767	UINT16 R/W per. -	CANopen 3012:4_h Modbus 4616
CUR_I_target -	Set current in operating mode current control(8-17)	A_{pk} -300.00 0.00 300.00 **Fieldbus** -30000 0 30000	INT16 R/W - -	CANopen 3020:4_h Modbus 8200
CURreference -	Selection of preset source for current control operating mode(8-17) 0: no 1: Reference value via +/-10V-interface ANA1 2: Reference value via parameter CUR_I_target	- 0 0 2	UINT16 R/W - -	CANopen 301B:10_h Modbus 6944
DCOMcompatib -	DriveCom status machine: Status transition 3->4() Determines the change of state between the SwitchOnDisabled (3) and ReadyTo-SwitchOn (4) states in CANopen devices. If not CANopen, this value is ignored! 0 = automatic (change of state takes place automatically) 1 = standard conform (change of state must be controlled by fieldbus)	- 0 0 1	UINT16 R/W per. -	CANopen 301B:13_h Modbus 6950

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
DCOMcontrol -	Drivecom control word(8-8) For bit coding see chapter on operation, operating states 0: Switch On 1 Enable Voltage 2: QuickStop 3: Enable Operation 4..6: op. mode specific 7: Fault Reset 8: Halt 9..15: reserved (must be 0)	- - 	UINT16 R/W - -	CANopen 6040:0$_h$ Modbus 6914
DCOMopmode -	Operating mode(8-12) DSP402-operating modes 1: Profile position 3 Profile velocity 6 : Homing --- Manufacturer operating modes: -1: jog -2: electronic gear -3: current control -4 : speed control -7 : oscillator mode	- -6 - 6 	INT16 R/W - -	CANopen 6060:0$_h$ Modbus 6918
DCOMstatus -	Drivecom status word(8-10) For bit coding see chapter on operation, status machine 0-3,5,6: Status bits 4: Voltage enabled 7: Warning 8: HALT request active 9: Remote 10: Target reached 11: reserved 12: op. mode specific 13: x_err 14 x_15err ref_ok	- - 	UINT16 R/- - -	CANopen 6041:0$_h$ Modbus 6916
DEVcmdinterf DEVC NONE$dEUC$	Specification of device control(7-13) **0 / none**: undefined (default)) **1 / IODevice / IO**: Local control mode **2 / CANopenDevice / CanO** CANopen **3 / ModbusDevice / Modb**: Modbus CAUTION: A change of the setting is not activated until the unit is switched on again (exception: Change of the value 0, at "First setup").	- 0 0 4 	UINT16 R/W per. -	CANopen 3005:1$_h$ Modbus 1282

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
ENC_pabsusr -	Setting position of the motor encoder directly(7-31) Value range depends on the sensor type. SRS: Sincos single turn: 0..max_pos_usr/rev. - 1 SRM: Sincos multiturn: 0 .. (4096 * max_pos_usr/rev.) -1 max_pos_usr/rev.: maximum user position for one motor revolution, with default position scaling this value is 16384. !!!Important: * If the process is to be conducted with direction inversion function, it must be set before setting the motor encoder position * The setting value will only be active when the controller is switched on the next time. After the write access a wait of at least 1 second is required until the controller is switched off. * Changing the value also changes the position of the virtual index pulse and the index pulse displaced at ESIM function.	usr 0 - 2147483647	UINT32 R/W - -	CANopen 3005:16$_h$ Modbus 1324
ESIMscale ESSC DRC-E55C	Encoder simulation - setting the resolution(7-30) Software version 1.102: The following resolutions are adjustable: 128 256 512 1024 2048 4096 from software version 1.103: the complete value range is available for the resolution. For resolutions that can be divided by 4 the index pulse must be at A=high and B=high. CAUTION: the values are not enabled until the controller is restarted. After the write access a wait of at least 1 second is required until the controller is switched off.	Inc 8 4096 65535	UINT16 R/W per. -	CANopen 3005:15$_h$ Modbus 1322
FLTAmpOnCyc -	ENABLE cycles up to time of error() Number of power amplifier turn-on processes after switching on the power supply (control voltage) up to the appearance of the error	- -	UINT16 R/- - -	CANopen 303C:5$_h$ Modbus 15370
FLTAmpOnTime -	Time error occurs after ENABLE()	s -	UINT16 R/- - -	CANopen 303C:6$_h$ Modbus 15372

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
FLT_class -	Error class(10-7) 0: Warning (no reaction) 1: error (Quick Stop -> status 7) 2: error (Quick Stop -> status 8.9) 3: Fatal error (state 9) 4: Fatal error (state 9, not resettable)	- 0 - 4	UINT16 R/- - -	CANopen 303C:2_h Modbus 15364
FLT_del_err -	Erase error memory(10-7) 1: Erases all entries in the error memory The erasing process is complete when a 0 is returned when reading.	- 0 - 1	UINT16 R/W - -	CANopen 303B:4_h Modbus 15112
FLT_err_num -	Error number(10-7) Reading this parameter brings the complete error entry (error class, time of error ...) into an intermediate memory from which all components of the error can be read. In addition, the read indicator of the error memory is automatically switched forward to the next error entry.	- 0 - 65535	UINT16 R/- - -	CANopen 303C:1_h Modbus 15362
FLT_Idq -	Motor current at error time() in 10 mA steps	A 0.00 - 0.00	UINT16 R/- - -	CANopen 303C:9_h Modbus 15378
FLT_MemReset -	Reset the error memory read pointer(10-7) 1: Set error memory read pointer to oldest error entry.	- 0 - 1	UINT16 R/W - -	CANopen 303B:5_h Modbus 15114
FLT_n -	Speed at error time()	1/min -	INT16 R/- - -	CANopen 303C:8_h Modbus 15376
FLT_powerOn POWO INF-Pobo	Number of turn-on processes()	- 0 - 4294967295	UINT32 R/- - -	CANopen 303B:2_h Modbus 15108
FLT_Qual -	Error additional information(10-7) This entry contains additional information about the error, depending on the error number. Example: a parameter address	- 0 - 65535	UINT16 R/- - -	CANopen 303C:4_h Modbus 15368
FLT_Temp_DEV -	Device temperature at error time()	°C -	INT16 R/- - -	CANopen 303C:B_h Modbus 15382
FLT_Temp_PA -	Power amplifier temperature at error time()	°C -	INT16 R/- - -	CANopen 303C:A_h Modbus 15380

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
FLT_Time -	Error time(10-7) referenced to the operating hours counter	s 0 - 536870911	UINT32 R/- - -	CANopen 303C:3$_h$ Modbus 15366
FLT_UDC -	DC bus voltage at error time() in 100mV steps	V 0.0 - 0.0	UINT16 R/- - -	CANopen 303C:7$_h$ Modbus 15374
GEARdenom -	Gear ratio denominator(8-21) see description GEARnum	- 1 1 2147483647	INT32 R/W per. -	CANopen 3026:3$_h$ Modbus 9734
GEARdir_enabl -	Enabled direction of motion of the gear processing(8-21) **1 / positive** : pos. direction **2 / negative**: neg. direction **3 / both**: both directions (default) This can be used to enable a return motion lock.	- 1 3 3	UINT16 R/W per. -	CANopen 3026:5$_h$ Modbus 9738
GEARnum -	Gear ratio numerator(8-21) $\text{Gear ratio} = \frac{\text{GEARnum}}{\text{GEARdenom}}$ The new gear ratio is enabled when the numerator value is transferred.	- -2147483648 1 2147483647	INT32 R/W per. -	CANopen 3026:4$_h$ Modbus 9736
GEARratio GFAC SET-GFAC	Selection of special gear ratios(8-21) 0: Use of the specified gear ratio from GEARnum/GEARdenom 1 : 200 2 : 400 3: 500 4 : 1000 5 : 2000 6 : 4000 7 : 5000 8: 10000 9 : 4096 10 : 8192 11 : 16384 Changing the reference variable by the stated value causes the motor to make one revolution.	- 0 0 11	UINT16 R/W per. -	CANopen 3026:6$_h$ Modbus 9740
GEARreference -	Operating mode electronic gear processing(8-21) 0: disabled 1: Real-time synchronisation 2: Synchronisation with compensation movement	- 0 0 2	UINT16 R/W - -	CANopen 301B:12$_h$ Modbus 6948

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMdisREFtoIDX -	Distance switch - index pulse after reference movement(8-39) Reading value provides the value of the difference between the index pulse position and the position on the switching flank of the limit or reference switch. Used to check how far the index pulse is from the switching edge and is used as a criterion for whether the reference movement can be correctly reproduced with index pulse processing in steps of 1/10000 revolutions	revolution 0.0000 - 0.0000	INT32 R/- - -	CANopen 3028:C_h Modbus 10264
HMdisusr -	Distance between the switching edge and the reference point(8-36) After leaving the switch, the drive is still positioned in the working range for a defined path and this position is defined as a reference point. The parameters are only effective with reference movements without index pulse searching.	usr 1 200 2147483647	INT32 R/W per. -	CANopen 3028:7_h Modbus 10254
HMIDispPara SUPV DRC-5uPU	HMI display while motor rotates() 0: device status (default) 1: current speed of rotation (n_act) 2: actual motor current (Idq_act)	- 0 0 2	UINT16 R/W per. -	CANopen 303A:2_h Modbus 14852
HMIlocked -	Block HMI(8-2) 0: HMI not blocked 1: HMI blocked When the HMI is blocked the following actions are no longer possible: - Change parameters - Manual operation (Jog) - Autotuning - FaultReset	- 0 0 1	UINT16 R/W per. -	CANopen 303A:1_h Modbus 14850

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMmethod -	Reference movement method(8-31) 1: LIMN with index pulse 2 : LIMP with index pulse 7 : REF+ with index pulse, inv., outside 8: REF+ with index pulse, inv., inside 9: REF+ with index pulse, not inv., inside 10: REF+ with index pulse, not inv., outside 11: REF- with index pulse, inv., outside 12: REF- with index pulse, inv., inside 13: REF- with index pulse, not inv., inside 14: REF- with index pulse, not inv., outside 17: LIMN 18: LIMP 23: REF+, inv., outside 24: REF+, inv., inside 25: REF+, not inv., inside 26: REF+, not inv., outside 27: REF-, inv., outside 28: REF-, inv., inside 29: REF-, not inv., inside 30: REF-, not inv., outside 33 : index pulse neg. direction 34: index pulse pos. direction 35: set dimensions Explanation of abbreviations: REF+: search movement in pos. direction REF-: search movement in neg. direction inv.: invert direction in switch not inv.: direction in switch not invert. outside: index pulse/distance outside switch inside: index pulse/distance inside switch	- 1 18 35	INT16 R/W - -	CANopen 6098:0_h Modbus 6936
HMn -	Set speed for search for the switch(8-31) The setting value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 60 13200	UINT16 R/W per. -	CANopen 6099:1_h Modbus 10248
HMn_out -	Set speed for release movement from switch(8-31) The setting value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 6 3000	UINT16 R/W per. -	CANopen 6099:2_h Modbus 10250
HMoutdisusr -	Maximum run-off(8-31) 0: run-off check inactive >0: run-off in user-defined units The switch must be disabled again inside this run-off, otherwise the reference movement is aborted	usr 0 0 2147483647	INT32 R/W per. -	CANopen 3028:6_h Modbus 10252
HMp_homeusr -	Position on reference point(8-31) After successful reference movement this position value is automatically set at the reference point.	usr -2147483648 0 2147483647	INT32 R/W per. -	CANopen 3028:B_h Modbus 10262
HMp_setpusr -	Position for dimension setting(8-44) Dimension setting position for homing method 35	 0 usr	INT32 R/W - -	CANopen 301B:16_h Modbus 6956

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMsrchdisusr -	Maximum search distance after traversing over the switch(8-31) 0: search distance processing inactive >0: search distance in user-defined units The switch must be disabled again inside this search distance, otherwise the reference movement is aborted	usr 0 0 2147483647	INT32 R/W per. -	CANopen 3028:D_h Modbus 10266
IO_AutoEnable IOAE DRC-, oRE	Automatic Enable at PowerOn, if ENABLE input is active() **0 / off**: active Enable at PowerOn does not cause switch-on of power amplifier (Default) **1 / on**: active Enable at PowerOn causes switch-on of the power amplifier	- 0 0 1	UINT16 R/W per. -	CANopen 3005:6_h Modbus 1292
IOdefaultMode IO-M DRC-, o-M	Start-up of operating mode for 'local control mode'(7-13) **0 / none / none** : none (default) **1 / CurrentControl / Curr**: Current controller (reference value from ANA1) **2 / SpeedControl / Sped**: Speed controller (reference value from ANA1) **3 / GearMode / Gear**: electronic gear The operating mode is activated automatically as soon as the drive switches to the 'OperationEnable' state and 'IODevice/IO' in DEVcmdinterf is set.	- 0 0 3	UINT16 R/W per. -	CANopen 3005:3_h Modbus 1286
IODirPosintf -	Counting direction at position interface() **0 / clockwise**: Clockwise **1 / counter clockwise**: Counterclockwise	- 0 0 1	UINT16 R/W per. -	CANopen 3008:7_h Modbus 2062
IOLogicType IOLT DRC-, oLt	Logic type of the digital inputs/outputs(7-13) **0 / source / sou**: for current supply outputs (default) **1 / sink / sin**: for current draw outputs WARNING: A change of the setting is not activated until the device is switched on again.	- 0 0 1	UINT16 R/W per. -	CANopen 3005:4_h Modbus 1288
IOposInterfac IOPI DRC-, oP,	Signal selection at position interface(7-13) RS422 IO interface (Pos) as: **0 / ABinput / AB**: input ENC_A, ENC_B, ENC_I (index pulse) 4x evaluation **1 / PDinput /PD**: input PULSE, DIR, ENABLE2 **2 / ESIMoutput / ESIM**: output: ESIM_A, ESIM_B, ESIM_I CAUTION: A change of the setting is not activated until the unit is switched on again.	- 0 0 2	UINT16 R/W per. -	CANopen 3005:2_h Modbus 1284

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOsigLimN -	LIMN signal evaluation(8-45) **0 / none**: inactive **1 / normally closed**: normally closed contact **2 / normally open**: normally open contact	- 0 1 2	UINT16 R/W per. -	CANopen 3006:F_h Modbus 1566
IOsigLimP -	LIMP signal evaluation(8-45) **0 / none**: inactive **1 / normally closed**: normally closed contact **2 / normally open**: normally open contact	- 0 1 2	UINT16 R/W per. -	CANopen 3006:10_h Modbus 1568
IOsigRef -	REF signal evaluation(8-45) **1 / normally closed**: normally closed contact **2 / normally open**: normally open contact The reference switch is only enabled while processing the reference movement to REF.	- 1 1 2	UINT16 R/W per. -	CANopen 3006:E_h Modbus 1564
JOGactivate -	Activation of jog(8-15) Bit0: clockwise rotation Bit1 : counterclockwise rotation Bit2 : 0=slow 1=fast	- 0 - 7	UINT16 R/W - -	CANopen 301B:9_h Modbus 6930
JOGn_fast NFST JOG-nFSt	Speed for fast jog(8-15) The setting value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 180 13200	UINT16 R/W per. -	CANopen 3029:5_h Modbus 10506
JOGn_slow NSLW JOG-nSLU	Speed for slow jog(8-15) The setting value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 60 13200	UINT16 R/W per. -	CANopen 3029:4_h Modbus 10504
JOGstepusr -	inching distance before continuous operation(8-15) 0: direct activation of continuous operation >0: positioning section per inching cycle	usr 0 20	INT32 R/W per. -	CANopen 3029:7_h Modbus 10510
JOGtime -	Waiting time before continuous operation(8-15) Time is only effective if an inching distance not equal to 0 has been set, otherwise direct transition to continuous operation.	ms 1 500 32767	UINT16 R/W per. -	CANopen 3029:8_h Modbus 10512
LIM_I_maxHalt LIHA SET-L, hA	Current limiting for Halt(8-64) Max. current during braking after Halt or termination of an operating mode. Maximum and default value settings depend on motor and power amplifier in 0.01Apk steps	A_{pk} - - -	UINT16 R/W per. -	CANopen 3011:6_h Modbus 4364

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
LIM_I_maxQSTP LIQS SET-L, 95	Current limiting for Quick Stop(8-63) Max. current during braking via torque ramp resulting from an error with error class 1 or 2, and when a software stop is triggered Maximum and default value setting depend on motor and power amplifier in 0.01Apk steps	A_{pk} - - -	UINT16 R/W per. -	CANopen 3011:5_h Modbus 4362
M_I_0 -	Motor constant current at standstill() in 0.01 Apk steps	A_{pk} - - -	UINT16 R/- - -	CANopen 300D:13_h Modbus 3366
M_I_max MIMA INF-n, nR	Motor maximum current() in 0.01 Apk steps	A_{pk} - - -	UINT16 R/- - -	CANopen 300D:6_h Modbus 3340
M_I_nom MINO INF-n, no	Nominal motor current() in 0.01 Apk steps	A_{pk} - - -	UINT16 R/- - -	CANopen 300D:7_h Modbus 3342
M_I2t -	max. allowable time for M_I_max()	ms - - -	UINT16 R/- - -	CANopen 300D:11_h Modbus 3362
M_Jrot -	Motor moment of inertia() in 0.1 kgcm^2 steps	kg cm^2 - - -	UINT16 R/- - -	CANopen 300D:C_h Modbus 3352
M_kE -	Motor EMF constant kE() Voltage constant in Vpk at 1000 1/min	- - - -	UINT16 R/- - -	CANopen 300D:B_h Modbus 3350
M_L_d -	Motor inductance d-direction() in 0.01 mH steps	mH - - -	UINT16 R/- - -	CANopen 300D:F_h Modbus 3358
M_L_q -	Motor inductance q-direction() in 0.01 mH steps	mH - - -	UINT16 R/- - -	CANopen 300D:E_h Modbus 3356
M_M_max -	Motor peak torque()	N cm - - -	UINT16 R/- - -	CANopen 300D:9_h Modbus 3346
M_M_nom -	Nominal motor torque()	N cm - - -	UINT16 R/- - -	CANopen 300D:8_h Modbus 3344

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
M_n_max -	maximum permissible motor speed()	1/min - - -	UINT16 R/- - -	CANopen 300D:4_h Modbus 3336
M_n_nom -	Nominal motor speed()	1/min - - -	UINT16 R/- - -	CANopen 300D:5_h Modbus 3338
M_Polepair -	Motor pole-pair number()	- - - -	UINT16 R/- - -	CANopen 300D:14_h Modbus 3368
M_R_UV -	Motor termination resistance() in 10mΩ steps	Ω - - -	UINT16 R/- - -	CANopen 300D:D_h Modbus 3354
M_Sensor -	Motor encoder type() **0 / unknown**: unknown **1**: reserved **2** reserved **3 / SRS** SinCos 1024 marks Single turn **4 / SRM**: SinCos 1024 marks Multiturn **5 / SKS**: SKS36 128 marks Singleturn **6 / SKM**: SKM36 128 marks Multiturn **7 / BLES**: BLES 16 marks Singleturn	- - - -	UINT16 R/- - -	CANopen 300D:3_h Modbus 3334
M_serialNo -	Motor serial number()	- - - -	UINT32 R/- - -	CANopen 300D:1_h Modbus 3330
M_T_max -	max. motor temperature(8-47)	°C	INT16 R/- - -	CANopen 300D:10_h Modbus 3360
M_T_warn -	Motor temperature warning threshold()	°C	INT16 R/- - -	CANopen 300D:15_h Modbus 3370
M_TempType -	Type of temperature sensor() 0: PTC switching 1: NTC linear	- - - -	UINT16 R/- - -	CANopen 300D:12_h Modbus 3364
M_Type -	Motor type() 0: no motor selected >0: connected motor type	- - - -	UINT32 R/- - -	CANopen 300D:2_h Modbus 3332
M_U_nom -	Motor nominal voltage() Voltage in 100mV steps	V - - -	UINT16 R/- - -	CANopen 300D:A_h Modbus 3348

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MBadr MBAD COM-nbAd	Modbus address(7-13) valid addresses : 1 to 247	- 1 1 247	UINT16 R/W per. -	CANopen 3016:4_h Modbus 5640
MBbaud MBBD COM-nbbd	Modbus baud rate(7-13) Allowed baud rates: 9600 19200 38400 CAUTION: A change of the setting is not activated until the unit is switched on again.	- 9600 19200 38400	UINT16 R/W per. -	CANopen 3016:3_h Modbus 5638
MBdword_order MBWO COM-nbLo	Modbus word sequence for double words (32 bit values)() Send High Word first or Low Word first **0 / HighLow / HiLo**: HighWord-LowWord, High Word first -> Modicon Quantum (default) **1 / LowHigh / LoHi** : LowWord-HighWord Low Word first -> Premium, HMI (Telemecanique)	- 0 0 1	UINT16 R/W per. -	CANopen 3016:7_h Modbus 5646
MBformat MBFO COM-nbFo	Modbus data format() **1 / 8Bit NoParity 1Stop / 8n1**: 8 bit, no parity bit, 1 stop bit **2 / 8Bit EvenParity 1Stop / 8e1**: 8 bit, even parity bit, 1 stop bit (default) **3 / 8Bit OddParity 1Stop / 8o1**: 8 bit, odd parity bit, 1 stop bit **4 / 8Bit NoParity 2Stop / 8n2**: 8 bit, no parity bit, 2 stop bits CAUTION: A change of the setting is not activated until the unit is switched on again.	- 1 2 4	UINT16 R/W per. -	CANopen 3016:5_h Modbus 5642
MBnode_guard -	Modbus Node Guard() Connection monitoring 0 : inactive (default) >0 : Monitoring time	ms 0 0 10000	UINT16 R/W - -	CANopen 3016:6_h Modbus 5644
MT_dismax -	Max. permissible distance() If the maximum permissible distance is exceeded with an active reference value, a class 1 error is triggered. value 0 disables the monitoring.	revolution 0.0 1.0 999.9 **Fieldbus** 0 10 9999	UINT16 R/W - -	CANopen 302E:3_h Modbus 11782
PA_I_max PIMA INF-PI nR	Maximum current of power amplifier() Current in 10 mA steps	A_{pk} - - -	UINT16 R/- per. -	CANopen 3010:2_h Modbus 4100
PA_I_nom PINO INF-PI no	Nominal current of power amplifier() Current in 10 mA steps	A_{pk} - - -	UINT16 R/- per. -	CANopen 3010:1_h Modbus 4098

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PA_T_max -	maximum permissible temperature of the power amplifier(8-47)	°C	INT16 R/- per. -	CANopen 3010:7$_h$ Modbus 4110
PA_T_warn -	Temperature limit of the power amplifier(8-47)	°C	INT16 R/- per. -	CANopen 3010:6$_h$ Modbus 4108
PA_U_maxDC -	max. permissible DC bus voltage() Voltage in 100mV steps	V - - -	UINT16 R/- per. -	CANopen 3010:3$_h$ Modbus 4102
PA_U_minDC -	DC bus undervoltage threshold for drive switch-off() Voltage in 100mV steps	V - - -	UINT16 R/- per. -	CANopen 3010:4$_h$ Modbus 4104
PA_U_minStopDC -	DC bus undervoltage threshold for Quick Stop() At this threshold the drive carries out a Quick Stop Voltage in 100mV steps	V - - -	UINT16 R/- per. -	CANopen 3010:A$_h$ Modbus 4116
PAR_CTRLreset RES TUN-rES	Reset controller parameter() 1: Control parameters of the speed and position controllers are reset The current controller is automatically set according to the connected motor.	- 0 - 1	UINT16 R/W - -	CANopen 3004:7$_h$ Modbus 1038
PAReeprSave -	Back up the parameters in the EEPROM memory() Bit 0=1: Back up the user parameters. The current parameters are backed up in the non-volatile memory (EEPROM). The storing process is complete if a 0 is returned when reading the parameters.	- - - -	UINT16 R/W - -	CANopen 3004:1$_h$ Modbus 1026
PARfactorySet FCS DRC-FCS	Restore factory setting (default values)(8-73) 1: Set all parameters to default values and back up in the EEPROM. The factory setting can be triggered via HMI or PowerSuite. CAUTION: The default state only becomes active at the next start-up.	- 0 - 3	UINT16 R/W - -	
PARuserReset -	Resetting the user parameters(8-73) 1: Set the user parameters to default values. All parameters are reset, with the exception of: - communication parameters - device control - logic type	- 0 - 1	UINT16 R/W - -	CANopen 3004:8$_h$ Modbus 1040

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
POSdirOfRotat PROT DRC-Prot	Definition of direction of rotation(8-71) **0 / clockwise / clw**: Clockwise **1 / counter clockwise / cclw**: Counterclockwise Interpretation: The drive rotates clockwise with positive speeds, looking onto the motor shaft at the flange. CAUTION: A change of the setting is not activated until the unit is switched on again CAUTION: When using limit switches, after changing the setting, the limit switch connections must be changed over. The limit switch which is actuated by moving in jog mode in clockwise direction must be connected to the LIMP input, and vice versa.	- 0 0 1	UINT16 R/W per. -	CANopen 3006:C_h Modbus 1560
POSscaleDenom -	Denominator of the position scaling factor(8-57) Description see numerator (POSscaleNum) Acceptance of a new scaling factor is by transfer of the numerator	usr 1 16384 2147483647	INT32 R/W per. -	CANopen 3006:7_h Modbus 1550
POSscaleNum -	Numerator of the position scaling factor(8-57) :Definition of scaling factor Motor revolutions[U] ---------- Change in user position [usr] Acceptance of a new scaling factor takes place on the entry of the numerator User limits can be reduced when internal system factors are taken into account	revolution 1 1 2147483647	INT32 R/W per. -	CANopen 3006:8_h Modbus 1552
PPn_target -	Speed setpoint for profile position mode(8-25) Maximum value is limited to the current setting in CTRL_n_max The setting value is internally limited to the current parameter setting in RAMPn_max.	1/min 0 60	UINT32 R/W - -	CANopen 6081:0_h Modbus 6942
PPp_targetusr -	Target position of profile position operating mode(8-25) Min/Max values are dependent upon: - Scaling factor - software limit switch (if this is activated)	usr -	INT32 R/W - -	CANopen 607A:0_h Modbus 6940
ProfileType -	Motion profile() 0: Linear	- 0 0 0	INT16 R/- - -	CANopen 6086:0_h Modbus 6954

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PVn_target -	Setpoint velocity profile velocity operating mode(8-29) Maximum value is limited to the current setting in CTRL_n_max. The setting value is internally limited to the current parameter setting in RAMPn_max.	1/min 0	INT32 R/W - -	CANopen 60FF:0_h Modbus 6938
PWM_fChop -	Switching frequency of power amplifier(7-19) Switching frequency of the power amplifier **0 / 4kHz**: 4kHz **1 / 8kHz**: 8kHz factory setting: for motors of the BSH family: the factory setting is automatically made for all other motors depending on the connected motor: 4KHz	- 0 0 1	UINT16 R/W per. expert	CANopen 3005:E_h Modbus 1308
RAMP_TAUjerk -	Jolt limiting() **0**: off **>0**: Setting for filter processing time The following values can be set: 0: inactive 1 2 4 8 16 32 64 128 Limits the acceleration change (jerk) of the setpoint position generation during the positioning transitions: Standstill - acceleration acceleration - constant movement constant movement - deceleration deceleration - standstill Processing in the following operating modes: - speed control - profile positioning - jog - homing Setting can only be made with inactive operating mode (x_end=1). Not active with braking process via moment ramp ("Halt" or "Quick Stop")	ms 0 0 128	UINT16 R/W per. -	CANopen 3006:D_h Modbus 1562
RAMPacc -	Profile generator acceleration(8-60)	(1/min)/s 30 600 3000000	UINT32 R/W per. -	CANopen 6083:0_h Modbus 1556

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMPdecel -	Deceleration of the profile generator(8-60)	(1/min)/s 750 750 3000000	UINT32 R/W per. -	CANopen 6084:0_h Modbus 1558
RAMPn_max -	Limiting set speed with operating modes with profile generation(8-60) The parameters are effective in the following operating modes: - profile positioning - profile velocity - homing - jog - oscillator If a higher setpoint speed is set in one of these operating modes a limit to RAMPn_max is automatically set. This makes it simple to conduct a commissioning with limited speed.	1/min 60 13200 13200	UINT16 R/W per. -	CANopen 607F:0_h Modbus 1554
RESext_P -	Nominal power of external braking resistor(7-19)	W 1 10 32767	UINT16 R/W per. -	CANopen 3005:12_h Modbus 1316
RESext_R -	Resistance value of external braking resistor(7-19)	Ω 0.01 100.00 327.67 **Fieldbus** 1 10000 32767	UINT16 R/W per. -	CANopen 3005:13_h Modbus 1318
RESext_ton -	max. permissible switch-in time for external braking resistor(7-19)	ms 1 1 30000	UINT16 R/W per. -	CANopen 3005:11_h Modbus 1314
RESint_ext -	Control of braking resistor(7-19) **0 / internal**: internal braking resistor **1 / external**: external braking resistor	- 0 0 1	UINT16 R/W per. -	CANopen 3005:9_h Modbus 1298
RESint_P -	Nominal power of internal braking resistor()	W	UINT16 R/- per. -	CANopen 3010:9_h Modbus 4114
RESint_R -	Internal braking resistor() in 10 mOhm steps	Ω - - -	UINT16 R/- per. -	CANopen 3010:8_h Modbus 4112
SPEEDn_target -	Set speed in operating mode speed control(8-19) The internal maximum speed is limited by the current setting in CTRL_n_max	1/min -30000 0 30000	INT16 R/W - -	CANopen 3021:4_h Modbus 8456

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPEEDreference -	Selection of preset source for speed control operating mode(8-19) 0: no 1: Reference value via +/-10V-interface ANA1 2: Reference value via parameter SPEEDn_target	- 0 0 2	UINT16 R/W - -	CANopen 301B:11$_h$ Modbus 6946
SPV_Flt_AC -	Error response to power failure on one phase(8-47) **1 / ErrorClass1**error class 1 **2 / ErrorClass2**: error class 2 **3 / ErrorClass3**: error class 3	- 1 2 3	UINT16 R/W per. -	CANopen 3005:A$_h$ Modbus 1300
SPV_Flt_pDiff -	Error response to tracking error(8-47) **1 / ErrorClass1**error class 1 **2 / ErrorClass2**: error class 2 **3 / ErrorClass3**: error class 3	- 1 3 3	UINT16 R/W per. -	CANopen 3005:B$_h$ Modbus 1302
SPV_EarthFlt -	Earth fault monitoring(8-55) **0 / off**: off **1 / on**: On (default) In exceptional cases deactivation may be required, e.g.: - parallel connection of multiple devices - operation on an IT mains - long motor lines Disable the monitoring only if it responds when not wanted	- 0 1 1	UINT16 R/W per. expert	CANopen 3005:10$_h$ Modbus 1312
SPV_MainsVolt -	Monitor mains phases(8-56) **0 / off**: off **1 / on**: default 3-phase devices must only be connected and operated on 3-phase mains. In exceptional cases it may be necessary to disable it, e.g.: - supply via the DC bus	- 0 1 1	UINT16 R/W per. expert	CANopen 3005:F$_h$ Modbus 1310
SPV_p_maxDiff -	Max. permissible tracking error of the position controller(8-47) The tracking error is the current position regulation offset minus the speed-dependent position regulation offset. Actually, only the position offset caused by the moment requirements is still referred to for tracking error monitoring.	revolution 0.0001 1.0000 200.0000 **Fieldbus** 1 10000 2000000	UINT32 R/W per. -	CANopen 6065:0$_h$ Modbus 4636
SPV_SW_Limits -	Monitoring the SW-limit switch(8-45) **0 / none**: none (default) **1 / SWLIMP**: Activating SW limit switch pos. direction **2 / SWLIMN**: Activating SW limit switch neg. direction **3 / SWLIMP+SWLIMN**: Activating SW limit switch both. directions The software limit switch is only monitored after a successful homing (ref_ok = 1)	- 0 0 3	UINT16 R/W per. -	CANopen 3006:3$_h$ Modbus 1542

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPVcommutat -	Monitoring commutation(8-54) **0 / off**: off **1 / on**: on (default)	- 0 1 1	UINT16 R/W per. -	CANopen 3005:5$_h$ Modbus 1290
SPVswLimNusr -	negative position limit for software limit switch(8-45) see description of 'SPVswLimPusr'	 -2147483648 usr	INT32 R/W per. -	CANopen 607D:1$_h$ Modbus 1546
SPVswLimPusr -	positive position limit for software limit switch(8-45) If a user-defined value outside the permissible user-defined area is set, the limit switch limits are automatically limited internally to the maximum user-defined value.	 2147483647 usr	INT32 R/W per. -	CANopen 607D:2$_h$ Modbus 1544
STANDp_win -	Standstill window, permissible control deviation(8-68) The offset for the standstill window time must lie in this range of values to allow recognition of the standstill of the drive. Info: The processing of the standstill window must be activated via the STANDpwinTime parameter.	revolution 0.0000 0.0010 3.2767 **Fieldbus** 0 10 32767	UINT16 R/W per. -	CANopen 6067:0$_h$ Modbus 4370
STANDpwinTime -	Standstill window, time(8-68) 0: Standstill window monitoring deactivated >0 : Time in ms within which the offset must lie in the standstill window	ms 0 0 32767	UINT16 R/W per. -	CANopen 6068:0$_h$ Modbus 4372
STANDpwinTout -	Timeout for the standstill window monitor(8-68) 0: timeout monitor deactivated >0 : Timeout in ms Setting the standstill window processing is accomplished via STANDp_win and STANDpwinTime The time monitoring begins at the moment the target position is reached (position controller setpoint) or at the end of the profile generator processing.	ms 0 0 16000	UINT16 R/W per. -	CANopen 3011:B$_h$ Modbus 4374

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Parameter Name Code HMI menu, Code	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
StartUpMessage -	Start-up messages() Read: Start-up messages write: Confirmation Read: Bit 0=1: First Setup Bit 1 = 1: Motor changed Bit 2 = 1: EEPROM data corrupt Bit 3 = 1: no motor connected Bit 4..15: reserved Write: Bit 0=1: First Setup confirmation Bit 1 = 1: Motor changed confirmation Bit 2..15: reserved	- -	UINT32 R/W - -	CANopen 3001:1C_h Modbus 312
SuppDriveModes -	Supported operating modes as per DSP402() Coding: Bit 0: profile position Bit 2: profile velocity Bit 5: homing Bit 16: jog Bit 17: electronic gear Bit 18: current control Bit 19: speed control Bit 20: position control Bit 21: manual tuning Bit 22: oscillator mode Note: availability depends on controller type	- -	UINT32 R/- - -	CANopen 6502:0$_h$ Modbus 6952

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12 Accessories and spare parts

12.1 Optional accessories

Description	Order no.
Peripheral control terminal	VW3A31101
PowerSuite V2 CD-ROM (commissioning software)	VW3A8104
PC connection kit, converter RS485 to RS232	VW3A8106
USIC (Universal Signal Interface Converter), for signal adaptation to RS422 standard	VW3M3102
Reference Value Adapter RVA for distribution of A/B or pulse/direction signals to 5 devices with 24VDC power supply device to 5VDC sensor power supply	VW3M3101
Holding brake control HBC	VW3M3103

12.2 External braking resistors

Description	Order no.
braking resistor IP65; 10 ohm; 400W; 0.75m connector cable	VW3A7601R07
braking resistor IP65; 10 ohm; 400W; 2m connector cable	VW3A7601R20
braking resistor IP65; 10 ohm; 400W; 3m connector cable	VW3A7601R30
braking resistor IP65; 27 ohm; 100W; 0.75m connector cable	VW3A7602R07
braking resistor IP65; 27 ohm; 100W; 2m connector cable	VW3A7602R20
braking resistor IP65; 27 ohm; 100W; 3m connector cable	VW3A7602R30
braking resistor IP65; 27 ohm; 200W; 0.75m connector cable	VW3A7603R07
braking resistor IP65; 27 ohm; 200W; 2m connector cable	VW3A7603R20
braking resistor IP65; 27 ohm; 200W; 3m connector cable	VW3A7603R30
braking resistor IP65; 27 ohm; 400W; 0.75m connector cable	VW3A7604R07
braking resistor IP65; 27 ohm; 400W; 2m connector cable	VW3A7604R20
braking resistor IP65; 27 ohm; 400W; 3m connector cable	VW3A7604R30
braking resistor IP65; 72 ohm; 100W; 0.75m connector cable	VW3A7605R07
braking resistor IP65; 72 ohm; 100W; 2m connector cable	VW3A7605R20
braking resistor IP65; 72 ohm; 100W; 3m connector cable	VW3A7605R30
braking resistor IP65; 72 ohm; 200W; 0.75m connector cable	VW3A7606R07
braking resistor IP65; 72 ohm; 200W; 2m connector cable	VW3A7606R20
braking resistor IP65; 72 ohm; 200W; 3m connector cable	VW3A7606R30
braking resistor IP65; 72 ohm; 400W; 0.75m connector cable	VW3A7607R07
braking resistor IP65; 72 ohm; 400W; 2m connector cable	VW3A7607R20
braking resistor IP65; 72 ohm; 400W; 3m connector cable	VW3A7607R30

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12.3 Motor cable

For BSH motor type

Description	Order no.
Motor cable 3m for Servomotor, 4*1.5mm² and 2*1.0mm² screened; Motor end 8-pole round plug, other cable end open	VW3M5101R30
Motor cable 5m for Servomotor, 4*1.5mm² and 2*1.0mm² screened; Motor end 8-pole round plug, other cable end open	VW3M5101R50
Motor cable 10m for Servomotor, 4*1.5mm² and 2*1.0mm² screened; Motor end 8-pole round plug, other cable end open	VW3M5101R100
Motor cable 15m for Servomotor, 4*1.5mm² and 2*1.0mm² screened; Motor end 8-pole round plug, other cable end open	VW3M5101R150
Motor cable 20m for Servomotor, 4*1.5mm² and 2*1.0mm² screened; Motor end 8-pole round plug, other cable end open	VW3M5101R200
Motor cable 3m for Servomotor, 4*2.5mm² and 2*1.0mm² screened; Motor end 8-pole round plug, other cable end open	VW3M5102R30
Motor cable 5m for Servomotor, 4*2.5mm² and 2*1.0mm² screened; Motor end 8-pole round plug, other cable end open	VW3M5102R50
Motor cable 10m for Servomotor, 4*2.5mm² and 2*1.0mm² screened; Motor end 8-pole round plug, other cable end open	VW3M5102R100
Motor cable 15m for Servomotor, 4*2.5mm² and 2*1.0mm² screened; Motor end 8-pole round plug, other cable end open	VW3M5102R150
Motor cable 20m for Servomotor, 4*2.5mm² and 2*1.0mm² screened; Motor end 8-pole round plug, other cable end open	VW3M5102R200
motor cable 3m for Servomotor, 4*4.0mm² and 2*1.0mm² shielded; motor end 8-pole M40 circular plug, other cable end open	VW3M5103R30
motor cable 5m for Servomotor, 4*4.0mm² and 2*1.0mm² shielded; motor end 8-pole M40 circular plug, other cable end open	VW3M5103R50
motor cable 10m for Servomotor, 4*4.0mm² and 2*1.0mm² shielded; motor end 8-pole M40 circular plug, other cable end open	VW3M5103R100
motor cable 15m for Servomotor, 4*4.0mm² and 2*1.0mm² shielded; motor end 8-pole M40 circular plug, other cable end open	VW3M5103R150
motor cable 20m for Servomotor, 4*4.0mm² and 2*1.0mm² shielded; motor end 8-pole M40 circular plug, other cable end open	VW3M5103R200

12.4 Encoder cables

For BSH motor type

Description	Order no.
Encoder cable 3m for Servomotor, 5*(2*0.25mm²) and 1*(2*0.5mm²) screened; Motor end 12-pole round plug, unit end 12-pole plug	VW3M8101R30
Encoder cable 5m for Servomotor, 5*(2*0.25mm²) and 1*(2*0.5mm²) screened; Motor end 12-pole round plug, unit end 12-pole plug	VW3M8101R50
Encoder cable 10m for Servomotor, 5*(2*0.25mm²) and 1*(2*0.5mm²) screened; Motor end 12-pole round plug, unit end 12-pole plug	VW3M8101R100
Encoder cable 15m for Servomotor, 5*(2*0.25mm²) and 1*(2*0.5mm²) screened; Motor end 12-pole round plug, unit end 12-pole plug	VW3M8101R150
Encoder cable 20m for Servomotor, 5*(2*0.25mm²) and 1*(2*0.5mm²) screened; Motor end 12-pole round plug, unit end 12-pole plug	VW3M8101R200

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12.5 RS 422: pulse/direction, ESIM and A/B

Description	Order no.
Cable pulse/direction, ESIM, A/B, unit end 10 pole, other end open, 0.5m	VW3M8201R05
Cable pulse/direction, ESIM, A/B, unit end 10 pole, other end open, 1.5m	VW3M8201R15
Cable pulse/direction, ESIM, A/B, unit end 10 pole, other end open, 3m	VW3M8201R30
Cable pulse/direction, ESIM, A/B, unit end 10 pole, other end open, 5m	VW3M8201R50
Cable ESIM, A/B, for Master/Slave operation of units 2* 10-pole, 0.5m	VW3M8202R05
Cable ESIM, A/B, for Master/Slave operation of units 2* 10-pole, 1.5m	VW3M8202R15
Cable ESIM, A/B, for Master/Slave operation of units 2* 10-pole, 3m	VW3M8202R30
Cable ESIM, A/B, for Master/Slave operation of units 2* 10-pole, 5m	VW3M8202R50
Cable pulse/direction, ESIM, AB on Premium CAY, 0.5m, 10-pole + 15-pole SubD	VW3M8203R05
Cable pulse/direction, ESIM, AB on Premium CAY, 1.5m, 10-pole + 15-pole SubD	VW3M8203R15
Cable pulse/direction, ESIM, AB on Premium CAY, 3m, 10-pole + 15-pole SubD	VW3M8203R30
Cable pulse/direction, ESIM, AB on Premium CAY, 5m, 10-pole + 15-pole SubD	VW3M8203R50
Cable pulse/direction, ESIM, AB on Premium CFY, 0.5m, 10-pole + 15-pole SubD	VW3M8204R05
Cable pulse/direction, ESIM, AB on Premium CFY, 1.5m, 10-pole + 15-pole SubD	VW3M8204R15
Cable pulse/direction, ESIM, AB on Premium CFY, 3m, 10-pole + 15-pole SubD	VW3M8204R30
Cable pulse/direction, ESIM, AB on Premium CFY, 5m, 10-pole + 15-pole SubD	VW3M8204R50
Cable pulse/direction, ESIM, AB on Siemens S5 IP247, 3m, 10-pole	VW3M8205R30
Cable pulse/direction, ESIM, AB on Siemens S5 IP247, 3m, 10-pole	VW3M8206R30
Cable pulse/direction, ESIM, AB Siemens S7-300 FM353, 3m, 10-pole	VW3M8207R30
cable pulse/direction, ESIM, AB on Siemens S7 FM354, 3m, 10-pin connector	VW3M8208R30
Cable pulse/direction, ESIM, AB on RVA, USIC or WP/WPM311, 0.5m	VW3M8209R05
Cable pulse/direction, ESIM, AB on RVA, USIC or WP/WPM311, 1.5m	VW3M8209R15
Cable pulse/direction, ESIM, AB on RVA, USIC or WP/WPM311, 3m	VW3M8209R30
Cable pulse/direction, ESIM, AB on RVA, USIC or WP/WPM311, 5m	VW3M8209R50
cable pulse/direction, USIC, 15-pin SubD, other end off, 0.5m	VW3M8210R05
cable pulse/direction, USIC, 15-pin SubD, other end off, 1.5m	VW3M8210R15
cable pulse/direction, USIC, 15-pin SubD, other end off, 3m	VW3M8210R30
cable pulse/direction, USIC, 15-pin SubD, other end off, 5m	VW3M8210R50
cascader cable for RVA, 0.5m	VW3M8211R05

12.6 Mains filter

Description	Order no.
mains filter 1~; 9A; 115/230VAC	VW3A31401
mains filter 3~; 7A; 230VAC	VW3A31402
mains filter 1~; 16A; 115/230VAC	VW3A31403
mains filter 3~; 15A; 230/480VAC	VW3A31404
mains filter 1~; 22A; 115/230VAC	VW3A31405

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Description	Order no.
mains filter 3~; 25A; 230/480VAC	VW3A31406
mains filter 3~; 47A; 230/480VAC	VW3A31407

12.7 Mains reactor s

Description	Order no.
Mains reactor 1~; 50-60Hz; 7A; 5mH; IP00	VZ1L007UM50
Mains reactor 1~; 50-60Hz; 18A; 2mH; IP00	VZ1L018UM20
Mains reactor 3~; 50-60Hz; 10A; 4mH; IP00	VW3A66502
Mains reactor 3~; 50-60Hz; 16A; 2mH; IP00	VW3A66503
Mains reactor 3~; 50-60Hz; 30A; 1mH; IP00	VW3A66504
Mains reactor 3~; 50-60Hz; 60A; 0.5mH; IP00	VW3A66505

12.8 CANopen

Description	Order no.
CAN branching socket	VW3CANTAP2
CAN-cable, 0.3m, both ends RJ45-plug	VW3CANCARR03
CAN-cable, 1m, both ends RJ45-plug	VW3CANCARR1

12.9 MODBUS

Description	Order no.
MODBUS branching socket, 3* screwed terminal rail, RC termination Connect with cable W3A8306D30.	TSXSCA50
MODBUS 2-way branching socket, 2*socket plug SubD 15-pole, 2* screwed terminal rail, RC termination Connect with cable W3A8306D30.	TSXSCA62
MODBUS connection module, 10*RJ45 plug and 1*screwed terminal rail	LU9GC3
MODBUS termination for RJ45 plug, 120 Ohm, 1nF	VW3A8306RC
MODBUS termination for RJ45 plug, 150 Ohm	VW3A8306R
MODBUS termination for screwed terminal rail, 120 Ohm, 1nF	VW3A8306DRC
MODBUS termination for screwed terminal rail, 150 Ohm	VW3A8306DR
MODBUS T-branching module with integral cable 0.3m	VW3A8306TF03
MODBUS T-branching module with integral cable 1m	VW3A8306TF10
MODBUS-cable, 3m, 1*RJ45 plug, other end insulated	VW3A8306D30
MODBUS-cable, 3m, 1*RJ45 plug, 1*SubD15pole plug, for TSXSCA62	VW3A8306
MODBUS-cable, 0.3m, 2*RJ45 plug	VW3A8306R03
MODBUS-cable, 1m, 2*RJ45 plug	VW3A8306R10
MODBUS-cable, 3m, 2*RJ45 plug	VW3A8306R30
MODBUS-cable, 100m, 4-core, screened and twisted	TSXCSA100

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Description	Order no.
MODBUS-cable, 200m, 4-core, screened and twisted	TSXCSA200
MODBUS-cable, 500m, 4-core, screened and twisted	TSXCSA500

12.10 Mounting material

Description	Order no.
adapter plate for top-hat rail mounting, width 77.5mm	VW3A11851
adapter plate for top-hat rail mounting, width 105mm	VW3A31852

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13 Service, maintenance and disposal

⚠ DANGER

Electric shock, fire or explosion

- Only qualified personnel who are familiar with and understand the contents of this manual are authorised to work on and with this drive system.
- The system manufacturer is responsible for compliance with all applicable regulations relevant to earthing the drive system.
- Many components, including printed wiring boards, operate at mains voltage. **Do not touch**. Do **not** touch unshielded components or screws of the terminals with voltage present.
- Install all covers and close the housing doors before applying power.
- The motor generates voltage when the shaft is rotated. Lock the shaft of the motor to prevent rotation before starting work on the drive system.
- Before working on the drive system:
  - Switch off power to all terminals.
  - Place a sign "DO NOT SWITCH ON" on the switch and lock to prevent switching on.
  - **Wait 6 minutes** (for discharge of DC bus capacitors). Do **not** short-circuit DC bus
  - Measure voltage at DC bus and check for <45V. (The DC bus LED is not a safe indication for absence of the DC bus voltage).

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

Destruction of unit components and loss of control!

Excessive currents can be created at the signal connections if the negative connection to the controller supply voltage is interrupted.

- Do not interrupt the negative connection between power supply unit and load with a fuse or switch
- Check for correct connection before switching on.
- Never connect the controller supply voltage or change its wiring while there is supply voltage present.

Failure to follow these instructions can result in injury or equipment damage.

You cannot carry out repairs yourself. The repair should only be carried out by a certified customer service organisation. No warranty or liability is accepted for repairs made by the customer.

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13.1 Service address

If you cannot resolve the fault yourself please contact your appointed sales partner. Have the following details available:

- Type, identification number and serial number of the product (type plate)
- Type of fault (possibly with fault number)
- Previous and concurrent conditions
- Your own ideas regarding the cause of the fault

Include this information if you return the product for inspection or repair.

If you have any questions please contact your local dealer.
Your dealer will be happy to give you the name of a customer service outlet in your area.

http://www.telemecanique.com

13.2 Maintenance

The device is maintenance free

13.2.1 "Power Removal" operating life safety function

The operating life for the "Power Removal" safety function is designed for 20 years. After this period correct function is no longer ensured. The expiry date of the device is determined by adding 20 years to the DOM shown on the type plate.

▶ This date must be included in the system maintenance schedule.

Example The name plate on the device includes the DOM in the DD.MM.YY format, z.B. 31.12.06. (31 December 2006). This means that the safety function is guaranteed until 31 December 2026 (06 + 20 = 26).

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13.3 Replacing units

⚠ WARNING

Unexpected responses may cause injury and damage to the system

The behaviour of the drive system is governed by numerous stored data or settings. Unsuitable settings or data may trigger unexpected movements or reactions to signals and disable monitoring functions.

- Do not operate a drive system with unknown settings or data.
- Check the stored data or settings.
- When commissioning carefully run tests for all operating states and fault cases.
- Check the functions after replacing the product and also after making changes to the settings or data.
- Only start the system if there are no persons or materials in the danger zone and the system can be operated safely.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Prepare a list with the parameters required for the functions in use.

Observe the following procedure when changing the devices.

- ▶ Store all parameter settings in your PC with the commissioning software, see 8.6.10.3 “Duplicate existing device settings“ page 8-74.
- ▶ Switch off all power supplies. Make sure that power is no longer connected (safety instructions).
- ▶ Label all connections and remove the product.
- ▶ Note the identification number and the serial number from the product name plate for later identification.
- ▶ Install the new product as specified in 6 “Installation“
- ▶ If the product that you are installing was previously used in a different part of the system, the factory settings must be reset before commissioning. See 8.6.10.2 “Restore factory settings“ from page 8-73.
- ▶ Carry out commissioning in accordance with chapter 7 “Commissioning“. Note that with the same motor setting the motor position will no longer match when the device is replaced. This also changes the position of the virtual index point. The motor position associated with the motor installation must be redefined, see parameter `ENC_pabsusr`.

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13.4 Changing the motor

⚠ WARNING

Unexpected motion may cause injury and damage to the system

Drives can make unexpected movements if incorrectly connected or because of other faults.

- Operate the unit with approved motors only. Even if motors are similar, different adjustment of the sensor system may be a source of danger.
- Check the wiring. Compatibility is not ensured even with matching connectors on power connection and sensor system.

Failure to follow these instructions can result in death, serious injury or equipment damage.

▶ Switch off all power supplies. Make sure that power is no longer connected (safety instructions).

▶ Label all connections and remove the product.

▶ Note the identification number and the serial number from the product name plate for later identification.

▶ Install the new product as specified in 6 “Installation“

If the motor originally fitted is changed for a different one, the motor data set is reread. If the device recognises a different motor type, the control parameters are recalculated and nOt is shown on the HMI.

When the motor is replaced the parameters for the encoder must also be reset, see chapter 7.4.11 “Setting parameters for encoder“.

Change motor type temporarily only

▶ Press ESC if you only want to operate the new motor type temporarily on this device.

◁ The newly calculated control parameters are not stored in the EEPROM. This means that the original motor can be put back into operation using the previously stored control parameters.

Change motor type permanently

▶ Press ENT if you wish to operate the new motor type permanently in this device.

◁ The newly calculated control parameters are stored in the EEPROM.

13.5 Shipping, storage, disposal

Note the environmental conditions on page 3-1!

Shipping The product must be protected against shocks during transport. Use the original packaging for this purpose.

Storage Store the product only under the specified, approved environmental conditions for room temperature and humidity.
Protect the product against dust and dirt.

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Disposal The product consists of various materials that can be recycled and must be disposed of separately. Dispose of the product in accordance with local regulations

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14 Glossary

14.1 Terms and Abbreviations

AC	Alternating Current
Actual position	Current absolute or relative position of moving components in the drive system.
CAN	(**C**ontroller **A**rea **N**etwork), standardized open Fieldbus over which the drives and other devices from different manufacturers communicate with one another.
DC	Direct current
Default value	Factory settings.
Direction of rotation	Rotation of the motor shaft in a positive or negative direction of rotation. A positive direction of rotation is defined as the motor shaft rotating clockwise as the observer faces the end of the protruding shaft.
Drive system	The drive system consists of the controller, power amplifier and motor.
Electronic gear	An input speed is recalculated by the drive system using the values of an adjustable gear factor to derive a new output speed for the motor movement.
EMC	Electromagnetic compatibility
Encoder	Sensor for recording the angular position of a rotating element. The encoder is mounted on the motor and signals the angular position of the rotor.
EU	European Union
Error class	Classification of operational faults into groups corresponding to the error responses
FI	Fault current
Holding brake	brake that only prevents the motor from rotating without power after it has stopped (e.g. a vertikal-axis lowering). It must not be used as a service brake for braking motion.
I^2t-monitoring	Predictive temperature monitoring. The expected temperature rise of unit components is calculated in advance on the basis of the motor current. If a limit value is exceeded, the drive system reduces the motor current.
I/O	Inputs/Outputs
Inc	Increment
Index pulse	Encoder signal for referencing the rotor position in the motor. The encoder sends one index pulse per revolution.
Internal units	Resolution of the power amplifier with which the motor is directed to the new setpoint. Internal units are given in increments.
IT network	Network in which all active components are isolated from earth or are earthed by a high impedance. IT: isolé terre (French), isolated earth
Limit switch	Switch that signals an overrun of the permissible travel range.

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NMT	network management (NMT), component of the CANopen communications profile, tasks: initialising network and devices, starting, stopping, monitoring devices
Node Guarding	Monitoring function with slave at an interface for cyclic communication.
NTC	resistance with negative temperature coefficient. Resistance value is reduced as the temperature rises.
Parameter	Device functions and values that can be set and called by the user.
PC	Personal Computer
PELV	Protective Extra Low Voltage, functional low voltage with safe isolation
persistent	Designation of whether the value of the parameter is persistent, i.e. after switching off the unit it is retained in the memory. When changing a value via commissioning software or fieldbus, the user must explicitly store the value change in the persistent memory. When entering via HMI the unit stores the value of the parameter automatically at each change.
PLC	Programmable Logic Controller
Power amplifier	A device that generates current for controlling the motor in accordance with the positioning signals from the controller.
Pulse direction signals	Digital signals with variable pulse frequencies which signal changes in position and rotation direction via separate signal wires.
Protection class	The protection class is a standardised specification for electrical equipment that describes the protection against the ingress of foreign bodies and water (for example, IP20).
PTC	resistance with positive temperature coefficient. Resistance value is increased as the temperature rises.
Quick Stop	Quick stop, function used to provide quick braking of the motor via a command or in the event of a fault.
Releasing the brake	Drive may move when unbraked
rms	Effective value of a voltage (V_{rms}) or a current (A_{rms}); abbreviation of “Root Mean Square”.
RS485	Fieldbus interface compliant with EIA-485, which enables serial data transmission with multiple devices.
Scaling factor	This factor gives the relationship between an internal unit and the user unit.
TT network, TN network	Earthed networks, distinguished by the PE conductor connection.
User-defined unit	Unit whose reference to motor rotation can be determined by the user via parameters.
Watchdog	Equipment that monitors cyclic basic functions in the drive system. Power amplifier and outputs are switched off in the event of error.

14.2 Product name

LXM05A	AC servo drive
PowerSuite	PC software for commissioning
HBC	Holding brake controller

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Peripheral control terminal	hand-held operating unit
USIC	(Universal Signal Interface Converter) adapter for RS422 standard
RVA	Reference value adapter for distribution of A/B or pulse/direction signals to 5 units

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