

SD328B

Stepper motor drive

Product manual

V2.03, 07.2010



Important information

This manual is part of the product.

Carefully read this manual and observe all instructions.

Keep this manual for future reference.

Hand this manual and all other pertinent product documentation over to all users of the product.

Carefully read and observe all safety instructions and the chapter "Before you begin - safety information".

Some products are not available in all countries.

For information on the availability of products, please consult the catalog.

Subject to technical modifications without notice.

All details provided are technical data which do not constitute warranted qualities.

Most of the product designations are registered trademarks of their respective owners, even if this is not explicitly indicated.

Table of contents

Important information	2
Table of contents	3
Writing conventions and symbols	9
1 Introduction	11
1.1 About this manual	11
1.2 Device overview	11
1.3 Scope of supply	12
1.4 Components and interfaces	13
1.5 Type code	14
1.6 Documentation and literature references	15
1.7 Declaration of conformity	16
1.8 TÜV certificate for functional safety	17
2 Before you begin - safety information	19
2.1 Qualification of personnel	19
2.2 Intended use	19
2.3 Hazard categories	20
2.4 Basic information	21
2.5 DC bus voltage measurement	23
2.6 Functional safety	24
2.7 Standards and terminology	24
3 Technical Data	25
3.1 Certifications	25
3.2 Ambient conditions	25
3.2.1 Degree of protection	26
3.3 Mechanical data	27
3.3.1 Dimensions	27
3.4 Electrical Data	28
3.4.1 Power stage	28
3.4.2 24Vdc controller supply voltage	29
3.4.3 Signals	29
3.4.4 Safety function STO	30
3.4.5 Fan	31
3.4.6 Mains filter	31

3.5	Technical data accessories	33
3.5.1	Reference value adapter RVA	33
3.5.2	Cables	34
3.6	Conditions for UL 508C	34
4	Basics	35
4.1	Functional safety	35
5	Engineering	37
5.1	Safety function STO ("Safe Torque Off")	37
5.1.1	Definitions	37
5.1.2	Function	37
5.1.3	Requirements for using the safety function	38
5.1.4	Application examples STO	40
5.2	Monitoring functions	41
6	Installation	43
6.1	Electromagnetic compatibility, EMC	43
6.1.1	Operation in an IT mains	47
6.2	Mechanical installation	48
6.2.1	Mounting the device	49
6.2.2	Mounting a mains filter	52
6.3	Electrical installation	53
6.3.1	Overview of procedure	55
6.3.2	Overview of all connections	56
6.3.3	Connection of motor phases	58
6.3.4	DC bus connection	60
6.3.5	Mains supply connection	61
6.3.6	Connection of rotation monitoring (CN2)	64
6.3.7	Connection of holding brake and controller supply voltage (CN3)	67
6.3.8	Connecting the fan	69
6.3.9	Connecting the encoder signals A, B, I (CN5)	70
6.3.10	Connecting PULSE (CN5)	72
6.3.11	Connection Profibus DP (CN1)	75
6.3.12	Connecting the digital inputs/outputs (CN1)	77
6.3.13	Connecting a PC or a remote terminal (CN4)	79
6.3.14	Reference Value Adapter	81
6.4	Checking installation	84
7	Commissioning	85
7.1	Overview	87
7.2	Commissioning tools	88
7.2.1	Overview	88
7.2.2	HMI: Human-Machine Interface	89
7.2.3	Lexium CT commissioning software	94

7.3	Commissioning procedure	95
7.3.1	"First Setup"	96
7.3.2	Operating state (state diagram)	100
7.3.3	Setting basic parameters and limit values	101
7.3.4	Digital inputs / outputs	103
7.3.5	Testing the signals of limit switches signals of fieldbus devices	105
7.3.6	Testing the safety function STO	106
7.3.7	Checking the direction of movement	107
7.3.8	Checking the fan	107
7.3.9	Optimizing the motion behavior	107
8	Operation	109
8.1	Overview of operating modes	109
8.2	Access control	109
8.2.1	Via HMI	109
8.2.2	Via fieldbus	110
8.2.3	Via commissioning software	110
8.2.4	Via hardware input signals	110
8.3	Operating states	111
8.3.1	State diagram	111
8.3.2	Indicating the operating states	115
8.3.3	Changing operating states	118
8.4	Starting and changing operating modes	120
8.4.1	Starting the operating mode	121
8.4.2	Changing the operating mode	122
8.5	Operating modes	123
8.5.1	Operating mode Jog	123
8.5.2	Operating mode Electronic gear	126
8.5.3	Operating mode Profile Position	132
8.5.4	Operating mode Profile Velocity	135
8.5.5	Operating mode Homing	137
8.6	Functions	151
8.6.1	Setting the motor phase current	151
8.6.2	Monitoring functions	152
8.6.3	Scaling	159
8.6.4	Motion profile	162
8.6.5	Quick Stop	165
8.6.6	Halt	166
8.6.7	Fast position capture	167
8.6.8	Speed window	170
8.6.9	Brake function	171
8.6.10	Reversal of direction of rotation	173
8.6.11	Restoring default values	174
9	Examples	177
9.1	Wiring	177
9.2	Wiring STO	178

10	Diagnostics and troubleshooting	179
10.1	Service	179
10.2	Error responses and error classes	179
10.3	Error indication	180
10.3.1	State diagram	180
10.3.2	Error indication at the HMI	182
10.3.3	Error indication using the commissioning software	183
10.3.4	Error indication via the fieldbus	183
10.4	Troubleshooting	186
10.4.1	Troubleshooting problems	186
10.4.2	Troubleshooting of errors sorted by error bit	187
10.5	Table of error numbers	189
11	Parameters	199
11.1	Representation of the parameters	199
11.1.1	Explanation of the parameter representation	200
11.2	List of all parameters	202
12	Accessories and spare parts	227
12.1	Optional accessories	227
12.2	Motor cables	227
12.3	Encoder cables	227
12.4	RS422: Pulse/direction and A/B	228
12.5	Mains filter	228
12.6	Mains reactors	228
12.7	Mounting material	228
13	Service, maintenance and disposal	229
13.1	Service address	229
13.2	Maintenance	229
13.2.1	Lifetime STO safety function	229
13.3	Replacing devices	230
13.4	Changing the motor	231
13.5	Shipping, storage, disposal	231
14	Extract	233
14.1	Extract for installation	233
14.2	Extract for commissioning	235
14.2.1	HMI menu structure	236
14.2.2	"First Setup" (FSU) via HMI	237
14.2.3	Jog	238
14.2.4	Duplicating existing device settings	239

- 15 Glossary..... 241**
 - 15.1 Units and conversion tables 241
 - 15.1.1 Length..... 241
 - 15.1.2 Mass..... 241
 - 15.1.3 Force..... 241
 - 15.1.4 Power 241
 - 15.1.5 Rotation 242
 - 15.1.6 Torque..... 242
 - 15.1.7 Moment of inertia 242
 - 15.1.8 Temperature 242
 - 15.1.9 Conductor cross section 242
 - 15.2 Terms and Abbreviations..... 243
- 16 Index..... 245**

Writing conventions and symbols

Work steps If work steps must be performed consecutively, this sequence of steps is represented as follows:

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

If a response to a work step is indicated, this allows you to verify that the work step has been performed correctly.

Unless otherwise stated, the individual steps must be performed in the specified sequence.

Bulleted lists The items in bulleted lists are sorted alphanumerically or by priority. Bulleted lists are structured as follows:

- Item 1 of bulleted list
- Item 2 of bulleted list
 - Subitem for 2
 - Subitem for 2
- Item 3 of bulleted list

Making work easier Information on making work easier is highlighted by this symbol:



Sections highlighted this way provide supplementary information on making work easier.

Parameters In text sections, parameters are shown with the parameter name, for example `POSdirOfRotat`. The way parameters are represented in tables is explained in the chapter Parameters. The parameter list is sorted alphabetically by parameter name.

SI units SI units are the original values. Converted units are shown in brackets behind the original value; they may be rounded.

Example:

Minimum conductor cross section: 1.5 mm² (AWG 14)

1 Introduction

1.1 About this manual

This manual is valid for all SD328B standard products. This chapter lists the type code for this product. The type code can be used to identify whether your product is a standard product or a customized model.

1.2 Device overview

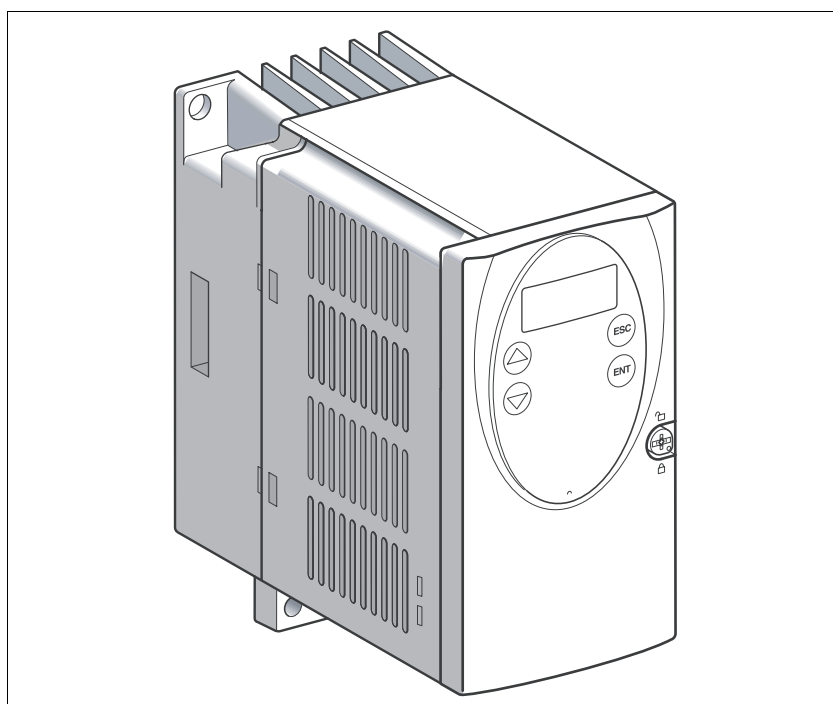


Figure 1.1 Device overview

Drive system This drive is used to control a 3-phase stepper motor.

Reference values are normally supplied and monitored by a master PLC or a motion controller, e.g. LMC.

An HMI (HMI, **H**uman-**M**achine-Interface) with display and keys is located at the front of the device.

Reference value supply Reference values are provided via:

- Profibus fieldbus for operating modes Profile Position and Profile Velocity.
- Pulse/direction signals or A/B encoder signals for the operating mode Electronic Gear.

Rotation monitoring / motor monitoring

If a stepper motor with integrated encoder is connected, the following functions can be activated:

- **Rotation monitoring:**
The calculated reference position and the actual position of the motor are compared. If a defined deviation is exceeded, a rotation monitoring error is signaled.
- **Cable monitoring:**
The encoder cable is monitored. If the encoder supply is interrupted, it is signaled that the encoder is not ready.
- **Motor temperature monitoring:**
The device shuts off if the motor temperature is too high.

Holding brake output

The device is equipped with an output for direct connection of a holding brake.

Safety function

The integrated safety function STO (IEC 61800-5-2) complies with Safety Integrity Level SIL2. The safety function allows for a category 0 stop as per IEC 60204-1 without external power contactors. It is not necessary to interrupt the supply voltage. This reduces the system costs and the response times.

1.3 Scope of supply

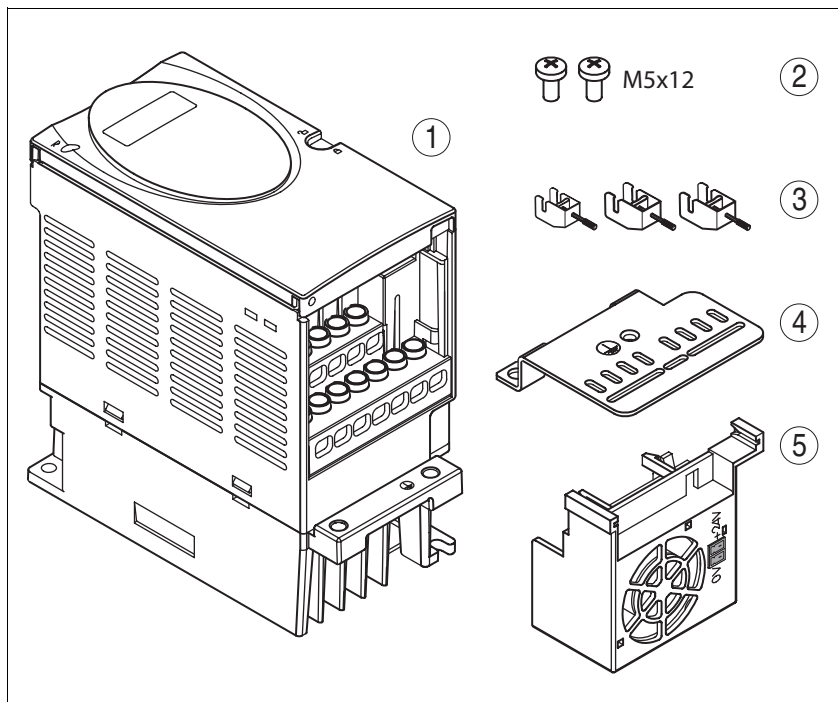


Figure 1.2 Scope of supply

- (1) SD32●●
- (2) Mounting screws
- (3) Shield terminal
- (4) EMC mounting plate
- (5) Fan (SD32●●U68 only)

0198441113706, V2.03, 07.2010

1.4 Components and interfaces

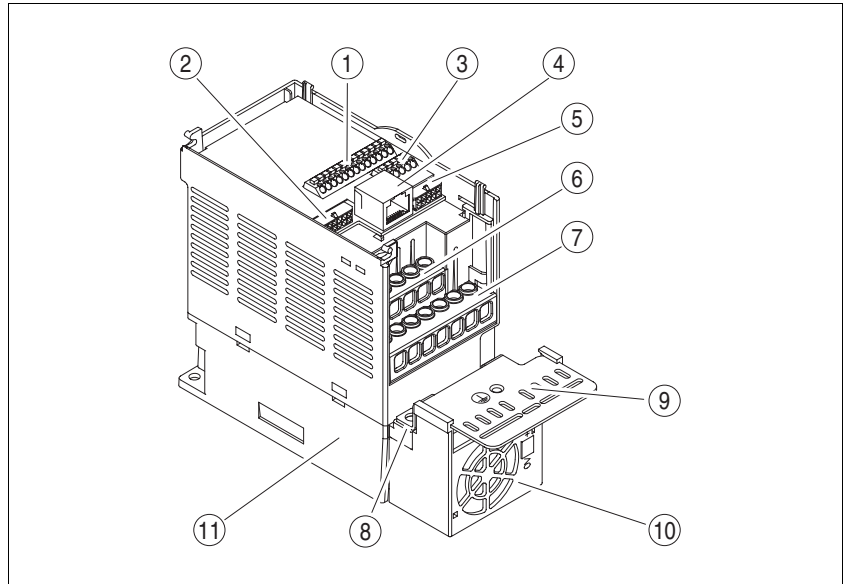


Figure 1.3 Components and interfaces

- (1) I/O signal connection CN1 (spring terminal)
 - Control via Profibus fieldbus
 - Eight digital inputs/outputs. The assignment depends on the selected operating mode
- (2) 12-pin female connector CN2 for motor encoder
- (3) Connection CN3 for 24 V power supply and holding brake
- (4) RJ45 socket CN4 for connection of
 - PC with commissioning software
 - Remote terminal
- (5) 10-pin socket CN5 for
 - Supply of pulse/direction of A/B encoder signals in operating mode Electronic Gear
- (6) Screw terminals for connection of the mains supply
- (7) Screw terminals for connecting the motor
- (8) Base for the EMC mounting plate
- (9) EMC mounting plate
- (10) Fan (SD32••U68 only)
- (11) Heat sink

1.5 Type code

	SD3	28	B	U25	S2
Product designation SD3 = Stepper motor drive 3-phase					
Product type 28 = Stepper motor drive for fieldbus					
Interfaces A = Fieldbus CANopen, fieldbus Modbus and analog input B = fieldbus Profibus					
Maximum motor phase current U25 = 2.5A U68 = 6.8A					
Power stage supply voltage S2 = 1~, 115V _{ac} /230V _{ac} (selectable)					

The device type is shown on the nameplate and on the inside of the front plate.

1.6 Documentation and literature references

The following manuals belong to this product:

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

Source manuals The latest versions of the manuals can be downloaded from the Internet at:

<http://www.schneider-electric.com>

Source EPLAN Macros For easier engineering, macro files and product master data are available for download from the Internet at:

<http://www.schneider-electric.com>

Further reading Recommended literature for further reading

- No recommendation for literature available.

1.7 Declaration of conformity



SCHNEIDER ELECTRIC MOTION DEUTSCHLAND GmbH & Co. KG
 Breslauer Str. 7 D-77933 Lahr

EC DECLARATION OF CONFORMITY
YEAR 2008

- according to EC Directive Machinery 98/37/EC
- according to EC Directive EMC 2004/108/EC
- according to EC Directive Low Voltage 2006/95/EC

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: Stepper motor drive

Type: SD328Axxxxxx, SD328Bxxxxxx

Product number: 00637111401xx, 00637111402xx

Applied harmonized standards, especially: EN ISO 13849-1:2006, Performance Level "d" (category 3)
 EN 61508:2002, SIL 2
 EN 62061:2005, SILcl 2
 EN 61800-3:2004, second environment
 EN 61800-5-1:2007

Applied national standards and technical specifications, especially: UL 508C
 Product documentation

Schneider Electric Motion Deutschland
 GmbH & Co. KG

Company stamp: Postfach 11 80 • D-77901 Lahr
 Breslauer Str. 7 • D-77933 Lahr

Date/ Signature: 10 July 2008

Name/ Department: Wolfgang Brandstätter/Development

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1.8 TÜV certificate for functional safety



2 Before you begin - safety information

2.1 Qualification of personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product. In addition, these persons must have received safety training to recognize and avoid hazards involved. These persons must have sufficient technical training, knowledge and experience and be able to foresee and detect potential hazards that may be caused by using the product, by changing the settings and by the mechanical, electrical and electronic equipment of the entire system in which the product is used.

All persons working on and with the product must be fully familiar with all applicable standards, directives, and accident prevention regulations when performing such work.

2.2 Intended use

This product is a drive for 3-phase stepper motors and intended for industrial use according to these instructions.

The product may only be used with a permanently installed connection in the control cabinet.

The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements and the technical data.

Prior to using the product, you must perform a risk assessment in view of the planned application. Based on the results, the appropriate safety measures must be implemented.

Since the product is used as a component in an entire system, you must ensure the safety of persons by means of the design of this entire system (for example, machine design).

Operate the product only with the specified cables and accessories. Use only genuine accessories and spare parts.

The product must NEVER be operated in explosive atmospheres (hazardous locations, Ex areas).

Any use other than the use explicitly permitted is prohibited and can result in hazards.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel.

2.3 Hazard categories

Safety instructions to the user are highlighted by safety alert symbols in the manual. In addition, labels with symbols and/or instructions are attached to the product that alert you to potential hazards.

Depending on the seriousness of the hazard, the safety instructions are divided into 4 hazard categories.

DANGER

DANGER indicates an imminently hazardous situation, which, if not avoided, **will result** in death or serious injury.

WARNING

WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

CAUTION

CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

CAUTION

CAUTION used without the safety alert symbol, is used to address practices not related to personal injury (e.g. **can result** in equipment damage).

2.4 Basic information

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation and who have received safety training to recognize and avoid hazards involved are authorized to work on and with this drive system. Installation, adjustment, repair and maintenance must be performed by qualified personnel.
- The system integrator is responsible for compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.
- Many components of the product, including the printed circuit board, operate with mains voltage. Do not touch. Only use electrically insulated tools.
- Do not touch unshielded components or terminals with voltage present.
- The motor generates voltage when the shaft is rotated. Prior to performing any type of work on the drive system, block the motor shaft to prevent rotation.
- AC voltage can couple voltage to unused conductors in the motor cable. Insulate both ends of unused conductors in the motor cable.
- Do not short across the DC bus terminals or the DC bus capacitors.
- Before performing work on the drive system:
 - Disconnect all power, including external control power that may be present.
 - Place a "DO NOT TURN ON" label on all power switches.
 - Lock all power switches in the open position.
 - **Wait 15 minutes** to allow the DC bus capacitors to discharge. Measure the voltage on the DC bus as per chapter "DC bus voltage measurement" and verify the voltage is $< 42 V_{dc}$. The DC bus LED is not an indicator of the absence of DC bus voltage.
- Install and close all covers before applying voltage.

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

⚠ WARNING**MOTOR WITHOUT BRAKING EFFECT**

If power outage and faults cause the power stage to be switched off, the motor is no longer stopped by the brake and may increase its speed even more until it reaches a mechanical stop.

- Verify the mechanical situation.
- If necessary, use a cushioned mechanical stop or a suitable holding brake.

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

⚠ WARNING**UNEXPECTED MOVEMENT**

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

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

- Carefully install the wiring in accordance with the EMC requirements.
- Switch off the voltage at the inputs $\overline{\text{STO_A}}$ ($\overline{\text{PWRR_A}}$) and $\overline{\text{STO_B}}$ ($\overline{\text{PWRR_B}}$) to avoid an unexpected restart of the motor before switching on and configuring the product.
- Do not operate the product with unknown settings or data.
- Perform a comprehensive commissioning test.

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

⚠ WARNING**LOSS OF CONTROL**

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are EMERGENCY STOP, overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical functions.
- System control paths may include communication links. Consideration must be given to the implication of unanticipated transmission delays or failures of the link.
- Observe the accident prevention regulations and local safety guidelines. ¹⁾
- Each implementation of the product must be individually and thoroughly tested for proper operation before being placed into service.

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

1) For USA: Additional information, refer to NEMA ICS 1.1 (latest edition), Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control and to NEMA ICS 7.1 (latest edition), Safety Standards for Construction and Guide for Selection, Installation for Construction and Operation of Adjustable-Speed Drive Systems.

2.5 DC bus voltage measurement

Disconnect all power prior to starting work on the product.

⚠ DANGER**HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH**

- Only appropriately trained persons who are familiar with and understand the safety instructions in the chapter "Before you begin - safety information" may perform the measurement.

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

The DC bus voltage can exceed 800 Vdc. Use a properly rated voltage-sensing device for measuring. Procedure:

- ▶ Disconnect all power.
- ▶ Wait 15 minutes to allow the DC bus capacitors to discharge.
- ▶ Measure the DC bus voltage between the DC bus terminals to verify that the voltage is $< 42 V_{dc}$.
- ▶ If the DC bus capacitors do not discharge properly, contact your local Schneider Electric representative. Do not repair or operate the product.

The DC bus LED is not an indicator of the absence of DC bus voltage.

2.6 Functional safety

Using the safety functions integrated in this product requires careful planning. For more information see chapter 5.1 "Safety function STO ("Safe Torque Off")" on page 37.

2.7 Standards and terminology

Technical terms, terminology and the corresponding descriptions in this manual are intended to use the terms or definitions of the pertinent standards.

In the area of drive systems, this includes, but is not limited to, terms such as "safety function", "safe state", "fault", "fault reset", "failure", "error", "error message", "warning", "warning message", etc.

Among others, these standards include:

- IEC 61800 series: "Adjustable speed electrical power drive systems"
- IEC 61800-7 series: "Adjustable speed electrical power drive systems - Part 7-1: Generic interface and use of profiles for power drive systems - Interface definition"
- IEC 61158 series: "Industrial communication networks - Fieldbus specifications"
- IEC 61784 series: "Industrial communication networks - Profiles"
- IEC 61508 series: "Functional safety of electrical/electronic/programmable electronic safety-related systems"

Also see the glossary at the end of this manual.

3 Technical Data

This chapter contains information on the ambient conditions and on the mechanical and electrical properties of the product family and the accessories.

3.1 Certifications

Product certifications:

Certified by	Assigned number	Validity
TÜV Nord	SAS-1741/08	2011-06-22
UL	File E153659	

Certified safety function This product has the following certified safety function:

- Safety function STO "Safe Torque Off" (IEC 61800-5-2)

3.2 Ambient conditions

Ambient conditions transportation and storage

The environment during transport and storage must be dry and free from dust. The maximum vibration and shock load must be within the specified limits.

Temperature	[°C]	-25 ... +70
-------------	------	-------------

Ambient temperature during operation

The maximum permissible ambient temperature during operation depends on the distance between the devices and the required power. Observe the pertinent instructions in the chapter Installation.

Operating temperature ^{1) 2)}	[°C]	0 ... +50
--	------	-----------

1) No icing

2) If the product is to be used in compliance with UL 508C, note the information provided in chapter 3.6 "Conditions for UL 508C".

Pollution degree

Pollution degree	2
------------------	---

Relative humidity

The following relative humidity is permissible during operation:

Relative humidity (non-condensing)	[%]	As per IEC 60721-3-3 5 ... 85 (class 3K3)
------------------------------------	-----	--

Installation altitude

The installation altitude is defined as height above sea level.

Installation altitude	[m]	≤1000
-----------------------	-----	-------

Installation altitude at a max. ambient temperature of 40°C, without cover film, with a free space at the sides > 50 mm	[m]	≤2000
---	-----	-------

Vibration and shock

Vibration, sinusoidal	As per IEC 60068-2-6 1.5 mm (from 3 Hz ... 13 Hz) 10 m/s ² (from 13 Hz ... 150 Hz)
Shock, semi-sinusoidal	As per IEC 60068-2-27 150 m/s ² (for 11 ms)

3.2.1 Degree of protection

The product has degree of protection IP20.

The top of the housing has degree of protection IP40 if the cover film covering the top of the housing is not removed. It may be necessary to remove the cover film for reasons of ambient temperature or mounting distances, see chapter 6.2.1 "Mounting the device", page 49.

Degree of protection if STO is used

You must ensure that conductive substances cannot get into the product (pollution degree 2). If you use the safety function and conductive substances get into the product, the safety function may become inoperative.

3.3 Mechanical data

3.3.1 Dimensions

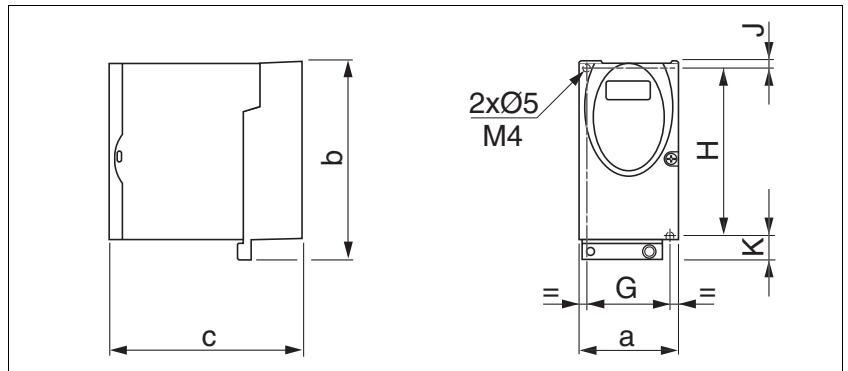


Figure 3.1 Dimensions

SD32••...		U25S2	U68S2
a	[mm]	72	72
b	[mm]	145	145
c	[mm]	140	140
G	[mm]	60	60
H	[mm]	121.5	121.5
J	[mm]	5	5
K	[mm]	18.5	18.5
Mass	[kg]	1.1	1.2
Type of cooling		Convection ¹⁾	Fan
DIN rail mounting	[mm]	77.5 ²⁾	77.5 ²⁾

1) >1 m/s

2) Width of adapter plate

3.4 Electrical Data

The products are intended for industrial use and may only be operated with a permanently installed connection.

3.4.1 Power stage

Electrical data

		SD32••...	U25S2	U68S2
Nominal voltage (switchable)	[V]		115/230 (1~)	115/230 (1~)
Input current (115V/230V)	[A]		4/3	7/5
Maximum motor phase current	[A]		2.5	6.8
Maximum speed of rotation of motor	[min ⁻¹]		3000	3000
Nominal power (115V/230V) (power output of device)	[W]		180/270	280/420
Maximum voltage to ground	[V _{ac}]		300	300
Maximum permissible short circuit current of the supply mains	[kA]		0.5	0.5
Power loss	[W]		≤26	≤65
Fuse to be connected upstream ¹⁾	[A]		10	10

1) Fuses: Class CC or J as per UL 248-4, alternatively circuit breakers with C characteristic.

Mains voltage: Range and tolerance

Mains voltage 115 V	[V _{ac}]	100-15 % ... 120+10 %
Mains voltage 230 V	[V _{ac}]	200-15% ... 240+10 %
frequency	[Hz]	50-5 % ... 60+5 %

transient overvoltages	overvoltage category III
------------------------	--------------------------

Inrush current and leakage current

Inrush current	[A]	<60
Leakage current at a motor cable length of <10 m and a design as per "IEC 60990 figure number 3"	[mA]	<30 ¹⁾

1) Measured on mains with grounded neutral point, without external mains filter. If residual current devices are used, note that a 30 mA residual current device can trigger at values as low as 15 mA. In addition, there is a high-frequency leakage current which is not considered in the measurement. Residual current device respond differently to this.

Input current and impedance of mains supply

The input current depends on the impedance of the supply mains. This is indicated by a possible short-circuit current. If the mains supply has a higher short-circuit current, use upstream mains reactors. Suitable mains reactors can be found in chapter 12 "Accessories and spare parts".

Approved motors

Approved motor families: BRS3, ExRDM, VRDM3
 Approved motor voltage: 230V_{ac} / 325V_{dc}
 Further information on approved motors can be found in the product catalog.

3.4.2 24V_{dc} controller supply voltage

Spring terminals The spring terminals have the following properties

Minimum conductor cross section	[mm ²]	0.14 (AWG 24)
Maximum connection cross section without wire ferrule	[mm ²]	1.5 (AWG 16)
Maximum connection cross section with wire ferrule	[mm ²]	0.75 (AWG 20)
Stripping length ¹⁾	[mm]	8.5 ... 9.5
Maximum current load	[A]	2

1) Mechanical conditions must be considered.

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

Input voltage	[V]	24 (-15 % / +20 %)
Input current ¹⁾	[A]	≤0.2
Residual ripple	[%]	<5

1) Without load on outputs

3.4.3 Signals

Signal inputs are protected against reverse polarity, outputs are short-circuit protected. The inputs/outputs are not galvanically isolated from 0V_{dc}.

24V input signals When configured as "Source", the levels of the inputs comply with IEC 61131-2, type 1

Logic 0 (U _{low})	[V]	-3 ... +5
Logic 1 (U _{high})	[V]	+15 ... +30
Input current (typical)	[mA]	10
Debounce time ¹⁾	[ms]	1.25 ... 1.5
Debounce time CAP1 and CAP2	[μs]	1 ... 10
Accuracy CAP1 and CAP2 ²⁾	[°]	<0.44 + accuracy of encoder

1) Except $\overline{STO_A}$ (PWRR_A), $\overline{STO_B}$ (PWRR_B), CAP1 and CAP2

2) The captured motor position is less accurate during the acceleration phase and the deceleration phase.

24V output signals The 24V output signals comply with IEC 61131-2.

Output voltage	[V]	≤30
Voltage drop at 50 mA load	[V]	≤1
Maximum switching current +BRAKE_OUT (o voltage reduction)	[A]	1.5
Maximum switching current other outputs	[mA]	≤50

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

Symmetrical	Conforming to RS422	
Resistance	[kΩ]	5
Pulse/direction frequency	[kHz]	≤400 ¹⁾
A/B frequency	[kHz]	≤400

1) Device revision (see nameplate) RS <05: 200 kHz

Profibus signals The Profibus signals comply with the Profibus standard and are short-circuit protected.

Encoder signals

Output ENC+5V_OUT		
Supply voltage	[V]	4.75 ... 5.25
Maximum output current	[mA]	100
Sense-controlled, short-circuit protected, overload-protected		
Inputs ENC_A, ENC_B and ENC_I		
Signal voltage	As per RS422	
Frequency	[kHz]	≤400

3.4.4 Safety function STO

When configured as "Source", the levels of the inputs comply with IEC 61131-2, type 1

Logic 0 (U_{low})	[V]	-3 ... +5
Logic 1 (U_{high})	[V]	+15 ... +30
Input current (typical)	[mA]	10
Debounce time	[ms]	1 ... 5
Detection of signal difference between STO_A ($PWRR_A$) and STO_B ($PWRR_B$)	[s]	<1
Response time (until shutdown of power stage)	[ms]	<10
Permitted test pulse width of upstream devices	[ms]	<1

Data for maintenance plan and safety calculations

Use the following data of the STO safety function for your maintenance plan and the safety calculations:

Lifetime (IEC 61508)		20 years
SFF (IEC 61508) Safe Failure Fraction	[%]	66
HFT (IEC 61508) Hardware Fault Tolerance Type B subsystem		1
Safety integrity level IEC 61508 IEC 62061		SIL2 SILCL2
PFH (IEC 61508) Probability of Dangerous Hardware Failure per Hour	[1/h]	$2.331 \cdot 10^{-9}$
PL (ISO 13849-1) Performance Level		d (Category 3)
MTTF _d (ISO 13849-1) Mean Time to Dangerous Failure		3788 years
DC (ISO 13849-1) Diagnostic Coverage	[%]	90

3.4.5 Fan

Only device type SD32••U68 comes with a fan.

Fan

Input voltage	[V _{dc}]	24
Input current	[mA]	130

3.4.6 Mains filter

Basics The EMC standards distinguish various use cases:

EN 61800-3:2001-02; IEC 61800-3, Ed.2	Description
First environment, category C1	Operation in residential areas
First environment, category C2	Operation in residential areas
Second environment, category C3	Operation in industrial power distribution networks

Limit values This product meets the EMC requirements according to the standard IEC 61800-3, if the measures described in this manual are implemented during installation.

If the selected composition is not designed for category C1, note the following:

▲ WARNING

HIGH-FREQUENCY INTERFERENCE

In a residential environment this product may cause high-frequency interference that may require interference suppression.

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

Better values can be achieved depending on the device and the application and as well as the design, for example, in the case of installation in an enclosed control cabinet with at least 15db attenuation.

The following limit values for conducted interference are met by EMC-compliant designs:

Devices without external mains filter	C3 up to a motor cable length of 10 m
Devices with external mains filter	C2 up to a motor cable length of 20 m, C3 up to a motor cable length of 50 m

The system integrator and/or machine owner/operator is responsible for complying with the EMC directives. See chapter 12 "Accessories and spare parts" for order data on external mains filters.

3.5 Technical data accessories

3.5.1 Reference value adapter RVA

For a description of the RVA, see chapter 6.3.14 "Reference Value Adapter", page 81.

Dimensions

Height	[mm]	77
Width	[mm]	135
Depth	[mm]	37

Installation on DIN rail.

Electrical data

Input		
Supply voltage	[V]	19.2 ... 30
Input current (5V _{SE} no load)	[mA]	50
Input current (5V _{SE} 300 mA)	[mA]	150
Output, encoder		
5V _{SE}	[V]	4.75 ... 5.25
Maximum output current	[mA]	300
Sense-controlled, short-circuit protected, overload-protected		

3.5.2 Cables

Overview of required cables

	Max. cable length [m]	in. conductor cross section [mm ²]	As per PELV	Shielded, both ends grounded	Twisted pair
Motor cables (see chapter 12.2 "Motor cables")	10/50 ¹⁾	4*1.5 (AWG 14)		X	
Mains supply	–	0.75 (AWG 18)			
Encoder cables (see chapter 12.3 "Encoder cables")	100	10*0.25 and 2*0.5 (AWG 22 and 18)	X	X	X
Controller supply voltage	–	0.75 (AWG 18)	X		

1) Length depends on the required limit values for conducted interference, see chapter 3.4.6 "Mains filter".

Motor cable and encoder cable

The motor cables and encoder cables are suitable for drag chain applications; they are available in various lengths. See page 227 for the versions available as accessories.

Motor cables		Style 20234
Encoder cable		Style 20963
Permissible voltage motor cable	[V _{ac}]	600 (UL and CSA)
Temperature range	[°C]	-40 ... +90 (permanently installed) -20 ... +80 (moving)
Minimum bending radius		4 x diameter (permanently installed) 7.5 x diameter (moving)
Cable jacket		Oil-resistant PUR
Shielding		Shield braiding
Coverage of shielding	[%]	≥85

Table 3.1 Data of the motor cable and encoder cable available as accessories

3.6 Conditions for UL 508C

If the product is used to comply with UL 508C, the following conditions must also be met:

Ambient temperature during operation

Surrounding air temperature	[°C]	0 ... +40
-----------------------------	------	-----------

Wiring

Use at least 60/75 °C copper conductors.

PELV power supply

Use only power supply units that are approved for overvoltage category III.

Short-circuit current rating

Short-circuit current rating	[kA]	5
------------------------------	------	---

4 Basics

4.1 Functional safety

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

Usually, the safety engineering requirements depend on the application. The level of the requirements results from the risk and the hazard potential arising from the specific application.

Working with IEC 61508

IEC 61508 standard

The standard IEC 61508 "Functional safety of electrical/electronic/programmable electronic safety-related systems" covers the safety-related function. Instead of a single component, an entire function chain (for example, from a sensor through the logical processing units to the actuator) is considered as a unit. This function chain must meet the requirements of the specific safety integrity level as a whole. Systems and components that can be used in various applications for safety tasks with comparable risk levels can be developed on this basis.

SIL, Safety Integrity Level

The standard IEC 61508 defines 4 safety integrity levels (SIL) for safety functions. SIL1 is the lowest level and SIL4 is the highest level. A hazard and risk analysis serves as a basis for determining the required safety integrity level. This is used to decide whether the relevant function chain is to be considered as a safety function and which hazard potential it must cover.

PFH, Probability of a dangerous hardware failure per hour

To maintain the safety function, the IEC 61508 standard requires various levels of measures for avoiding and controlling faults, depending on the required SIL. All components of a safety function must be subjected to a probability assessment to evaluate the effectiveness of the measures implemented for controlling faults. This assessment determines the PFH (probability of a dangerous failure per hour) for a safety system. This is the probability per hour that a safety system fails in a hazardous manner and the safety function cannot be correctly executed. Depending on the SIL, the PFH must not exceed certain values for the entire safety system. The individual PFH values of a function chain are added; the total PFH value must not exceed the maximum value specified in the standard.

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

HFT and SFF Depending on the SIL for the safety system, the IEC 61508 standard requires a specific hardware fault tolerance HFT in connection with a specific proportion of safe failures SFF (safe failure fraction). The hardware fault tolerance is the ability of a system to execute the required 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. According to IEC 61508, the maximum achievable SIL of a system is partly determined by the hardware fault tolerance HFT and the safe failure fraction SFF of the system.

IEC 61508 distinguishes two types of subsystems (type A subsystem, type B subsystem). These types are specified on the basis of criteria which the standard defines for the safety-relevant components.

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

Fault avoidance measures Systematic errors in the specifications, in the hardware and the software, usage faults and maintenance faults of the safety system must be avoided to the maximum degree possible. To meet these requirements, IEC 61508 specifies a number of measures for fault avoidance that must be implemented depending on the required SIL. These measures for fault avoidance must cover the entire life cycle of the safety system, i.e. from design to decommissioning of the system.

5 Engineering

This chapter contains information on the application of the product that is vital in the design phase.

5.1 Safety function STO ("Safe Torque Off")

See page 35 for information on using the IEC 61508 standard.

5.1.1 Definitions

<i>Safety function STO (IEC 61800-5-2)</i>	The safety function STO ("Safe Torque Off") shuts off the motor torque safely. It is not necessary to interrupt the supply voltage. There is no monitoring for standstill.
<i>"Power Removal"</i>	The STO safety function ("Safe Torque Off") is also known as "Power Removal".
<i>Category 0 stop (IEC 60204-1)</i>	Stopping by immediate removal of power to the machine actuators (i.e. an uncontrolled stop).
<i>Category 1 stop (IEC 60204-1)</i>	Controlled stop with power available to the machine actuators to achieve the stop. Power is not interrupted until the stop is achieved.

5.1.2 Function

The STO safety function integrated into the product can be used to implement an "EMERGENCY STOP" (IEC 60204-1) for category 0 stops. With an additional, approved EMERGENCY STOP module, it is also possible to implement category 1 stops.

Function principle The STO safety function is triggered via 2 redundant inputs. The circuits of the two inputs must be separate so that there are always two channels.

The switching process must be simultaneous for both inputs (offset <1s). The power stage is disabled and an error message is generated. The motor can no longer generate torque and coasts down without braking. A restart is possible after resetting the error message with a "Fault Reset".

The power stage is disabled and an error message is generated if only one of the two inputs is switched off or if the time offset is too great. This error message can only be reset by switching off the product.

5.1.3 Requirements for using the safety function

⚠ DANGER**ELECTRIC SHOCK CAUSED BY INCORRECT USE**

The safety function STO ("Safe Torque Off") does not cause electric isolation. The DC bus 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 SAFETY FUNCTION**

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

- Observe the requirements for using the safety function.

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

Category 0 stop During a category 0 stop, the motor coasts down in an uncontrolled way. If access to the machine coasting down involves a hazard (results of the hazard and risk analysis), you must take appropriate measures.

Category 1 stop A controlled stop must be triggered with a category 1 stop. The controlled standstill is not monitored by the drive system. In the case of power outage or an error, a controlled stop is impossible. Final shutoff of the motor is achieved by switching off the two inputs of the STO safety function. The shutoff is usually controlled by a standard EMERGENCY STOP module with a safe time delay.

Behavior of holding brake Triggering the STO safety function means that the delay time for motors with holding brake is not effective. The motor cannot generate holding torque to bridge the time to application of the holding brake. Especially in the case of vertical axes it is important to verify whether additional measures are required to avoid lowering of the load.

Vertical axes, external forces If external forces act on the motor (vertical axis) and an unwanted movement, for example caused by gravity, could cause a hazard, the motor must not be operated without additional measures for fall protection.

Unintended restart Note that a master controller must not trigger an unintended restart after restoration of power (e.g. after a power outage).

Degree of protection if STO is used You must ensure that conductive substances cannot get into the product (pollution degree 2). If you use the safety function and conductive substances get into the product, the safety function may become inoperative.

Protected cable installation

If short circuits or cross circuits can be expected in connection with the two signals of the STO safety function and if they are not detected by upstream devices, protected cable installation is required.

In the case of an unprotected cable installation, the two signals of the STO safety function may be connected to external voltage if a cable is damaged. If the two signals are connected to external voltage, the STO safety function is no longer operative.

Protected cable installation possibilities:

- Use separate cables for two signals. Any additional wires in these cables may only carry voltages according to PELV.
- Use a shielded cable. The grounded shield is designed to dissipate the external voltage in the case of damages and to trip the fuse in this way.
- Use a separately grounded shield. If there are other wires in the cable, the two signals must be isolated from these wires by a grounded, separate shield.

Data for maintenance plan and safety calculations

Use the following data of the STO safety function for your maintenance plan and the safety calculations:

Lifetime (IEC 61508)		20 years
SFF (IEC 61508) Safe Failure Fraction	[%]	66
HFT (IEC 61508) Hardware Fault Tolerance Type B subsystem		1
Safety integrity level IEC 61508 IEC 62061		SIL2 SILCL2
PFH (IEC 61508) Probability of Dangerous Hardware Failure per Hour	[1/h]	$2.331 \cdot 10^{-9}$
PL (ISO 13849-1) Performance Level		d (Category 3)
MTTF _d (ISO 13849-1) Mean Time to Dangerous Failure		3788 years
DC (ISO 13849-1) Diagnostic Coverage	[%]	90

Hazard and risk analysis

As a system manufacturer you must conduct a hazard and risk analysis of the entire system. The results must be taken into account in the application of the STO safety function.

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

5.1.4 Application examples STO

Example of category 0 stop Application without EMERGENCY STOP module, category 0 stop.

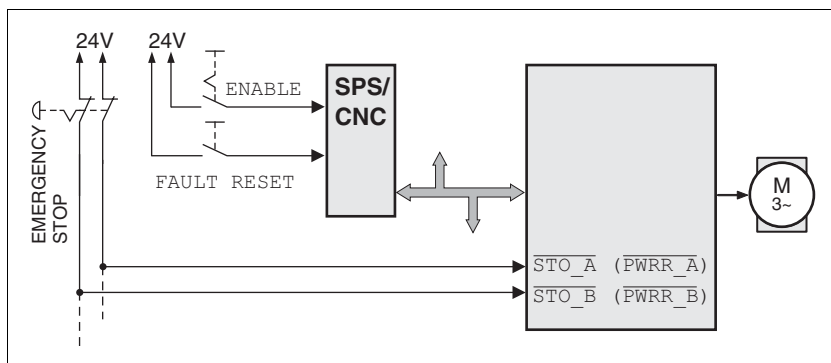


Figure 5.1 Example of category 0 stop

Please note:

- When the EMERGENCY STOP switch is tripped, this initiates a category 0 stop

Example of category 1 stop Application with EMERGENCY STOP module, category 1 stop.

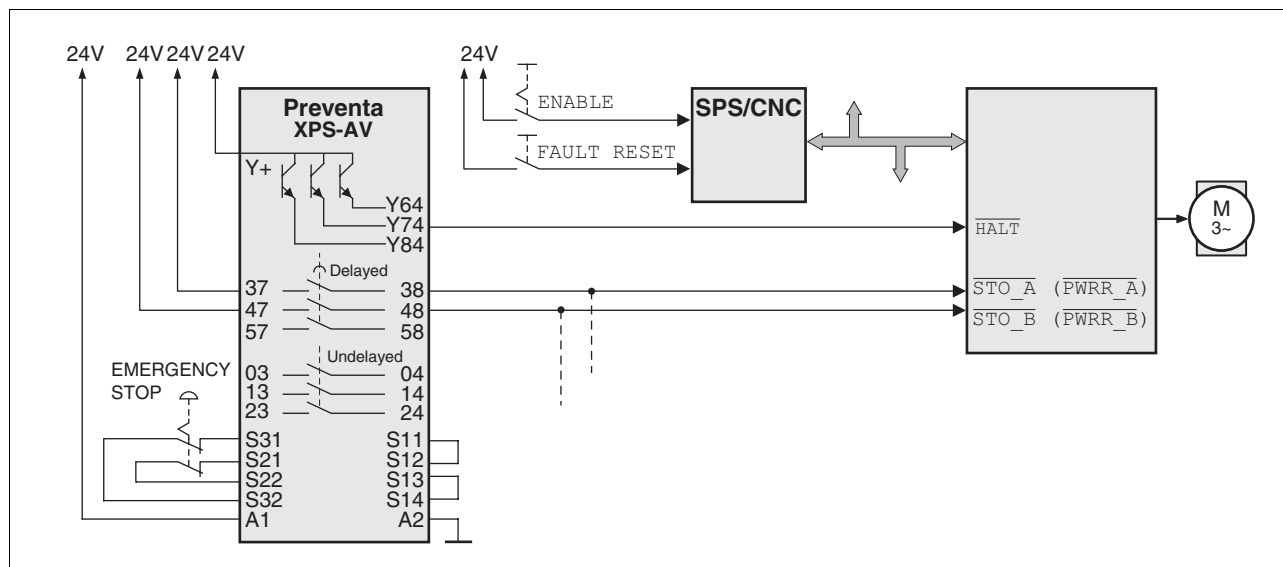


Figure 5.2 Example of category 1 stop

Please note:

- A "Halt" is initiated without a delay via the HALT input.
- The inputs $\overline{STO_A}$ (PWRR_A) and $\overline{STO_B}$ (PWRR_B) must be switched off with a time delay. The delay is set at the EMERGENCY STOP safety module. If the motor has not yet stopped when the delay time has elapsed, it coasts down in an uncontrolled way (uncontrolled stop).
- The specified minimum current and the permissible maximum current of the relay must be observed for the relay outputs of the EMERGENCY STOP module.

5.2 Monitoring functions

The monitoring functions in the product can help to guard the system and reduce the risks involved in a system misoperation. These monitoring functions may not be used to protect persons.

The following monitoring functions are available:

Monitoring	Task
Data link	Error response if the link becomes inoperative
Limit switch signals	Monitors for permissible range of travel
Overvoltage and undervoltage	Monitors for overvoltage and undervoltage of the supply voltage
Overtemperature	Monitors the device for overtemperature
Rotation monitoring (optional)	Monitors the motor movement and the motor temperature
Short circuit / ground fault	Monitors for short circuit between motor phase and motor phase and between motor phase and ground

For a description of the monitoring functions, see chapter 8.6.2 "Monitoring functions", page 152.

6 Installation



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

6.1 Electromagnetic compatibility, EMC

⚠ WARNING

SIGNAL AND DEVICE INTERFERENCE

Signal interference can cause unexpected responses of device.

- Install the wiring in accordance with the EMC requirements.
- Verify compliance with the EMC requirements.

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

Limit values

This product meets the EMC requirements according to the standard IEC 61800-3, if the measures described in this manual are implemented during installation.

If the selected composition is not designed for category C1, note the following:

⚠ WARNING

HIGH-FREQUENCY INTERFERENCE

In a residential environment this product may cause high-frequency interference that may require interference suppression.

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

EMC scope of supply and accessories

The device is shipped with SK shield clamps and an EMC plate. The number of shield clamps depends on the device type. The shield clamps are not designed to be used as a strain relief.

See page 227 for information pre-assembled cables.

Control cabinet design

EMC measures	Objective
Use EMC plate or galvanized or chrome-plated mounting plates, connect large surface areas of metal parts, remove paint from contact surfaces.	Improves conductivity due to surface contact.
Ground the control cabinet, door and EMC plate with ground straps or cables with a cross section greater than 10 mm ² (AWG 6).	Reduces emissions.
Fit switching devices such as contactors, relays or solenoid valves with interference suppression assemblies or arc suppressors (for example, diodes, varistors, RC circuits).	Reduces mutual interference
Install power and control components separately.	Reduces mutual interference

Shielding

EMC measures	Objective
Connect large surface areas of cable shields, use cable clamps and ground straps	Reduces emissions.
Use cable clamps to connect a large surface area of the shields of all shielded cables to the mounting plate at the control cabinet entry.	Reduces emissions.
Ground shields of digital signal wires at both ends by connecting them to a large surface or via conductive connector housings.	Reduces interference affecting the signal wires, reduces emissions
Ground the shields of analog signal wires directly at the device (signal input); insulate the shield at the other cable end or ground it via a capacitor (for example, 10 nF).	Reduces ground loops due to low-frequency interference.
Use only shielded motor cables with copper braid and a coverage of at least 85%, ground a large surface area of the shield at both ends.	Diverts interference currents in a controlled way, reduces emissions

Cable installation

EMC measures	Objective
Do not route fieldbus cables and signal wires in a single cable duct together with lines with DC and AC voltages of more than 60 V. (Fieldbus cables, signal lines and analog lines may be in the same cable duct) Recommendation: Use separate cable ducts at least 20 cm apart.	Reduces mutual interference
Keep cables as short as possible. Do not install unnecessary cable loops, use short cables from the central grounding point in the control cabinet to the external ground connection.	Reduces capacitive and inductive interference.
Use equipotential bonding conductors in systems with - wide-area installations - different voltage supplies - networking across several buildings	Reduces current in the cable shield, reduces emissions.
Use equipotential bonding conductors with fine wires	Diverts high-frequency interference currents.
If motor and machine are not conductively connected, for example by an insulated flange or a connection without surface contact, ground the motor with a ground wire (> 10 mm ²) or a ground strap.	Reduces emissions, increases immunity.
Use twisted pair for 24 V _{dc} signals.	Reduces interference affecting the signal cables, reduces emissions.

Power supply

EMC measures	Objective
Operate product on mains with grounded neutral point (mains filter is not effective in IT mains).	Enables effectiveness of mains filter.
Protective circuit if there is a risk of overvoltage.	Reduces the risk of damage caused by overvoltage.

Motor and encoder cables Motor and encoder cables are especially critical in terms of EMC. Use only pre-assembled cables or cables that comply with the specifications and implement the EMC measures described below.

EMC measures	Objective
Do not install switching elements in motor cables or encoder cables.	Reduces interference.
Route the motor cable at a distance of at least 20 cm from the signal cable or use shielding plates between the motor cable and signal cable.	Reduces mutual interference
For long lines, use equipotential bonding conductors.	Reduces current in the cable shield.
Route the motor cable and encoder cable without cutting them. ¹⁾	Reduces emission.

1) If a cable has to be cut for the installation, it has to be connected with shield connections and a metal housing at the point of the cut.

Additional measures for EMC improvement An EMC-compliant design is required to meet the specified limit values. Depending on the application, better results can be achieved with the following measures:

EMC measures	Objective
Upstream mains reactors	Reduces mains harmonics, prolongs product service life.
Upstream external mains filters	Improves the EMC limit values.
Particularly EMC-compliant design, e.g. in a closed control cabinet with 15 dB damping of radiated interference	Improves the EMC limit values.

Equipotential bonding conductors Potential differences can result in excessive currents on the cable shields. Use equipotential bonding conductors to reduce currents on the cable shields.

The equipotential bonding conductor must be rated for the maximum current flowing. Practical experience has shown that the following conductor cross sections can be used:

- 16 mm² (AWG 4) for equipotential bonding conductors up to a length of 200 m
- 20 mm² (AWG 4) for equipotential bonding conductors with a length of more than 200 m

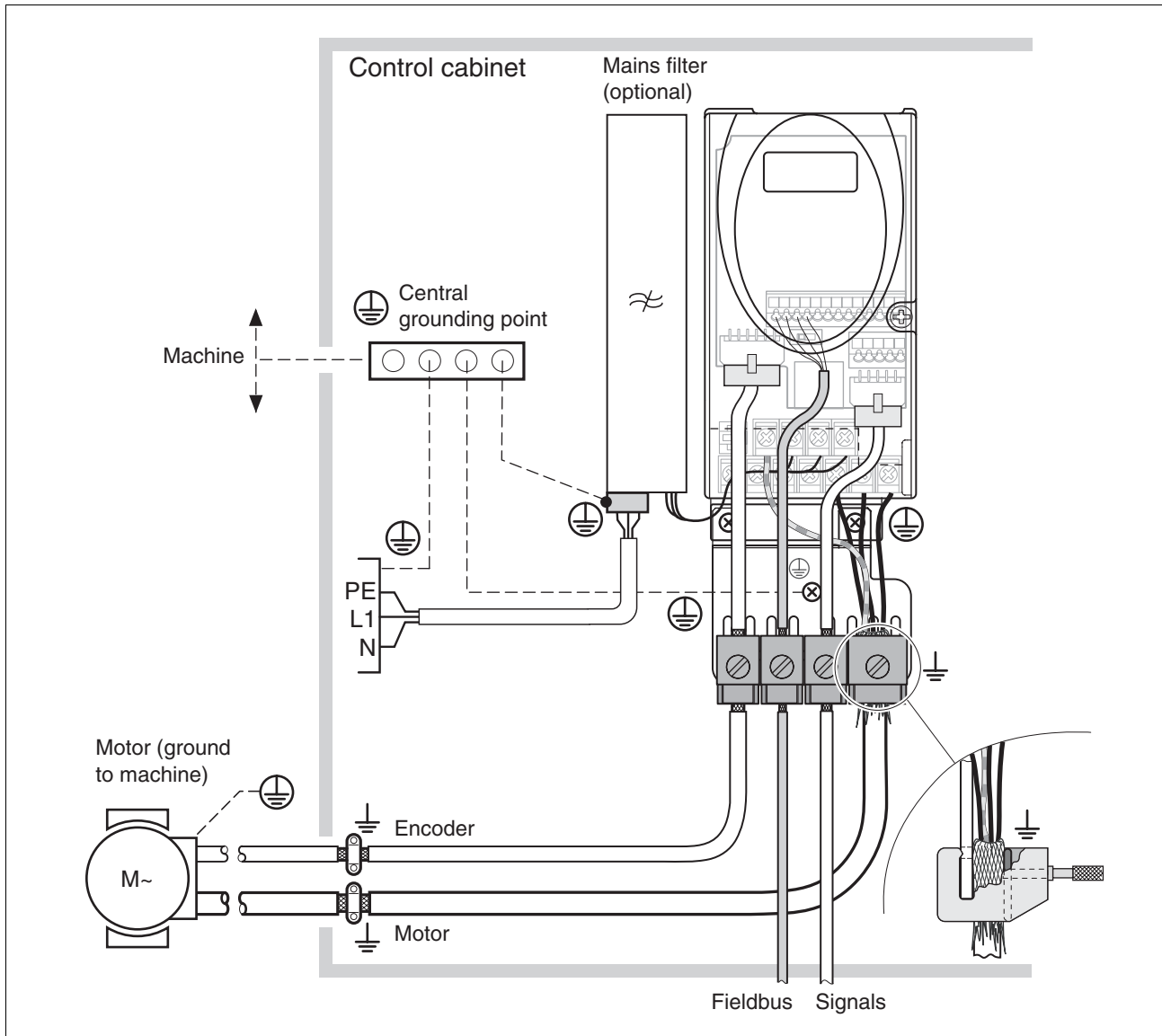


Figure 6.1 EMC measures¹

1. Number of shield clamps depends on the device type.

6.1.1 Operation in an IT mains

An IT mains has a neutral conductor that is isolated or grounded via high impedance. If you use permanent isolation monitoring, it must be suitable for non-linear loads (e.g. Merlin Gerin type XM200). If, in spite of correct wiring, an error is signaled, you can, in the case of products with integrated mains filters, disconnect the ground connection of the Y capacitors (deactivate the Y capacitors).

In the case of all other mains except for IT mains, the ground connection via the Y capacitors must remain effective!

If the ground connections of the Y capacitors are disconnected, the specifications for radiated interference are no longer met (specified categories, see chapter 3.4.6 "Mains filter", page 31). You must take all the measures required for compliance with all applicable directives, regulations and standards.

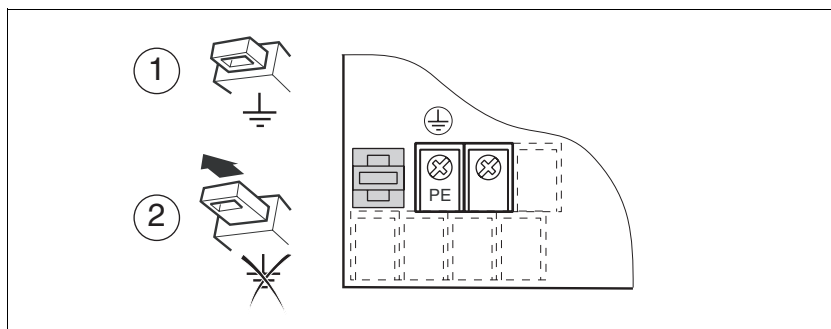


Figure 6.2 Operation in an IT mains

- (1) Y capacitors of the internal filter operative (standard)
- (2) Y-capacitors of the internal filter deactivated (IT mains)

6.2 Mechanical installation

⚠ DANGER

ELECTRIC SHOCK CAUSED BY FOREIGN OBJECTS OR DAMAGE

Conductive foreign objects in the product or serious damage may cause parasitic voltage.

- Do not use damaged products.
- Keep foreign objects such as chips, screws or wire clippings from getting into the product.
- Do not use products that contain foreign objects.

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

⚠ WARNING

LOSS OF SAFETY FUNCTION CAUSED BY FOREIGN OBJECTS

Conductive foreign objects, dust or liquids may cause the STO safety function to become inoperative.

- Do not use the STO safety function unless you have protected the system against contamination by conductive substances.

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

⚠ CAUTION

HOT SURFACES

The heat sink at the product may heat up to over 100°C (212°F) during operation.

- Avoid contact with the hot heat sink.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity.
- Consider the measures for heat dissipation described.

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

6.2.1 Mounting the device

Control cabinet The control cabinet must have a sufficient size so that all devices and components can be permanently installed and wired in compliance with the EMC requirements.

The ventilation of the control cabinet must be sufficient to remove the heat generated by all devices and components operated in the control cabinet.

Mounting distances, ventilation When selecting the position of the device in the control cabinet, note the following:

- Mount the device in a vertical position ($\pm 10^\circ$). This is required for cooling the device.
- Adhere to the minimum installation distances for required cooling. Avoid heat accumulations.
- Do not mount the device close to heat sources.
- Do not mount the device on flammable materials.
- The heated airflow from other devices and components must not heat up the air used for cooling the device.
- If the thermal limits are exceeded during operation, the drive switches off (overtemperature).
- When planning installation distances, consider the dimensions of a mains filter, see also notes on page 52

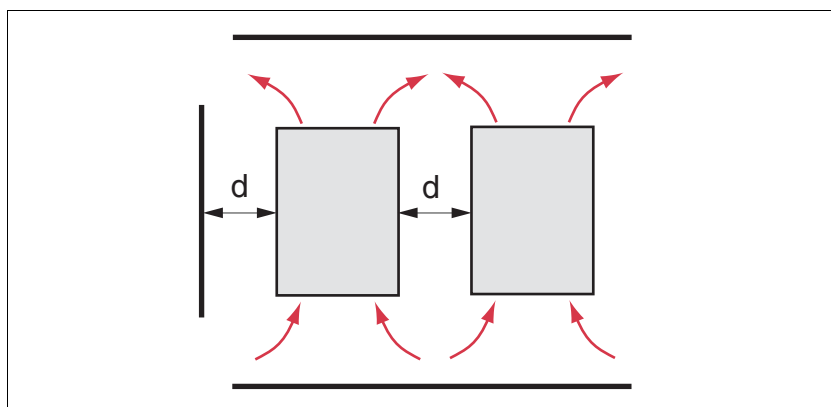


Figure 6.3 Mounting distances and air circulation

Temperature ¹⁾	Distance ²⁾	Measures without cover film ³⁾	Measures with cover film
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 > 10mm (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 ⁴⁾
	d < 50mm (d < 1.97 in.)	Reduce nominal current and continuous current ⁴⁾	Operation impossible

1) Maximum operating temperature for use as per UL: max. +40°C (104°F)

2) Distance in front of the device: 10mm (0.39 in.), above: 50mm (1.97 in.), below: 200mm (7.87 in.)

3) Recommendation: Remove cover film after installation

4) 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.
 At least 50mm of free space is required above the device.
 The connecting cables are routed out of the housing at the bottom. At least 200mm of free space is required below the device to allow for cable installation without bends.

Mounting the device For the dimensions of the mounting holes, see chapter 3.3.1 "Dimensions", page 27.

- ▶ Mount the device in a vertical position ($\pm 10^\circ$). This is required for cooling the device.
- ▶ Mount the EMC plate at the bottom of the device, see also Figure 6.1, or use alternative connection elements (busbars, shield clamps or similar).

Attaching a label with safety instructions

- ▶ Select the label suitable for the target country. Observe the safety regulations in the target country.
- ▶ Attach the label to the front of the device so that it is clearly visible.

Instead of mounting the device directly to the control cabinet mounting plate, you can use adapter plates for DIN rail mounting which are available as accessories, see chapter 3.3.1 "Dimensions".

In this case mains filters cannot be mounted directly next to or behind the device.

NOTE: Painted surfaces have an insulating effect. Before mounting the device to a painted mounting plate, remove all paint across a large area of the mounting points until the metal is completely bare.

Mounting the fan

Device type SD32●●U68 comes with a fan. The fan must be mounted and connected.

- ▶ Mount the fan as shown in the illustration below.
- ▶ Mount the fan before carrying out the electrical installation of the product.

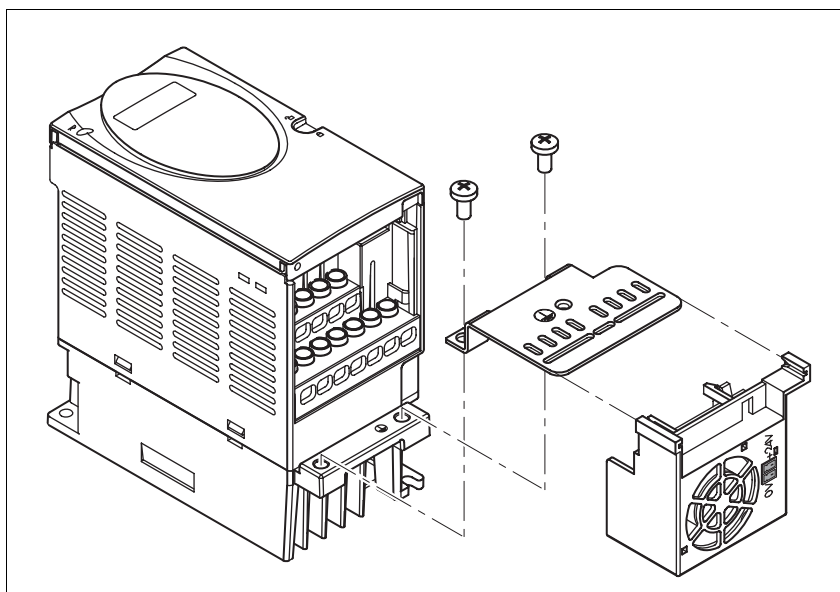


Figure 6.4 Mounting the fan

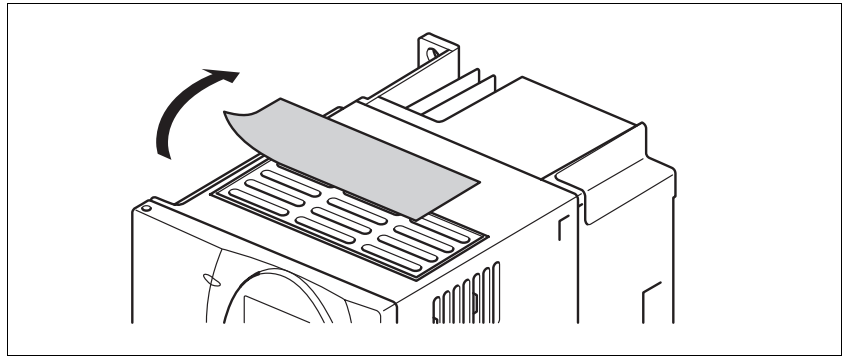
Removing the cover film

Figure 6.5 Removing the cover film

- ▶ Remove the cover film only after completion of all installation work. The cover film must be removed if required by the thermal conditions.

6.2.2 Mounting a mains filter

For technical data of external mains filters, see page 31.
Information on the electrical installation can be found in chapter 6.3.5 "Mains supply connection", page 61.

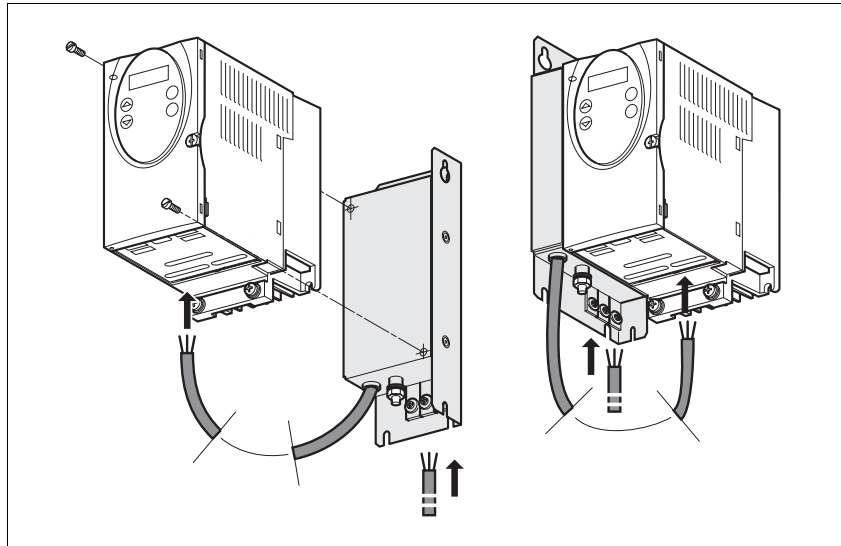


Figure 6.6 Mounting a mains filter

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



If the mains filter is mounted behind the device, the mains filter connections are no longer accessible after installation of the EMC plate.

If you use DIN rail mounting plates, the mains filter cannot be mounted directly next to or behind the device.

6.3 Electrical installation

⚠ DANGER

ELECTRIC SHOCK CAUSED BY FOREIGN OBJECTS OR DAMAGE

Conductive foreign objects in the product or serious damage may cause parasitic voltage.

- Do not use damaged products.
- Keep foreign objects such as chips, screws or wire clippings from getting into the product.
- Do not use products that contain foreign objects.

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

⚠ DANGER

ELECTRIC SHOCK CAUSED BY INSUFFICIENT GROUNDING

Insufficient grounding causes the hazard of electric shocks.

- Ground the drive system before applying voltage.
- Do not use conduits as protective ground conductors; use a protective ground conductor inside the conduit.
- The cross section of the protective ground conductor must comply with the applicable standards.
- Ground the cable shields at both ends; however, the shields are not protective ground conductors.

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

⚠ WARNING

THIS PRODUCT MAY CAUSE DIRECT CURRENT IN THE PROTECTIVE GROUND CONDUCTOR

If a residual current device (RCD) is used, conditions must be observed.

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

Conditions for use of residual current device Where the installation regulations require upstream protection against direct or indirect contact by means of a residual current device (RCD) or a residual current monitor (RCM), a residual current device of "type A" can be used for a single-phase drive with connection between N and L. In all other cases, a "type B" RCD must be used.

Note the following:

- Filtering of high-frequency currents.
- Delayed triggering to avoid triggering as a result of capacitance which may be present when the unit is switched on. 30 mA residual current devices rarely have a delay. Use residual current devices which are not sensitive to unintentional triggering, for example residual current devices with increased immunity.

Use residual current devices that meet the following conditions:

- For single-phase devices, type A: Residual current devices of series s.i (super-immunized, Schneider Electric).
- For three-phase devices, type B: sensitive to all current types with approval for frequency inverters

Suitability of the cables Cables must not be twisted, stretched, crushed or bent. Use only cables that comply with the cable specification. Consider the following in determining suitability of the cables:

- Suitable for drag chain applications
- Temperature range
- Chemical resistance
- Outdoor installation
- Underground installation

6.3.1 Overview of procedure

- ▶ Take into account the information on the basic settings described in chapter 5 "Engineering", page 37.
 - Chapter 5.1 "Safety function STO ("Safe Torque Off")", page 37
 - ▶ Unlock the front plate of the device and open the front plate.
 - ▶ Connect the ground connection of the device or the EMC plate to the central grounding point of the system.
 - ▶ Make all required connections according to the sequence as shown in the table below. If you do not make the connections in the sequence described, the connection terminals may be covered by other cables.
- Verify compliance with the EMC requirements, see page 43.
- ▶ Finally, lock the front plate.

Chapter	Page
6.3.3 "Connection of motor phases"	58
6.3.4 "DC bus connection"	60
6.3.5 "Mains supply connection"	61
6.3.6 "Connection of rotation monitoring (CN2)"	64
6.3.7 "Connection of holding brake and controller supply voltage (CN3)"	67
6.3.8 "Connecting the fan"	69
6.3.9 "Connecting the encoder signals A, B, I (CN5)"	70
6.3.10 "Connecting PULSE (CN5)"	72
6.3.11 "Connection Profibus DP (CN1)"	75
6.3.12 "Connecting the digital inputs/outputs (CN1)"	77
6.3.13 "Connecting a PC or a remote terminal (CN4)"	79



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

6.3.2 Overview of all connections

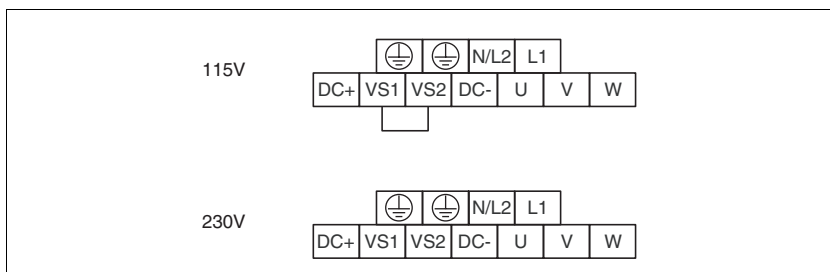
Power connections

Figure 6.7 Power connections

Power connections	Meaning
PE	Ground connection
L1, N/L2	Mains connection
DC+, DC-	DC bus
VS1, VS2	Setting the voltage range
U, V, W	Motor phases

Signal connections

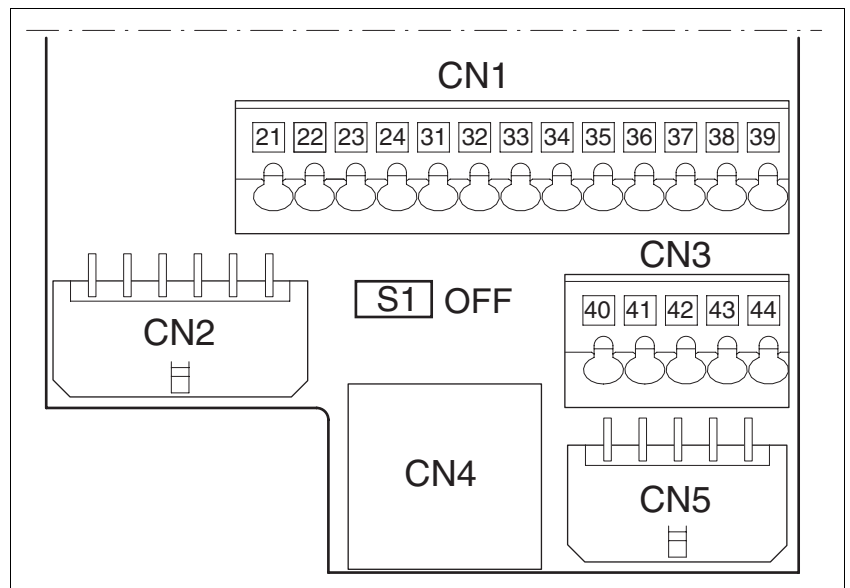


Figure 6.8 Overview of signal connections

Connection/ switch	Assignment
CN1	Profibus, pins 21-24
	Digital inputs/outputs pins 31-39
CN2	Encoder
CN3	Holding brake connection, pins 40-41
CN3	24V PELV controller supply voltage, pins 41-44
CN4	PC, remote terminal; (RJ45)
CN5	PULSE/DIR in, encoder signals A/B/I in ¹⁾
S1	Switch for fieldbus terminating resistor

1) Depend on "First Setup"

6.3.3 Connection of motor phases

⚠ DANGER

ELECTRIC SHOCK

High voltages at the motor connection may occur unexpectedly.

- The motor generates voltage when the shaft is rotated. Prior to performing any type of work on the drive system, block the motor shaft to prevent rotation.
- AC voltage can couple voltage to unused conductors in the motor cable. Insulate both ends of unused conductors in the motor cable.
- The system integrator is responsible for compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment. Supplement the motor cable grounding conductor with an additional protective ground conductor to the motor housing.

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

Cable specifications and terminal

- Shielded cable
- Shield grounded at both ends

Maximum cable length ¹⁾	[m]	10/50
Minimum conductor cross section	[mm ²]	1.5
Maximum connection cross section	[mm ²]	1.5
Tightening torque	[Nm] (lb-in)	0.5 ... 0.6 (4.4 ... 5.3)

1) Depends on the required limit values for conducted interference, see chapter 3.4.6 "Mains filter".

- See chapter 3.5.2 "Cables" for additional information.
- ▶ Use pre-assembled cables (page 227) to reduce the risk of wiring errors.
- ▶ Use only the cables available as accessories, the use of other cables may destroy the product.

Approved motors

Approved motor families: BRS3, ExRDM, VRDM3

Approved motor voltage: 230V_{ac} / 325V_{dc}

Further information on approved motors can be found in the product catalog.

Assembling cables Note the dimensions specified when assembling cables. The specified dimensions refer to a cable arrangement as shown in the figure "EMC measures", page 45.

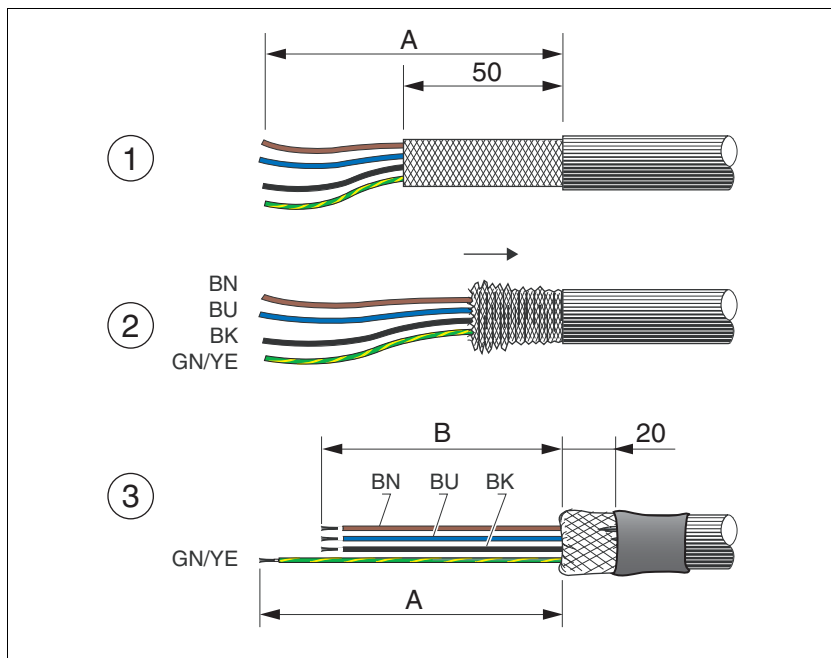


Figure 6.9 Steps (1-3) for assembling the motor cable

(A) 130 mm

(B) 75 mm

- ▶ (1) Strip the cable jacket (length A) and shorten the shield braiding to approx. 50mm.
- ▶ (2) Slide the shield braiding back over the cable jacket and fasten it with heat shrink tubing, tape or by other means. Note that approx. 20 mm of the shield braiding must not be insulated for the required large-surface connection of the shield braiding to the EMC plate.
- ▶ (3) Shorten the three motor phase wires (U, V, W) to length B. The protective ground conductor has length A.

Use fork-type cable lugs or wire ferrules. Insert the conductor in such a way that it fully fills the entire length of the ferrule for maximum current capacity and vibration resistance.

Monitoring The motor phases are monitored for:

- Short circuit between the motor phases
- Short circuit to ground

- Connecting the motor cable*
- ▶ Note the EMC requirements for the motor cables, see page 45.
 - ▶ Connect the motor phases and the protective ground conductor to terminals U, V, W and PE (ground). The connection assignments at the motor and device ends must match.
 - ▶ Connect a large area of the cable shield to the EMC plate.

Wiring diagram

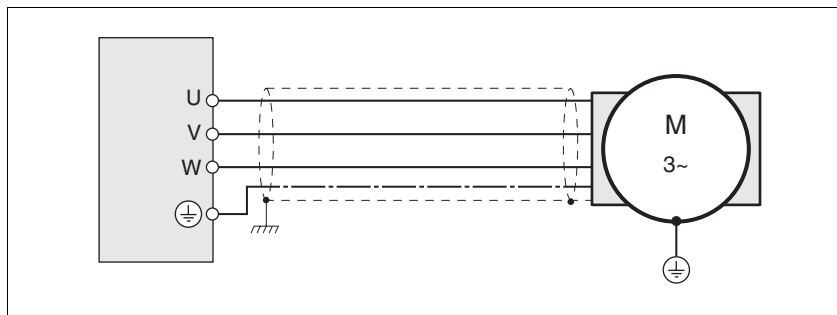


Figure 6.10 Wiring diagram motor

Connection	Meaning	Color ¹⁾
U	Motor phase	Brown (BN)
V	Motor phase	Blue (BU)
W	Motor phase	Black (BK)
PE	Protective ground conductor	Green/yellow (GN/YE)

1) Color information relates to the cables available as accessories.

6.3.4 DC bus connection

CAUTION

NON-APPROVED PARALLEL CONNECTION

Operation with parallel connection via the DC bus may destroy the drives immediately or after a delay.

- Do not connect the DC bus of several drives.

Failure to follow these instructions can result in equipment damage.

6.3.5 Mains supply connection

⚠ DANGER

ELECTRIC SHOCK CAUSED BY INSUFFICIENT GROUNDING

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

- Use a protective ground conductor at with least 10 mm² (AWG 6) or two protective ground conductors with the cross section of the conductors supplying the power terminals. Verify compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.

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

⚠ WARNING

INSUFFICIENT PROTECTION AGAINST OVERCURRENTS

- Use the external fuses specified in "Technical data".
- Do not connect the product to a power supply in which the short-circuit capacity exceeds the maximum short-circuit current approved in "Technical data".

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

CAUTION

DESTRUCTION DUE TO INCORRECT MAINS VOLTAGE

Incorrect mains voltage may destroy the product.

- Before switching on and configuring the product, verify that it is approved for the mains voltage.

Failure to follow these instructions can result in equipment damage.

The products are intended for industrial use and may only be operated with a permanently installed connection.

Cable specifications and terminal

Minimum conductor cross section	[mm ²]	0.75 (AWG 18)
Maximum connection cross section	[mm ²]	1.5 (AWG 16)
Tightening torque	[Nm] (lb-in)	0.5 ... 0.6 (4.4 ... 5.3)

- See chapter 3.5.2 "Cables", page 34 for additional information.

The wires must have a sufficiently large cross section so that the fuse at the mains connection can trip if required.

Note the information in chapter 6.1.1 "Operation in an IT mains" when connecting the device to an IT mains.

Verify the suitability of the cables, see page 54, and the EMC-compliant connection, see page 44.

Assembling cables

Use fork-type cable lugs or wire ferrules. Insert the conductor in such a way that it fully fills the entire length of the ferrule for maximum current capacity and vibration resistance.

Wiring diagram

The figure below shows the mains supply connection. The figure also shows the wiring of an optional external mains filter.

NOTE: In three-phase systems, the neutral conductor N must be used instead of L2 in the majority of cases.

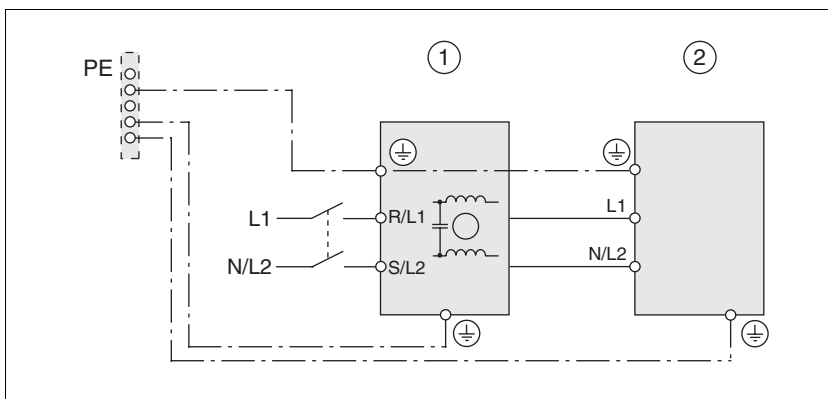


Figure 6.11 Wiring diagram mains supply for single-phase device

- (1) Mains filter (optional)
- (2) Product

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

Setting the voltage range ► Set the device to the correct voltage range.

VS1 bridged to VS2: 115 V

VS1 not bridged to VS2: 230 V (factory setting)

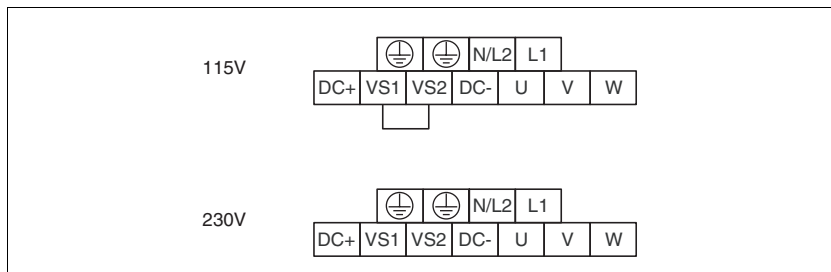


Figure 6.12 Setting the voltage range

Connecting mains supply

Note the following information:

- The device must be set to the correct voltage range.
- If you use an external mains filter, the mains cable must be shielded and grounded at both ends if the length between the external mains filter and the device exceeds 200 mm.
- Observe the EMC requirements. If necessary, use surge arresters, mains filters and mains reactors, see page 52.
- See page 34 for a UL-compliant design.
- Connect the mains wires. Note the terminal assignment of your device, see chapter 6.3.2 "Overview of all connections".

6.3.6 Connection of rotation monitoring (CN2)

Encoder The motor encoder is an incremental encoder integrated into the motor. It signals changes of the position of the motor shaft in the form of A/B/I signals.

- Cable specifications*
- Twisted pair
 - Shielded cable
 - Shield grounded at both ends

Maximum cable length	[m]	100
Minimum conductor cross section	[mm ²]	10*0.25 + 2*0.5 (AWG 22)

- See chapter 3.5.2 "Cables", page 34 for additional information.

- Assembling cables*
- ▶ Use pre-assembled cables to reduce the risk of wiring errors. Step 5 in the illustration below must be carried out even with pre-assembled cables. The dimensions for connecting the shield to the housing are applicable when the included EMC plate is used.
 - ▶ If you do not use a pre-assembled cable, follow the procedure below.

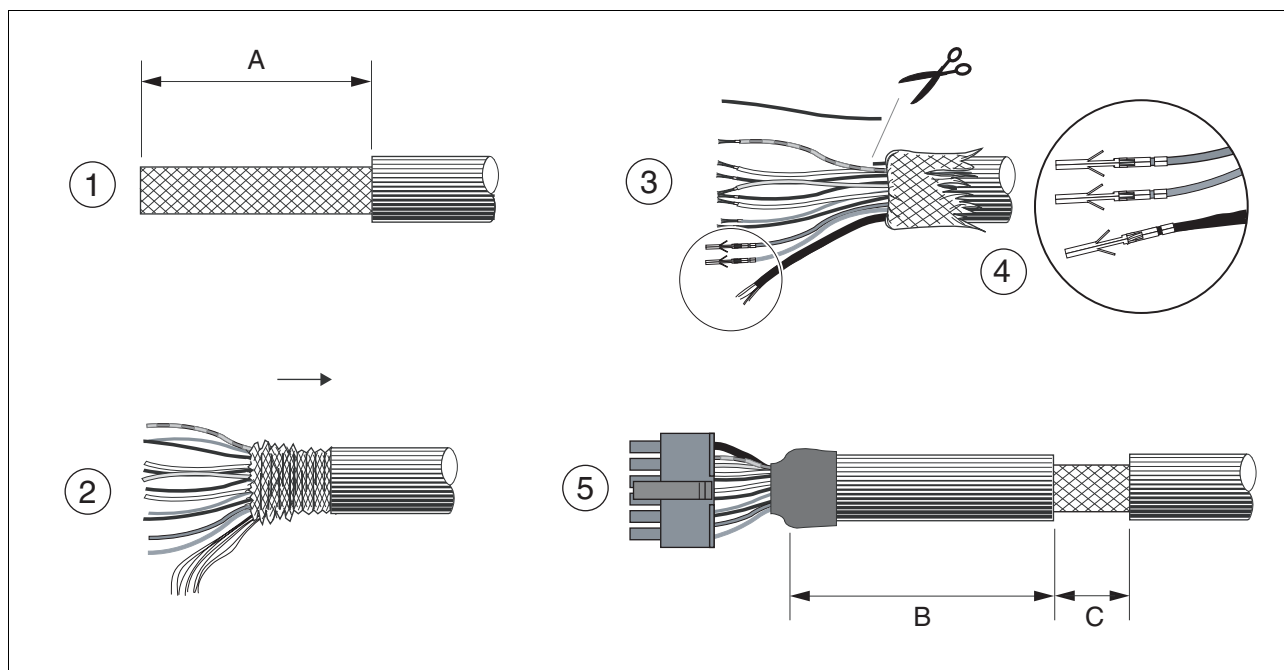


Figure 6.13 Steps (1-5) for assembling the encoder cable

- (A) 25 mm
 (B) 90 mm
 (C) 15 mm

Stripping length [mm]	Manufacturer's crimp contact no.	Crimping tool	Connector manufacturer	Connector type
2.5 ..3.0	43030-0007	69008-0982	Molex	Micro-Fit 43025-1200

- ▶ (1) Strip the cable jacket, length A.
- ▶ (2) Slide the shield braiding back over the cable jacket. The shield drain wire is required as connection.
- ▶ (3) The wire with the color blue/red is not required and may be cut. Insulate the shield drain wire with heat shrink tube.
- ▶ (4) Crimp the contacts to the remaining wires and to the insulated shield drain wire. Insulate the shield braiding with heat shrink tube. Plug the crimp contacts into the connector housing; see Figure 6.14 for the pin assignment.
- ▶ (5) Strip the cable jacket to length C at the position shown; at this point, the cable is fastened to the EMC plate with a clamp (shield to ground connection).

- Connecting the motor encoder**
- ▶ Verify that wiring, cables and connected interfaces meet the PELV requirements.
 - ▶ Note the EMC requirements for the encoder cable, page 45; use equipotential bonding conductors for equipotential bonding.
 - ▶ Connect the connector to CN2.
 - ▶ Fasten the cable to the EMC plate and verify that the cable shield is connected to a large surface area.

Wiring diagram

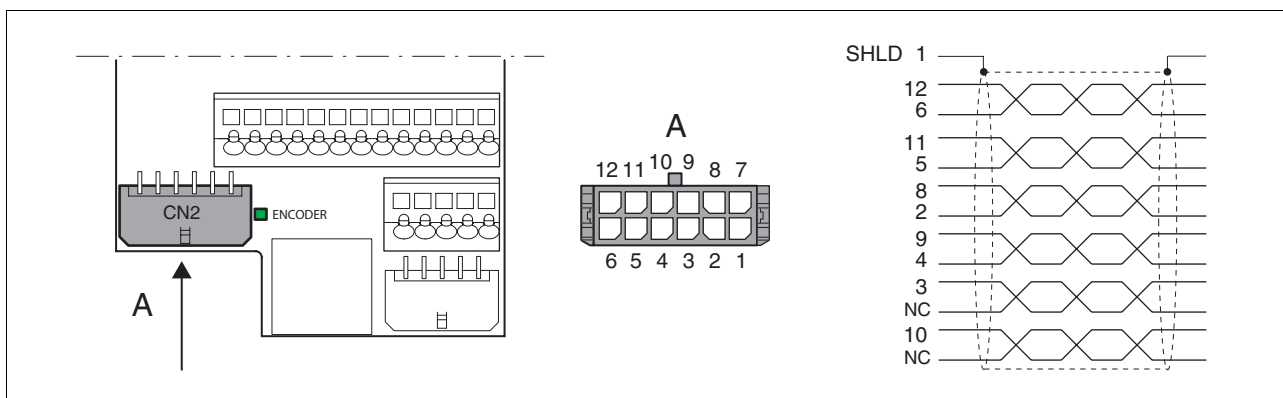


Figure 6.14 Wiring diagram rotation monitoring

Pin	Signal	Motor, pin	Color ¹⁾	Pair	Meaning	I/O
12	ENC_A	1	White	1	Encoder signal channel A	I
6	$\overline{\text{ENC_A}}$	2	Brown	1	Encoder signal channel A, inverted	I
11	ENC_B	3	Green	2	Encoder signal channel B	I
5	$\overline{\text{ENC_B}}$	4	Yellow	2	Encoder signal channel B, inverted	I
10	ENC_0V_OUT	7	Blue	3	Reference potential to ENC+5V_OUT ²⁾	O
4	ENC+5V_OUT	8	Red	3	5V _{dc} supply for encoder, max. 100mA ²⁾	O
9	ENC_0V_SENSE	9	Black	4	Reference potential to ENC+5V_SENSE ²⁾	I
3	ENC+5V_SENSE	10	Violet	4	SENSE line to ENC+5V_OUT ²⁾	I
8	ENC_I	5	Gray	5	Encoder signal index pulse	I
2	$\overline{\text{ENC_I}}$	6	Pink	5	Encoder signal index pulse, inverted	I
7	T_MOT	11	Gray/pink		Temperature sensor PTC	I
1	SHLD				Shield drain wire	

1) Color information relates to the cables available as accessories.

2) At the end of the motor cable (motor end), the signal wire ENC+5V_OUT must be connected to ENC+5V_SENSE and the signal wire ENC_0V_OUT must be connected to ENC_0V_SENSE. The LED "ENCODER lights up when the encoder supply is on."

6.3.7 Connection of holding brake and controller supply voltage (CN3)



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

⚠ DANGER

ELECTRIC SHOCK CAUSED BY INCORRECT POWER SUPPLY UNIT

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

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

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

⚠ WARNING

DAMAGE TO SYSTEM COMPONENTS AND LOSS OF CONTROL

Interruptions of the negative connection of the controller supply voltage can cause excessively high voltages at the signal connections.

- Do not interrupt the negative connection between the power supply unit and load with a fuse or switch.
- Verify correct connection before switching on.
- Do not connect the controller supply voltage or change its wiring while the supply voltage is present.

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

CAUTION

DAMAGE TO CONTACTS

The connection for the controller supply voltage at the product does not have an inrush current limitation. If the voltage is switched on by means of switching of contacts, damage to the contacts or contact welding may result.

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

Failure to follow these instructions can result in equipment damage.

Wiring diagram

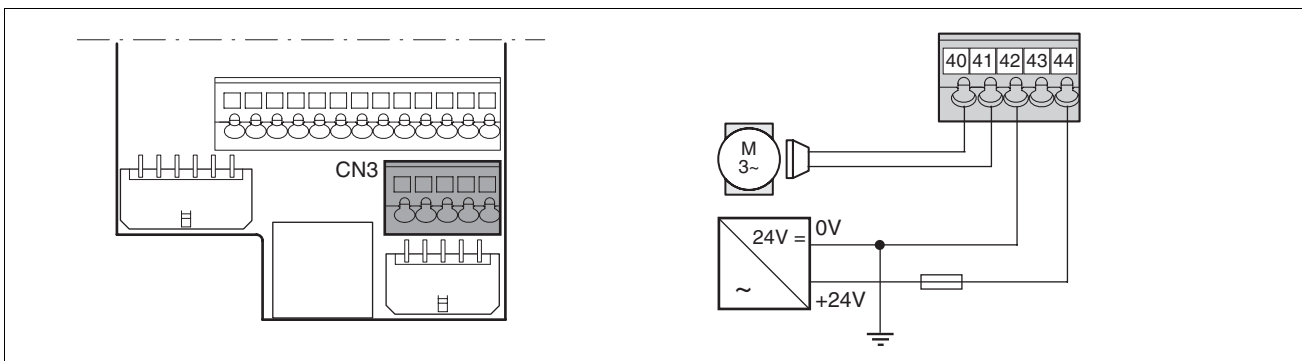


Figure 6.15 Wiring diagram CN3

Pin	Signal	Meaning	I/O
40	+BRAKE_OUT	Holding brake connection	O
41	0VDC	Reference potential to +24VDC/+BRAKE_OUT	
42	0VDC	Reference potential to +24VDC	
43	+24VDC	Controller supply voltage	
44	+24VDC	Controller supply voltage	

*Cable specifications***Minimum conductor cross section**

Controller supply voltage	[mm ²]	0.75 (AWG 18)
Holding brake	[mm ²]	0.75 (AWG 18)

Connecting the controller supply voltage

- ▶ Verify that wiring, cables and connected interfaces meet the PELV requirements.
- ▶ Route the controller supply voltage from a power supply unit (PELV) to the device.
- ▶ Ground the negative output at the power supply unit.
- ▶ Note the maximum permissible terminal current when connecting several devices.
- ▶ Verify that the connector locks snap in properly at the housing.

Connecting the holding brake

The holding brake can be connected directly. A holding brake controller is not required.

- ▶ Connect the holding brake directly.

6.3.8 Connecting the fan

The connection is only required in the case of device type SD32●●U68.

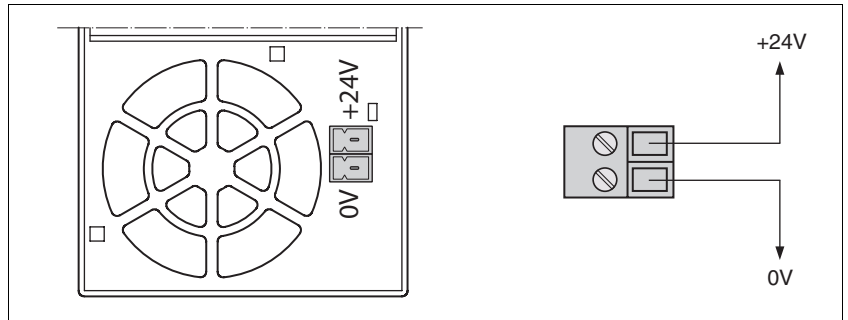


Figure 6.16 Wiring diagram fan

Connecting the supply

- ▶ Verify that wiring and cables meet the PELV requirements.
- ▶ Route the power supply cable from a power supply unit (PELV) to the fan connection.

6.3.9 Connecting the encoder signals A, B, I (CN5)

Function In the operating mode Electronic Gear, reference values can be supplied at CN5 via external A/B signals and the index pulse (I).

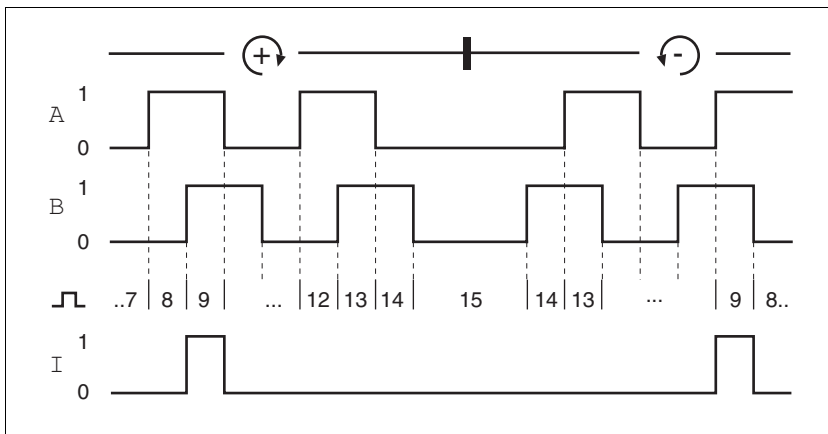


Figure 6.17 Time chart with A, B and index pulse signal, counting forwards and backwards

- Cable specifications*
- Twisted pair
 - Shielded cable
 - Shield grounded at both ends

Maximum cable length	[m]	100
Minimum conductor cross section	[mm ²]	0.25 (AWG 22)

- ▶ Use equipotential bonding conductors, see page 45.
- ▶ Use pre-assembled cables (page 227) to reduce the risk of wiring errors.

- Connecting the encoder*
- ▶ Connect the connector to CN5. If you do not use a pre-assembled cable, verify correct pin assignment.
 - ▶ Make the appropriate settings during commissioning. See "First Setup", page 96.

Wiring diagram

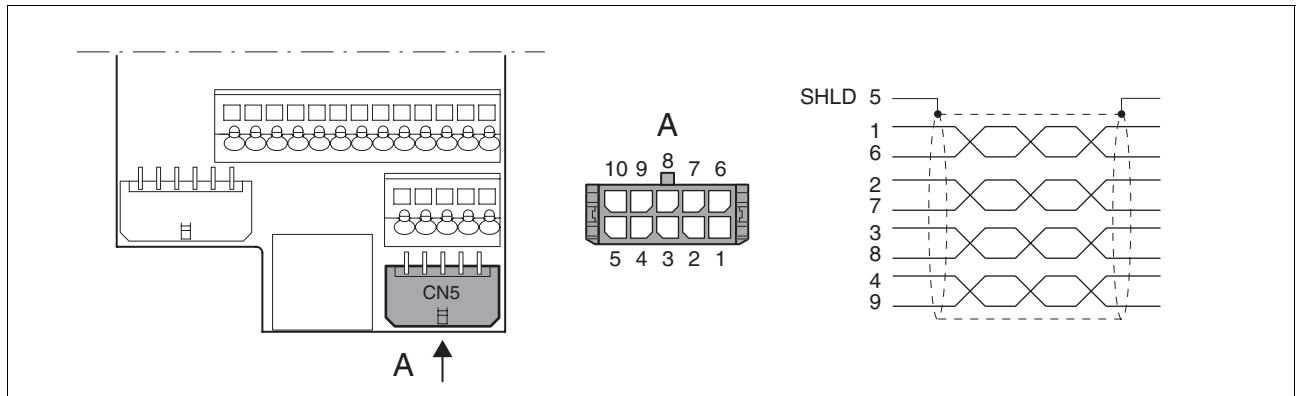


Figure 6.18 Wiring diagram, encoder to CN5

Pin	Signal	Color ¹⁾	Meaning	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	Gray	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) Color information relates to the cables available as accessories.

6.3.10 Connecting PULSE (CN5)

⚠ WARNING**UNEXPECTED MOVEMENT**

Incorrect or interfered signals as reference values can cause unexpected movements.

- Use shielded twisted-pair cables.
- If possible, operate the interface with push-pull signals.
- Do not use signals without push-pull in critical applications or in environments subject to interference.
- Do not use signals without push-pull in the case of cable lengths of more than 3 m and limit the frequency to 50 kHz

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

⚠ WARNING**DESTRUCTION OF THE PRODUCT AND LOSS OF CONTROL**

The inputs at this connection are only rated for 5V. Excessive voltage can cause immediate or later destruction of the product.

- Verify correct wiring before switching on.

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

Function The device is suitable for reference values supplied by means of external direction signals (*PULSE/DIR*). These are required, for example, for the operating mode Electronic Gear.

The signal interface is used for positioning the motor. Operating readiness and a possible errors are signaled.

PULSE / DIR The motor performs an angle step with the rising edge of the *PULSE* signal. The direction is controlled by the *DIR* signal.

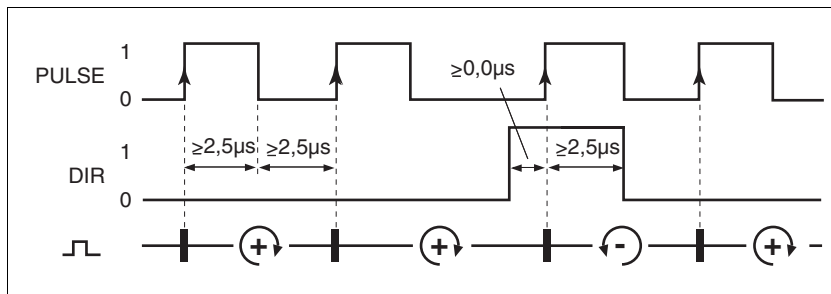


Figure 6.19 Pulse/direction signal

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

The maximum frequency of *PULSE* and *DIR* is 200 kHz.

If there is no error, the output *ACTIVE2_OUT* indicate operating readiness approx. 100 ms after the power stage is enabled.

ACTIVE2_OUT

ACTIVE2_OUT is an open collector output and switches to 0 V.

Signal input circuits

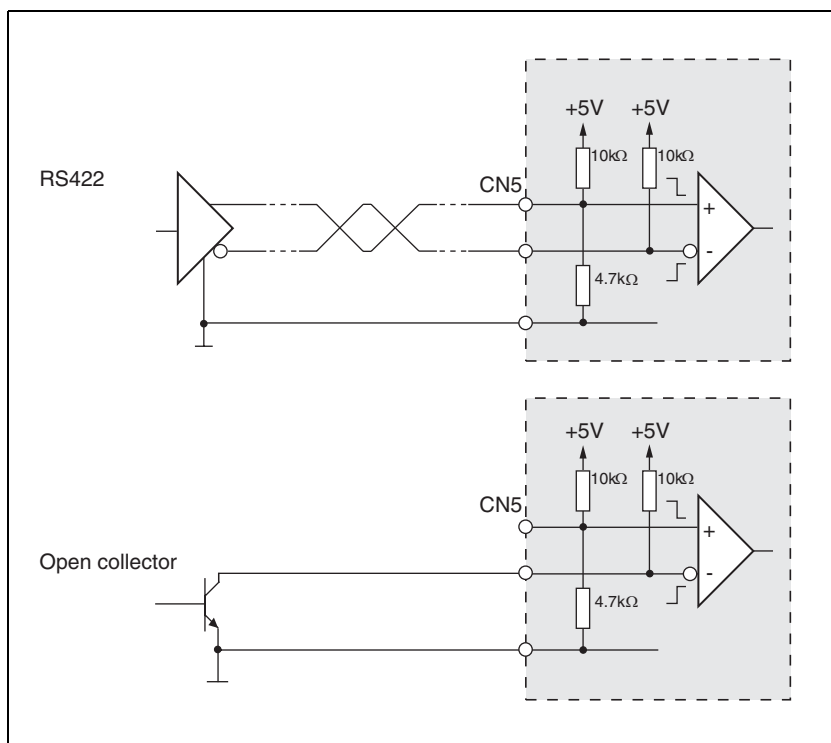


Figure 6.20 Signal input circuits

- Cable specifications*
- Twisted pair
 - Shielded cable
 - Shield grounded at both ends

Maximum cable length	[m]	100
Minimum conductor cross section	[mm ²]	0.14 (AWG 24)

- ▶ Use equipotential bonding conductors, see page 45.
- ▶ Use pre-assembled cables (page 228) to reduce the risk of wiring errors.

- Connecting PULSE*
- ▶ Connect the connector to CN5. If you do not use a pre-assembled cable, verify correct pin assignment.
 - ▶ Make the appropriate settings during commissioning. See "First Setup", page 96.

Wiring diagram

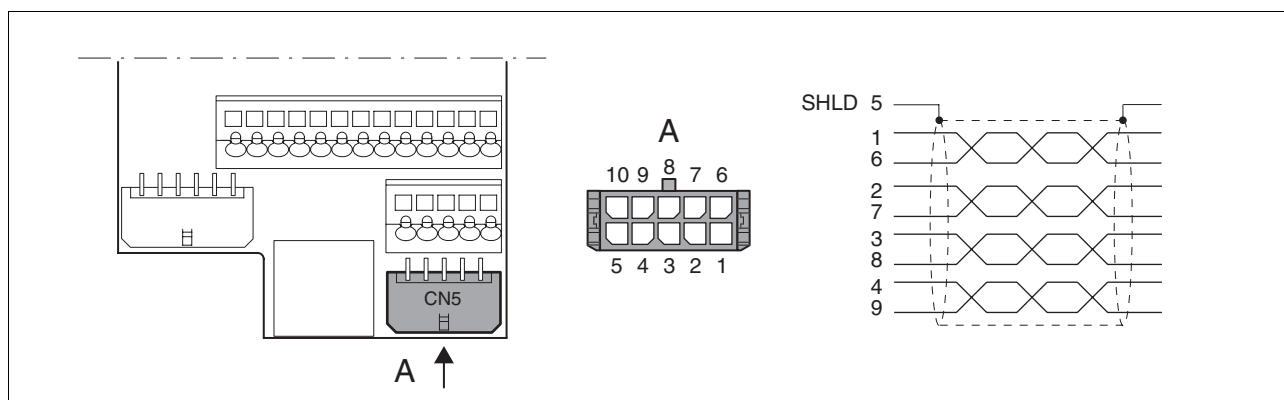


Figure 6.21 Wiring diagram PULSE

Pin	Signal	Color ¹⁾	Meaning	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	nc	Gray	Not assigned	-
8	nc	Pink	Not assigned	-
4	$\overline{\text{ACTIVE2_OUT}}$	Red	Drive ready	Open collector
9	POS_0V	Blue	Reference potential	-
5	SHLD		Shield	
10	nc		Not assigned	

1) Color information relates to the cables available as accessories.

6.3.11 Connection Profibus DP (CN1)

Function The PROFIBUS DP interface allows you to network the product as a slave in a Profibus network.

The drive system receives data and commands from a master bus device. Status information such as operating state and processing state is sent to the master as acknowledgement.

Every network device must be configured before it can be operated on the network. It receives a unique address between 1 and 126 (slave addresses: 3 to 126).

The address is set during commissioning. See "First Setup", page 96.

The baud rate must be the same for all devices in the fieldbus; the product detects the baud rate automatically.

For additional information see the fieldbus manual, see page 227 for the order number.

Cable specifications and terminal

- Twisted pair lines
- Shielded cable
- Grounding of the shield at both ends

Minimum conductor cross section	[mm ²]	0.34 (AWG 22)
---------------------------------	--------------------	---------------

Maximum connection cross section without wire ferrule	[mm ²]	1.5 (AWG 16)
---	--------------------	--------------

Maximum connection cross section with wire ferrule	[mm ²]	0.75 (AWG 20)
--	--------------------	---------------

Stripping length ¹⁾	[mm]	8.5 ... 9.5
--------------------------------	------	-------------

1) Mechanical conditions must be accounted for

- The maximum cable length depends on the baud rate and the signal propagation delay. The higher the baud rate, the shorter the bus cable needs to be.

Baud rate [Kbaud]	max. cable length [m]
9.6	1200
19.2	1200
45.45	1200
93.75	1200
187.5	1000
500	400
1500	200
3000	100
6000	100
12000	100

- ▶ Use equipotential bonding conductors, see page 45.
- ▶ Use pre-assembled cables to reduce the risk of wiring errors.
- ▶ Verify that wiring, cables and connected interfaces meet the PELV requirements.

Terminating resistor Both ends of the entire bus system must be terminated with a terminating resistor.

The terminating resistor is already integrated and can be activated at the ends of the network line with a switch.

The diagram below shows the integrated terminating resistor combination.

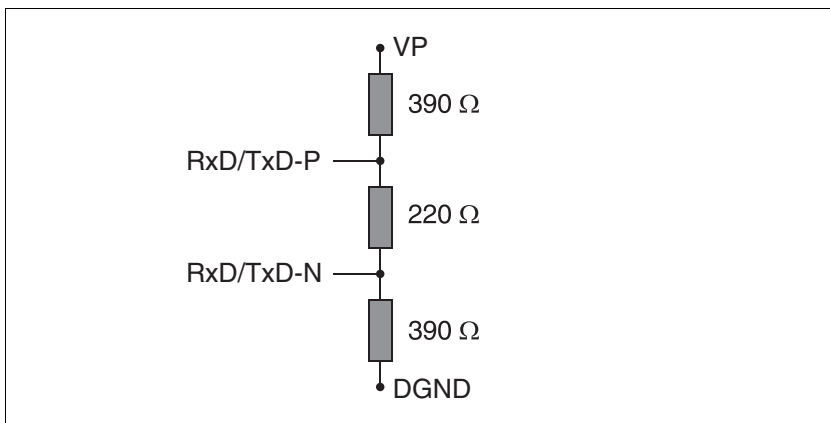


Figure 6.22 Terminating resistor Profibus

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

Wiring diagram

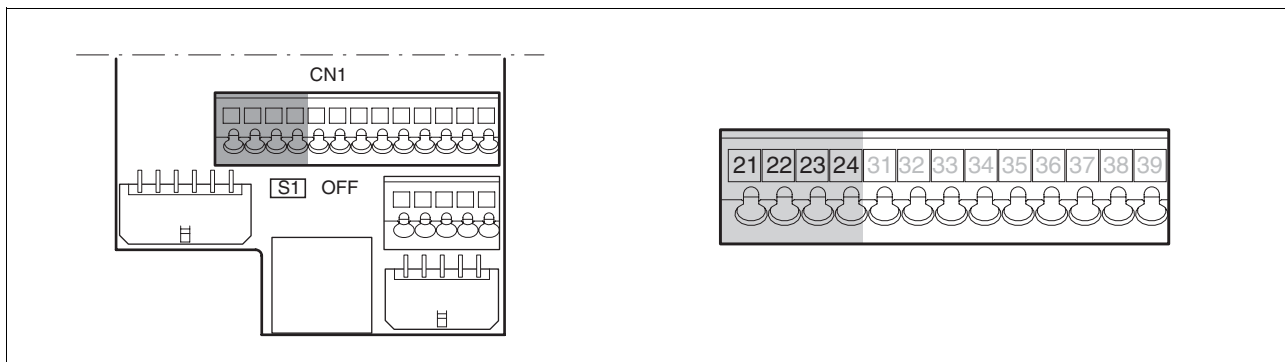


Figure 6.23 Wiring diagram Profibus to CN1

Pin	Signal	Meaning	Color	I/O
21	RxD/TxD-N-In	Profibus interface A1	Green	RS485 level, I
22	RxD/TxD-P-In	Profibus interface B1	Red	RS485 level, I
23	RxD/TxD-N-Out	Profibus interface A2	Green	RS485 level, O
24	RxD/TxD-P-Out	Profibus interface B2	Red	RS485 level, O

- Connecting Profibus**
- ▶ Connect the Profibus input signal to CN1.21 and CN1.22. If the terminating resistor is not activated, the signals from CN1.21 to CN1.23 and the signals from CN1.22 to CN1.24 are bridged. This allows another fieldbus device to be connected directly to CN1.23 and CN1.24. If the terminating resistor is activated, no signals are available at CN1.23 and CN1.24.

6.3.12 Connecting the digital inputs/outputs (CN1)

⚠ WARNING

LOSS OF CONTROL

The use of $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$ can provide some protection against hazards (e.g. collision with mechanical stop caused by incorrect reference values).

- Use $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$ where possible.
- Verify that the external sensors or switches are properly connected.
- Verify the correct installation of the limit switches. The limit switches must be mounted in a position far enough away from the mechanical stop to allow for an adequate stopping distance.
- Before you can use $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$, you must enable them.

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

Cable specifications and terminal

Maximum cable length at minimum conductor cross section	[m]	15
Minimum conductor cross section	[mm ²]	0.14 (AWG 24)
Maximum connection cross section	[mm ²]	1.5 (AWG 16)

Minimum connection assignment

⚠ WARNING

LOSS OF SAFETY FUNCTION

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

- Observe the requirements for using the safety function.

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

Information on the signals $\overline{\text{STO_A}}$ ($\overline{\text{PWRR_A}}$) and $\overline{\text{STO_B}}$ ($\overline{\text{PWRR_B}}$) of the safety function can be found in chapter 5.1 "Safety function STO ("Safe Torque Off")" and in chapter 3.4.4 "Safety function STO".

It is imperative to connect the following signals.

Pin	Signal	Remarks
33	$\overline{\text{REF}}$	Only for fieldbus control mode
34	$\overline{\text{LIMN}}$	Only for fieldbus control mode
35	$\overline{\text{LIMP}}$	Only for fieldbus control mode
36	$\overline{\text{HALT}}$	
37	$\overline{\text{STO_A}}$ ($\overline{\text{PWRR_A}}$)	Dual-channel connection, signals are not managed by means of parameters.
38	$\overline{\text{STO_B}}$ ($\overline{\text{PWRR_B}}$)	

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

Connecting the digital inputs/ outputs

- ▶ Wire the digital connections to CN1.
- ▶ Connect the limit switch that limits the working range for positive direction of rotation to $\overline{\text{LIMP}}$.
- ▶ Connect the limit switch that limits the working range for negative direction of rotation to $\overline{\text{LIMN}}$.
- ▶ Ground both ends of the shield to a large surface area (low resistance).

Wiring diagram local control mode

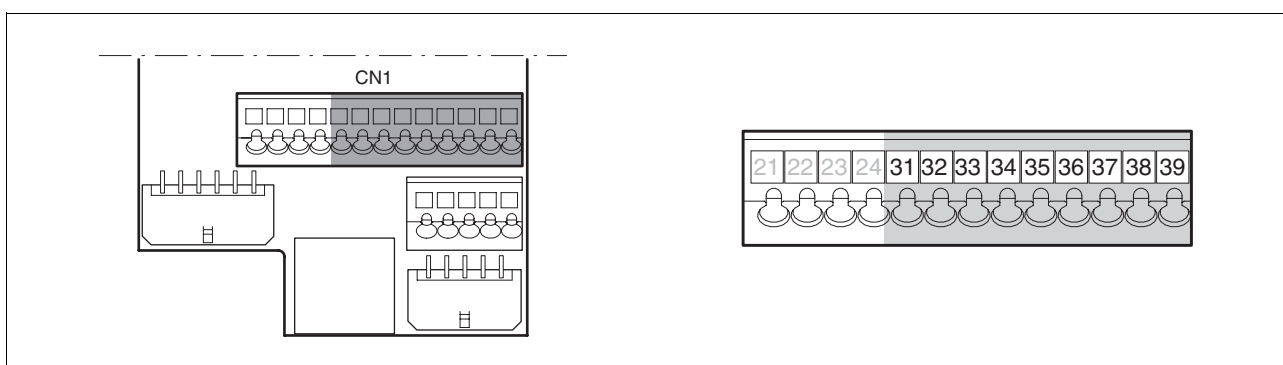


Figure 6.24 Wiring diagram, digital inputs/outputs

Pin	Signal	Meaning	I/O
31	NO_FAULT_OUT	Error output	24V, O
32	ACTIVE1_OUT	0: Motor without current 1: Motor has current.	24V, O
33	$\overline{\text{REF}}$	Reference switch signal (factory setting: disable)	24V, I
34	$\overline{\text{LIMN}}$	Limit switch signal negative	24V, I
34	CAP2	Fast position capture channel 2	24V, I
35	$\overline{\text{LIMP}}$	Limit switch signal positive	24V, I
35	CAP1	Fast position capture channel 1	24V, I
36	$\overline{\text{HALT}}$	Function "Halt"	24V, I
37	$\overline{\text{STO_B}}$ ($\overline{\text{PWRR_B}}$)	Safety function STO	24V, I
38	$\overline{\text{STO_A}}$ ($\overline{\text{PWRR_A}}$)	Safety function STO	24V, I
39	+24VDC	Only for jumpering pin 37 and 38 if STO safety func- tion is not used	-

6.3.13 Connecting a PC or a 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 remote terminal

The remote terminal with LC display and keypad can be directly connected to CN4 by means of the RJ45 cable shipped with the device, see chapter Accessories, page 227. This allows the device to be operated at a distance from the system. The functions and display of the remote terminal are identical to those of the HMI.

Cable specifications and terminal

- Shielded cable
- Twisted pair
- Shield grounded at both ends

Maximum cable length	[m]	400
Minimum conductor cross section	[mm ²]	0.14 (AWG 24)
Maximum connection cross section	[mm ²]	1.5 (AWG 16)

Connecting a PC

An RS485 to RS232 converter is required to connect a PC, see chapter Accessories, page 227. The voltage for the converter is supplied by the device.

Wiring diagram

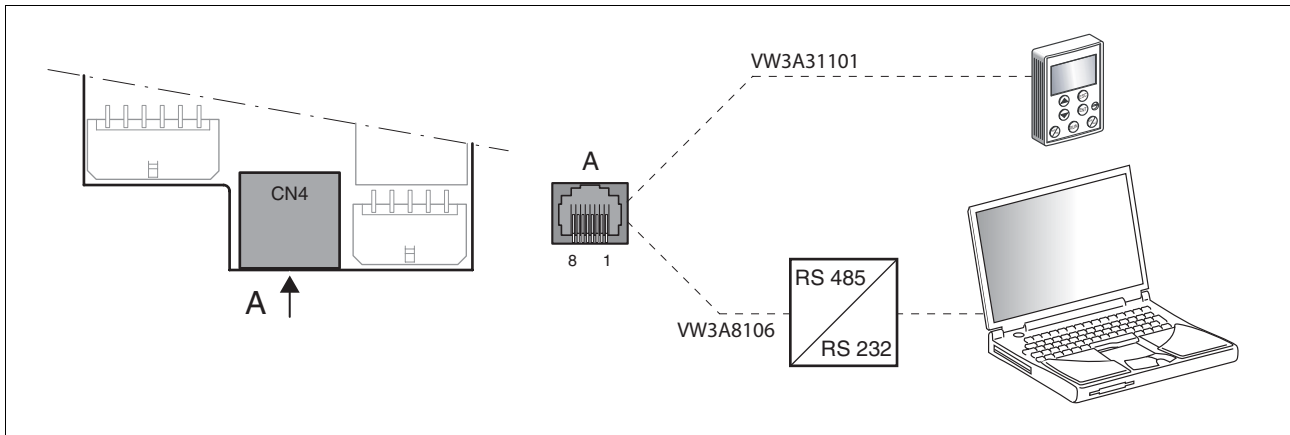


Figure 6.25 Wiring diagram PC or remote terminal

Pin	Signal	Meaning	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 to MOD+10V_OUT	O

6.3.14 Reference Value Adapter

Reference value adapter RVA Reference signals of a master device can be sent simultaneously to up to 5 devices using the RVA (Reference Value Adapter). This adapter also provides the voltage supply (5V, monitored via SENSE lines¹) for the encoder. Correct power supply is indicated by an LED "5VSE".

The master can be an external encoder (A/B signals) or an encoder simulation (ESIM). It is also possible to send pulse/direction signals from a master controller.

Connecting the reference value adapter RVA

- Verify that wiring, cables and connected interfaces meet the PELV requirements.

The RVA reference value adapter is supplied with 24 V at the connections CN9. A master controller (pulse/direction) can be connected to CN6. An external encoder signal or an ESIM signal can be applied to CN7.

Up to 5 devices that evaluate the supplied reference signals can be connected to CN1 to CN5.

Switch S1 is used to set the evaluation of the $\overline{\text{ACTIVE2_OUT}}$ signal. The ready signal $\overline{\text{ACTIVE2_OUT}}$ is evaluated by the device if the assigned switch is set to off. If readiness is signaled by all devices, the LED ACTIVE CN1...CN5 lights.

Connection CN1..5	Switch setting S1
Connected devices at CN1...CN5	Corresponding switches 1..5 to "OFF", signal $\overline{\text{ACTIVE2_OUT}}$ of the corresponding device is evaluated
Unconnected devices CN1..CN5	Corresponding switches 1..5 to "ON", signal $\overline{\text{ACTIVE2_OUT}}$ is simulated

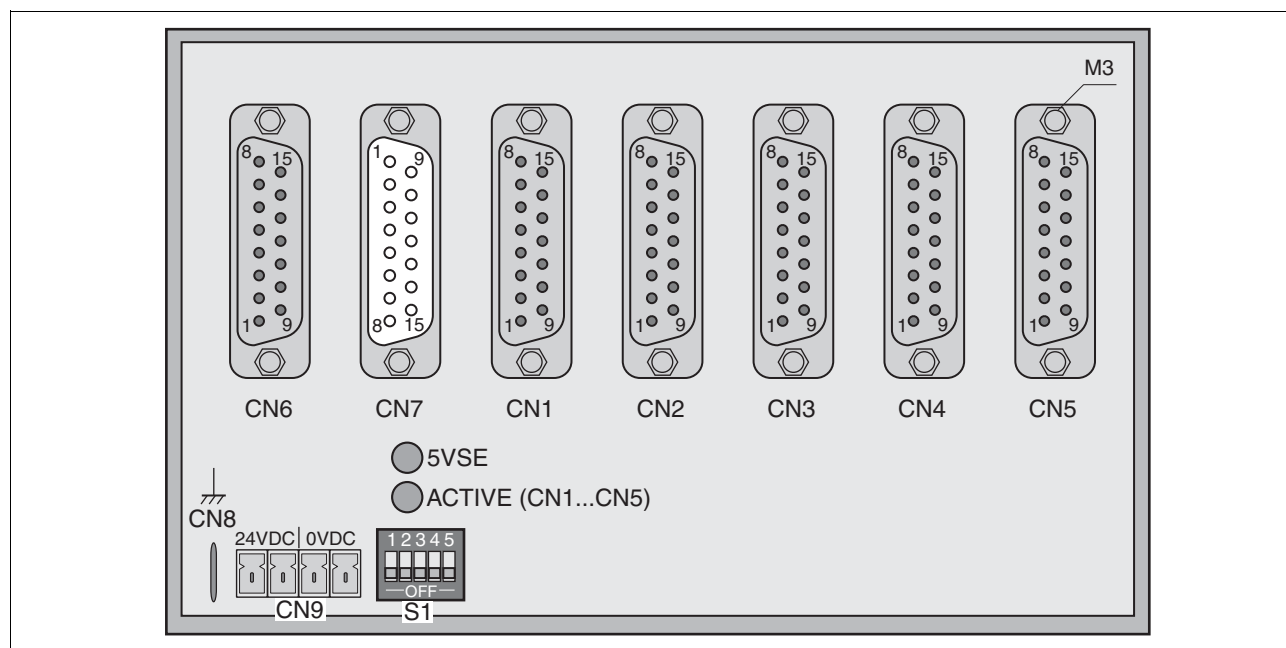


Figure 6.26 Reference Value Adapter

1. At the encoder, signal wire CN7/2 (5VDC_OUT) must be connected to CN7/10 (SENSE+) and signal wire CN7/3 (POS_0V) to CN7/11 (SENSE-).

The following table shows the connection assignment of CN1 - CN5:

Pin	Signal	Meaning	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	

The following table shows the connection assignment of CN6:

Pin	Signal	Meaning	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	

The following table shows the connection assignment of CN7:

Pin	Signal	Meaning	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 of motor encoder supply ¹⁾	I
11	SENSE-	Reference potential for motor encoder monitoring ²⁾	I
2	5VDC_OUT	5V motor encoder supply ¹⁾	O
3	POS_0V	Reference potential to 5VDC_OUT ²⁾	
4, 7, 8, 14, 15	nc	Not assigned	

1) At the end of the encoder cable (motor end), the signal wire CN7.2 (5VDC_OUT) must be connected to 7.10 (SENSE+).

2) At the end of the encoder cable (motor end), the signal wire CN7.2 (POS_0V) must be connected to 7.10 (SENSE-).

Pre-assembled cables are available for the Reference Value Adapter, see chapter 12 "Accessories and spare parts".

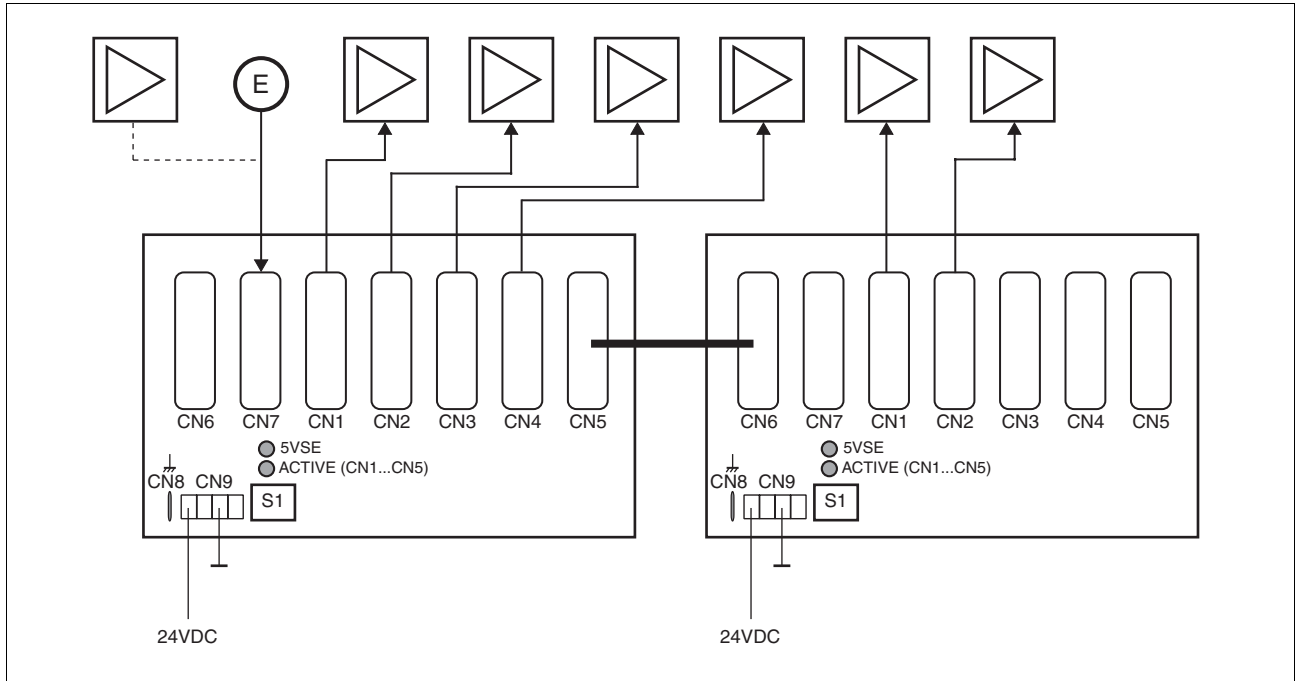


Figure 6.27 Wiring example: Encoder signals A/B/I (at CN7) are sent to 6 devices via two cascaded Reference Value Adapters

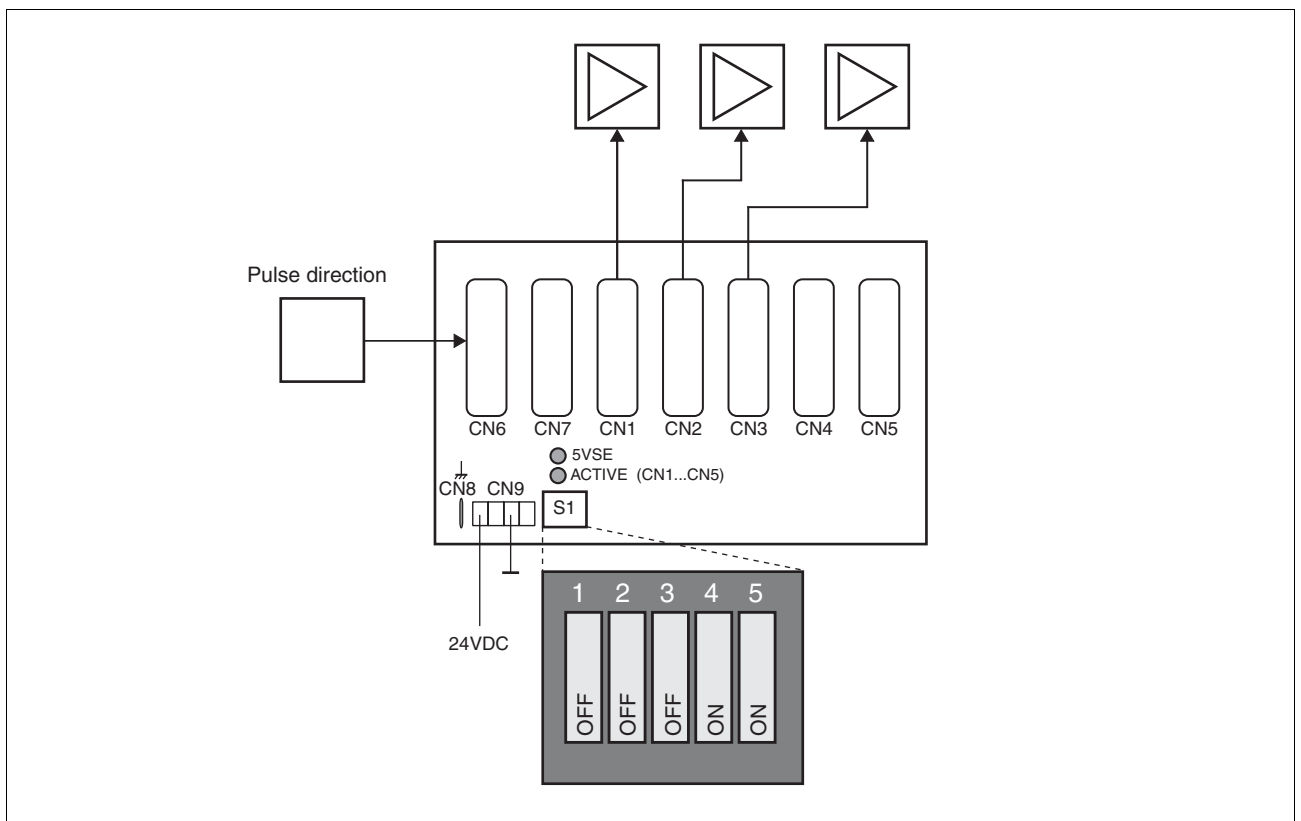


Figure 6.28 Wiring example: Pulse direction signals (at CN6) are sent to 3 devices.

6.4 Checking installation

Verify proper installation:

- ▶ Check the mechanical installation of the entire drive system:
 - Does the installation meet the specified distance requirements?
 - Did you tighten all fastening screws with the specified torque?
- ▶ Check the electrical connections and the cabling:
 - Did you connect all protective ground conductors?
 - Do all fuses have the correct rating; are the fuses of the specified type?
 - Did you connect both ends of all live cables or insulate them (no exposed cable ends)?
 - Did you properly connect and install all cables and connectors?
 - Are the mechanical locks of the connectors correct and effective?
 - Did you properly connect the signal wires?
 - Are the required shield connections EMC-compliant?
 - Did you take all measures for EMC compliance?
- ▶ Verify that all covers and seals of the control cabinet are properly installed to meet the required degree of protection.
- ▶ If necessary, remove the cover film (see chapter 6.2.1 "Mounting the device").

7 Commissioning

⚠ DANGER

ELECTRIC SHOCK CAUSED BY INCORRECT USE

The safety function STO ("Safe Torque Off") does not cause electric isolation. The DC bus 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.

⚠ DANGER

UNINTENDED CONSEQUENCES OF EQUIPMENT OPERATION

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

- Only start the system if there are no persons in the hazardous area.

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

⚠ WARNING

UNINTENDED BEHAVIOR

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

- Do NOT operate the drive system with unknown settings or data.
- Verify that the stored data and settings are correct.
- When commissioning, carefully run tests for all operating states and potential fault situations.
- Verify 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 obstructions in the hazardous area.

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

▲ WARNING**UNEXPECTED MOVEMENT**

When the drive is operated for the first time, there is a risk of unexpected movements caused by possible wiring errors or unsuitable parameters.

- Perform the first test run without coupled loads.
- Verify that a functioning button for EMERGENCY STOP is within reach.
- Anticipate movements in the incorrect direction or oscillation of the drive.
- Only start the system if there are no persons or obstructions in the hazardous area.

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

▲ CAUTION**HOT SURFACES**

The heat sink at the product may heat up to over 100°C (212°F) during operation.

- Avoid contact with the hot heat sink.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity.
- Consider the measures for heat dissipation described.

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

7.1 Overview



You must also re-commission an already configured product if you want to use it under changed operating conditions.



*An alphabetically sorted overview of **all** parameters can be found in the chapter "Parameters". The use and the function of some parameters are explained in more detail in this chapter.*

To be done

Chapter	Page
Check the installation	Page 84
Perform the "First Setup"	Page 96
Check and set critical device parameters	Page 101
Set, test digital signals	Page 103
Limit switch function, tests the signals $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$	Page 105
Check the signals of the STO safety function, even if the STO safety function is not used.	Page 106
Check the direction of rotation of the motor	Page 107

7.2 Commissioning tools

7.2.1 Overview

The following tools can be used for commissioning, parameterization and diagnostics:

- Integrated HMI
- Remote terminal
- Commissioning software
- Fieldbus

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

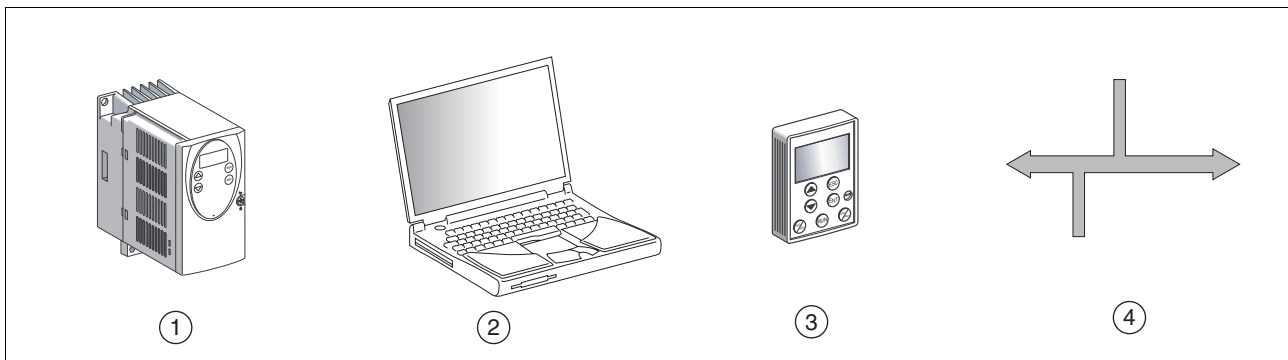


Figure 7.1 Commissioning tools

- (1) Integrated HMI
- (2) PC with commissioning software
- (3) Remote terminal
- (4) Fieldbus

7.2.2 HMI: Human-Machine Interface

Function The device allows you to edit parameters via the integrated Human-Machine Interface (HMI). Diagnostics information can also be displayed. The sections on commissioning and operation include information on whether a function can be carried out via the HMI or whether the commissioning software must be used.

The following sections provide a brief introduction to the HMI structure and the operation.

Control panel The following figure shows the HMI (left) and the remote terminal (right).

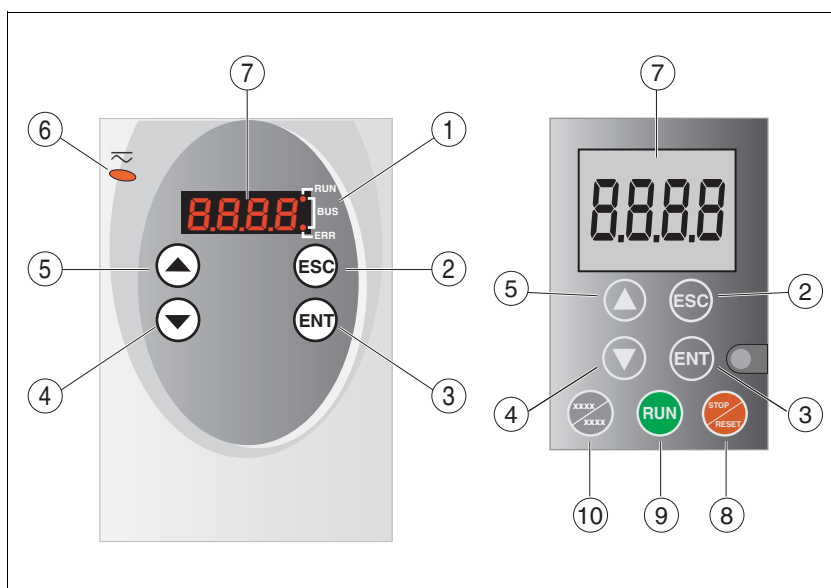


Figure 7.2 HMI and remote terminal

- (1) Status LEDs
- (2) ESC:
 - Close a menu or parameter
 - Return from displayed value to last stored value
- (3) ENT:
 - Display a menu or parameter
 - Save displayed value to the EEPROM
- (4) Down Arrow:
 - Go to next menu or parameter
 - Decrease the displayed value
- (5) Up arrow:
 - Return to previous menu or parameter
 - Increase the displayed value
- (6) Red LED on: Voltage present at DC bus
- (7) Status indication
- (8) Quick Stop (Software Stop)
- (9) No function
- (10) No function

LEDs for Profibus The fieldbus status can be checked using the two LEDs at the HMI:

LED "RUN"	LED "ERR"	Meaning
off	off	Fieldbus communication inactive
lights	off	Fieldbus communication active
off	lights	Fieldbus error (e.g. watchdog)
off	flashes	Missing or incorrect parameterization

Font on HMI display The following table shows the assignment of the letters and numbers to the symbols displayed by the HMI as used in the sections on parameters. Uppercase and lowercase are only distinguished for the letter "C".

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R																					
À	á	â	ã	ä	å	ç	è	é	ê	ë	ì	í	î	ï	ñ	ò	ó	ô	õ	ö	÷																	
S	T	U	V	W	X	Y	Z	1	2	3	4	5	6	7	8	9	0																					
š	ţ	ù	ú	û	ü	ý	ÿ	¿	¡	¢	£	¤	¥	¦	§	¨	©	ª	«	¬	®	¯	°	±	²	³	´	µ	¶	·	¸	¹	º	»	¼	½	¾	¿

Displaying parameters via the HMI Each parameter that can be displayed is accessed via a menu item. The following figure shows an example of displaying a parameter and entering a parameter value.

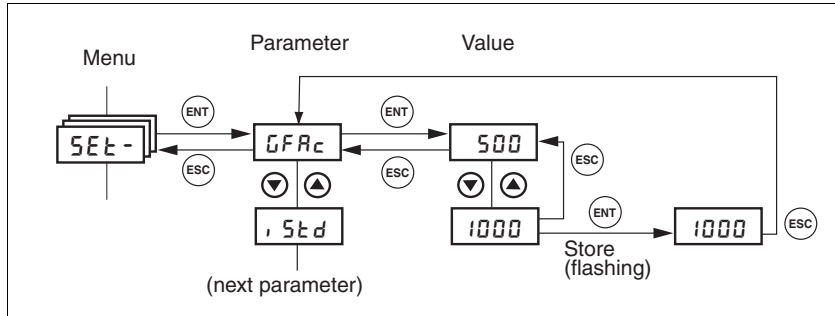


Figure 7.3 HMI, example of setting a parameter

The two arrow keys are used to set numerical values within the permitted range of values; alphanumeric values are selected from lists.

Press ENT to confirm the selected value. The display flashes once for confirmation. The modified value is immediately written to the EEPROM.

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

Menu structure The HMI is menu-driven. The following illustration shows the top level of the menu structure.

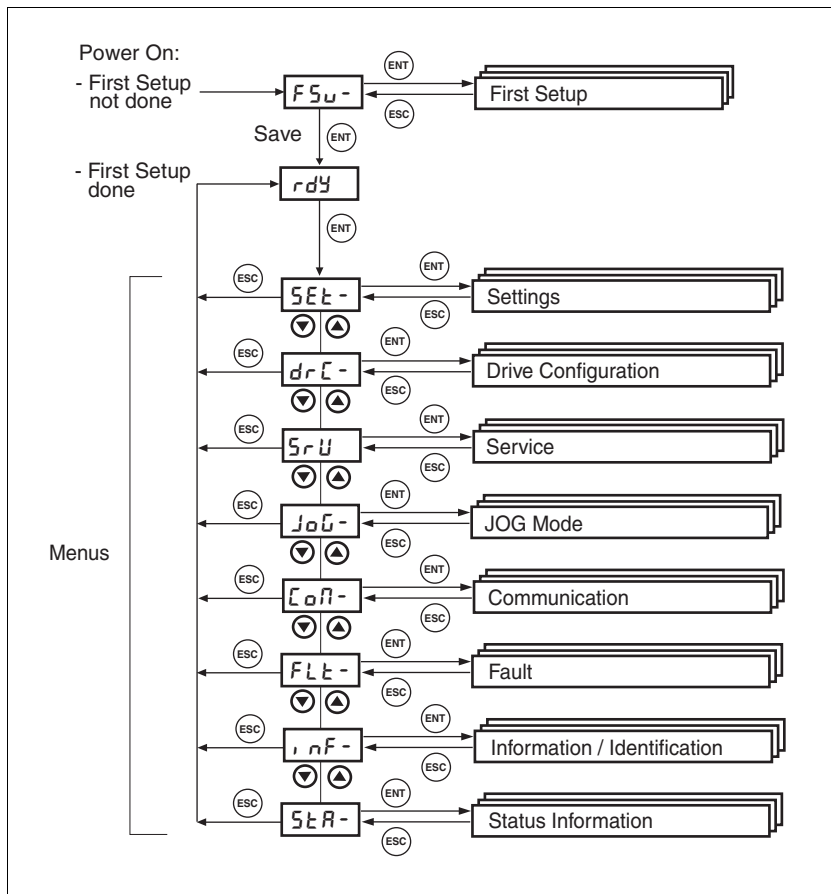


Figure 7.4 HMI menu structure

HMI menu		Description
FSU-	<i>FSU-</i>	F irst S et U p for initial settings
	<i>nLYP</i>	Motor selection
	<i>EnCn</i>	Processing of motor encoder position
	<i>oPi</i>	Signal selection position interface
	<i>PbAd</i>	Profibus address
	<i>SAUE</i>	Saving the settings
SET-	<i>SEt-</i>	S ETtings (device settings)
	<i>GFRC</i>	Selection of special gear ratios
	<i>iStd</i>	Percentage of phase current at standstill
	<i>i r nP</i>	Percentage of phase current during acceleration / deceleration component
	<i>i c nS</i>	Percentage of phase current during constant movement
DRC-	<i>drC-</i>	D Rive C onfiguration
	<i>nLYP</i>	Motor selection
	<i>EnCn</i>	Processing of motor encoder position
	<i>oPi</i>	Signal selection position interface
	<i>Pr ot</i>	Definition of direction of rotation

HMI menu		Description
	<i>FCS</i>	Restore factory settings (default values)
	<i>bEL</i>	Time delay for applying the holding brake
	<i>bErE</i>	Time delay for releasing the holding brake
	<i>SuPU</i>	Value displayed by HMI when motor moves
SRV-	<i>SrU-</i>	Service
	<i>brRH</i>	Releasing/applying the holding brake (requirement: power stage supply is off)
JOG-	<i>JoU-</i>	JOG
	<i>StRt</i>	Start jog
	<i>nSLu</i>	Speed for slow jog
	<i>nFSt</i>	Speed for fast jog
COM-	<i>CoM-</i>	COMM unication
	<i>PbAd</i>	Profibus address
	<i>MbAd</i>	Modbus address (commissioning software)
	<i>MbFo</i>	Modbus data format (commissioning software)
	<i>MbBd</i>	Modbus baud rate (commissioning software)
	<i>MbWo</i>	Modbus word sequence for double words (32 bit values) (commissioning software)
FLT-	<i>FLt-</i>	FauLT (Information on operating state Fault)
	<i>StPF</i>	Error number of last stop fault
INF-	<i>i nF-</i>	IN formation / Identification
	<i>dEUt</i>	Currently selected control mode
	<i>_nRN</i>	Product Name
	<i>_Pnr</i>	Program number firmware
	<i>_PUr</i>	Version number firmware
	<i>Polu</i>	Number of power on cycles
	<i>Pi no</i>	Nominal current of power stage
	<i>Mi no</i>	Nominal motor current
STA-	<i>StR-</i>	Monitoring of device, motor and motion data (STA tus Information)
	<i>i oRE</i>	Status of digital inputs and outputs
	<i>nREt</i>	Actual speed of motor
	<i>PREu</i>	Actual motor position in user-defined units
	<i>Pd, F</i>	Current deviation between reference and actual positions
	<i>i REt</i>	Total motor current
	<i>udER</i>	DC bus voltage of the power stage supply voltage
	<i>t dEU</i>	Device temperature
	<i>tPR</i>	Power stage temperature
	<i>W r nS</i>	Saved warnings, bit-coded
	<i>S, tS</i>	Saved status of monitoring signals
	<i>oPh</i>	Operating hours counter

Status indication By default, the current operating state is displayed, see page 111. You can set the following via the menu item *dr c - / 5uPU*:

- *StRt* displays the current operating state
- *nRt* displays the current speed of rotation of the motor
- *iRt* displays the current motor current

A change only becomes active when the power stage is disabled.

7.2.3 Lexium CT commissioning software

CAUTION**DAMAGE TO PC**

If this commissioning interface at the product is directly connected to a Gigabit Ethernet interface at the PC, the PC interface may be destroyed.

- Never directly connect an Ethernet interface to the commissioning interface of this product.

Failure to follow these instructions can result in equipment damage.

The commissioning software has a graphic user interface and is used for commissioning, diagnostics and testing settings.

Source of commissioning software

The latest version of the commissioning software is available for download from the internet.

<http://www.schneider-electric.com>

Functions of the commissioning software

The functions of the commissioning software include:

- Scan various fieldbuses for devices
- Extensive information on connected devices
- Display and enter device parameters
- Archive and duplicate device parameters
- Manual positioning of the motor
- Test input signals and output signals
- Record, evaluate and archive motion and signals
- Error diagnostics
- Optimize control performance (servo motors only)

System requirements

The minimum hardware requirements for installation and operation of the software are:

- IBM-compatible PC
- Approx. 200 MB of hard disk space
- 512 MB RAM
- Graphics card and monitor with a resolution of at least 1024x768 pixels
- Free serial interface (RS232) or free USB interface
- Operating system Windows 2000, Windows XP Professional or Windows Vista
- Acrobat Reader 5.0 or later
- Internet connection (for initial installation and updates)

Online help

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

7.3 Commissioning procedure

▲ WARNING

LOSS OF CONTROL DUE TO UNSUITABLE PARAMETER VALUES

Unsuitable parameter values may disable monitoring functions and trigger unexpected movements or responses of signals.

- Prepare a list with the parameters required for the functions used.
- Check the parameters before operation.
- Only start the system if there are no persons or obstructions in the hazardous area.

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

7.3.1 "First Setup"

A "First Setup" is required when the controller supply voltage is switched on for the first time or after the factory settings have been restored.

- Preparation*
- A PC with the commissioning software must be connected to the device unless commissioning is performed exclusively via the HMI.
 - ▶ Switch on the controller supply voltage.

"First Setup" via HMI The following diagram shows the sequence via the HMI.

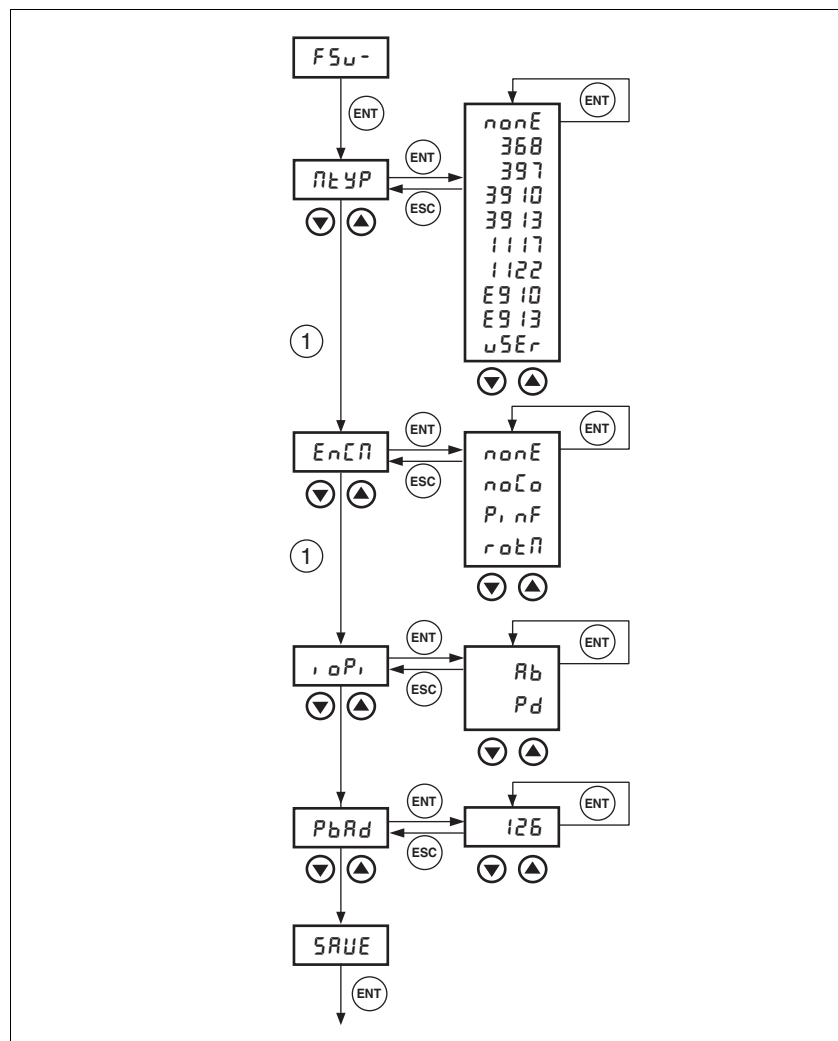


Figure 7.5 "First Setup" via HMI

- (1) The next menu item can only be selected if the previous menu item has a valid value ($\neq nonE$).

- Motor type** ▶ Use the parameter *SM_Type* (*MTYP*) to specify the motor connected to the device.

When you select a defined motor type, the motor-specific data is automatically set.

In the case of a user-specific motor, the corresponding motor-specific data must be set via the commissioning software or the fieldbus. The following parameters must be checked and adjusted:

SM_I_nom, *SM_Pole_Pairs*, *SM_Ind_U_V*, *SM_Res_U_V*, *SM_n_90%*, *SM_n_50%* and *SM_n_20%*.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
<i>SM_Type</i>	Motor type	-	UINT32	Modbus 3588
DRC- - MTYP	0 / none / none : No motor selected (default)	-	UINT32	Profibus 3588
<i>drc</i> - <i>MTYP</i>	368 / VRDM368/50LW / 368 : VRDM368/ 50LW 397 / VRDM397/50LW / 397 : VRDM397/ 50LW 3910 / VRDM3910/50LW / 3910 : VRDM3910/50LW 3913 / VRDM3913/50LW / 3913 : VRDM3913/50LW 5368 / BRS 368W / 5368 : BRS 368W 5397 / BRS 397W / 5397 : BRS 397W 31117 / VRDM31117/50LW / 31117 : VRDM3117/50LW 31122 / VRDM31122/50LW / 31122 : VRDM31122/50LW 43910 / ATEX ExRDM3910/50 / 43910 : ATEX ExRDM3910/50 43913 / ATEX ExRDM3913/50 / 43913 : ATEX ExRDM3913/50 51117 / BRS 3ACW / 51117 : BRS 3ACW 51122 / BRS 3ADW / 51122 : BRS 3ADW 53910 / BRS 39AW / 53910 : BRS 39AW 53913 / BRS 39BW / 53913 : BRS 39BW 54910 / ATEX BRS 39AA / 54910 : ATEX BRS 39AA 54913 / ATEX BRS 39BA / 54913 : ATEX BRS 39BA 99999999 / user defined motor / 99999999 : User-defined	-	per. -	
After selection of a motor type from the list, the motor-specific parameters are automatically set. When you select 'user-defined', you must set the motor-specific parameters via the commissioning software or the fieldbus.				

- Motor encoder* ► Use the parameter `CTRLS_MotEnc` (`Encn`) to specify whether or not a motor encoder is connected to the device and to indicate its function.

Select `noEnc` if no motor encoder is not connected. If `PosnF` or `RotnF` is selected, an encoder must be connected for operation. In addition, temperature monitoring for the encoder is activated. `PosnF` delivers only position information, rotation monitoring is not active. Select `RotnF` to activate rotation monitoring.

If "no motor encoder connected" is selected, the corresponding reference values `_p_refusr` or `_n_pref` are output as the motor position (`_p_actusr`) or the motor speed (`_n_act`).

If rotation monitoring is activated and the encoder cable is connected correctly, the "ENCODER" LED lights up when the device is switched on.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRLS_MotEnc	Processing of motor encoder position	-	UINT16	Modbus 5138
DRC- - ENCM	0 / undefined / noEnc : Undefined (default)	0	UINT16	Profibus 5138
drc- - Encn	1 / NoEncCon / noEnc : No motor encoder connected 2 / ShowEncPos / PosnF : Motor encoder connected, rotation monitoring inactive, only position info 3 / RotMonOn / RotnF : Motor encoder connected, rotation monitoring active	3	R/W per.	-
	If you select "Motor encoder connected", temperature monitoring of the encoder is also activated. If you select "No motor encoder connected", the reference values <code>_p_refusr</code> and <code>_n_pref</code> are output as motor position (<code>_p_actusr</code>) and motor speed (<code>_n_act</code>).			

- Function of the RS422 interface* ► Set the assignment for the RS422 interface with the `IOposInterfac` (`ioPi`) parameter.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOposInterfac	Signal selection position interface	-	UINT16	Modbus 1284
DRC- - ioPi	0 / AInput / Ab : Input ENC_A, ENC_B, ENC_I (index pulse) quadruple evaluation	0	UINT16	Profibus 1284
drc- - ioPi	1 / PDIinput / Pd : Input PULSE, DIR, ENABLE2	1	R/W per.	-
	RS422 I/O interface (Pos)			
	NOTE: Changed settings do not become active until the unit is switched on the next time.			

Fieldbus Profibus ► Set the fieldbus address with the parameter P_{Badr} ($PbAd$).

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
P_{Badr}	Profibus address	-		
COM- - $PbAD$	Valid addresses: 1 to 126	1 126	R/W per.	
$\mathcal{L}a\mathcal{P}$ - - $PbAd$	NOTE: Changed settings do not become active until the unit is switched on the next time	126	-	

Saving data

CAUTION

DAMAGE TO THE PRODUCT CAUSED BY POWER OUTAGE

If the supply voltage becomes unavailable during an update, the product will be damaged and must be sent in for repair.

- Do not switch off the supply voltage during the update.
- Update the firmware only with a reliable supply voltage.

Failure to follow these instructions can result in equipment damage.

- Save all entries when you are done.
HMI: Save your settings with $SRUE$
Commissioning software: Save your settings via "Configuration - Save in EEPROM"

- ◁ The device saves all set values to the EEPROM and displays the status $nr d\mathcal{Y}$, $r d\mathcal{Y}$ or $d\mathcal{Y}$ on the HMI.

A restart of the device is required for the changes to become effective.

Further steps

- Attach a label to the device that contains information for servicing the device such as fieldbus type, fieldbus address and fieldbus baud rate.
- Make the settings described below for commissioning.

Note that you can only return to the "First Setup" by restoring the factory settings, see chapter 8.6.11.2 "Restoring the factory settings", page 174.

7.3.2 Operating state (state diagram)

After switching on and when an operating mode is started, the product goes through a number of operating states.

The state diagram (state machine) shows the relationships between the operating states and the state transitions.

The operating states are monitored and influenced by internal monitoring functions and system functions such as temperature monitoring or current monitoring.

Graphical representation The state diagram is represented as a flow chart.

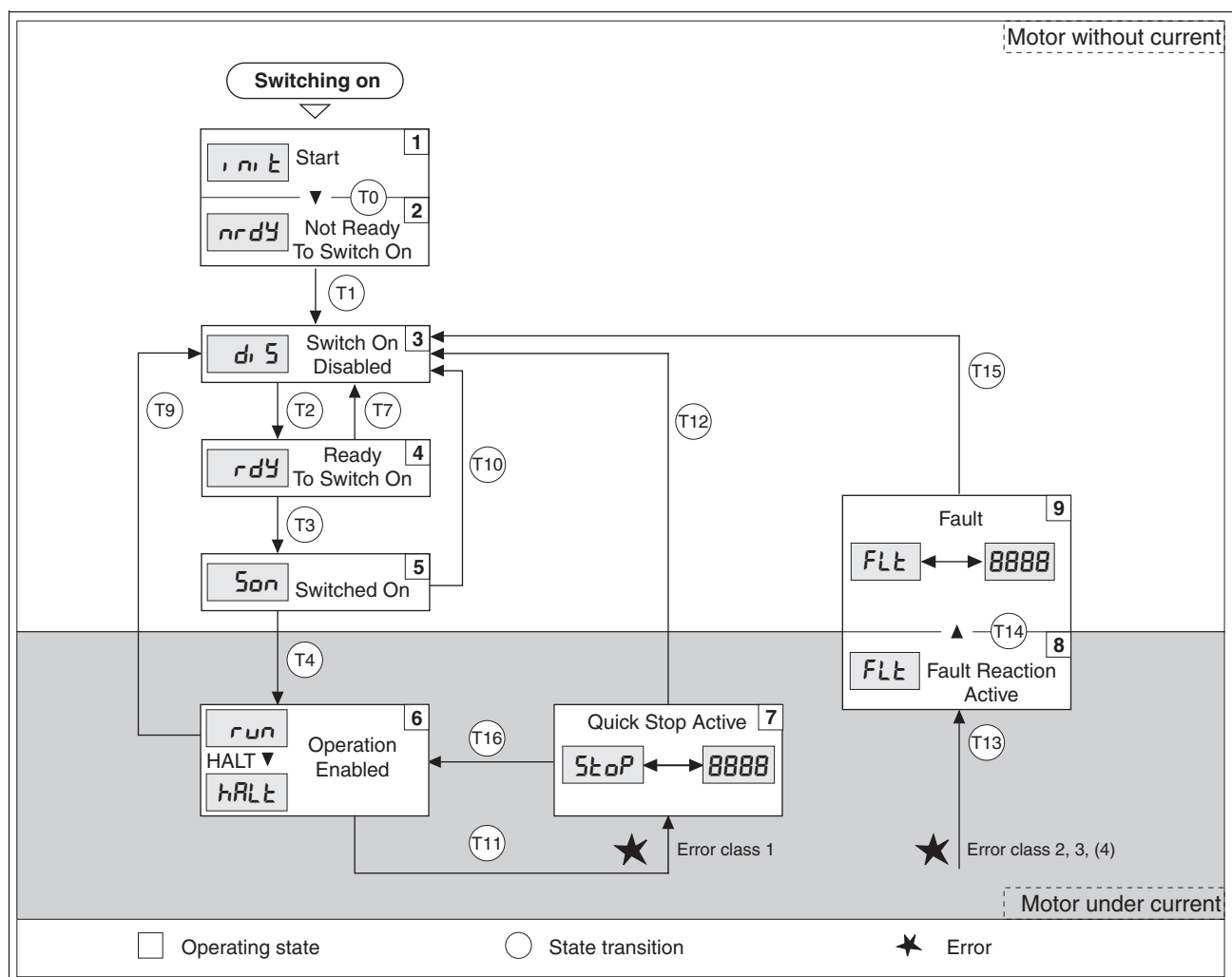


Figure 7.6 State diagram

Operating states and state transitions

See chapter 8.3 "Operating states" for detailed information on operating states and state transitions.

Releasing and applying the holding brake via the HMI

The holding brake can be manually released and applied via the HMI. This requires the power stage to be disabled. Note that the load may drop in the case of vertical axes (Z axes) when the holding brake is released!

Select the HMI menu *SrU-* and the submenu *brRH* for releasing and applying the holding brake.

7.3.3 Setting basic parameters and limit values

⚠ WARNING

LOSS OF CONTROL DUE TO UNSUITABLE PARAMETER VALUES

Unsuitable parameter values may disable monitoring functions and trigger unexpected movements or responses of signals.

- Prepare a list with the parameters required for the functions used.
- Check the parameters before operation.
- Only start the system if there are no persons or obstructions in the hazardous area.

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

Setting limit values

Suitable limit values must be determined and calculated on the basis of the system and motor data. As long as the motor is operated without external loads, the default settings do not need to be changed.

For example, the maximum motor current as the factor determining the torque must be reduced if the permissible torque of a system component will be exceeded without such a reduction.

Ramp for "Quick Stop" and "Halt"

Acceleration and deceleration are limited by ramp functions in the operating modes Profile Position, Profile Velocity, Oscillator and Homing.

- ▶ Use the parameter `RAMPquickstop` to set the maximum deceleration for "Quick Stop". The ramp shape for "Quick Stop" is linear.
- ▶ "Halt" uses the deceleration ramp set with the parameter `RAMPdecel`.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMPquickstop	Deceleration ramp for Quick Stop	min ⁻¹ /s 200	UINT32	Modbus 1572
-	Deceleration of the drive when a software stop is triggered or if an error of error class 1 has occurred.	6000 3000000	UINT32 R/W per. -	Profibus 1572
RAMPdecel	Deceleration of profile generator	min ⁻¹ /s 200	UINT32	Modbus 1558
-		750	UINT32 R/W	Profibus 1558
-		3000000	per. -	

Limitation of reference speed of rotation

For operating modes that are executed with the profile generator (ramps), the reference speed can be limited with the parameter `RAMPn_max`.

- ▶ Use the parameter `RAMPn_max` to set the maximum reference speed of rotation.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMPn_max	Limitation of ref. speed for op. modes with profile generation	min ⁻¹ 60 3000 3000	UINT16 UINT16 R/W per. -	Modbus 1554 Profibus 1554
-	The parameter is active in the following operating modes: - Profile position - Profile velocity - Homing - Jog			
	If a greater reference speed is set in one of these operating modes, it is automatically limited to RAMPn_max. This way, commissioning at limited speed is easy to perform.			

7.3.4 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 on the HMI, but they cannot be modified.

- ▶ Open the menu item *5LR- / 1, 0RL*.
- ◁ The digital inputs are displayed in a bit-coded way.
- ▶ Press "Up Arrow".
- ◁ The digital outputs are displayed in a bit-coded way.

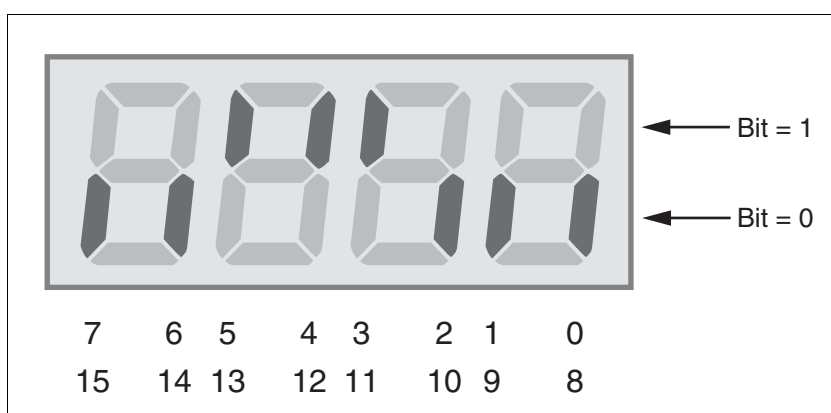


Figure 7.7 HMI, status of the digital inputs/outputs

Bit	Signal	I/O
0	$\overline{\text{REF}}$	I
1	$\overline{\text{LIMN}}$	I
2	$\overline{\text{LIMP}}$	I
3	$\overline{\text{HALT}}$	I
4	$\overline{\text{STO_B}}$ (PWRR_B)	I
5	$\overline{\text{STO_A}}$ (PWRR_A)	I
6	-	I
7	-	I
8	NO_FAULT	O
9	ACTIVE1_OUT	O
10	-	O
11	-	O
12	-	O
13	-	O
14	-	O
15	-	O

Fieldbus The current switching states are contained in the parameter `_IO_act` in a bit-coded way. The values "1" and "0" correspond to the current state of the input or output.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
<code>_IO_act</code>	Physical status of the digital inputs and outputs	-	UINT16	Modbus 2050
<code>STA- - ioAC</code>		-	UINT16	Profibus 2050
<code>5tR- - , oR</code>	Assignment of the 24 V inputs: Bit 0: REF Bit 1: LIMN,CAP2 Bit 2: LIMP,CAP1 Bit 3: HALT Bit 4: STO_B (PWRR_B) Bit 5: STO_A (PWRR_A) Bit 6: - Bit 7: reserved	0 -	R/- -	

7.3.5 Testing the signals of limit switches signals of fieldbus devices

▲ WARNING

LOSS OF CONTROL

The use of $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$ can provide some protection against hazards (e.g. collision with mechanical stop caused by incorrect reference values).

- Use $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$ where possible.
- Verify that the external sensors or switches are properly connected.
- Verify the correct installation of the limit switches. The limit switches must be mounted in a position far enough away from the mechanical stop to allow for an adequate stopping distance.
- Before you can use $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$, you must enable them.

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

- ▶ Set up the limit switches in such a way as to keep the motor from overtraveling the limit switches.
- ▶ Trigger the limit switches manually.
- ◁ The HMI displays an error message, see chapter Diagnostics, page 182.

The appropriate parameters can be used to release the input signals $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$ and $\overline{\text{REF}}$ and to set the evaluation to active 0 or active 1, see page 152.



Use active 0 monitoring signals if possible, because they are failsafe.

7.3.6 Testing the safety function STO

Operation with STO If you want to use the STO safety function, carry out the following steps:

- Power stage supply voltage is switched off.
Controller supply voltage is switched off.
- ▶ Verify that the inputs $\overline{\text{STO_A}}$ ($\overline{\text{PWRR_A}}$) and $\overline{\text{STO_B}}$ ($\overline{\text{PWRR_B}}$) are isolated from each other. The two signals must not have a connection.
- Power stage supply voltage is switched on.
Controller supply voltage is switched on.
- ▶ Start the Jog operating mode (without motor movement).
(see page 123)
- ▶ Trigger the safety function. $\overline{\text{STO_A}}$ ($\overline{\text{PWRR_A}}$) and $\overline{\text{STO_B}}$ ($\overline{\text{PWRR_B}}$) must be switched off simultaneously.
- ◁ The power stage is disabled and error message 1300 is generated.
(NOTE: Error message 1301 indicates a wiring error.)
- ▶ Check the behavior of the drive during fault conditions.
- ▶ Document all tests of the safety function in your acceptance certificate.

Operation without STO If you do not want to use the STO safety function:

- ▶ Verify that the inputs $\overline{\text{STO_A}}$ ($\overline{\text{PWRR_A}}$) and $\overline{\text{STO_B}}$ ($\overline{\text{PWRR_B}}$) are connected to +24VDC.

7.3.7 Checking the direction of movement

Direction of rotation Rotation of the motor shaft in a positive or negative direction of rotation. Positive direction of rotation is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft.

- ▶ Start the operating mode Jog.
(HMI: `JOG_ / SET`)
- ◁ The HMI displays `JG`.
- ▶ Start a movement with positive direction of rotation.
(HMI: "Up Arrow")
- ◁ The motor rotates with positive direction of rotation.
The HMI displays `JG-`.
- ▶ Start a movement with negative direction of rotation.
(HMI: "Down Arrow")
- ◁ The motor rotates with negative direction of rotation.
The HMI displays `-JG`.

Reversing the motor phases results in unexpected movements.

- ▶ If the arrow and direction of rotation do not match, correct this with the `POSdirOfRotat` parameter, see chapter 8.6.10 "Reversal of direction of rotation", page 173.

7.3.8 Checking the fan

Verify proper operation of the fan in the case of SD32••U68 devices. The airflow must be directed from bottom to top.

7.3.9 Optimizing the motion behavior

The factory setting for acceleration and deceleration is a linear ramp. Alternatively, a motor-optimized ramp for the acceleration and deceleration phases is available. This ramp compensates for the typical torque drop of a stepper motor at increasing speeds by reducing the acceleration, see chapter 8.6.4 "Motion profile", page 162.

If motors are selected during the "First Setup" or with parameter `SM_Type`, motor-specific values are automatically set as fixed values. If the motor type "USER" is selected, the motor-specific values must be entered in parameters, see page 96.

8 Operation

The chapter "Operation" describes the basic operating states, operating modes and functions of the device.



*An alphabetically sorted overview of **all** parameters can be found in the chapter "Parameters". The use and the function of some parameters are explained in more detail in this chapter.*

8.1 Overview of operating modes

The table below shows the relationships between reference value interface, control loop and the use of the profile generator of the individual operating modes.

Operating mode	Reference value interface	Control loop	Profile generator	Description
Jog	Fieldbus commands or HMI	Position controller	X	Page 123
Electronic Gear	P/D or A/B	Position controller	-	Page 126
Profile Position	Fieldbus commands	Position controller	X	Page 132
Profile Velocity	Fieldbus commands	Position controller	X	Page 135
Homing	Fieldbus commands	Position controller	X	Page 137

8.2 Access control

8.2.1 Via HMI

The HMI receives access control when the operating mode Jog is started. Control via the commissioning software or the fieldbus is not possible when the HMI has access control.

The HMI can be locked using the parameter `HMIlocked`. This means that control via the HMI is no longer possible.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMIlocked	Lock HMI	-	UINT16	Modbus 14850
-	0 / not locked: HMI not locked	0	UINT16	Profibus 14850
-	1 / locked: HMI locked	1	R/W per.	
	The following functions can no longer be started when the HMI is locked:		-	
	- Parameter change			
	- Jog			
	- Fault reset			

8.2.2 Via fieldbus

Fieldbus control mode In local control mode, you can use the `AccessLock` parameter to restrict access control to the fieldbus.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
AccessLock	Locking other access channels	-	UINT16	Modbus 316
-	0: Release other access channels	0	UINT16	Profibus 316
-	1: Lock other access channels	-	R/W	-
	The fieldbus can lock active access to the device via the following access channels with this parameter:	1	-	-
	- Commissioning software			
	- HMI			
	- A second fieldbus			
	Processing of the input signals (such as HALT) cannot be locked.			

8.2.3 Via commissioning software

The commissioning software receives access control via the "Access" button. Access via HMI or fieldbus is then impossible.

8.2.4 Via hardware input signals

The digital input signals `HALT`, `STO_A` (`PWRR_A`) and `STO_B` (`PWRR_B`) are effective, even if the HMI or the commissioning software have access control.

8.3 Operating states

8.3.1 State diagram

After switching on and when an operating mode is started, the product goes through a number of operating states.

The state diagram (state machine) shows the relationships between the operating states and the state transitions.

The operating states are monitored and influenced by internal monitoring functions and system functions such as temperature monitoring or current monitoring.

Graphical representation The state diagram is represented as a flow chart.

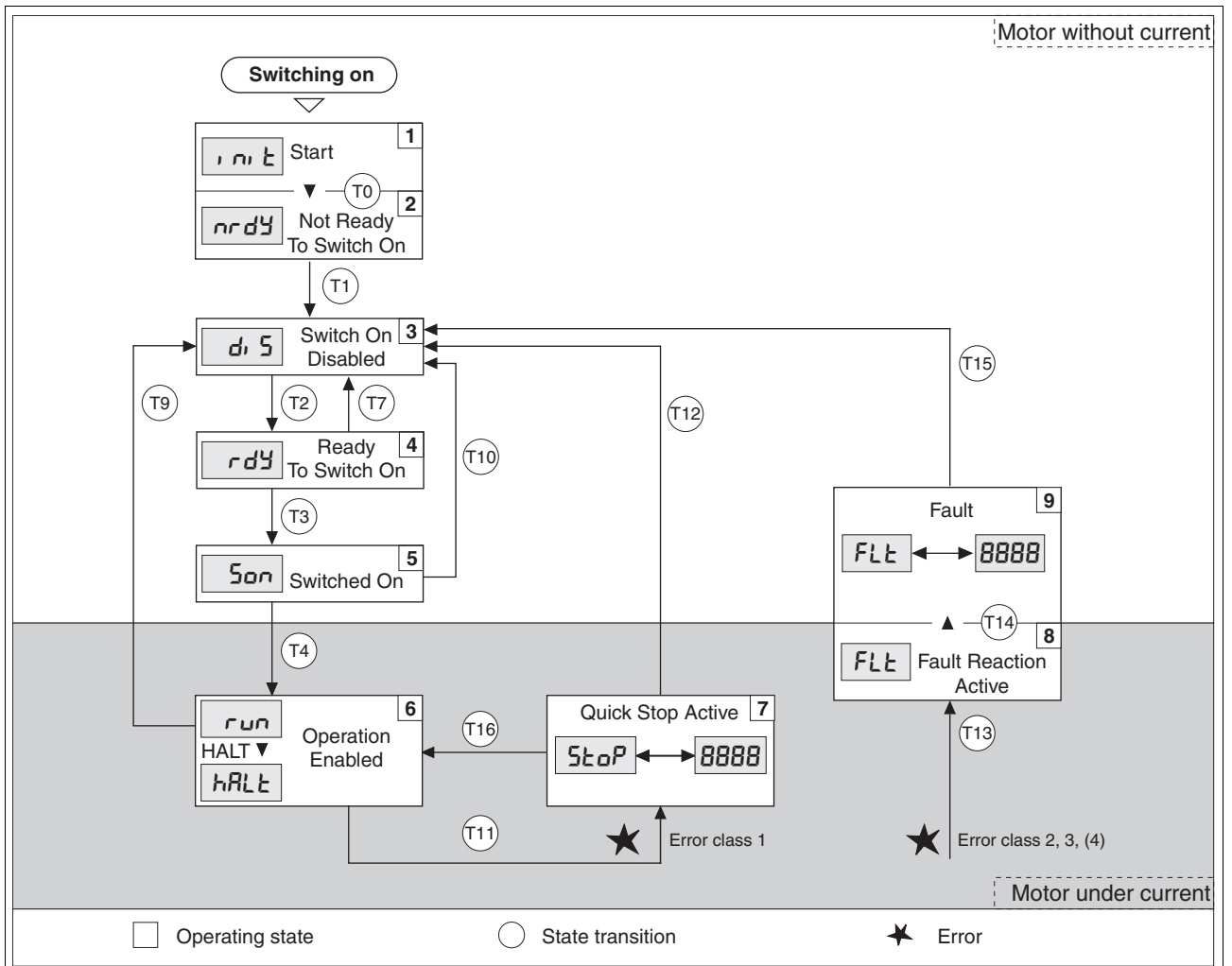


Figure 8.1 State diagram

Operating states The operating states are displayed by default by the HMI and the commissioning software.

Display	Operating state	Description of operating state
<i>o n i t</i>	1 Start	Controller supply voltage on, electronics are being initialized
<i>n r d y</i>	2 Not ready to switch on	The power stage is not ready to switch on
<i>d i s</i>	3 Switch on disabled	Enabling of power stage locked
<i>r d y</i>	4 Ready to switch on	The power stage is ready to switch on
<i>5 o n</i>	5 Switched on	Motor not supplied with current Power stage ready No operating mode active
<i>r u n</i> <i>h a l t</i>	6 Operation enable	<i>r u n</i> : Selected operating mode is active <i>h a l t</i> : Motor is stopped, power stage is enabled
<i>5 t o p</i>	7 Quick Stop active	"Quick Stop" is being executed
<i>F L t</i>	8 Fault Reaction active	An error has been detected, error response activated
<i>F L t</i>	9 Fault	Operating state "Fault"

Error class The product triggers an error response if it switches to the operating state Fault as a result of an error. Depending upon the severity of the fault, the device responds in accordance with one of the following error classes:

Error class	Response	Meaning
0	Warning	Message only, no interruption
1	"Quick Stop"	Motor stops with "Quick Stop", power stage and controller remain switched on and enabled.
2	"Quick Stop" with switch-off	Motor stops with "Quick Stop", power stage and controller are disabled after standstill has been achieved.
3	Fatal error	Power stage and controller switch off immediately without stopping the motor first.
4	Uncontrolled operation	Power stage and controller switch off immediately without stopping the motor first. The error response can only be reset by switching the device off.

Error response The state transition T13 (error class 2, 3 or 4) initiates an error response as soon as an internal occurrence signals an error to which the device must react.

Error class	State from -> to	Response
2	x -> 8	Stop movement with "Quick Stop" Holding brake is applied Power stage disabled
3,4 or Safety function STO	x -> 8 -> 9	Power stage is disabled immediately, even if "Quick Stop" is still active.

An error can be triggered by a temperature sensor, for example. The device cancels the motion command and starts the error response, for example deceleration and stopping with "Quick Stop" or disabling the power stage. Subsequently, the operating state changes to "Fault".

To exit the "Fault" operating state, the cause of the error must be remedied and a Fault Reset must be executed.

In the event of a "Quick Stop" triggered by errors of class 1 (operating state 7), a "Fault Reset" returns you directly to operating state 6.

State transitions State transitions are triggered by an input signal, a fieldbus command or as a response to a monitoring signal.

Transition	Operating state	Condition / event ^{1) 2)}	Response
T0	1-> 2	• Device electronics successfully initialized	
T1	2-> 3	• Parameter successfully initialized	
T2	3-> 4	• No undervoltage Encoder successfully checked Actual speed: <1000 min ⁻¹ $\overline{STO_A}$ ($\overline{PWRR_A}$) and $\overline{STO_B}$ ($\overline{PWRR_B}$) = +24V	
T3	4-> 5	• Request for enabling the power stage	
T4	5-> 6	• Automatic transition	Power stage is enabled User-defined parameters are checked Holding brake is released (if available)
T7	4-> 3	• Undervoltage • $\overline{STO_A}$ ($\overline{PWRR_A}$) and $\overline{STO_B}$ ($\overline{PWRR_B}$) = 0V • Actual speed: >1000 min ⁻¹ (for example by external driving force)	-
T9	6-> 3	• Request for disabling the power stage	Power stage is immediately disabled.
T10	5-> 3	• Request for disabling the power stage	
T11	6-> 7	• Class 1 error	Motion command is canceled with "Quick Stop".
T12	7-> 3	• Request for disabling the power stage	Power stage is disabled immediately, even if "Quick Stop" is still active.
T13	x-> 8	• Error of classes 2, 3 or 4	Error response is carried out, see "Error Response"
T14	8-> 9	• Error response terminated (error of class 2) • Error of classes 3 or 4	
T15	9-> 3	• Function: "Fault Reset"	Error is reset (cause of error must be corrected).
T16	7-> 6	• Function: "Fault reset"	

1) In order to initiate a state transition it is sufficient if one condition is met

2) Fieldbus commands only with fieldbus control mode

Special note on switching on (transition T4) If the parameter `CTRLS_Toggle` is activated, the stepper motor performs a small movement to move the shaft into a stable position.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRLS_toggle	Toggle of motor when power stage is activated	-	UINT16	Modbus 5136
-		-	UINT16	Profibus 5136
-	0 / inactive: Inactive	-	R/W	
-	1 / active: Active (default)	-	per.	
			-	

8.3.2 Indicating the operating states

In fieldbus control mode, the operating state is indicated via the fieldbus, the HMI or the commissioning software.

In the case of a fieldbus, the receive data are evaluated in the process data channel, see also fieldbus manual.

Receive data format, detailed description

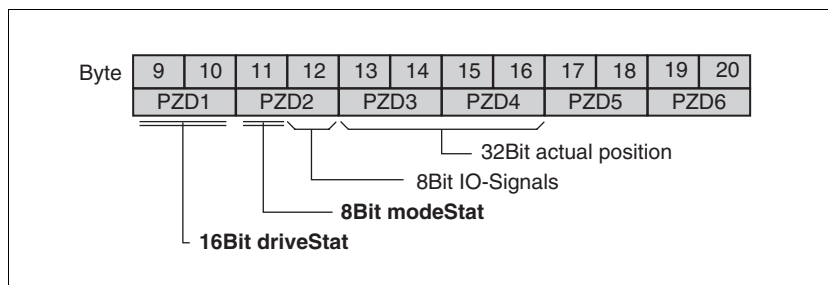


Figure 8.2 Receive data in the process data channel: slave to master

Bytes 9 ... 10: driveStat, contains the current operating state, warning bits and error bits and the status of the current operating mode as a fieldbus status word.

Byte 11: "modeStat", returns the current operating mode

Byte 12: "ioSignals", status of the input signals

Bytes 13 ... 16: "32 bit actual position", current position data

Bytes 17 ... 20 : These bytes can be parameterized, the content is specified via index and subindex. There is no time consistency with bytes 9 ... 16.

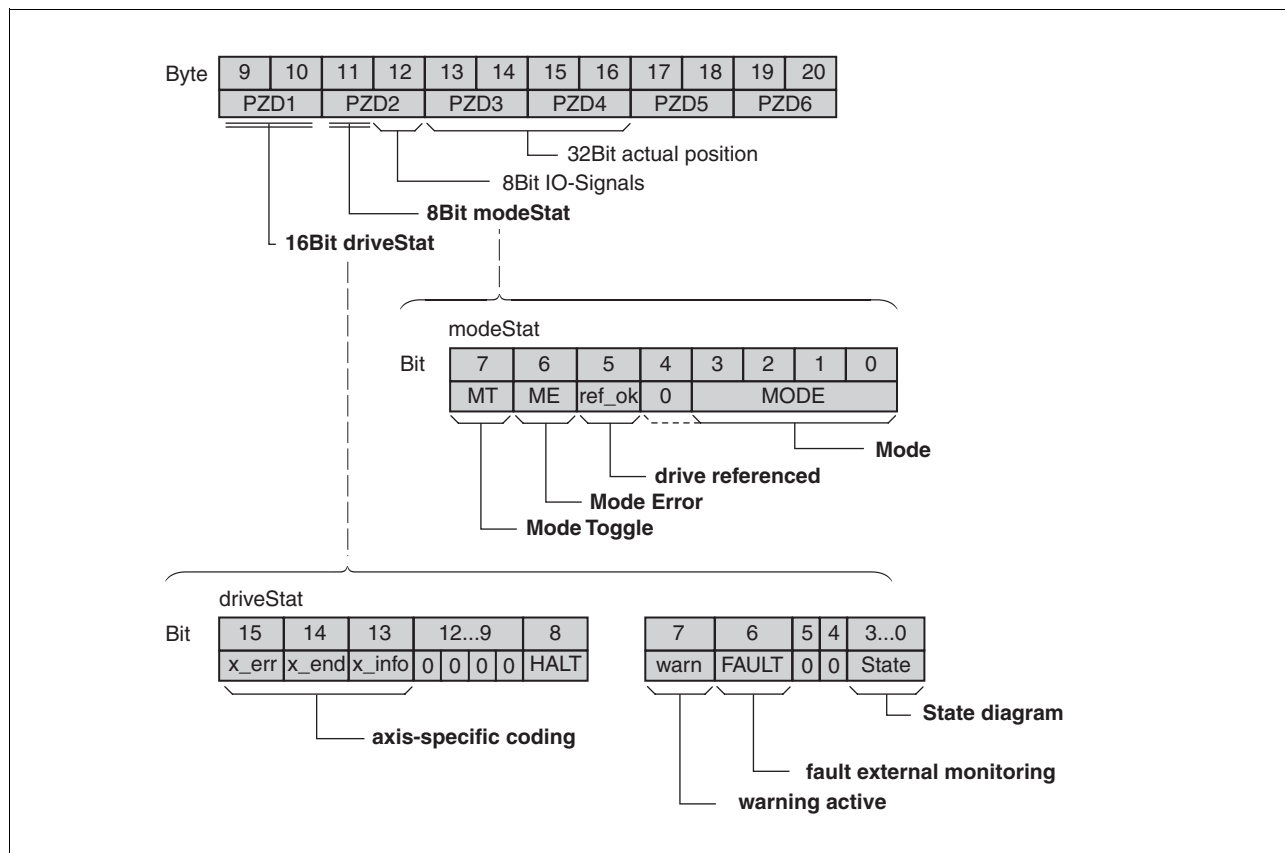


Figure 8.3 Structure of receive data in the process data channel

Description of driveStat The driveStat status word has the following structure

Bit	Name	Description
0...3	State	State diagram, state
6	FAULT	Error detection, error occurred
7	Warn	A warning was generated
8	HALT	A HALT request is active
13	x_info	Additional information on operating mode
14	x_end	Termination identifier operating mode
15	x_err	Error identifier operating mode

Description of modeStat modeStat indicates the current processing state of the operating modes:

Bit	Name	Description
0...3	Mode	Currently selected operating mode as with transmit data
5	ref_ok	Is set if homing of the drive system by means of a reference movement or position setting was successful. If a motor with an encoder is connected, the valid reference point remains valid even if the power stage is disabled.
6	ME, ModeError	Set if a request of the master via transmit data was rejected.
7	MT, ModeToggle	Mirrored bit 7 (Mode Toggle) of transmit data, this acknowledges acceptance of transmit data. Data may only be evaluated if the MT sent from the master is equal to the MT of the slave.

Synchronized processing is possible with the transmit data modeStat, Bit 7 (ModeToggle – MT) and the receive data, Bit 6 and 7 (ModeError – ME and ModeToggle – MT). Synchronized processing means that the master waits for feedback messages from the slave and responds to them.

Description of I/O signals (byte 12)

The current physical states of the signals are represented in a bit-coded way. If the bit is "0", there is no voltage. If the bit is "1", there is voltage.

Bit	Assignment
Bit 0	Reference switch \overline{REF}
Bit 1	Negative limit switch \overline{LIMN}
Bit 2	Positive limit switch \overline{LIMP}
Bit 3	Function \overline{HALT}
Bit 4	Safety function STO $\overline{STO_B}$ ($\overline{PWRR_B}$)
Bit 5	Safety function STO $\overline{STO_A}$ ($\overline{PWRR_A}$)
Bit 6	Not assigned
Bit 7	Not assigned

8.3.3 Changing operating states

The master can control the operating state of the slave via the process data channel, e.g. enable and disable the power stage, trigger and reset a "Quick Stop", reset errors and enable operating modes.

Changing operating states and activating operating modes must be executed separately. An operating mode can normally only be activated if the operating state is already "Operation Enable".

In the process data channel, driveCtrl is used for controlling, see also fieldbus manual.



In the case of this family of devices, the parameter address corresponds to the index. The subindex is 0.

Description driveCtrl:

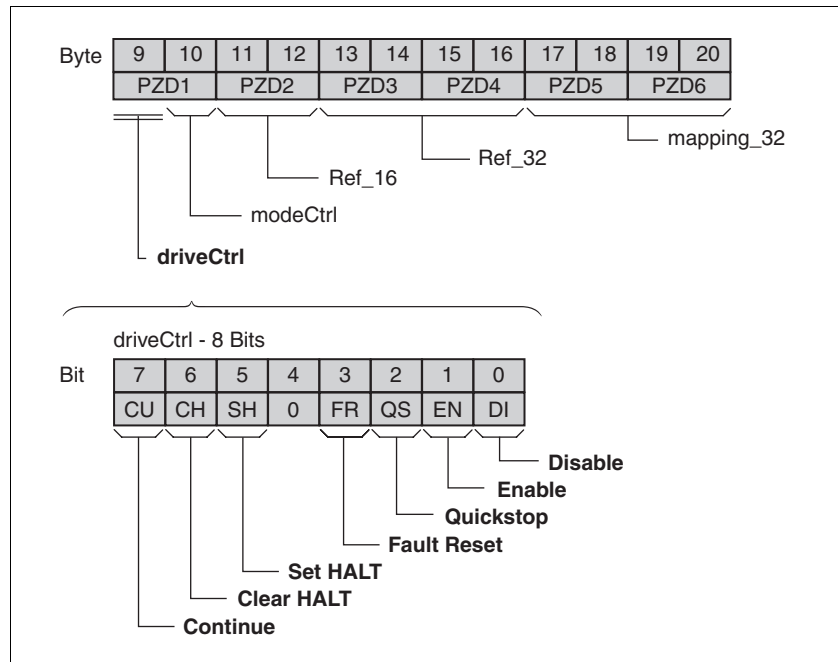


Figure 8.4 Transmit data in the process data channel: driveCtrl

The operating states are changed via the process data channel or the parameter channel .

In the case of access via the process data channel, these bits respond in an edge-selective way, i.e. the corresponding function is triggered with rising edge.

In the case of access via the parameter channel, a write access with a set bit value is sufficient.

NOTE: The Enable bit must be set as long as current is to be applied to the motor.

Change of operating state ^{1) 2)}	Effect on operating states
Bit 0: Power stage Disable	6 - 3 - 4 (Operation enable ⇒ Switch on disable -> Ready to switch on)
Bit 1: Power stage Enable	4 - 5 - 6 (Ready to switch on ⇒ Switched on ⇒ Operation Enable)
Bit 2: Quick Stop	6 - 7 (Operation enable ⇒ Quick Stop active)
Bit 3: Fault Reset	9 - 3 - 4 (Fault ⇒ Switch on disable ⇒ Ready to switch on)

1) Process data channel: Processing is started with a rising edge.

2) Parameter channel: Processing is started with write access if bit value = 1.

8.4 Starting and changing operating modes

▲ WARNING

UNINTENDED OPERATION

- Note that any changes to the values of these parameters are executed by the drive controller immediately on receipt of the data set.
- Verify 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.

Prerequisites The device must be ready for operation and properly initialized for an operating mode to be started.

The product cannot run in two operating modes at the same time. If an operating mode is active, you can only change to a different operating mode if the current operating mode is terminated or canceled.

An operating mode is terminated if the drive is at a standstill, for example, if the target position of a positioning process is reached or if the drive is stopped by a "Quick Stop" or "Halt". If an error occurs during processing which causes the current operating mode to be canceled, the movement can be resumed or you can change to a different operating mode after the cause of the error has been removed.

8.4.1 Starting the operating mode

In fieldbus control mode, the operating mode is set and started via a single write access. This is done in the process data channel with `modeCtrl`.

Description modeCtrl:

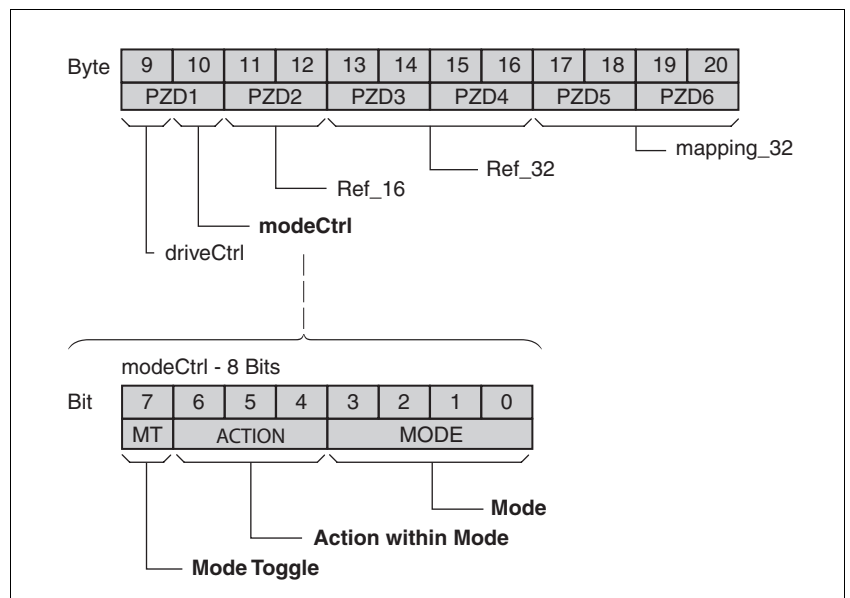


Figure 8.5 Transmit data in the process data channel: `modeCtrl`

The operating modes are controlled by means of `modeCtrl`. The master must enter the following values to activate an operating mode or to change reference values:

- Reference values in fields PZD2, PZD3 and PZD4
- Select operating mode and action with `modeCtrl`, Bits 0..6, (MODESELECTION)
- Toggle `modeCtrl`, Bit 7 (MT)

Operating mode	modeCtrl ¹⁾	Description	Reference value ref_16, PZD2	Reference value ref_32, PZD3+4
Jog	01h	Jog - classical jog	Operation (selection of direction of rotation and speed of rotation) as JOGactivate	-
Homing	02h	Position setting	-	Position for position setting as HMP_setpusr
	12h	Reference movement	Type of reference movement as HMmethod	-
Profile position	03h	Absolute positioning	Reference speed as PPn_target	Reference position as Ppp_absusr
	13h	Relative positioning with reference to the currently set target position	Reference speed as PPn_target	Reference position as Ppp_relprefusr
	23h	Relative positioning with reference to the currently set motor position	Reference speed as PPn_target	Reference position as Ppp_relpactusr
Profile Velocity	04h	Profile Velocity	Reference speed as PVn_target (16 bit only!)	
Electronic gear	05h	Electronic gear, immediate synchronization	Denominator of gear ratio as GEARdenom (16 bit only!)	Numerator of gear ratio as GEARnum
	15h	Electronic gear, synchronization with compensation movement	Denominator of gear ratio as GEARdenom (16 bit only!)	Numerator of gear ratio as GEARnum

1) Column corresponds to the value to be entered in byte modeCtrl, however, without ModeToggle (Bit 7)

If operating mode, reference position and reference speed are simultaneously transmitted via the process data channel, the data must be consistent. Therefore, the operating mode data is only evaluated if Bit 7 has been toggled. Toggling means that since the last transmission a change between "0" and "1" has been detected in this bit.

Bit 7 is mirrored in the receive data set which allows the master to determine that the data has been accepted by the slave. Bit 7 is mirrored in the receive data set which allows the master to determine that the data has been accepted by the slave.

8.4.2 Changing the operating mode

The operating modes can be changed during operation. For this purpose, the current process must be completed or explicitly canceled. The drive must be at a standstill. Then proceed as described in "Starting an operating mode".

8.5 Operating modes

8.5.1 Operating mode Jog

▲ WARNING

UNINTENDED OPERATION

- Note that any changes to the values of these parameters are executed by the drive controller immediately on receipt of the data set.
- Verify 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 jog

The motor moves by one jog unit or at constant speed of rotation in continuous operation. The length of the jog unit, the values for the speed of rotation and the waiting time prior to continuous operation can be set.

The current motor position is the start position for the Jog operating mode. The jog distance and the values for the speed of rotation are entered in user-defined units.

Starting the operating mode

The operating mode can be started via the HMI. The power stage is enabled and current applied to the motor with *JOG - Start*. To rotate the motor shaft, press the "Arrow Up" or "Arrow Down" keys. Press the ENT key simultaneously to switch between slow and fast movement.

The operating mode is set in the process data channel in modeCtrl via the fieldbus. Writing the parameter value causes the operating mode to start.

With the start signal for the jog movement, the motor first moves by a defined jog distance *JOGstepusr*. If the start signal is still available after a specified waiting time *JOGtime*, the device switches to continuous operation until the start signal is canceled.

PZD2	Bit 0: positive direction of rotation Bit 1: negative direction of rotation Bit2: 0=slow 1=fast
------	---

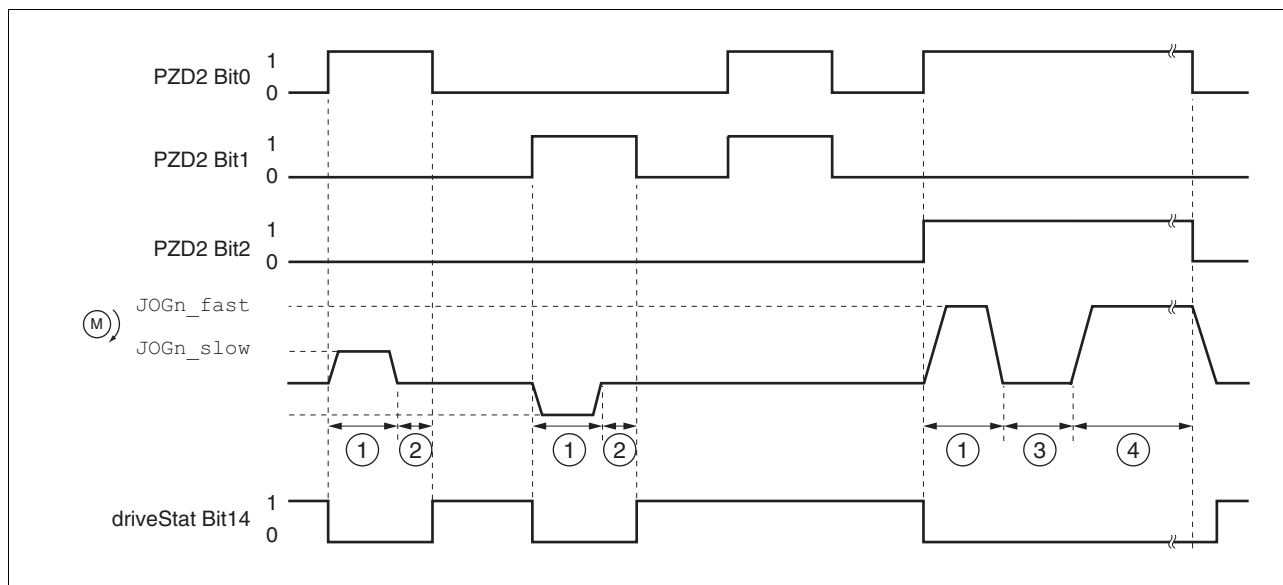


Figure 8.6 Jog, slow and fast

- (1) JOGstepusr
- (2) $t < \text{JOGtime}$
- (3) $t > \text{JOGtime}$
- (4) Continuous operation

Jog distance, waiting time and jog speeds are adjustable. If the jog distance is zero, the jog movement starts directly with continuous operation irrespective of the wait time.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
JOGn_slow JOG- - NSLW JOG - nSLW	Speed for slow jog The adjustable value is internally limited to the current parameter setting in RAMPn_max.	min ⁻¹ 1 60 3000	UINT16 UINT16 R/W per. -	Modbus 10504 Profibus 10504
JOGn_fast JOG- - NFST JOG - nFSt	Speed for fast jog The adjustable value is internally limited to the current parameter setting in RAMPn_max.	min ⁻¹ 1 180 3000	UINT16 UINT16 R/W per. -	Modbus 10506 Profibus 10506
JOGstepusr - -	Jog distance prior to continuous run 0: Direct activation of continuous run >0: Positioning distance per jog cycle	usr 0 20 2147483647	INT32 INT32 R/W per. -	Modbus 10510 Profibus 10510
JOGtime - -	Wait time prior to continuous run This time is only effective if you have set a jog distance not equal to 0, otherwise the drive immediately starts a continuous run.	ms 1 500 32767	UINT16 UINT16 R/W per. -	Modbus 10512 Profibus 10512

Terminating the operating mode Jog is finished when the motor has come to a standstill and

- the direction signal is inactive
- the operating mode has been interrupted by "Halt" or an error

Further options For further settings and functions for the operating mode, see page 151.

8.5.2 Operating mode Electronic gear

⚠ WARNING**UNINTENDED OPERATION**

- Note that any changes to the values of these parameters are executed by the drive controller immediately on receipt of the data set.
- Verify 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 Electronic Gear operating mode, the reference signals are supplied in the form of A/B signals or pulse/direction signals. A new position reference value is calculated on the basis of these signals plus an adjustable gear ratio.

The parameter `IOposInterfac` is used to determine whether A/B signals or pulse/direction signals are to be processed.

Example An NC control provides reference signals to two units. The motors execute different, proportional positioning movements in accordance with the gear ratios.

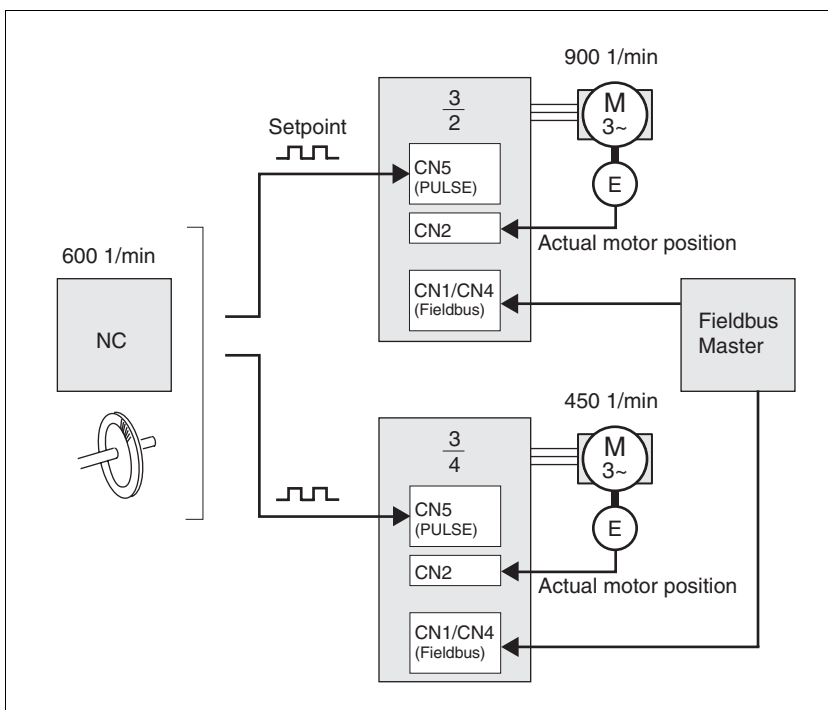


Figure 8.7 Reference value via NC controller

A write access to the parameter `GEARreference` sets the type of synchronization and starts the operating mode Electronic Gear. If changed reference positions are supplied, the device applies the gear ratio and positions the motor to the new reference position.

Position values are specified in internal units. If the values change, the device follows immediately.

Terminating the operating mode Processing is terminated by:

- Deactivation of the operating mode and standstill of motor
- Standstill of motor caused by "Halt" or by an error

8.5.2.1 Parameterization

Overview The following overview shows the function principle of the parameters which can be set for the operating mode Electronic Gear.

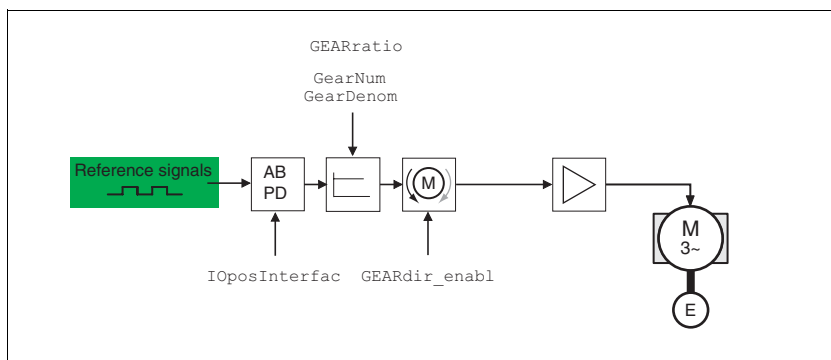


Figure 8.8 Operating mode Electronic Gear, effect of adjustable parameters

The resulting positioning distance depends on the current motor resolution. It amounts to 131072 motor increments per revolution.

Settings for the electronic gear which are independent of the type of synchronization, include:

- Gear ratio (predefined value or user-defined gear ratio)
- Release of direction of rotation

Synchronization The device operates synchronously with other devices, for example, other drives. If the operating mode is terminated, synchronicity with the other drives is lost. Position changes of the reference signals that occur during the interruption continue to be counted internally.

Position change with power stage disabled

If "Synchronization with compensation movement" is selected, the parameter `GEARposChgMode` determines the way changes to the motor position and reference value (RS422 interface) are handled with disabled power stage. These position changes can be ignored or taken into account for transitions to the "OperationEnable" state:

- Off: All position changes with disabled power stage are not taken into account
- On: Position changes with disabled power stage are taken into account. Please note that all position changes between starting the operating mode and the subsequent enabling of the power stage are not taken into account.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
GEARposChgMode	Consideration of position changes with inactive power stage	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 9750 Profibus 9750
-	0 / off: Position changes in states with inactive power stage are discarded. 1 / on: Position changes in states with inactive power stage are considered.			
	This setting has an effect only if gear processing is started in the mode 'Synchronization with compensation movement'.			

Gear ratio The gear ratio is the ratio of the number of motor increments and the number of externally supplied reference increments.

$$\text{Gear factor} = \frac{\text{Motor increments}}{\text{Reference increments}} = \frac{\text{Gear factor numerator}}{\text{Gear factor denominator}}$$

The parameter `GEARratio` allows you to set a predefined gear ratio. It is also possible to set your own gear ratio.

The user-defined gear ratio is defined with the parameters `GEARnum` and `GEARdenom`. A negative numerator value reverses the motor's direction of rotation.

The gear ratio is set via PZD2 (`GEARdenom` as a 16 bit value) and PZD3,4 (`GEARnum` as a 32 bit value).

Example With a setting of 1000 reference increments, the motor is to rotate by 2000 motor increments. This results in a gear factor of 2.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
GEARratio	Selection of special gear ratios	-	UINT16	Modbus 9740
SET- - GFAC	0 / GearFactor / FRct: Usage of gear ratio adjusted with GEARnum/GEARdenom 1 / 200 / 200: 200 2 / 400 / 400: 400 3 / 500 / 500: 500 4 / 1000 / 1000: 1000 5 / 2000 / 2000: 2000 6 / 4000 / 4000: 4000 7 / 5000 / 5000: 5000 8 / 10000 / 10000: 10000 9 / 4096 / 4096: 4096 10 / 8192 / 8192: 8192 11 / 16384 / 16384: 16384 A change of the reference value by the specified value causes one motor revolution.	0	UINT16	Profibus 9740
SET- - GFRC		11	R/W	
		-	per.	
GEARnum	Numerator of gear ratio	-	INT32	Modbus 9736
-	GEARnum	-2147483648	INT32	Profibus 9736
-	----- = Gear ratio	1	R/W	
-	GEARdenom	2147483647	per.	
	The new gear ratio is applied when the numerator value is supplied.			
GEARdenom	Denominator of gear ratio	-	INT32	Modbus 9734
-	See description GEARnum	1	INT32	Profibus 9734
-		1	R/W	
-		2147483647	per.	

Application cases for limitation of speed of rotation and acceleration

Depending on the application, the speed of rotation and acceleration must be limited in the operating mode Electronic Gear.

- Reference signals generated: `GEARcontrol = 0` (inactive)

The user must supply the external reference signals in such a way that the motor can follow them. For example, this is the case if the reference value is generated by an external profile generator.

- Reference signals erratic: `GEARcontrol = 1` (active)

The external reference signals may specify speeds of rotation and accelerations which the motor cannot follow. For example, this is the case if the reference value is supplied via pulse packets. By limiting the speed of rotation (`GEAR_n_max`) and the acceleration (`GEARramp`), you generate a motion profile the motor can follow. The motor is no longer position-synchronized during this period. The position deviation can be read via `_p_difGEAR`.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
GEARcontrol	Activate speed and acceleration limitations	-	UINT16	Modbus 9744
-	0 / off: Inactive	0	UINT16	Profibus 9744
-	1 / on: Active	0	R/W	
	If GEARcontrol is active, the reference value for acceleration/deceleration is limited to the value of parameter GEARramp and the reference speed value to the value of parameter GEAR_n_max. This helps to keep the motor from stalling. If the limitation is activated, this causes a deviation of the calculated reference position and the internally effective reference position which is compensated for. The maximum deviation is limited to 400 revolutions. If this value is exceeded, the unit cancels with a fault.	1	per.	-
GEAR_n_max	Maximum speed in gearing	min ⁻¹	UINT16	Modbus 9746
-	This function is only available if the limitation via GEARcontrol is active.	1	UINT16	Profibus 9746
-		3000	R/W	
		3000	per.	-
GEARramp	Maximum acceleration in gearing	min ⁻¹ /s	UINT32	Modbus 9748
-	This function is only available if the limitation via GEARcontrol is active.	30	UINT32	Profibus 9748
-	This value is effective both in the acceleration and the deceleration phase. The system uses a linear ramp. The start/stop speed has no effect.	600	R/W	
		3000000	per.	-
_p_difGear	Position difference in electronic gear caused by limitation	Inc	INT32	Modbus 7724
-		-2147483648	INT32	Profibus 7724
-		-	R/-	
	If speed and acceleration limitation was set in 'Electronic Gear' mode (see parameter GEARcontrol) and the limits are reached during processing, the drive no longer follows the reference value. This parameter allows you to read out the resulting position deviation.	2147483647	-	-

Release of direction Release of direction allows you to limit movements to positive or negative direction. Release of direction is set with the parameter GEARdir_enabl.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
GEARdir_enabl	Enabled movement direction of gear processing	- 1 3 3	UINT16 UINT16 R/W per. -	Modbus 9738 Profibus 9738
-	1 / positive: Pos. direction			
-	2 / negative: Neg. direction			
-	3 / both: Both directions			
	This allows you to activate a return movement lock function.			

Further options For further settings and functions for the operating mode, see page 151.

8.5.3 Operating mode Profile Position

⚠ WARNING

UNINTENDED OPERATION

- Note that any changes to the values of these parameters are executed by the drive controller immediately on receipt of the data set.
- Verify 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 motion profile is performed from a start position to a target position. The value of the target position can be specified as either a relative or an absolute position.

You can set a motion profile with values for acceleration ramp, deceleration ramp and target speed.

Relative and absolute positioning

In the case of absolute positioning, the positioning distance is specified absolutely with reference to the zero point of the axis. A zero point must be defined with the Homing operating mode before absolute positioning can be used for the first time.

In the case of a relative positioning, the positioning distance is specified relatively with reference to the current axis position or the target position.

Absolute positioning or relative positioning is set via modeCtrl.

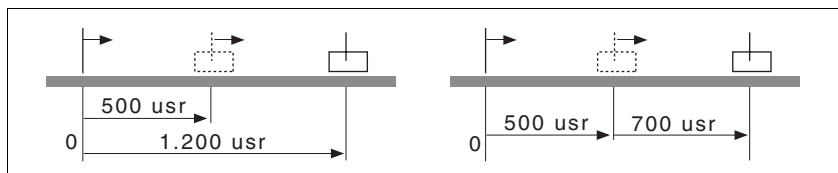


Figure 8.9 Absolute positioning (left) and relative positioning (right) Absolute positioning (left) and relative positioning (right)

Prerequisites

The device must be in operating state "Operation enable".

See chapter 8.4 "Starting and changing operating modes".

8.5.3.1 Parameterization

The Profile Position operating mode can be set and executed via parameters or the process data channel. See the fieldbus manual for settings and examples.

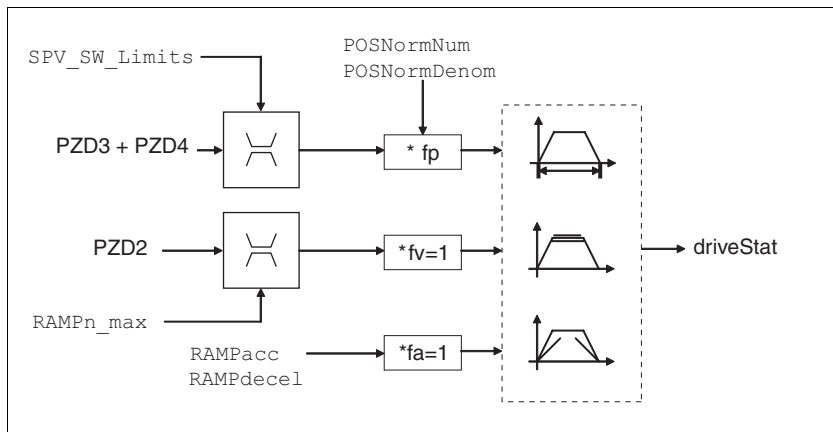


Figure 8.10 Operating mode Profile Position, effect of adjustable parameters

PZD2	Corresponds to parameter PPn_target
PZD3 + PZD4	Absolute: Corresponds to parameter PPp_absusr Relative: Corresponds to parameter $PPp_relprefusr$ or parameter $PPp_relpactusr$

In the case of absolute positioning, the positioning distance is specified absolutely with reference to the zero point of the axis.

In the case of a relative positioning, the positioning distance is specified relatively with reference to the current axis position or the target position.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PPn_target	Reference speed in operating mode profile position	min^{-1} 1	UINT16 R/W	Modbus 8970 Profibus 8970
-	The adjustable value is internally limited to the current parameter setting in $RAMPn_max$.	60 3000	- -	-
AbsHomeRequest	Absolute positioning only after homing	- 0	UINT16 R/W	Modbus 1580 Profibus 1580
-	0 / no: No 1 / yes: Yes	0 1	per.	-
-	Available as of software version V1.211.	-	-	-
PPp_absusr	Target position absolute of operating mode profile position	usr -	R/W	-
-	Min./max values depend on:	0	-	-
-	- Scaling factor - Software limit switches (if they are activated)	-	-	-

019844113706, V2.03, 07.2010

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PPp_relactusr - -	<p>Target position relative to current motor position</p> <p>Min./max values depend on: - Position normalization factor - Software limit switches (if they are activated)</p> <p>In the case of active positioning in Profile Position mode, relative positioning refers to the current motor position. The absolute user position limits can only be overrun if the drive is at standstill when the movement starts (x_end=1). In this case, implicit position setting to position 0 is performed.</p>	usr - 0 -	R/W - -	
PPp_relprefusr - -	<p>Target position relative to the current target position</p> <p>Min./max values depend on: - Position normalization factor - Software limit switches (if they are activated)</p> <p>In the case of active positioning in operating mode Profile Position, relative positioning refers to the target position of the current movement. The absolute user position limits can only be overrun if the drive is at standstill when the movement starts (x_end=1). In this case, implicit position setting to position 0 is performed.</p>	usr - 0 -	R/W - -	

Current position The current position can be determined with the 2 parameters `_p_actusr` and `_p_actRAMPusr`.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
<code>_p_actusr</code> STA- - PACu 5tR- - PRLu	Actual motor position in user units	usr - 0 -	INT32 INT32 R/- -	Modbus 7706 Profibus 7706
<code>_p_actRAMPusr</code> - -	Actual position of motion profile generator In user units	usr - 0 -	INT32 INT32 R/- -	Modbus 7940 Profibus 7940

8.5.4 Operating mode Profile Velocity

⚠ WARNING

UNINTENDED OPERATION

- Note that any changes to the values of these parameters are executed by the drive controller immediately on receipt of the data set.
- Verify 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 operating mode Profile Velocity, the drive accelerates to an adjustable target speed of rotation. You can set a motion profile with values for acceleration and deceleration ramps.

Prerequisites The device must be in operating state "Operation enable".

See chapter 8.3 "Operating states".

8.5.4.1 Parameterization

Overview The following overview shows the function principle of the parameters which can be set for the operating mode Profile Velocity.

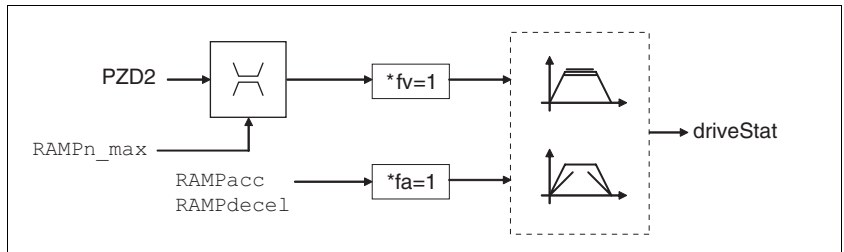


Figure 8.11 Operating mode Profile Velocity, effects of adjustable parameters

PZD2	Corresponds to parameter PVn_target
------	-------------------------------------

Reference speed The reference speed is assigned in the process data channel via the parameter PVn_target in revolutions per minutes and can be changed during the movement. The operating mode is not limited by the positioning range limits. New speed values are accepted immediately during the execution of a running motion command.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PVn_target	Reference speed of operating mode profile velocity	min ⁻¹ -3000	INT32 INT32	Modbus 9218 Profibus 9218
-	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	- 3000	R/W -	

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Current speed The current speed is determined by using the 2 parameters `_n_act` and `_n_actRAMP`.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
<code>_n_act</code>	Actual motor speed	min^{-1}	INT16	Modbus 7696
STA- - NACT		-	INT16	Profibus 7696
5tR- - nRt		0	R/-	
<code>_n_actRAMP</code>	Actual speed of motion profile generator	min^{-1}	INT32	Modbus 7948
-		-	INT32	Profibus 7948
-		0	R/-	
-		-	-	

8.5.5 Operating mode Homing

⚠ WARNING

UNINTENDED OPERATION

- Note that any changes to the values of these parameters are executed by the drive controller immediately on receipt of the data set.
- Verify 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

The operating mode Homing establishes an absolute position reference between the motor position and a defined axis position. Homing can be carried out by a means of a reference movement or by position setting.

- A reference movement is a movement to a defined point, the reference point, on the axis; the objective is to establish the absolute position reference between the motor position and the axis position. The reference point also defines the zero point that is used for all subsequent absolute positioning movements as a reference point. It is possible to parameterize a shift of the zero point.

A reference movement must be completed for the new zero point to be valid. If the reference movement is interrupted, it must be started again. As opposed to the other operating modes, a reference movement must be completed before a new operating mode can be activated.

The signals required for the reference movement must be wired. Monitoring signals that are not used must be deactivated.

- Position setting lets you set the current motor position to a desired position value to which the subsequent position values will relate.

Types of reference movements

There are 4 standard types of reference movements:

- Movement to negative limit switch $\overline{\text{LIMN}}$
- Movement to positive limit switch $\overline{\text{LIMP}}$
- Movement to reference switch $\overline{\text{REF}}$ with negative direction of rotation
- Movement to reference switch $\overline{\text{REF}}$ with positive direction of rotation

Reference movements are possible with or without index pulse.

- Reference movement without index pulse
Movement from the switching edge to a parameterizable distance from switching edge
- Reference movement with index pulse
Movement from the switching edge to the physical index pulse of the motor.

For reference movements with index pulse a motor with encoder must be connected. The `CTRLS_MotEnc` parameter must be set to "Motor encoder connected".

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRLS_MotEnc	Processing of motor encoder position	-	UINT16	Modbus 5138
DRC- - ENCM	0 / undefined / none : Undefined (default)	0	UINT16	Profibus 5138
drL - - EnLf	1 / NoEncCon / none : No motor encoder connected 2 / ShowEncPos / P, nF : Motor encoder connected, rotation monitoring inactive, only position info 3 / RotMonOn / rotF : Motor encoder connected, rotation monitoring active If you select "Motor encoder connected", temperature monitoring of the encoder is also activated. If you select "No motor encoder connected", the reference values <code>_p_refusr</code> and <code>_n_pref</code> are output as motor position (<code>_p_actusr</code>) and motor speed (<code>_n_act</code>).	0 3	R/W per. -	

In the process data channel, the reference movement is started via `driveCtrl` and `modeCtrl` corresponding to the parameter `HMmethod`. The status is mapped to the receive data in `driveStat` and `modeStat`.

Operating mode terminated

The operating mode is terminated after successful homing, a motor standstill by "Halt" or an error.

If a motor with an encoder is connected, the valid reference point remains valid even if the power stage is disabled.

8.5.5.1 Parameterization, general

Description There are various methods of homing which can be selected via the parameter `HMmethod`.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
----------------------------	-------------	---	--	-----------------------------------

Use the parameter `IOsigREF` to set the evaluation of the reference switch $\overline{\text{REF}}$ to active_0 or active_1. A release of the switch is not required.

Use the parameters `IOsigLimN` and `IOsigLimP` to set the evaluation to active_0 or active_1 and to enable the limit switches.



Use active 0 monitoring signals if possible, because they are failsafe.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOsigRef	Signal evaluation REF	-	UINT16	Modbus 1564
-	1 / normally closed: Normally closed NC	1	UINT16	Profibus 1564
-	2 / normally open: Normally open NO	2	R/W per.	-
	The reference switch is only activated (to REF) while homing is processed.			
IOsigLimN	Signal evaluation LIMN	-	UINT16	Modbus 1566
-	0 / inactive: Inactive	0	UINT16	Profibus 1566
-	1 / normally closed: Normally closed NC	1	R/W	
-	2 / normally open: Normally open NO	2	per.	-
IOsigLimP	Signal evaluation LIMP	-	UINT16	Modbus 1568
-	0 / inactive: Inactive	0	UINT16	Profibus 1568
-	1 / normally closed: Normally closed NC	1	R/W	
-	2 / normally open: Normally open NO	2	per.	-

The parameters `HMn` and `HMn_out` are used to set the speeds for searching the switch and for moving away from the switch.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMn	Speed of rotation for search of switch	min ⁻¹	UINT16	Modbus 10248
-	The adjustable value is internally limited to the current parameter setting in <code>RAMPn_max</code> .	1	UINT16	Profibus 10248
-		60	R/W	
-		3000	per.	-

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMn_out	Speed of rotation for moving away from switch	min ⁻¹ 1	UINT16 UINT16	Modbus 10250 Profibus 10250
-	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	6 3000	R/W per. -	

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 HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMp_homeusr	Position at reference point	usr -2147483648	INT32 INT32	Modbus 10262 Profibus 10262
-	After a successful reference movement, this position is automatically set at the reference point.	0 2147483647	R/W per. -	

The parameters `HMoutdisusr` and `HMsrchdisusr` can be used for activation of the monitoring of the switch function.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMoutdisusr	Maximum distance for search for switching edge	usr 0	INT32 INT32	Modbus 10252 Profibus 10252
-	0: Monitoring of distance inactive	0	R/W	
-	>0: Maximum distance in user-defined units	2147483647	per. -	
	After detection of the switch, the drive starts to search for the defined switching edge. If it is not found within the distance defined here, the reference movement is canceled with an error.			
HMsrchdisusr	Max. search distance after overrun of switch	usr 0	INT32 INT32	Modbus 10266 Profibus 10266
-	0: Search distance processing disabled	0	R/W	
-	>0: Search distance in user units	2147483647	per. -	
	The switch must be activated again within this search distance, otherwise the reference movement is canceled.			

Preferred method The parameter `SaveHomeMethod` allows you to save a preferred homing method. The meaning of the values of the parameter `SaveHomeMethod` corresponds to the meaning of the values of the parameter `HMmethod`.

When the device is switched on, the value in the parameter `HMmethod` is overwritten by the value set in the parameter `SaveHomeMethod`.

The function is available as of software version 1.501 and higher.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
SaveHomeMethod	Default homing method	-	INT16	Modbus 6968
-		1	INT16	Profibus 6968
-		18	R/W	
-		35	per.	
			-	

8.5.5.2 Reference movement without index pulse

Description A reference movement without index pulse is set via PZD2 = 17 to 30, see parameter HMmethod for the bit assignment.

First, the product moves to the defined limit switch or reference switch. Then the product moves to a defined distance from the switching edge.

The distance from the switching edge can be specified with the parameter HMdisusr.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMdisusr	Distance from switching edge to reference point	usr 1 200 2147483647	INT32 INT32 R/W per. -	Modbus 10254 Profibus 10254
-	After the drive 'leaves' the switch, it is positioned into the working area by a defined distance. This target point is defined as the reference point.			
	The parameter is only effective during reference movements without index pulse search.			

Reference movement to limit switch The following illustration shows a reference movement to the negative limit switch with distance from the switching edge (HMmethod = 17).

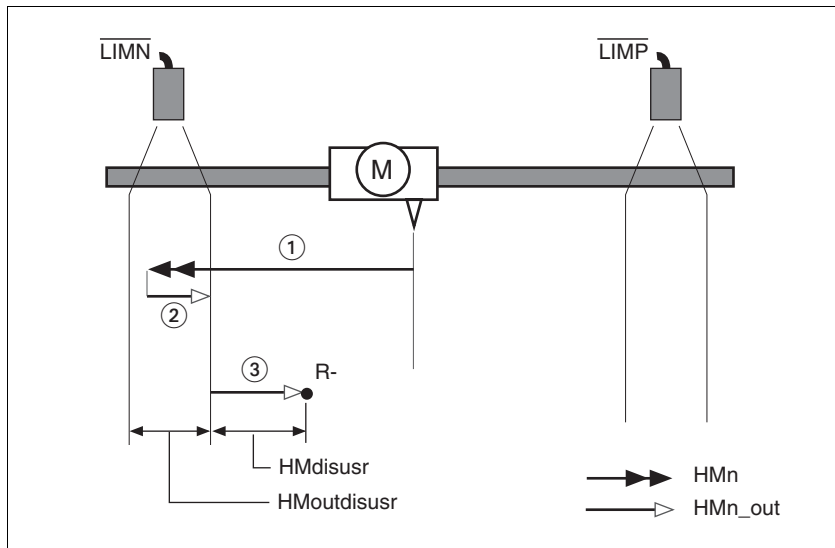


Figure 8.12 Reference movement to the negative limit switch

- (1) Movement to limit switch at search speed
- (2) Movement to switching edge at speed for moving away from switch
- (3) Movement to distance from switching edge at speed for moving away from switch

Reference movement to reference switch

The following illustration shows reference movements to the reference switch with distance from the switching edge ($HM_{method} = 27$ to 30).

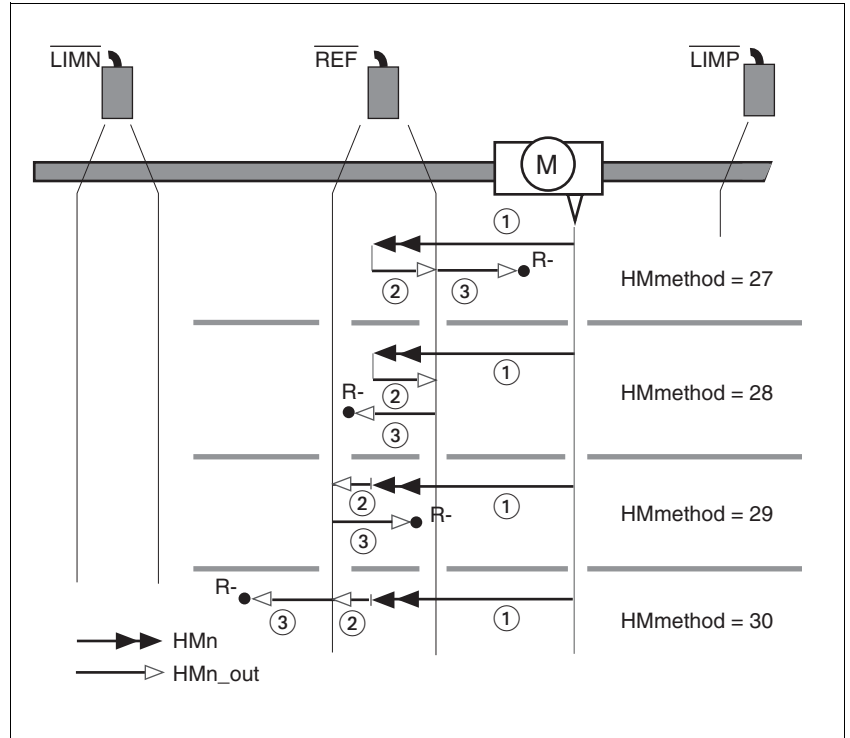


Figure 8.13 Reference movements to the reference switch

- (1) Movement to reference switch at search speed
- (2) Movement to switching edge at speed for moving away from switch
- (3) Movement to distance from switching edge at speed for moving away from switch

Examples The following illustration shows reference movements to the reference switch with distance from the switching edge ($HMmethod=27$). You can see different responses at different search speeds and start positions.

- Movement to the reference switch with first movement in negative direction; the reference switch is once in front of the starting point (A1, A2), once behind it (B1, B2).
- Additional movement when the unit moves through the switch range (A2, B2).

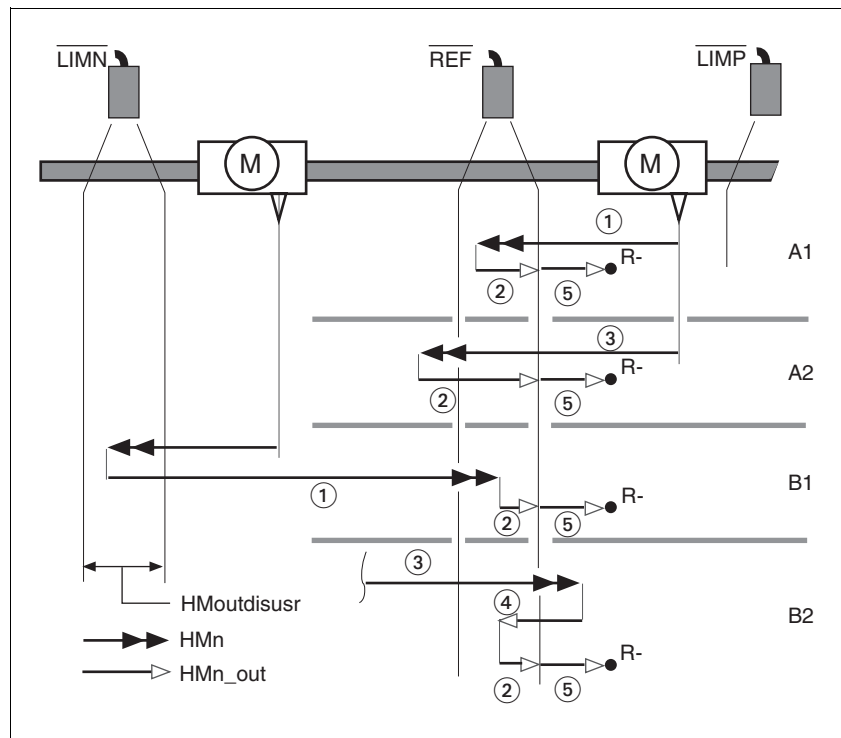


Figure 8.14 Reference movements to the reference switch

- (1) Movement to reference switch at search speed
- (2) Movement to switching edge at speed for moving away from switch
- (3) Excessively fast movement to reference switch at search speed
- (4) Return movement to switch range at speed for moving away from switch
- (5) Movement to distance from switching edge at speed for moving away from switch

8.5.5.3 Reference movement with index pulse

For reference movements with index pulse a motor with encoder must be connected. The `CTRLS_MotEnc` parameter must be set to "Motor encoder connected".

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
<code>CTRLS_MotEnc</code>	Processing of motor encoder position	-	UINT16	Modbus 5138
<code>DRC- - ENCM</code>	0 / undefined / none : Undefined (default)	0	UINT16	Profibus 5138
<code>drL - - EnEn</code>	1 / NoEncCon / none : No motor encoder connected 2 / ShowEncPos / P: nF : Motor encoder connected, rotation monitoring inactive, only position info 3 / RotMonOn / rotEn : Motor encoder connected, rotation monitoring active If you select "Motor encoder connected", temperature monitoring of the encoder is also activated. If you select "No motor encoder connected", the reference values <code>_p_refusr</code> and <code>_n_pref</code> are output as motor position (<code>_p_actusr</code>) and motor speed (<code>_n_act</code>).	0 3	R/W per. -	

Description A reference movement with index pulse is set via `PZD2 = 1 to 14`, see parameter `HMmethod` for the bit assignment.

First, the product moves to the defined limit switch or reference switch. Then the product moves to the nearest index pulse.

Parameterization The position distance between the switching edge and index pulse can be determined with the parameter `HMdisREFtoIDX`.

The value should be >0.05 .

This way, the reference movement with index pulse is reproducible.

If the index pulse is too close to the switching edge, the limit switch or reference switch can be moved mechanically.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
<code>HMdisREFtoIDX</code>	Distance from switching edge to index pulse	revolution	INT32	Modbus 10264
-	This read value delivers the difference between the index pulse position and the position at the switching edge of the limit or reference switch.	-	INT32	Profibus 10264
-	It allows to check the distance between the index pulse and the switching edge and serves as a criterion for determining whether the reference movement with index pulse processing can be reproduced. In increments of 1/10000 revolutions	0.0000	R/- -	

Reference movement to limit switch The following illustration shows a reference movement to the positive limit switch with movement to the first index pulse ($HMmethod = 2$).

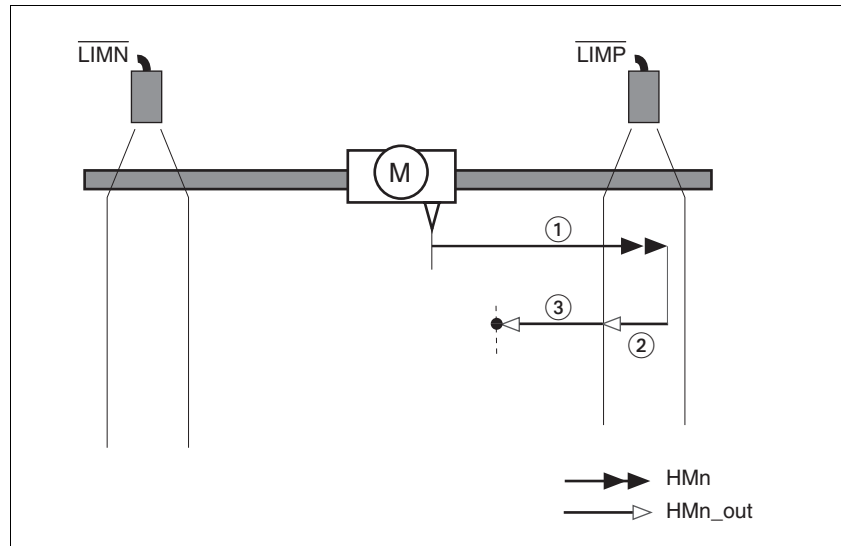


Figure 8.15 Reference movement to the positive limit switch

- (1) Movement to limit switch at search speed
- (2) Movement to switching edge at speed for moving away from switch
- (3) Movement to index pulse at speed for moving away from switch

Reference movement to reference switch

The following illustration shows reference movements to the reference switch with movement to the first index pulse (HMmethod = 11 to 14).

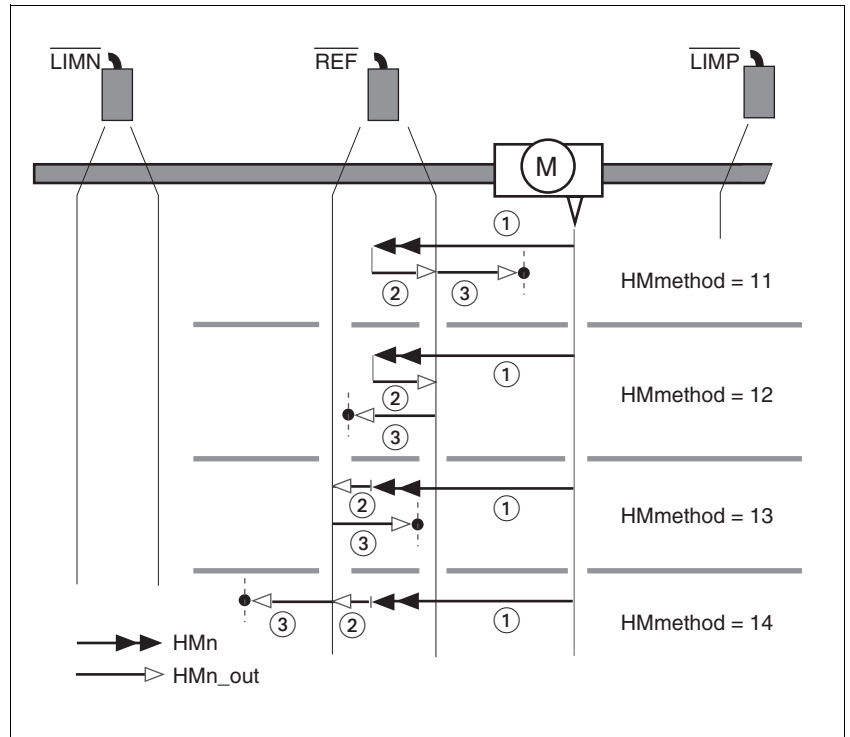


Figure 8.16 Reference movements to the reference switch

- (1) Movement to reference switch at search speed
- (2) Movement to switching edge at speed for moving away from switch
- (3) Movement to index pulse at speed for moving away from switch

Examples The following illustration shows reference movements to the reference switch with movement to the first index pulse ($HMmethod = 11$). Various responses at different search speeds and start positions are shown.

- Movement to the reference switch with first movement in negative direction; the reference switch is once in front of the starting point (A1, A2), once behind it (B1, B2).
- Additional movement when the unit moves through the switch range (A2, B2).

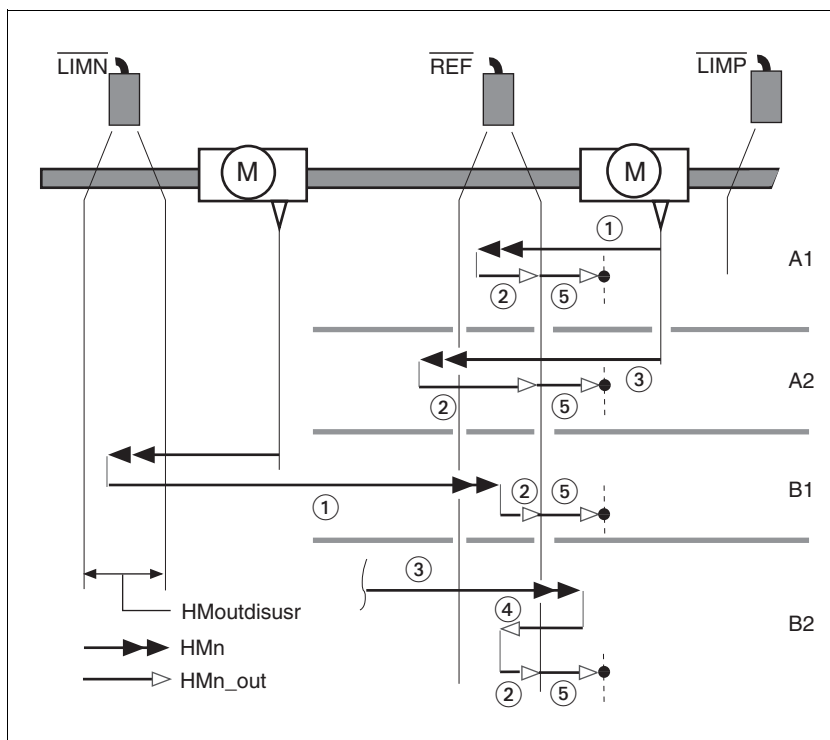


Figure 8.17 Reference movements to the reference switch

- (1) Movement to reference switch at search speed
- (2) Movement to switching edge at speed for moving away from switch
- (3) Excessively fast movement to reference switch at search speed
- (4) Return movement to switch range at speed for moving away from switch
- (5) Movement to index pulse at speed for moving away from switch

8.5.5.4 Reference movement to the index pulse

For reference movements with index pulse a motor with encoder must be connected. The `CTRLS_MotEnc` parameter must be set to "Motor encoder connected".

Description A reference movement to the index pulse is set via `PZD2 = 33` and `34`, bit assignment see parameter `HMmethod`

Reference movement to index pulse The following illustration shows reference movements to the index pulse (`HMmethod = 33` and `34`).

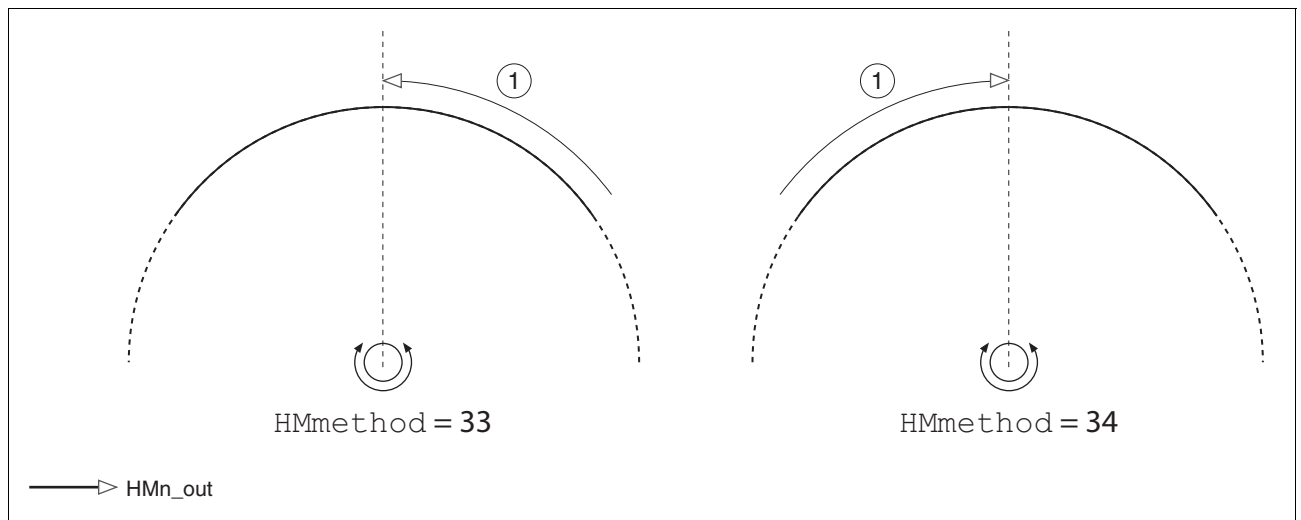


Figure 8.18 Reference movements to the index pulse

- (1) Movement to index pulse at speed for moving away from switch

8.5.5.5 Homing by position setting

Description Homing by position setting is set via PZD2 = 35, see parameter `HMmethod` for the bit assignment.

By means of position setting, the current motor position is set to the position value in parameter `HMp_setpusr`. This also defines the zero point.

Homing by position 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 position setting.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
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Example Position setting can be used to carry out a continuous motor movement without exceeding the positioning limits.

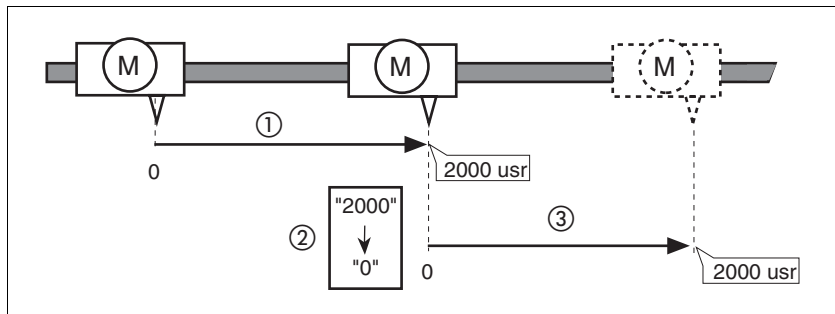


Figure 8.19 Positioning by 4000 usr units with position setting

- (1) The motor is positioned by 2000 usr.
- (2) By means of position setting to 0, the current motor position is set to position value 0 which, at the same time, defines a new zero point.
- (3) When a new motion command by 2000 usr is triggered, the new target position is 2000 usr.

This method avoids overtravel of the absolute position limits during a positioning operation because the zero point is continuously adjusted.

The reference position is read by means of parameter `_p_refusr`.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
<code>_p_refusr</code>	Reference position in user units	usr	INT32	Modbus 7704
-	-	-	INT32	Profibus 7704
-	-	0	R/-	-
-	-	-	-	-

8.6 Functions

8.6.1 Setting the motor phase current

The motor phase current (and, by implication, the torque) can be set to a value between 0% and 100% of the nominal motor current $CTRLS_I_Nom$. The value can be set separately for motor standstill with parameter $CTRLS_I_Stand\%$, for acceleration and deceleration with parameter $CTRLS_I_Ramp\%$ and for constant movement with parameter $CTRLS_I_Const\%$, depending on the system requirements.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
$CTRLS_I_nom$	Used nominal current	A_{rms}	UINT16	Modbus 5122
-	Corresponds to the lower value of SM_I_nom and PA_I_nom .	0.00	UINT16	Profibus 5122
-	The value is updated when a motor is selected or the motor type changed. The value corresponds to the motor current at a setting of 100% in phase current percentage for the different movement states.	-	R/- -	-
$CTRLS_I_Stand\%$	Percentage of phase current at standstill	%	UINT16	Modbus 5140
SET- - $iStd$	100% correspond to the value in $CTRLS_I_nom$	1	UINT16	Profibus 5140
SEt - - , $5td$		50	R/W	
		100	per. -	
$CTRLS_I_Ramp\%$	Percentage of phase current during acceleration/deceleration	%	UINT16	Modbus 5142
SET- - $irMP$	100% correspond to the value in $CTRLS_I_nom$	1	UINT16	Profibus 5142
SEt - - , rMP		100	R/W	
		100	per. -	
$CTRLS_I_Const\%$	Percentage of phase current during constant movement	%	UINT16	Modbus 5144
SET- - $icnS$	100% correspond to the value in $CTRLS_I_nom$	1	UINT16	Profibus 5144
SEt - - , cnS		80	R/W	
		100	per. -	
	The setting has no effect in the following operating modes (in these modes, ' $CTRLS_I_Ramp\%$ ' is used): - Electronic gear			
$CTRLS_I_Const\%$	Percentage of phase current during constant movement	%	UINT16	Modbus 5144
SET- - $icnS$	100% correspond to the value in $CTRLS_I_nom$	1	UINT16	Profibus 5144
SEt - - , cnS		80	R/W	
		100	per. -	
	The setting has no effect in the following operating modes (in these modes, ' $CTRLS_I_Ramp\%$ ' is used): - Electronic gear			

8.6.2 Monitoring functions

8.6.2.1 Status monitoring during operation

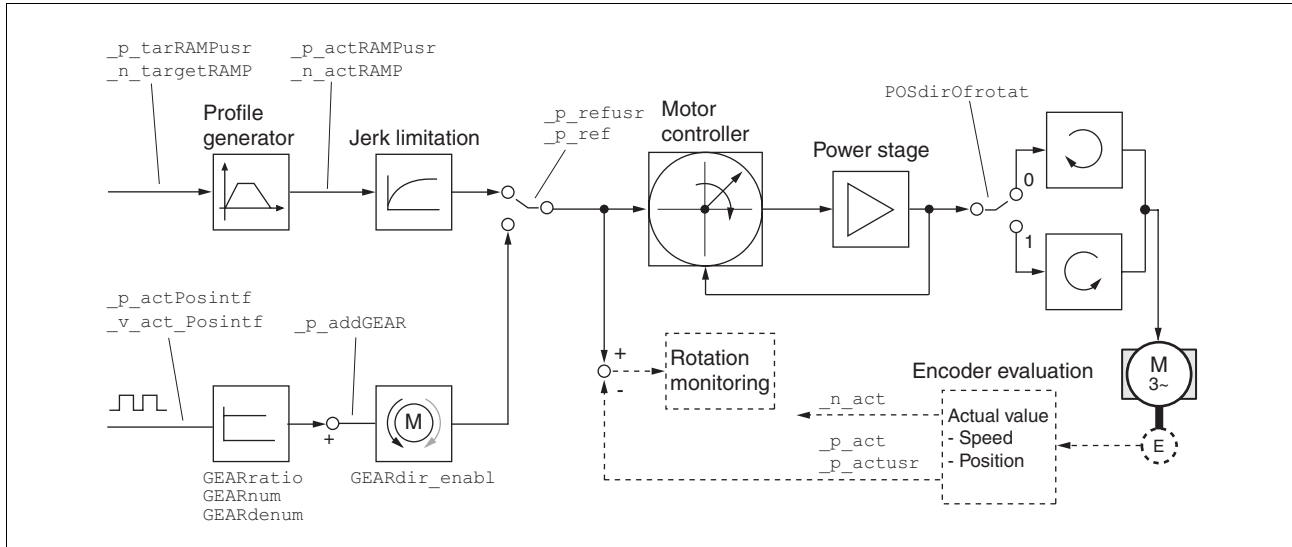


Figure 8.20 Status monitoring of the control loops

8.6.2.2 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`.

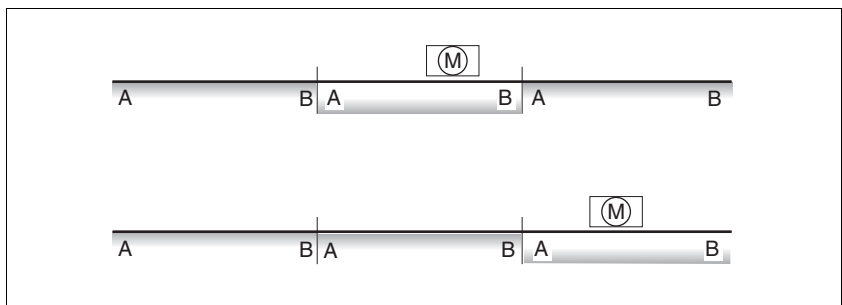


Figure 8.21 Positioning range

The positioning limits, with default scaling, are:

- (A) -268435456 usr
- (B) 268435455 usr

Overtraveling of the positioning limits is possible in all operating modes, except during absolute positioning in Profile Position operating mode.

If the motor overtravels the positioning limit, the reference point is lost.

In the case of relative positioning in the operating mode Profile Position, the unit checks whether the position limits will be overtraveled before the movement is started. If so, internal position setting to 0 is triggered when the movement is started. The reference point is lost (`ref_ok = 1 -> 0`).

Software limit switches The positioning range can be limited by software limit switches. This is possible as soon as the drive has a valid zero point ($ref_ok = 1$). The position values are specified with reference to the zero point. The software limit switches are set via the parameters *SPVswLimPusr* and *SPVswLimNusr* are activated via *SPV_SW_Limits*. Bit 2 of parameter *_SigLatched* signals the triggering of a software limit switch.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
SPVswLimPusr - -	Positive position limit for software limit switch If a user value entered is outside of the permissible user range, the limit switch limits are automatically set to the max. user value.	usr - 2147483647 -	INT32 INT32 R/W per. -	Modbus 1544 Profibus 1544
SPVswLimNusr - -	Negative position limit for software limit switch Refer to description 'SPVswLimPusr'	usr - -2147483648 -	INT32 INT32 R/W per. -	Modbus 1546 Profibus 1546
SPV_SW_Limits - -	Monitoring of software limit switches 0 / none: None (default) 1 / SWLIMP: Activation of software limit switches positive direction 2 / SWLIMN: Activation of software limit switches negative direction 3 / SWLIMP+SWLIMN: Activation of software limit switches both directions Monitoring of software limit switches only works in case of successful homing ($ref_ok = 1$).	- 0 0 3	UINT16 UINT16 R/W per. -	Modbus 1542 Profibus 1542

Limit switches

▲ WARNING**LOSS OF CONTROL**

The use of $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$ can provide some protection against hazards (e.g. collision with mechanical stop caused by incorrect reference values).

- Use $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$ where possible.
- Verify that the external sensors or switches are properly connected.
- Verify the correct installation of the limit switches. The limit switches must be mounted in a position far enough away from the mechanical stop to allow for an adequate stopping distance.
- Before you can use $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$, you must enable them.

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

During movements the two limit switches are monitored via the input signals $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$. If the drive hits a limit switch, the motor stops. Triggering of the limit switch is signaled.

The parameters IOsigLimP and IOsigLimN are used to release the input signals $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$ and to set the evaluation to active 0 or active 1.



Use active 0 monitoring signals if possible, because they are failsafe.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOsigLimN	Signal evaluation LIMN	-	UINT16	Modbus 1566
-	0 / inactive: Inactive	0	UINT16	Profibus 1566
-	1 / normally closed: Normally closed NC	1	R/W	
-	2 / normally open: Normally open NO	2	per.	
			-	
IOsigLimP	Signal evaluation LIMP	-	UINT16	Modbus 1568
-	0 / inactive: Inactive	0	UINT16	Profibus 1568
-	1 / normally closed: Normally closed NC	1	R/W	
-	2 / normally open: Normally open NO	2	per.	
			-	
IOsigRef	Signal evaluation REF	-	UINT16	Modbus 1564
-	1 / normally closed: Normally closed NC	1	UINT16	Profibus 1564
-	2 / normally open: Normally open NO	1	R/W	
		2	per.	
			-	
	The reference switch is only activated (to REF) while homing is processed.			

Moving drive out The drive can be moved away from the limit switch range to the movement range in the operating mode Jog.

8.6.2.3 Monitoring internal signals

Motor temperature monitoring In the case of motors with encoder and if the parameter CTRLS_MotEncUse is set to "Motor encoder connected", the motor temperature is also monitored. The temperature limit values are fixed. If the temperature exceeds the limit value, the power stage and controller are switched off. The device signals a temperature error.

Power stage temperature monitoring Sensors monitor the temperature of the power stage. If the power stage temperature approaches the limit temperature PA_T_warn, a warning message is generated. If the temperature reaches the max. permissible temperature of the power stage, the power stage and controller are shut down. The device signals a temperature error.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_Temp_act_DEV	Device temperature	°C	INT16	Modbus 7204
STA- - TDEV		-	INT16	Profibus 7204
StR- - tDEV		0	R/-	
		-	-	
_Temp_act_PA	Power stage temperature	°C	INT16	Modbus 7200
STA- - TPA		-	INT16	Profibus 7200
StR- - tPR		0	R/-	
		-	-	
PA_T_max	Maximum permissible power stage temperature	°C	INT16	Modbus 4110
-		-	INT16	Profibus 4110
-		0	R/-	
		-	per.	
		-	-	
PA_T_warn	Temperature warning threshold of power stage	°C	INT16	Modbus 4108
-		-	INT16	Profibus 4108
-		0	R/-	
		-	per.	
		-	-	

Monitoring parameters The device status and operating state can be monitored by means of various objects.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_SigActive	Current status of monitoring signals	-	UINT32	Modbus 7182
-	See _SigLatched for more details on the bit codes.	-	UINT32	Profibus 7182
-		0	R/-	
		-	-	
		-	-	

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_SigLatched	Saved status of monitoring signals	-	UINT32	Modbus 7184
STA- - SiGS	Signal status:	-	UINT32	Profibus 7184
5tR- - 5, 55	0: Not activated 1: Activated	0	R/-	
	Bit assignments: Bit 0: General fault Bit 1: Limit switches (LIMP/LIMN/REF) Bit 2: Out of range (SW limit switches, tuning) Bit 3: Quickstop via fieldbus Bit 4: Inputs STO are 0 Bit 5: Reserved Bit 6: RS485 fault Bit 7: CAN fault Bit 8: Ethernet fault Bit 9: Frequency of reference signal too high Bit 10: Fault current operating mode Bit 11: Reserved Bit 12: Profibus fault Bit 13: Reserved Bit 14: Undervoltage DC bus Bit 15: Overvoltage DC bus Bit 16: Mains phase missing Bit 17: Motor connection fault Bit 18: Motor overcurrent/short circuit Bit 19: Motor encoder fault Bit 20: Undervoltage 24VDC Bit 21: Overtemperature (power stage, motor) Bit 22: Tracking error Bit 23: Max. speed exceeded Bit 24: Inputs STO different Bit 25: Reserved Bit 26: Reserved Bit 27: Reserved Bit 28: Reserved Bit 29: EEPROM fault Bit 30: System booting (Hardware fault or parameter error) Bit 31: System error (e.g. watchdog)	-	-	
	Monitoring functions are product-dependent.			
_WarnActive	Active warnings, bit-coded	-	UINT16	Modbus 7190
-	See _WarnLatched for more details on the bit codes.	0	UINT16 R/-	Profibus 7190
-		-	-	

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_WarnLatched	Saved warnings, bit-coded	-	UINT16	Modbus 7192
STA- - WRNS	Saved warning bits are deleted in the case of a FaultReset.	-	UINT16	Profibus 7192
5LR- - Lrn5	Bits 10, 11, 13 are deleted automatically.	0	R/-	
	Signal status: 0: Not activated 1: Activated	-	-	
	Bit assignments: Bit 0: General warning (see _LastWarning) Bit 1: Temperature of power stage high Bit 2: Temperature of motor high Bit 3: Reserved Bit 4: Power stage overload (I ² t) Bit 5: Motor overload (I ² t) Bit 6: Braking resistor overload (I ² t) Bit 7: CAN warning Bit 8: Motor encoder warning Bit 9: RS485 protocol warning Bit 10: STO_A (PWRR_A) and/or STO_B (PWRR_B) Bit 11: DC bus undervoltage/missing mains phase Bit 12: Profibus warning Bit 13: Position not yet valid (position capture still running) Bit 14: Ethernet warning Bit 15: Reserved			
	Monitoring functions are product-dependent.			
_actionStatus	Action word	-	UINT16	Modbus 7176
-	Signal status: 0: not activated	0	UINT16	Profibus 7176
-	1: activated	-	R/-	
	Bit 0: Warning Bit 1: Error class 1 Bit 2: Error class 2 Bit 3: Error class 3 Bit 4: Error class 4 Bit 5: Reserved Bit 6: Drive is at standstill (<9 [1/min]) Bit 7: Drive rotates clockwise Bit 8: Drive rotates counter-clockwise Bit 9: Reserved Bit 10: Reserved Bit 11: Profile generator idle (reference speed is 0) Bit 12: Profile generator decelerates Bit 13: Profile generator accelerates Bit 14: Profile generator moves at constant speed Bit 15: Reserved			
_StopFault	Error number of last stop fault	-	UINT16	Modbus 7178
FLT- - STPF		-	UINT16	Profibus 7178
FLt- - 5tPF		0	R/-	
		-	-	
		-	-	

8.6.2.4 Ground fault and short-circuit monitoring

Function principle When the power stage is enabled, the device continuously monitors the motor phases for ground fault and short circuit. A ground fault or short circuit of one or more motor phases is detected. A ground fault of the DC bus is not detected.

8.6.3 Scaling

⚠ WARNING

UNEXPECTED MOVEMENT CAUSED BY CHANGED SCALING

Changing the scaling changes the effect of the values in user-defined units. The same motion commands can therefore cause different movements.

- Note that the scaling affects all relationships between the set values and the movements of the drive.
- Check the corresponding usr parameters and values of the system in user-defined units.

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

Description Scaling translates user units to internal units of the device, and vice versa. The device saves position values in user-defined units.

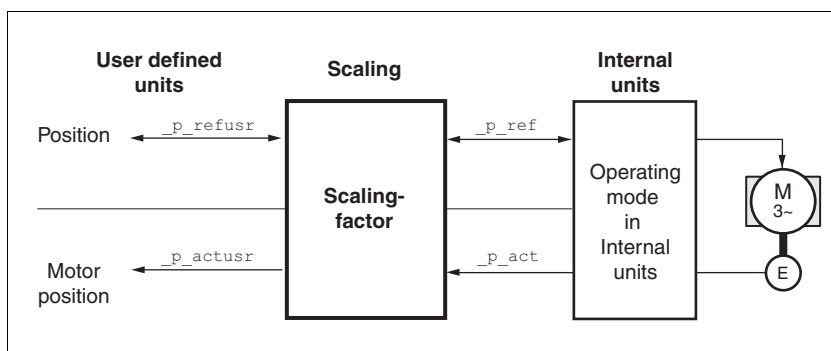


Figure 8.22 Scaling

Scaling factor The scaling factor is the relationship between the number of motor revolutions and the required user-defined units [usr].

$$\text{Scaling factor} = \frac{\text{Motor revolutions}}{\text{Change of the user position [usr]}}$$

Figure 8.23 Representation of the scaling factor

The scaling factor is set using the parameters `POSscaleNum` and `POSscaleDenom`. A new scaling factor is activated when you specify the numerator value.

When specifying the scaling factor, note that numerator and denominator can only be integer values. A scaling factor less than 1/131072 will limit the working range. An error is signaled when the working range is exceeded.

The scaling factor can only be changed when the power stage is disabled. Values in user-defined units are converted to internal units when the power stage is enabled.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
POSScaleNum	Numerator of position scaling	revolution	INT32	Modbus 1552
-	Specification of the scaling factor:	1	INT32	Profibus 1552
-	Motor revolutions [U]	2147483647	R/W	
	----- Change of user position [usr]		per.	-
	A new scaling is activated when the numerator value is supplied.			
	User limit values may be reduced due to the calculation of an internal factor.			
POSScaleDenom	Denominator of position scaling	usr	INT32	Modbus 1550
-	Refer to numerator (POSScaleNum) for a description.	1	INT32	Profibus 1550
-		16384	R/W	
-		2147483647	per.	-
	A new scaling is activated when the numerator value is supplied.			



If an existing device is replaced by this device, and if the same positioning commands are to be used, the scaling must be set in accordance with the settings used previously.

Default scaling

A value of 16384 user-defined units per motor revolution is set as the default scaling.

Examples

3 situations can be distinguished as far as setting user-defined units is concerned.

- Scaling corresponds to default scaling
1 motor revolution = 16384 user-defined units
=> Every eighth motor position can be approached.
- Scaling corresponds to motor resolution (minimum 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.

The following persistent parameters must be adapted in addition to the user-defined values to obtain the same positioning movement of the motor after changing the scaling factor: HMoutdisusr, HMdisusr, HMp_homeusr, HMsrchdisusr, JOGstepusr, SPVswLimPusr and SPVswLimNusr.

If the parameters are not adjusted, this may, for example, cause an incorrect reference movement since the distance to the switching edge of the limit switch or reference switch is no longer sufficient to leave the switching range.

Example 1 Positioning by 1111 user-defined units is to correspond to 3 motor revolutions. This results in

$$\text{Scaling factor} = \frac{3 \text{ rev}}{1111 \text{ usr}}$$

Figure 8.24 Calculation of the scaling factor, example 1

If you now start relative positioning by 900 user-defined units, the motor moves by $900 \text{ usr} * 3/1111 \text{ rev/usr} = 2.4302 \text{ revolutions}$.

Example 2 Calculation of a scaling factor in length units: 1 motor revolution corresponds to a distance of 100 mm. Each user-defined unit [usr] is to correspond to one step of 0.01 mm.

This means: $1 \text{ usr} = 0.01 \text{ mm} * 1 \text{ rev} / 100 \text{ mm} = 1/10000 \text{ revolutions}$.

$$\text{Scaling factor} = \frac{1 \text{ rev}}{10000 \text{ usr}}$$

Figure 8.25 Calculation of the scaling factor, example 2

Example 3 Setting positioning in 1/1000 rad

$$1 \text{ rad} = 1 \text{ rev} / (2 * \pi)$$

$$\pi = 3.1416 \text{ (rounded)}$$

$$\text{User value} = 1 \text{ usr}$$

$$\text{Device value} = 1 / (2 * \pi * 1000) \text{ U}$$

$$\text{Scaling factor} = \frac{1 \text{ rev}}{2 * 3,1416 * 1000 \text{ usr}} = \frac{1 \text{ rev}}{6283,2 \text{ usr}} = \frac{10 \text{ rev}}{62832 \text{ usr}}$$

Figure 8.26 Calculation of the scaling factor, example 3

8.6.4 Motion profile

Profile generator Target position and target speed of rotation are input values to be specified by the user. The profile generator uses these values to calculate a motion profile depending on the selected operating mode.

The values of the profile generator plus the values of a jerk limitation are transformed into a motor movement.

The acceleration and deceleration behavior of the motor can be described as a ramp function of the profile generator. The characteristic values of the ramp function are the ramp shape and the ramp steepness.

Ramp shape A linear ramp and a motor-optimized ramp are available for the acceleration and deceleration phases. The profile settings are valid for both directions of movement of the motor.

The linear ramp shape is used for "Quick Stop".

The motor-optimized ramp is used to compensate for the typical torque drop of a stepper motor at increasing speeds by reducing the acceleration.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMP_TypeSel	Selection of ramp type	-	INT16	Modbus 1574
-	-1 / motoroptimized: Motor-optimized ramp	-	INT16	Profibus 1574
-	0 / linear: Linear ramp	-	R/W per.	-

Start/stop speed A special property of stepper motors is the very fast acceleration from standstill, adjustable as the start-stop speed.

Depending on the load, the start-stop speed can be set to up to 60 min⁻¹. If the lower speed value is too low, the stepper motor may develop mechanical resonances with low external damping.

Too high a value for the start-stop speed can be detected by the fact that only reduced ramp values can be set for acceleration and deceleration.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMPnstart0	Start/stop speed	min ⁻¹	UINT16	Modbus 1570
-	Start and end speed of profile	-	UINT16	Profibus 1570
-		-	R/W per.	-

Ramp steepness The steepness of the ramp determines the speed changes of the motor per time unit. The ramp steepness can be set for the acceleration ramp via the parameter `RAMPacc` and for the deceleration ramp via `RAMPdecel`.

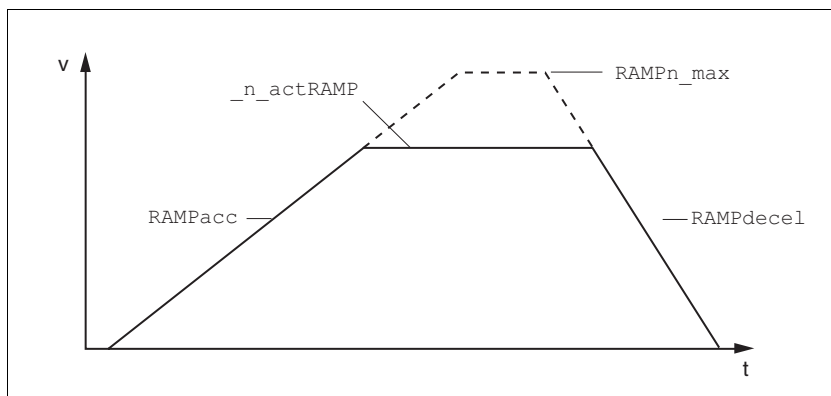


Figure 8.27 Acceleration and deceleration ramps

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMPacc	Acceleration of profile generator	min^{-1}/s 1 600 3000000	UINT32 UINT32 R/W per. -	Modbus 1556 Profibus 1556
RAMPdecel	Deceleration of profile generator	min^{-1}/s 200 750 3000000	UINT32 UINT32 R/W per. -	Modbus 1558 Profibus 1558
RAMPn_max	Limitation of ref. speed for op. modes with profile generation The parameter is active in the following operating modes: - Profile position - Profile velocity - Homing - Jog If a greater reference speed is set in one of these operating modes, it is automatically limited to RAMPn_max. This way, commissioning at limited speed is easy to perform.	min^{-1} 60 3000 3000	UINT16 UINT16 R/W per. -	Modbus 1554 Profibus 1554

Jerk limitation Jerk limitation removes sudden changes in the acceleration to obtain smooth, virtually jerk-free changes of the speed of rotation.

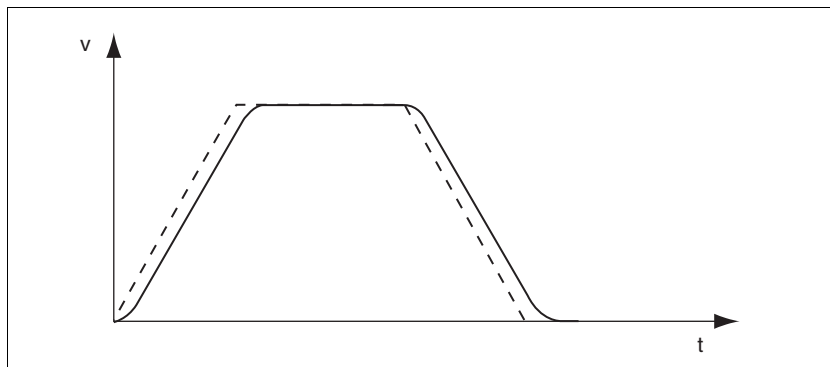


Figure 8.28 Speed curve with and without (dotted) jerk limitation

The jerk limitation is activated and adjusted via the parameter RAMP_TAUjerk.

The end of the movement ($x_{end} = 1$) is not signaled until the target position at the end of the jerk limitation has been reached.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMP_TAUjerk	Jerk limitation	ms	UINT16	Modbus 1562
-	0 / off: Off	0	UINT16	Profibus 1562
-	1 / 1: 1 ms	0	R/W	
-	2 / 2: 2 ms	128	per.	
	4 / 4: 4 ms		-	
	8 / 8: 8 ms			
	16 / 16: 16 ms			
	32 / 32: 32 ms			
	64 / 64: 64 ms			
	128 / 128: 128 ms			
	Limits the acceleration change (jerk) of the reference position generation during the positioning transitions: Standstill - acceleration Acceleration - constant speed Constant speed - deceleration Deceleration - standstill			
	Processing in the following operating modes: - Profile velocity - Profile position - Jog - Homing			
	Adjustments can only be made if the operating mode is inactive ($x_{end}=1$).			

8.6.5 Quick Stop

"Quick Stop" is a quick brake function which stops the motor as a result of an error of error classes 1 and 2 or as a result of a software stop.

In the event of an error response to an error of error class 1, the power stage remains enabled. In the case of error class 2, the power stage is disabled after the drive has come to a standstill.

"Quick Stop" ramp The "Quick Stop" ramp must be set in such a way that the drive comes to a standstill with the desired deceleration when the function is triggered.

The drive absorbs excess braking energy during deceleration. If the DC bus voltage exceeds the permissible limit the power stage is disabled and the device signals "DC bus overvoltage". The motor coasts down without any braking force.

If the device frequently signals "DC Bus Overvoltage" during "Quick Stop", you must reduce the drive load.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMPquickstop	Deceleration ramp for Quick Stop	min ⁻¹ /s 200	UINT32 UINT32	Modbus 1572 Profibus 1572
-	Deceleration of the drive when a software stop is triggered or if an error of error class 1 has occurred.	6000 3000000	R/W per. -	

"Quick Stop reset" A "Quick Stop" must be reset by a "Fault Reset".

If a "Quick Stop" has been triggered by the positive or negative limit switch the drive can be moved back into the movement range via the jog operating mode.

8.6.6 Halt

The function "Halt" decelerates the motor with a torque ramp. The parameter `LIM_I_maxHalt` specifies the current for the torque ramp.

After the drive has come to a standstill, the position is determined internally, position control is activated and the motor is held with the power stage enabled.

When all "Halt" requests are cleared, the interrupted movement is resumed. If the `HALT` signal is already cleared during deceleration, the drive continues to decelerate until it comes to a standstill and then accelerates again.

"Halt" ramp

The "Halt" ramp must be set in such a way that the drive comes to a standstill with the desired deceleration after a "Halt" request.

The drive absorbs excess braking energy during deceleration. If the DC bus voltage exceeds the permissible limit the power stage is disabled and the device signals "DC bus overvoltage". The motor coasts down without any braking force.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMPdecel	Deceleration of profile generator	min ⁻¹ /s 200 750 3000000	UINT32 UINT32 R/W per. -	Modbus 1558 Profibus 1558

8.6.7 Fast position capture

The "Fast Position Capture" function captures the current motor position at the point in time a digital 24V signal is available at a capture input.

Settings 2 independent capture inputs are available for the "Fast Position Capture" function.

- $\overline{\text{LIMP}}/\text{CAP1}$ (CAP1)
- $\overline{\text{LIMN}}/\text{CAP2}$ (CAP2)

One of 2 possible functions for capture can be selected for each capture input:

- One-time position capture
One-time capture means that the motor position is captured at the first edge.
- Continuous position capture
Continuous capture means that the motor position is captured anew at every edge. The the previous captured value is lost.

The position can be captured when the edge at the capture input rises or falls.

- ▶ Set the type of edge with the parameter `Cap1Config`.
- ▶ Set the type of method with the parameter `Cap1Activate`.

Continuous capture means that the motor position is captured anew at every defined edge; the previous captured value is lost.

Activating fast position capture Activating one-time position capture

- For CAP1: Write value 1 to parameter `Cap1Activate`
- For CAP2: Write value 1 to parameter `Cap2Activate`

Activating continuous position capture

- For CAP1: Write value 2 to parameter `Cap1Activate`
- For CAP2: Write value 2 to parameter `Cap2Activate`

Terminating position capture In the case of one-time position capture, the "Fast Position Capture" function is terminated when the first signal edge is detected.

In the case continuous position capture or if no signal edge is detected, the capture can be stopped by writing the parameter `Cap1Activate`, value 0 or `Cap2Activate`, value 0.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
Cap1Activate	Capture unit 1 start/stop	- 0	UINT16 UINT16	Modbus 2568 Profibus 2568
-	0 / Capture stop: Cancel capture function	-	R/W	
-	1 / Capture once: Start one-time capture	2	-	
-	2 / Capture continuous: Start continuous capture		-	
	In the case of one-time capture, the function is terminated when the first value is captured.			
	In the case of continuous capture, the function continues to run.			
	Position capture can only be activated in "fieldbus control mode".			
Cap1Config	Capture unit 1 configuration	- 0	UINT16 UINT16	Modbus 2564 Profibus 2564
-	0 / 1->0: Position capture at 1->0 change	0	R/W	
-	1 / 0->1: Position capture at 0->1 change	1	-	
-			-	
Cap1Count	Capture unit 1 event counter	- -	UINT16 UINT16	Modbus 2576 Profibus 2576
-	Counts the capture events.	0	R/-	
-	The counter is reset when capture unit 1 is activated.	-	-	
Cap1Pos	Capture unit 1 captured position	usr -	INT32 INT32	Modbus 2572 Profibus 2572
-	Captured position at the time of the "capture signal".	0	R/-	
-	The captured position is calculated again after "Position Setting" or "Homing".	-	-	
Cap2Activate	Capture unit 2 start/stop	- 0	UINT16 UINT16	Modbus 2570 Profibus 2570
-	0 / Capture stop: Cancel capture function	-	R/W	
-	1 / Capture once: Start one-time capture	2	-	
-	2 / Capture continuous: Start continuous capture		-	
	In the case of one-time capture, the function is terminated when the first value is captured.			
	In the case of continuous capture, the function continues to run.			
	Position capture can only be activated in "fieldbus control mode".			
Cap2Config	Capture unit 2 configuration	- 0	UINT16 UINT16	Modbus 2566 Profibus 2566
-	0 / 1->0: Position capture at 1->0 change	0	R/W	
-	1 / 0->1: Position capture at 0->1 change	1	-	
-			-	
Cap2Count	Capture unit 2 event counter	- -	UINT16 UINT16	Modbus 2578 Profibus 2578
-	Counts the capture events.	0	R/-	
-	The counter is reset when capture unit 2 is activated.	-	-	
-			-	

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
Cap2Pos	Capture unit 2 captured position	usr	INT32	Modbus 2574
-	Captured position at the time of the "capture signal".	-	INT32	Profibus 2574
-	The captured position is calculated again after "Position Setting" or "Homing".	0	R/-	
CapStatus	Status of the capture units	-	UINT16	Modbus 2562
-	Read access:	-	UINT16	Profibus 2562
-	Bit 0: position capture via input CAP1 carried out	0	R/-	
-	Bit 1: position capture via input CAP2 carried out	-	-	
-	Bit 2: position capture via index pulse actual position encoder carried out (used internally)	-	-	

8.6.8 Speed window

The reference speed is considered to have been reached if the speed of the drive is within the speed window $SPVn_win$ during the parameterized time $SPVn_winTime$.

The parameters $SPVn_win$ and $SPVn_winTime$ define the size of the window.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
$SPVn_win$	Speed window, permissible speed deviation	min^{-1} 1 30 65535	UINT16 UINT16 R/W per. -	Modbus 1576 Profibus 1576
$SPVn_winTime$	Speed window, time	ms 0 0 16383	UINT16 UINT16 R/W per. -	Modbus 1578 Profibus 1578
-	Value = 0: speed window monitoring deactivated			
-	Changing the value causes a restart of speed monitoring, feedback for reaching the reference speed is set to 0.			

8.6.9 Brake function

Holding brake The motor holding brake has the task of blocking the motor shaft when no current is supplied to the motor (for example, in the case of a vertical axis). The holding brake is not a safety function.

Adjustable parameters It is possible to parameterize a time delay for releasing the holding brake (BRK_trelease) and for applying the holding brake (BRK_tclose).

Releasing and applying the holding brake via the HMI The holding brake can be manually released and applied via the HMI. This requires the power stage to be disabled. Note that the load may drop in the case of vertical axes (Z axes) when the holding brake is released!

Select the HMI menu *5rU-* and the submenu *brRH* for releasing and applying the holding brake.

Time for releasing the holding brake The parameter BRK_trelease is used to specify the time the holding brake needs to be released. Enabling the power stage is delayed by the corresponding value.

The setting of the parameter BRK_trelease depends on the motor type and can be found in the motor data sheet.

If the parameter CTRLS_Toggle is activated, the stepper motor performs a small movement so that the stepper motor is not at an unstable position.

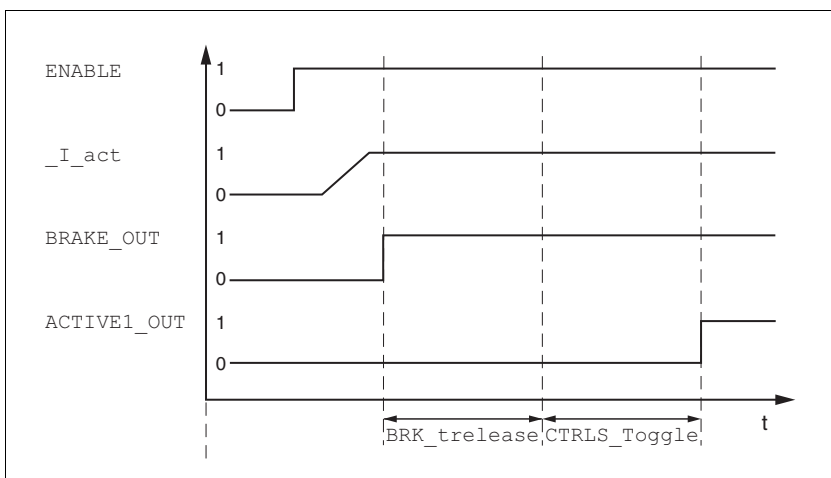


Figure 8.29 Releasing the holding brake

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_I_act	Total motor current	A _{rms}	INT16	Modbus 7720
STA- - iACT 5tR- - , R[<i>t</i>	In 0.01Arms	- 0.00 -	INT16 R/ -	Profibus 7720
BRK_trelease	Time delay during opening/releasing the holding brake	ms 0 1000	UINT16 UINT16 R/W per. -	Modbus 1294 Profibus 1294
DRC- - BTRE dr[- - btrE				

0198441113706, V2.03, 07.2010

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRLS_toggle	Toggle of motor when power stage is activated	-	UINT16	Modbus 5136
-	0 / inactive: Inactive	-	UINT16	Profibus 5136
-	1 / active: Active (default)	-	R/W per.	-

A motor with a released holding brake heats up. In the case of temperature-critical applications, a holding brake controller with voltage reduction can be used to reduce the heat build-up, see also motor manual. The holding brake controller integrated in the device has no voltage reduction.

Delayed application When the power stage is disabled, the holding brake is applied. However, current continues to be applied to the motor for the period of time defined with the parameter BRK_tclose.

The setting of the parameter BRK_tclose depends on the motor type and can be found in the motor data sheet.

The delay time is not effective if the power stage is disabled via the STO safety function. Especially in the case of vertical axes it is important to verify whether additional measures are required to avoid lowering of the load.

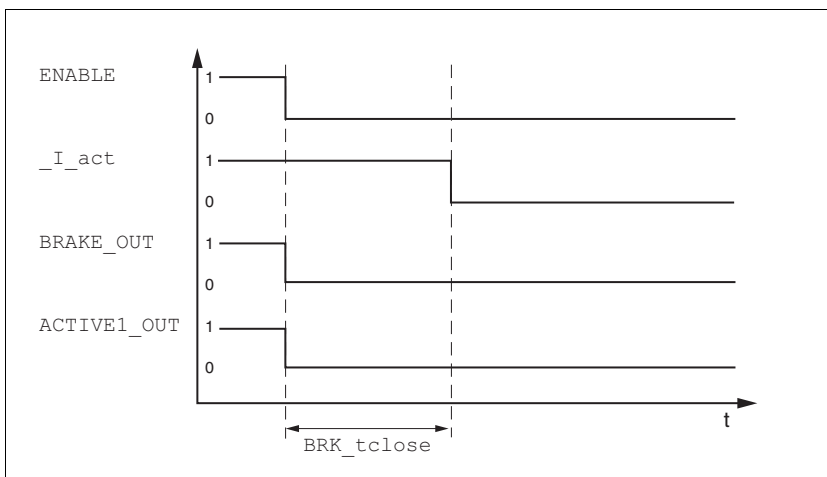


Figure 8.30 Applying the holding brake

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
$_I_{act}$	Total motor current	A_{rms}	INT16	Modbus 7720
STA- - iACT	In 0.01Arms	-	INT16	Profibus 7720
5tR- - , Rct		0.00	R/-	
		-	-	

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Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
BRK_tclose	Time delay during closing of holding brake	ms 0	UINT16 UINT16	Modbus 1296 Profibus 1296
DRC- - BTCL		100	R/W	
<i>drC - bCLL</i>		1000	per. -	

8.6.10 Reversal of direction of rotation

The parameter `POSdirOfRotat` can be used to reverse the direction of rotation of the motor. Note that changed settings do not become active until after the device is switched off and on again.

Connect the limit switch that limits the working range for positive direction of rotation to `LIMP`. Connect the limit switch that limits the working range for negative direction of rotation to `LIMN`.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
POSdirOfRotat	Definition of direction of rotation	- 0	UINT16 UINT16	Modbus 1560 Profibus 1560
DRC- - PRoT	0 / clockwise / CLL: Clockwise	0	R/W	
<i>drC - PrOt</i>	1 / counter clockwise / CLLL: Counter-clockwise	1	per. -	
	Meaning: At positive speeds, the drive rotates clockwise (looking at the motor shaft at the flange).			
	NOTE: If you use limit switches, you must interchange the limit switch connections after changing the settings. The limit switch which is reached with a jog movement in positive direction must be connected to the LIMP input and vice versa.			

If the direction of rotation of the motor must be reversed, all parameter values can be used unchanged.

Reversal of the direction of rotation changes the actual position `_p_actusr` determined by the device.

- Set the same direction of rotation during commissioning that will be used for later operation of this motor.

8.6.11 Restoring default values



All parameter values set by the user are lost in this process. It is possible at any time to save all parameter values set for a device as a configuration using the commissioning software.

8.6.11.1 Restoring the "First Setup"

The parameter `PARuserReset` is used to restore the settings made with the "First Setup". All parameter values are reset to the default values with the exception of the communication parameters. The data in the memory is deleted, but not written to the EEPROM. Particularly in fieldbus mode, this allows for a defined start behavior that ignores any changes you may have made via the HMI.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PARuserReset	Reset user parameters	-	UINT16	Modbus 1040
-	Bit 0 = 1: Set persistent parameters to default values.	0	UINT16	Profibus 1040
-	All parameters are reset with the exception of:	-	R/W	-
	- Communication parameters	7	-	-
	- Definition of the direction of rotation			
	- Signal selection position interface			
	- Motor type			
	- Processing of motor encoder position			
	NOTE: The new settings are not saved to the EEPROM!			

8.6.11.2 Restoring the factory settings

The parameter `PARfactorySet` is used to restore the factory settings. All parameter values are reset to the default values.

- ▶ Disconnect the product from the the fieldbus in order to avoid conflicts by simultaneous access.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PARfactorySet	Restore factory settings (default values)	-		
DRC- - FCS	0 / No / n0: No	0	R/W	
drE- - FL5	1 / Yes / YE5: Yes	3	-	
	All parameters are set to their default values, these are saved to the EEPROM. Restoring the factory settings is possible via the HMI or the commissioning software. The saving process is complete when the parameter is read and 0 is returned.			
	NOTE: The default becomes active only when the unit is switched on the next time.			

- Factory settings via HMI* ► Select $dr\bar{E}$ and then $F\bar{E}5$ at the HMI and confirm the selection with $\bar{y}E5$.

All parameter values are reset to the default values. See also "First Setup", page 96.

The new settings only become active until after the device is switched off and on again.

Factory settings via commissioning software

The factory settings are loaded via the menu items Configuration => Factory Settings. All parameter values are reset to the default values. See also "First Setup", page See also First Setup, page 96..

The new settings only become active until after the device is switched off and on again.

8.6.11.3 Duplicating existing device settings

CAUTION

DAMAGE TO THE PRODUCT CAUSED BY POWER OUTAGE

If the supply voltage becomes unavailable during an update, the product will be damaged and must be sent in for repair.

- Do not switch off the supply voltage during the update.
- Update the firmware only with a reliable supply voltage.

Failure to follow these instructions can result in equipment damage.

- Application and advantage*
- Multiple devices are to have the same settings, for example, when devices are replaced.
 - The "First Setup" does not have to be run via the HMI.
- Prerequisites*
- Device type, motor type and device firmware must be identical. The tool to be used is the Windows-based commissioning software. The controller supply voltage must be switched on at the device.
- Device settings: Saving*
- The commissioning software can save the settings of a device in the form of a configuration file.
- Save the configuration of the device via "File - Save".
- Device settings: Opening*
- You can copy a stored configuration to a device of the same type. Please note that the fieldbus address is copied along with this information.
- In the commissioning software, select "File - Open" and load the desired configuration.

9 Examples

9.1 Wiring

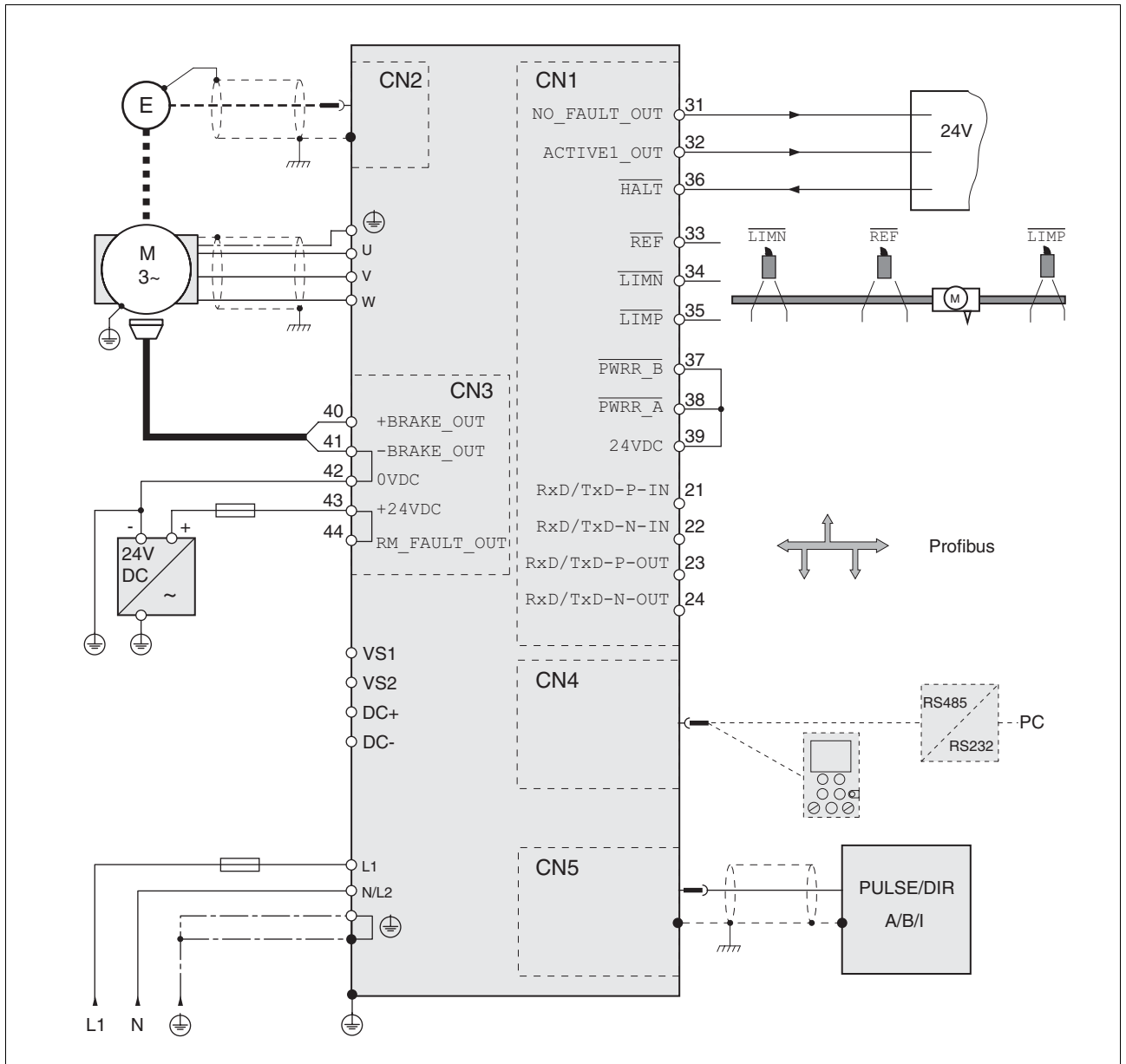


Figure 9.1 Wiring example

9.2 Wiring STO

Using the safety functions integrated in this product requires careful planning. For more information see chapter 5.1 "Safety function STO ("Safe Torque Off")" on page 37.

10 Diagnostics and troubleshooting

10.1 Service

If you cannot resolve an error yourself please contact your sales office. Have the following details available:

- Nameplate (type, identification number, serial number, DOM, ...)
- Type of error (such as LED flash code or error number)
- Previous and concomitant circumstances
- Your own assumptions concerning the cause of the error

Also include this information if you return the product for inspection or repair.

10.2 Error responses and error classes

Error class The product triggers an error response if it switches to the operating state Fault as a result of an error. Depending upon the severity of the fault, the device responds in accordance with one of the following error classes:

Error class	Response	Meaning
0	Warning	Message only, no interruption
1	"Quick Stop"	Motor stops with "Quick Stop", power stage and controller remain switched on and enabled.
2	"Quick Stop" with switch-off	Motor stops with "Quick Stop", power stage and controller are disabled after standstill has been achieved.
3	Fatal error	Power stage and controller switch off immediately without stopping the motor first.
4	Uncontrolled operation	Power stage and controller switch off immediately without stopping the motor first. The error response can only be reset by switching the device off.

The device signals the occurrence of an event in the following way:

Event	State	HMI display	Cause of last stop (_StopFault)	Entry in error memory
Halt	Operation Enabled	<i>hRLt</i>	-	-
Software stop	Quick Stop active	<i>StoP A306</i>	E A306	-
Hardware limit switch (for example <i>LIMP</i>)	Quick Stop active	<i>StoP A302</i>	E A302	E A302
Error of error class 1	Quick Stop active	<i>StoP A320</i>	E A320	E A320
Error of error class>1	Fault	<i>FLt A320</i>	E A320	E A320

10.3 Error indication

The last cause of stop and the last 10 error messages are stored. The HMI allows you to display the last cause of stop; the commissioning software and the fieldbus let you display the last 10 error messages in addition to the last cause of stop. For a description of all error numbers, see page 189.

10.3.1 State diagram

After switching on and when an operating mode is started, the product goes through a number of operating states.

The state diagram (state machine) shows the relationships between the operating states and the state transitions.

The operating states are monitored and influenced by internal monitoring functions and system functions such as temperature monitoring or current monitoring.

Graphical representation The state diagram is represented as a flow chart.

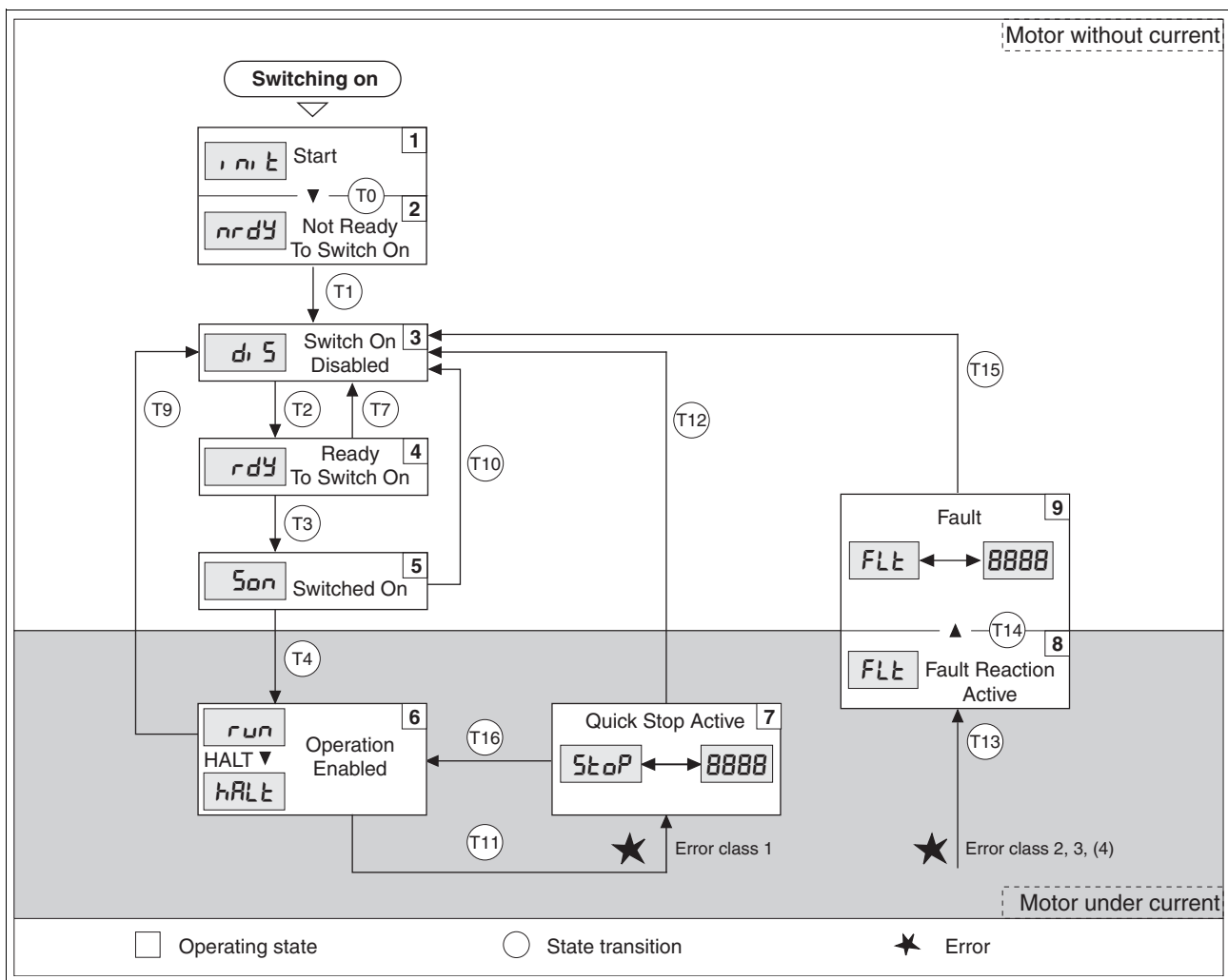


Figure 10.1 State diagram

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Operating states The operating states are displayed by default by the HMI and the commissioning software.

Display	Operating state	Description of operating state
<i>i n i t</i>	1 Start	Controller supply voltage on, electronics are being initialized
<i>n r d y</i>	2 Not ready to switch on	The power stage is not ready to switch on
<i>d i s</i>	3 Switch on disabled	Enabling of power stage locked
<i>r d y</i>	4 Ready to switch on	The power stage is ready to switch on
<i>5 o n</i>	5 Switched on	Motor not supplied with current Power stage ready No operating mode active
<i>r u n</i> <i>h a l t</i>	6 Operation enable	<i>r u n</i> : Selected operating mode is active <i>h a l t</i> : Motor is stopped, power stage is enabled
<i>5 t o P</i>	7 Quick Stop active	"Quick Stop" is being executed
<i>F L t</i>	8 Fault Reaction active	An error has been detected, error response activated
<i>F L t</i>	9 Fault	Operating state "Fault"

State transitions State transitions are triggered by an input signal, a fieldbus command or as a response to a monitoring signal.

Transi- tion	Operating state	Condition / event ^{1) 2)}	Response
T0	1-> 2	• Device electronics successfully initialized	
T1	2-> 3	• Parameter successfully initialized	
T2	3-> 4	• No undervoltage Encoder successfully checked Actual speed: <1000 min ⁻¹ $\overline{\text{STO_A}} (\overline{\text{PWRR_A}})$ and $\overline{\text{STO_B}} (\overline{\text{PWRR_B}}) = +24\text{V}$	
T3	4-> 5	• Request for enabling the power stage	
T4	5-> 6	• Automatic transition	Power stage is enabled User-defined parameters are checked Holding brake is released (if available)
T7	4-> 3	• Undervoltage • $\overline{\text{STO_A}} (\overline{\text{PWRR_A}})$ and $\overline{\text{STO_B}} (\overline{\text{PWRR_B}}) = 0\text{V}$ • Actual speed: >1000 min ⁻¹ (for example by external driving force)	-
T9	6-> 3	• Request for disabling the power stage	Power stage is immediately disabled.
T10	5-> 3	• Request for disabling the power stage	
T11	6-> 7	• Class 1 error	Motion command is canceled with "Quick Stop".
T12	7-> 3	• Request for disabling the power stage	Power stage is disabled immediately, even if "Quick Stop" is still active.
T13	x-> 8	• Error of classes 2, 3 or 4	Error response is carried out, see "Error Response"
T14	8-> 9	• Error response terminated (error of class 2) • Error of classes 3 or 4	
T15	9-> 3	• Function: "Fault Reset"	Error is reset (cause of error must be corrected).

Transition	Operating state	Condition / event ^{1) 2)}	Response
T16	7 -> 6	• Function: "Fault reset"	

1) In order to initiate a state transition it is sufficient if one condition is met
 2) Fieldbus commands only with fieldbus control mode

10.3.2 Error indication at the HMI

- State indication uL oL* The display shows uL oL (WDOG) during initialization. The controller supply voltage is too low.

 - ▶ Check controller supply voltage.

- State indication nr dY* The product remains in the state nr dY (NRDY).

 - ▶ After the "First Setup", you must switch the device off and on again.
 - ▶ Finally, verify proper installation.
 If the installation is correct, then there is an internal error. To diagnose the error, read out the error memory using the commissioning software.
 If you cannot resolve the error yourself please contact your sales office.

- State indication d, 5* If the product remains in the state d, 5 (DIS), there is no DC bus voltage or the safety function STO is active.

 - ▶ Check the following:
 - Is the safety function STO active?
 - Verify correct installation of the signal connections. Pay particular attention to the minimum assignment, see page 6.3.12 "Connecting the digital inputs/outputs (CN1)".
 - Is the mains voltage to the power stage on and does the voltage correspond to the specifications in the technical data?

- State indication FLt* The display alternately shows FLt (FLT) and a 4-digit error number. The error number can also be found in the list of the error memory. See chapter 10.5 "Table of error numbers" for the meaning of the error number.

- State indication St oP* The HMI displays St oP (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.

 - ▶ Fix the cause of the error and acknowledge the error.

- State indication Wd oL* The display shows Wd oL (WDOG) during initialization. Internal monitoring has detected an error (watchdog).

 - ▶ Contact technical support. Inform the support of the conditions under which the error occurred (operating mode, application).
 - ▶ The error can be reset by switching the device off and on again.

- Cause of last stop*

 - ▶ Press the ENT key on the HMI to acknowledge the current error message.
 - ▶ Display the FLt menu. The last cause of stop (parameter `_StopFault`) is displayed in the form of an error number, see chapter 10.5 "Table of error numbers".

10.3.3 Error indication using the commissioning software

- You need a PC with the commissioning software and a working connection to the product, see chapter 6.3.13 "Connecting a PC or a remote terminal (CN4)", page 79.
- ▶ Select "Diagnostics - Error memory". A dialog box which shows the error messages is displayed.

The commissioning software shows a 4 digit error number in the list of the error memory with a prefixed "E".

The error messages are displayed along with the status, error class, time when the error occurred and a short description. The "Additional information" lets you verify the exact conditions when the error occurred.

- ▶ Correct the error and reset the error message.
In the case of errors of class 4, you must switch off the controller supply voltage and switch it on again.

10.3.4 Error indication via the fieldbus

Error indication via process data Errors are indicated via the process data PZD1, `driveStat`. Error bit 15 `x_err` is set.

If a request for an operating mode sent via the transmit data telegram cannot be processed, the slave rejects processing and sets `modeStat`, Bit 6 (ModeError) in the receive data telegram. This does not interrupt the current process. To determine the cause of the error, the master can read the error number from the parameter `ModeError`, 6962:00 by means of an access via the parameter channel.

The error indication is reset when the next valid data telegram is transmitted.

Cause of last stop The parameter `_StopFault` allows you to read out of the error number and the last cause of stop. If there is no error, the value of the parameter is 0. If an error occurs, the error is written to the error memory along with other status information. In the case of subsequent errors, only the triggering cause of error is stored.

Error memory The error memory is an error history of the last 10 errors; it is not cleared even if the device is switched off. The following parameters allow you to manage the error memory:

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
FLT_del_err	Clear error memory	-	UINT16	Modbus 15112
-	1: Delete all entries in the error memory	0	UINT16	Profibus 15112
-	The clearing process is completed if a 0 is returned after a read access.	1	R/W	-
FLT_MemReset	Reset error memory read pointer	-	UINT16	Modbus 15114
-	1: Set error memory read pointer to oldest error entry.	0	UINT16	Profibus 15114
-		1	R/W	-
-			-	-

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 set to the next entry; a read access delivers the next error entry. If the error number 0 is returned there is no error entry.

Position of the entry	Meaning
1	1st error entry, oldest message
2	2nd error entry, later message, if present
...	...
10	10th error entry. In the case of 10 error entries, the most recent error value is contained here.

An individual error entry consists of several pieces of information which are read out using various parameters. When you read out an error entry, the error number must be read out first with the parameter `FLT_err_num`.

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
FLT_err_num	Error number	-	UINT16	Modbus 15362
-	Reading this parameter copies the entire error entry (error class, time of occurrence of error, ...) to an intermediate memory from which all elements of the error can then be read.	0	UINT16	Profibus 15362
-		65535	R/-	-
-	In addition, the read pointer of the error memory is automatically set to the next error entry.		-	-

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
FLT_class	Error class	-	UINT16	Modbus 15364
-	0: Warning (no response)	0	UINT16	Profibus 15364
-	1: Error (Quick Stop -> state 7)	-	R/-	
-	2: Error (Quick Stop -> state 8, 9)	4	-	
	3: Fatal error (state 9, can be acknowledged)		-	
	4: Fatal error (state 9, cannot be acknowledged)			
FLT_Time	Error time	s	UINT32	Modbus 15366
-	With reference to operating hours counter	0	UINT32	Profibus 15366
-		-	R/-	
-		536870911	-	
			-	
FLT_Qual	Error additional information	-	UINT16	Modbus 15368
-	This entry contains additional information on the error, depending on the error number.	0	UINT16	Profibus 15368
-	Example: a parameter address	-	R/-	
		65535	-	
			-	

10.4 Troubleshooting

10.4.1 Troubleshooting problems

Problem	Cause	Troubleshooting
Motor does not rotate	Motor blocked by holding brake	Release holding brake, check wiring.
Motor phase interrupted	Check motor cable and connection. One or more motor phases are not connected.	
No torque	Set parameter for current to a value greater than zero.	
Incorrect operating mode selected	Set the input signal and parameters for the desired operating mode.	
Drive system switched off	Switch on drive system, generate enable signal.	
Motor mechanically blocked	Check coupled components.	
Motor rotates in the wrong direction	Motor phases reversed	Check motor cable and connection: Connect motor phases U, V and W in the same way at the motor and device ends.
Motor temperature too high	incorrect motor type set	Select the correct motor type; reduce the maximum motor current; use holding brake controller with voltage reduction for motors with holding brake, see motor manual.
Short motor movement with shutdown by rotation monitoring	Motor phases reversed	Check motor cable and connection: Connect motor phases U, V and W in the same way at the motor and device ends.
Encoder problem	Check encoder cable.	
Error message communication error	Drive system switched off	Switch on the drive system.
Wiring error	Verify proper wiring.	
Wrong PC interface selected	Select correct interface.	
Error message temperature	Poor or no air circulation, Fan (SD32●●U68 only) defective, blocked or not connected, overload	Check air circulation, replace or connect fan of SD32●●U68, reduce runtime for peak current, load or peak torque,

10.4.2 Troubleshooting of errors sorted by error bit

To facilitate troubleshooting, all error numbers are categorized by so-called error bits. The error bits can be read using the parameter `_SigLatched`. Signal status "1" indicates an error or warning message.

Error bit	Meaning	Error class	Cause	Troubleshooting
0	General error	0		
1	Limit switch (LIMP/LIMN/REF)	1	Limit switch is or was activated, line interrupted	Move drive into movement range, match positioning data to axis range, special message in error memory
2	Range of travel exceeded (software limit switch)	1	Motor not in range of travel	Check range of travel, home the drive again
3	"Quick Stop" via fieldbus	1	Fieldbus command	
4	Inputs $\overline{STO_A}$ ($\overline{PWRR_A}$) and $\overline{STO_B}$ ($\overline{PWRR_B}$) are "0"	3	STO safety function was triggered	Check guard door, cabling
5	Reserved			
6	RS485 fieldbus error, Modbus		Interruption of fieldbus communication, RS485 only, for example Modbus	Check the communication cables, check the fieldbus, check the communication parameters, see also fieldbus manual
8	Reserved			
9	Incorrect reference signals (frequency too high)		Frequency too high, interference	EMC measures, do not exceed maximum frequency (technical data)
10	Error in processing of the current operating mode	2	Processing error in operating modes Electronic Gear, Homing or Jog.	For detailed information see additional information in the error memory
11	Reserved			
12	Profibus fieldbus error	0	Interruption of fieldbus communication, Profibus only	Check the communication cables, check the fieldbus, check the communication parameters, see also fieldbus manual
13	Reserved			
14	DC bus undervoltage	2 3	DC bus voltage below threshold value for "Quick Stop" DC bus voltage below threshold value for switching off the drive	Check or increase mains voltage Check for power outage
15	DC bus overvoltage	3	DC bus overvoltage, deceleration too fast	Extend the deceleration phase
17	Connection to motor (motor phase interrupted, ground fault, commutation)	3	Short circuit or ground fault in motor phase or encoder cable. Motor problem. External torque exceeds the motor torque (selected motor current too low).	Check connections, replace motor cable or encoder cable. Replace motor. Reduce external torque or increase the motor current.
18	Motor overload (phase current too high)	3	I^2t monitoring for motor	Reduce load, use a motor with a greater nominal power

Error bit	Meaning	Error class	Cause	Troubleshooting
20	Undervoltage controller supply voltage		Controller supply voltage has fallen below the minimum value	Check controller supply voltage. Check for short-term voltage dips during load changes
21	Temperature too high (power stage or motor)	3	Power stage overheated Motor overheated Temperature sensor not connected	Fan defective or blocked, reduce runtime for peak current, load or peak torque Allow motor to cool down, reduce load, use motor with greater nominal power, temperature sensor defective, check/replace motor encoder cables; use holding brake controller with voltage reduction for motors with holding brake, see motor manual.
22	Rotation monitoring error	3	Rotation monitoring error	Reduce external load or acceleration
24	Inputs $\overline{STO_A}$ ($\overline{PWRR_A}$) and $\overline{STO_B}$ ($\overline{PWRR_B}$) are different	4	Interruption of the signal wires	Check signal cable and signal connection, check signal source, replace
25 ... 28	Reserved			
29	EEPROM error	3-4	Checksum in EEPROM incorrect	Run a "First Setup", save the user-defined parameters to the EEPROM, contact your local sales office
30	System start-up error (hardware or parameter error)	3-4	Cause of error as indicated	Resolution depends on indicated cause of error
31	Internal system error (for example Watchdog)	4	Internal system error System error, e.g. division by 0 or timeout checks, inadequate EMC	Switch device off and on, replace device Comply with EMC measures, switch device off and on, contact your local sales office

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 with the error class, the error class is parameterizable.

Error number categories:

Error number	range
E 1xxx	General
E 2xxx	Overcurrent
E 3xxx	Voltage
E 4xxx	Temperature
E 5xxx	Hardware
E 6xxx	Software
E 7xxx	Interface, wiring
E Axxx	Motor movement
E Bxxx	Communication

Information on error bits and troubleshooting can be found on page 187.

Error number	Class	Bit	Description, cause and correctives
E 1100	-	-	Parameter out of permissible range
E 1101	-	-	Parameter does not exist Fault signaled by parameter management: parameter (index) does not exist.
E 1102	-	-	Parameter does not exist Fault signaled by parameter management: parameter (subindex) does not exist.
E 1103	-	-	Parameter write not permissible (READ only) Write access to read only parameter.
E 1104	-	-	Write access denied (no access authorization) Parameter only accessible at expert level. The write access level expert is required.
E 1106	-	-	Command not allowed while power stage is active Command not allowed while the power stage is enabled (state "OperationEnable" or "QuickStopActive"). Disable the power stage and repeat the command.
E 1107	-	-	Access via other interface blocked Access occupied by another channel (e.g.: commissioning software is active and fieldbus access was tried at the same time). Check the channel that blocks the access.
E 110B	3	30	Initialization error (additional info=Modbus register address) Error detected at power enable parameter check e.g. reference speed value for profile position is greater than max. allowed speed of drive. Value in additional error info shows the Modbus register address of the parameter where the initialization error was detected.
E 110C	-	-	Write access only allowed for a motor specified by the user

Error number	Class	Bit	Description, cause and correctives
E 110D	1	0	Basic configuration of controller required after factory setting The "First Setup" (FSU) was not run at all or not completed.
E 110E	-	-	Parameter changed that requires a restart of the drive Only displayed by the commissioning software. A parameter modification requires the drive to be switched off and on. Restart the drive to activate the parameter functionality. Check the parameter chapter for the parameter that required a restart of the drive.
E 1300	3	4	Safety function STO activated The safety function STO was activated in "Operation enable" state. Reset the fault; check the wiring of the STO inputs.
E 1301	4	24	STO_A (PWRR_A) and STO_B (PWRR_B) different level The levels of the inputs STO_A (PWRR_A) and STO_B (PWRR_B) were different for more than 1 second. The drive has to be switched off and the reason fixed (e.g.: check emergency stop active) before it is switched on.
E 1310	3	9	Reference signal frequency too high The frequency of the pulse signal (A/B, Pulse/Direction, CW/CCW) is higher than the allowed value. Adapt the output pulse frequency of the controller to fit the input specification of the drive. Take care to also adapt the electronic gear ratio for the application requirements (position accuracy and speed).
E 1312	-	-	Limit or reference switch signal in I/O functions not defined Reference movements require limit switches. These limit switches are not assigned to inputs. Assign the LIMP, LIMN and REF functions to the inputs.
E 2300	3	18	Power stage overcurrent Motor short circuit and deactivation of the power stage. Check the motor power connection.
E 3200	3	15	DC bus overvoltage Excessive regeneration during braking. Check deceleration ramp, check dimensioning of drive and braking resistor.
E 3201	3	14	DC bus undervoltage (switch-off threshold) Power supply loss, poor power supply.
E 3202	2	14	DC bus undervoltage (Quick Stop threshold) Power supply loss, poor power supply.
E 3206	0	11	DC bus undervoltage, no mains phase (warning) Power supply loss, poor power supply.
E 4100	3	21	Power stage overtemperature Transistors overtemperature: ambient temperature is too high, fan is inoperative, dust. Improve the heat dissipation.

Error number	Class	Bit	Description, cause and correctives
E 4101	0	1	Warning power stage overtemperature Transistors overtemperature: ambient temperature is too high, fan is inoperative, dust. Improve the heat dissipation.
E 4102	0	4	Power stage overload (I2t) warning The current has exceeded the nominal value for an extended period of time. Check dimensioning, reduce cycle time.
E 4200	3	21	Device overtemperature Board overtemperature: ambient temperature is too high.
E 4300	3	21	Motor overtemperature Resistance of thermal sensor is too high; overload, ambient temp (see I2t); encoder cable. Check motor installation: the heat must be dissipated via the mounting surface. Check encoder cable.
E 4302	0	5	Motor overload (I2t) warning The current has exceeded the nominal value for an extended period of time.
E 4303	3	21	Motor overtemperature or motor encoder not connected
E 5600	3	17	Motor connection phase fault Motor phase(s) are not connected . Check connection of motor phases.
E 610D	-	-	Error in selection parameter Wrong parameter value selected. Check the value to be written.
E 7100	4	30	System error: invalid power stage data Power stage data stored in device is corrupt (wrong CRC), error in internal memory data. Contact technical support or replace the device.
E 7122	4	30	Invalid motor data Motor data stored in motor encoder is corrupt, error in internal memory data. Contact technical support or replace the motor.
E 7123	4	30	Motor current offset outside permissible range Motor current measurement circuit is defective. Contact technical support or replace the device.
E 7338	0	13	No valid motor absolute position Warning to inform you that absolute position has not yet been determined. Depending on application, fix the absolute position. Device still usable and all functions are OKAY.
E 7500	0	9	RS485/Modbus: overrun error EMC; cabling problem. Check cables.

Error number	Class	Bit	Description, cause and correctives
E 7501	0	9	RS485/Modbus: framing error EMC; cabling problem. Check cables.
E 7502	0	9	RS485/Modbus: parity error EMC; cabling problem. Check cables.
E 7503	0	9	RS485/Modbus: receive error EMC; cabling problem. Check cables.
E A060	2	10	Calculated speed in electronic gear/pulse control too high Gear ratio or speed reference value too high Reduce the gear ratio or speed reference value.
E A061	2	10	Position change in reference value with electronic gear/pulse control too high Position reference change is too high. Reference value input signal disturbance. Reduce the resolution of the master. Check reference value input signal.
E A062	2	10	Position offset between Topac filter input position and output position too great
E A063	2	10	Reference speed at Topac filter input too great
E A064	2	10	Speed of rotation difference (reference pulse frequency - current motor speed) at Topac filter too great
E A300	-	-	Braking procedure after HALT request still active HALT was removed too soon. New command was sent before motor standstill was reached after a HALT request. Wait for complete stop before removing HALT signal. Wait until motor has come to a complete standstill.
E A301	-	-	Drive in state 'Quick Stop active' Error with error class 1 occurred. Drive stopped with Quick Stop command.
E A302	1	1	Interruption by LIMP LIMP was activated because working range was exceeded, misoperation of limit switch or signal disturbance. Check application. Check limit switch function and connection.
E A303	1	1	Interruption by LIMN LIMN was activated because working range was exceeded, misoperation of limit switch or signal disturbance. Check application. Check limit switch function and connection.
E A305	-	-	Power stage cannot be activated in the current operating state (state diagram) Fieldbus: trying to enable the power stage in operating state "Not ready to switch on". Refer to the state diagram in the operation chapter of the manual.

Error number	Class	Bit	Description, cause and correctives
E A306	1	3	<p>Interruption by user-initiated software stop</p> <p>Drive is in state "Quick Stop active" due to a software stop request. The activation of a new operating mode is not possible, the error code is sent as the response to the activation command.</p> <p>Clear break condition with command Fault Reset.</p>
E A307	-	-	<p>Interruption by internal software stop</p> <p>In homing and jog modes, the movement is internally interrupted using an internal software stop. The activation of a new operating mode is not possible, the error code is sent as the response to the activation command.</p> <p>Clear break condition with command Fault Reset.</p>
E A308	-	-	<p>Drive in state 'Fault'</p> <p>Error with error class 2 or higher occurred.</p> <p>Check error code (HMI or commissioning tool), remove error condition and clear error state with command Fault Reset.</p>
E A309	-	-	<p>Drive not in state 'Operation Enable'</p> <p>A command which requires the state "Operation enable" was sent (e.g.: omode change).</p> <p>Set drive to state "OperationEnable" and repeat the command.</p>
E A310	-	-	<p>Power stage not active</p> <p>Command is not possible because the power stage is not enabled (state "Operation Enabled" or "Quick Stop").</p> <p>Set drive to a state with the power stage enabled, refer to the state diagram in the operation chapter of the manual.</p>
E A313	-	-	<p>Position overrun, reference point is therefore no longer defined (ref_ok=0)</p> <p>The position range limits were exceeded which resulted in a loss of the reference point. An absolute movement cannot be made until the definition of a new reference point.</p> <p>Define a new reference point by means of homing mode.</p>
E A314	-	-	<p>No reference position</p> <p>Command needs a defined reference point (ref_ok=1).</p> <p>Define a new reference point by means of homing mode.</p>
E A315	-	-	<p>Homing active</p> <p>Command not possible if homing is active.</p> <p>Wait until homing movement is finished.</p>
E A317	-	-	<p>Drive is not at standstill</p> <p>Command sent which is not allowed when the motor is not at a standstill e.g.</p> <ul style="list-style-type: none"> - change of software limit switches - change of handling of monitoring signals - setting of reference point - teach in of data set <p>Wait until motor has come to a standstill (x_end = 1).</p>
E A318	-	-	<p>Operating mode active (x_end=0)</p> <p>Activation of a new operating mode is not possible while the current operating mode is still active.</p> <p>Wait until the command in the operating mode has finished (x_end=1) or terminate current operating mode with HALT command.</p>

Error number	Class	Bit	Description, cause and correctives
E A31B	-	-	<p>HALT requested</p> <p>Command not allowed while a HALT is requested.</p> <p>Clear HALT request and repeat command.</p>
E A31C	-	-	<p>Invalid position setting with software limit switch</p> <p>Value for negative (positive) software limit switch is greater (less) than value for positive (negative) software limit switch.</p> <p>Homing position value is set outside the range of the software limits.</p> <p>Set correct position values.</p>
E A31D	-	-	<p>Speed range overflow ('CTRL_n_max')</p> <p>The reference speed value was set to a value greater than the max. speed defined in 'CTRL_n_max'.</p> <p>Increase the value of 'CTRL_n_max' or reduce the reference speed value.</p>
E A31E	1	2	<p>Interruption by positive software limit switch</p> <p>Command not possible because of overtravel of positive software limit switch.</p> <p>Jog back to software limit range.</p>
E A31F	1	2	<p>Interruption by negative software limit switch</p> <p>Command not possible because of overrun of negative software limit switch.</p> <p>Jog back to software limit range.</p>
E A320	par.	22	<p>Tracking error too high</p> <p>External load or acceleration are too high.</p> <p>Reduce external load or acceleration, error response is adjustable via 'Flt_pDiff'.</p>
E A321	-	-	<p>RS422 position interface is not defined as input signal</p> <p>RS422 interface is defined as output (e.g. ESIM) at start of electronic gear mode.</p> <p>Define RS422 interface as input via 'IOposInterfac' parameter.</p>
E A324	1	10	<p>Error during homing (additional info = detailed error number)</p> <p>Homing movement was stopped by an error, the detailed reason is indicated by the additional info in the error buffer.</p> <p>Possible sub error codes: EA325 EA326 EA327 EA328 EA329</p>
E A325	1	10	<p>Limit switch to be approached not enabled</p> <p>Homing to LIMP or LIMN and limit switches are disabled.</p> <p>Enable limit switch via 'IOsigLimP' or 'IOsigLimN'.</p>
E A326	1	10	<p>REF switch not found between LIMP and LIMN</p> <p>REF input switch defective or not correctly connected.</p> <p>Check the function and wiring of the REF switch.</p>
E A327	1	10	<p>Reference movement to REF without direction reversal, improper enabling of limit switch LIM</p> <p>Search of REF without direction reversal in positive (negative) direction with LIMP (LIMN) activated.</p> <p>Check the function and wiring of the LIMP (LIMN) switch.</p>

Error number	Class	Bit	Description, cause and correctives
E A328	1	10	Reference movement to REF without direction reversal, overrun of LIM or REF not permissible Search of REF without direction reversal and REF or LIM overtravel. Reduce homing speed ('HMn') or increase deceleration ('RAMPdecel'). Check the function and wiring of LIMP, LIMN and REF switch.
E A329	1	10	More than one signal LIMP/LIMN/REF active REF or LIM not connected correctly or supply voltage for switches too low. Check the wiring and 24VDC supply voltage.
E A32A	1	10	Ext. monitoring signal LIMP with neg. direction of rotation Start reference movement with neg. direction of rotation (e.g. reference movement to LIMN) and activate the LIMP switch (switch in opposite direction of movement). Check correct connection and function of limit switch. Activate a jog movement with negative direction of rotation (target limit switch must be connected to the inputs LIMN).
E A32B	1	10	Ext. monitoring signal LIMN with pos. direction of rotation Start reference movement with pos. direction of rotation (e.g. reference movement to LIMP) and activate the LIMN switch (switch in opposite direction of movement). Check correct connection and function of limit switch. Activate a jog movement with positive direction of rotation (target limit switch must be connected to the inputs LIMP).
E A32C	1	10	REF error (switch signal briefly enabled or switch overtraveled) Switch signal disturbance. Motor subjected to vibration or shock when stopped after activation of the switch signal. Check supply voltage, cabling and function of switch. Check motor reaction after stopping and optimize controller settings.
E A32D	1	10	LIMP error (switch signal briefly enabled or switch overtraveled) Switch signal disturbance. Motor subjected to vibration or shock when stopped after activation of the switch signal. Check supply voltage, cabling and function of switch. Check motor reaction after stopping and optimize controller settings.
E A32E	1	10	LIMN error (switch signal briefly enabled or switch overtraveled) Switch signal disturbance. Motor subjected to vibration or shock when stopped after activation of the switch signal. Check supply voltage, cabling and function of switch. Check motor reaction after stopping and optimize controller settings.
E A330	-	-	Reference movement to index pulse cannot be reproduced. Index pulse is too close to the switch The position difference between the change of the switch signal and the occurrence of the index pulse is too low. Change mounting point of limit switch (the optimum is a position one half of a motor revolution away from the current mechanical position, direction towards the outside of the working range).
E A332	1	10	Jog error (additional info = detailed error number) Jog movement was stopped by error. For additional info, check the detailed error number in the error buffer.

Error number	Class	Bit	Description, cause and correctives
E A334	2	0	<p>Timeout at Standstill window monitor</p> <p>Position deviation after movement finished greater than standstill window, e.g. caused by an external load.</p> <p>Check load. Check settings for standstill window ('STANDp_win', 'STANDpwinTime' and 'STANDpwinTout'). Optimize controller settings.</p>
E A335	1	10	<p>Processing only possible in fieldbus control mode</p> <p>Reference movement started in local control mode (homing not possible if 'DEVcmdinterf' is not set to a fieldbus device, no limit switches).</p> <p>'DEVcmdinterf' must be set to a fieldbus device.</p>
E A337	0	10	<p>Operating mode cannot be continued</p> <p>Continuation of interrupted movement in profile position mode is not possible because another mode had been active in the meantime. In Motion Sequence mode, continuation is impossible if a motion blend was interrupted.</p>
E A339	-	-	<p>No processing of motor encoder selected or fast position detection motor index pulse active</p>
E A33A	-	-	<p>Reference point is not defined (ref_ok=0)</p> <p>No homing done and no motor with absolute encoder connected. Homing position lost because the working position range was left.</p> <p>Start homing. Use motor with multiturn encoder if no homing is to be done.</p>
E B100	0	9	<p>RS485/Modbus: unknown service</p> <p>Unsupported Modbus service was received.</p> <p>Check application on the Modbus master.</p>
E B200	0	9	<p>RS485/Modbus: Protocol error</p> <p>Logical protocol error: wrong length or unsupported subfunction.</p> <p>Check application on the Modbus master.</p>
E B201	2	6	<p>RS485/Modbus: Nodeguard error</p> <p>Modbus is defined as command interface ('DEVcmdinterf'=Modbus): connection monitoring parameter ('MBnode_guard') is <>0ms and a nodeguard event was detected.</p> <p>Check application on the Modbus master or change value (set to 0ms or increase the parameter 'MBnode_guard' monitoring time).</p>
E B202	0	9	<p>RS485/Modbus: Nodeguard warning</p> <p>Modbus is not defined as command interface ('DEVcmdinterf' <>Modbus): connection monitoring parameter ('MBnode_guard') is <>0ms and a nodeguard event was detected.</p> <p>Check application on the Modbus master or change (set to 0ms or increase the parameter 'MBnode_guard' monitoring time).</p>
E B302	0	12	<p>Profibus: write access denied (incorrect job identification)</p> <p>Wrong AK used at write command.</p> <p>Check AK and data type of parameter.</p>

Error number	Class	Bit	Description, cause and correctives
E B303	1	12	Profibus: incorrect processing of process data channel Error while processing PZD: PZD1-4 contains invalid value. Check PZD content (application).
E B305	1	12	Profibus: parameter cannot be mapped to the output data frame The requested parameter cannot be mapped to the PZD. Check PZD content (application).
E B306	1	12	Profibus: incorrect processing of process data channel Error while processing PZD: PZD5-8 contains invalid value. Check PZD content (application).
E B308	0	0	Profibus: parameter cannot be read
E B309	0	12	Profibus: subindex not equal to zero Subindex within parameter identifier PKE is not zero. Set subindex to zero.
E B30A	1	0	Profibus: parameter does not exist Parameter sent by parameter channel (PKW) does not exist. Check parameter number.
E B30B	2	12	Profibus: Watchdog The bus cycle time of the Profibus master is greater than the programmed watchdog time. Increase watchdog time in the Profibus master.
E B30C	2	12	Profibus: motor stop via clear command of master Clear command sent by master, bus error. Check application
E B30D	0	12	Profibus: parameter cannot be mapped It is not allowed to map this parameter to the PZD because the parameter does not exist or is read-only. Check parameter number of mapped parameter.
E B310	2	12	Profibus: data communication error System or bus error, EMC. Check Profibus connection, shielding.

11 Parameters

This chapter provides an overview of the parameters which can be used for operating the product.

In addition, special parameters for communication via the fieldbus are described in the corresponding fieldbus manual.

▲ WARNING

UNINTENDED BEHAVIOR CAUSED BY PARAMETERS

The behavior of the drive system is governed by numerous parameters. Unsuitable parameter values can trigger unintended movements or signals or deactivate monitoring functions.

- Never change a parameter unless you understand its meaning.
- Only start the system if there are no persons or obstructions in the hazardous area.
- When commissioning, carefully run tests for all operating states and potential fault situations.

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

11.1 Representation of the parameters

When parameters are explained, this contains, on the one hand, information which is needed for unique identification of a parameter. On the other hand, the parameter explanations can also provide information on settings, defaults and parameter properties.

Entering values

Please note that parameter values are entered via the fieldbus without a decimal point. All decimal places must be entered.

Input examples:

Value	Commissioning software	Fieldbus
20	20	20
5.0	5.0	50
23.57	23.57	2357
1.000	1.000	1000

11.1.1 Explanation of the parameter representation

A parameter explanation has the following features:

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
Example_Name	Brief description (cross-reference)	A _{pk}	UINT32	fieldbus 1234:5 _h
INF- - DEVC	Selection values	0.00	R/W	
INF- - dEUC	1 / Selection value1 / AbC 1: Explanation 1 2 / Selection value2 / AbC 2: Explanation 2	3.00 300.00	per. -	
	Further description and details			

- Parameter Name* The parameter name clearly identifies a parameter.
- HMI menu* The HMI menu shows the sequence of menus and commands by which the parameter is called up via the HMI.
- Description* Brief description (cross-reference)
The brief description contains some information on the parameter and a cross-reference to the page that describes the function of the parameter.

Selection values
In the case of parameters which offer a selection of settings, the value to be entered via the fieldbus and the designation of the value for input via the commissioning software and the HMI are specified.
1 = Value via fieldbus
Selection value1 = Selection value via commissioning software
AbC 1 = Selection value via HMI

Further description and details
Provides further information on the parameter.
- Unit* The unit of the value.
- Minimum value* The minimum value which can be entered.
- Factory setting* The factory setting.
- Maximum value* The maximum value which can be entered.
- Data type* If the minimum and the maximum values are not explicitly indicated, the valid range of values is determined by the data type.

Data type	Byte	Minumum value	Maximum value
INT8	1 Byte / 8 Bit	-128	127
UINT8	1 Byte / 8 Bit	0	255
INT16	2 Byte / 16 Bit	-32768	32767
UINT16	2 Byte / 16 Bit	0	65535
INT32	4 Byte / 32 Bit	-2147483648	2147483647
UINT32	4 Byte / 32 Bit	0	4294967295

0198441113706, V2.03, 07.2010

<i>R/W</i>	Indicates read and/or write values "R/" values can only be read "R/W" values can be read and written.
<i>Persistent</i>	"per." indicates whether the value of the parameter is persistent, i.e. whether it remains in the memory after the device is switched off . When changing a value via commissioning software or fieldbus, the user must explicitly store the changed value in the persistent memory.
<i>Parameter address</i>	Each parameter has a unique parameter address. The parameter address is used to access the parameter via the fieldbus.

11.2 List of all parameters

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_acc_pref	Acceleration of reference value generation	min ⁻¹ /s	INT32	Modbus 7954
-	Sign according to the changed speed value:	-	INT32	Profibus 7954
-	Increased speed: pos. sign	0	R/-	
-	Reduced speed: neg. sign	-	-	
_AccessInfo	Current access channel for action objects	-	UINT16	Modbus 280
-	Low byte :	-	UINT16	Profibus 280
-	0 : Used by channel in high byte	0	R/-	
-	1 : Exclusively used by channel in high byte	-	-	
	High byte: Current assignment of access channel			
	0: reserved			
	1: IO			
	2: HMI			
	3: Modbus RS485			
	4: CANopen			
	5: CANopen via seconds SDO channel			
	6: Profibus			
	7: DeviceNet			
	8: reserved			
	9: Ethernet			
	10..15: Modbus TCP			
_actionStatus	Action word (157)	-	UINT16	Modbus 7176
-	Signal status:	-	UINT16	Profibus 7176
-	0: not activated	0	R/-	
-	1: activated	-	-	
	Bit 0: Warning			
	Bit 1: Error class 1			
	Bit 2: Error class 2			
	Bit 3: Error class 3			
	Bit 4: Error class 4			
	Bit 5: Reserved			
	Bit 6: Drive is at standstill (<9 [1/min])			
	Bit 7: Drive rotates clockwise			
	Bit 8: Drive rotates counter-clockwise			
	Bit 9: Reserved			
	Bit 10: Reserved			
	Bit 11: Profile generator idle (reference speed is 0)			
	Bit 12: Profile generator decelerates			
	Bit 13: Profile generator accelerates			
	Bit 14: Profile generator moves at constant speed			
	Bit 15: Reserved			
_I_act	Total motor current (171)	A _{rms}	INT16	Modbus 7720
STA- - iACT	In 0.01Arms	-	INT16	Profibus 7720
5tR- - , Rct		0.00	R/-	
		-	-	

019844113706, V2.03, 07.2010

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_IO_act	Physical status of the digital inputs and outputs (104)	-	UINT16	Modbus 2050
STA- - ioAC		-	UINT16	Profibus 2050
5tR- - oPc	Assignment of the 24 V inputs: Bit 0: REF Bit 1: LIMN,CAP2 Bit 2: LIMP,CAP1 Bit 3: HALT Bit 4: STO_B (PWRR_B) Bit 5: STO_A (PWRR_A) Bit 6: - Bit 7: reserved	0	R/-	
_LastWarning	Last warning as number	-	UINT16	Modbus 7186
-	Number of the most recent warning.	-	UINT16	Profibus 7186
-	If the warning becomes inactive again, the number is memorized until the next fault reset. Value 0: No warning occurred	0	R/-	
_n_act	Actual motor speed (136)	min ⁻¹	INT16	Modbus 7696
STA- - NACT		-	INT16	Profibus 7696
5tR- - nAct		0	R/-	
_n_actRAMP	Actual speed of motion profile generator (136)	min ⁻¹	INT32	Modbus 7948
-		-	INT32	Profibus 7948
-		0	R/-	
-		-	-	
_n_l_act	Optimized read access to actual speed values and current values	-	INT32	Modbus 7726
-		-	INT32	Profibus 7726
-	High word: Actual speed $_n_act$ [min ⁻¹] Low word: Actual current [A _{rms}]	0	R/-	
-		-	-	
_n_pref	Speed of reference value generation	min ⁻¹	INT32	Modbus 7950
-		-	INT32	Profibus 7950
-		0	R/-	
-		-	-	
_n_targetRAMP	Reference speed of motion profile generator	min ⁻¹	INT32	Modbus 7946
-		-	INT32	Profibus 7946
-		0	R/-	
-		-	-	
_OpHours	Operating hours counter	s	UINT32	Modbus 7188
STA- - oPh		-	UINT32	Profibus 7188
5tR- - oPh		0	R/-	
-		-	-	
_p_act	Actual position of motor in internal units	Inc	INT32	Modbus 7700
-		-	INT32	Profibus 7700
-		0	R/-	
-		-	-	

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_p_actPosintf - -	Actual position at position interface Counted position increments at RS 422 signal interface CN5 if signal direction is defined as input (see parameter IOposInterface)	Inc -2147483648 - 2147483647	INT32 INT32 R/- -	Modbus 2058 Profibus 2058
_p_actRAMPusr - -	Actual position of motion profile generator (134) In user units	usr - 0 -	INT32 INT32 R/- -	Modbus 7940 Profibus 7940
_p_actusr STA- - PACu 5tR- - PRCu	Actual motor position in user units (134)	usr - 0 -	INT32 INT32 R/- -	Modbus 7706 Profibus 7706
_p_addGEAR - -	Initial position electronic gear When electronic gear is inactive, the reference position for the position controller can be determined here. This position is set when electronic gear is activated with the selection of 'Synchronization with compensation movement'.	Inc - 0 -	INT32 INT32 R/- -	Modbus 7942 Profibus 7942
_p_dif STA- - PDiF 5tR- - Pd, F	Current deviation between reference and actual position Corresponds to the current deviation between reference and actual motor position.	revolution -214748.3648 - 214748.3647	INT32 INT32 R/- -	Modbus 7716 Profibus 7716
_p_difGear - -	Position difference in electronic gear caused by limitation (130) If speed and acceleration limitation was set in 'Electronic Gear' mode (see parameter GEARcontrol) and the limits are reached during processing, the drive no longer follows the reference value. This parameter allows you to read out the resulting position deviation.	Inc -2147483648 - 2147483647	INT32 INT32 R/- -	Modbus 7724 Profibus 7724
_p_ref - -	Reference position in internal units	Inc - 0 -	INT32 INT32 R/- -	Modbus 7698 Profibus 7698
_p_refusr - -	Reference position in user units (150)	usr - 0 -	INT32 INT32 R/- -	Modbus 7704 Profibus 7704
_p_tarRAMPusr - -	Target position of motion profile generator Absolute position value of the profile generator, calculated on the basis of the relative and absolute position values received. In user units	usr - 0 -	INT32 INT32 R/- -	Modbus 7938 Profibus 7938

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_prgNoDEV	Firmware program number	-	UINT16	Modbus 258
INF- - _PNR	Example: PR840.1	-	UINT16	Profibus 258
INF- - _Pnr	The value is entered as a decimal value: 8401	0.0	R/-	
		-	-	
_prgVerDEV	Firmware version number	-	UINT16	Modbus 260
INF- - _PVR	Example: V4.201	-	UINT16	Profibus 260
INF- - _Pvr	The value is entered as a decimal value: 4201	0.000	R/-	
		-	-	
_serialNoDEV	Device serial number	-	UINT32	Modbus 302
-	Serial number: unique number for identifica-	0	UINT32	Profibus 302
-	tion of the product	-	R/-	
		4294967295	per.	
		-	-	
_SigActive	Current status of monitoring signals (155)	-	UINT32	Modbus 7182
-	See _SigLatched for more details on the bit	-	UINT32	Profibus 7182
-	codes.	0	R/-	
-		-	-	
		-	-	

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_SigLatched	Saved status of monitoring signals (156)	-	UINT32	Modbus 7184
STA- - SiGS	Signal status:	0	UINT32	Profibus 7184
5tR- - 5, 55	0: Not activated 1: Activated	-	R/- - -	
	Bit assignments: Bit 0: General fault Bit 1: Limit switches (LIMP/LIMN/REF) Bit 2: Out of range (SW limit switches, tuning) Bit 3: Quickstop via fieldbus Bit 4: Inputs STO are 0 Bit 5: Reserved Bit 6: RS485 fault Bit 7: CAN fault Bit 8: Ethernet fault Bit 9: Frequency of reference signal too high Bit 10: Fault current operating mode Bit 11: Reserved Bit 12: Profibus fault Bit 13: Reserved Bit 14: Undervoltage DC bus Bit 15: Overvoltage DC bus Bit 16: Mains phase missing Bit 17: Motor connection fault Bit 18: Motor overcurrent/short circuit Bit 19: Motor encoder fault Bit 20: Undervoltage 24VDC Bit 21: Overtemperature (power stage, motor) Bit 22: Tracking error Bit 23: Max. speed exceeded Bit 24: Inputs STO different Bit 25: Reserved Bit 26: Reserved Bit 27: Reserved Bit 28: Reserved Bit 29: EEPROM fault Bit 30: System booting (Hardware fault or parameter error) Bit 31: System error (e.g. watchdog)			
	Monitoring functions are product-dependent.			
_StopFault	Error number of last stop fault (157)	-	UINT16	Modbus 7178
FLT- - STPF		0	UINT16	Profibus 7178
FLt- - 5tPF		-	R/- - -	
_Temp_act_DEV	Device temperature (155)	°C	INT16	Modbus 7204
STA- - TDEV		-	INT16	Profibus 7204
5tR- - t dEU		0	R/- - -	
_Temp_act_PA	Power stage temperature (155)	°C	INT16	Modbus 7200
STA- - TPA		-	INT16	Profibus 7200
5tR- - tPR		0	R/- - -	

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_U_ref - -	Total motor voltage In increments of 0.1V	V - 0.0 -	INT16 INT16 R/- -	Modbus 7722 Profibus 7722
_UDC_act STA- - uDCA 5tR- - udLR	Voltage at DC bus DC bus voltage in increments of 0.1 V	V - 0.0 -	UINT16 UINT16 R/- -	Modbus 7198 Profibus 7198
_v_act_Posintf - -	Actual speed at position interface Determined pulse frequency at RS 422 signal interface CN5 if signal direction is defined as input (see parameter IOposInterface)	Inc/s -2147483648 - 2147483647	INT32 INT32 R/- -	Modbus 2060 Profibus 2060
_WarnActive - -	Active warnings, bit-coded (156) See _WarnLatched for more details on the bit codes.	- - 0 -	UINT16 UINT16 R/- -	Modbus 7190 Profibus 7190
_WarnLatched STA- - WRNS 5tR- - brn5	Saved warnings, bit-coded (157) Saved warning bits are deleted in the case of a FaultReset. Bits 10, 11, 13 are deleted automatically. Signal status: 0: Not activated 1: Activated Bit assignments: Bit 0: General warning (see _LastWarning) Bit 1: Temperature of power stage high Bit 2: Temperature of motor high Bit 3: Reserved Bit 4: Power stage overload (I ² t) Bit 5: Motor overload (I ² t) Bit 6: Braking resistor overload (I ² t) Bit 7: CAN warning Bit 8: Motor encoder warning Bit 9: RS485 protocol warning Bit 10: STO_A (PWRR_A) and/or STO_B (PWRR_B) Bit 11: DC bus undervoltage/missing mains phase Bit 12: Profibus warning Bit 13: Position not yet valid (position capture still running) Bit 14: Ethernet warning Bit 15: Reserved Monitoring functions are product-dependent.	- - 0 -	UINT16 UINT16 R/- -	Modbus 7192 Profibus 7192
AbsHomeRequest - -	Absolute positioning only after homing (133) 0 / no: No 1 / yes: Yes Available as of software version V1.211.	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 1580 Profibus 1580

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
AccessLock - -	Locking other access channels (110) 0: Release other access channels 1: Lock other access channels The fieldbus can lock active access to the device via the following access channels with this parameter: - Commissioning software - HMI - A second fieldbus Processing of the input signals (such as HALT) cannot be locked.	- 0 - 1	UINT16 UINT16 R/W -	Modbus 316 Profibus 316
BRK_tclose DRC- - BTCL <i>drL - - btLL</i>	Time delay during closing of holding brake (173)	ms 0 100 1000	UINT16 UINT16 R/W per. -	Modbus 1296 Profibus 1296
BRK_trelease DRC- - BTRE <i>drL - - btrE</i>	Time delay during opening/releasing the holding brake (171)	ms 0 0 1000	UINT16 UINT16 R/W per. -	Modbus 1294 Profibus 1294
Cap1Activate - -	Capture unit 1 start/stop (168) 0 / Capture stop: Cancel capture function 1 / Capture once: Start one-time capture 2 / Capture continuous: Start continuous capture In the case of one-time capture, the function is terminated when the first value is captured. In the case of continuous capture, the function continues to run. Position capture can only be activated in "fieldbus control mode".	- 0 - 2	UINT16 UINT16 R/W -	Modbus 2568 Profibus 2568
Cap1Config - -	Capture unit 1 configuration (168) 0 / 1->0: Position capture at 1->0 change 1 / 0->1: Position capture at 0->1 change	- 0 0 1	UINT16 UINT16 R/W -	Modbus 2564 Profibus 2564
Cap1Count - -	Capture unit 1 event counter (168) Counts the capture events. The counter is reset when capture unit 1 is activated.	- - 0 -	UINT16 UINT16 R/- -	Modbus 2576 Profibus 2576
Cap1Pos - -	Capture unit 1 captured position (168) Captured position at the time of the "capture signal". The captured position is calculated again after "Position Setting" or "Homing".	usr - 0 -	INT32 INT32 R/- -	Modbus 2572 Profibus 2572

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
Cap2Activate	Capture unit 2 start/stop (168)	-	UINT16	Modbus 2570
-	0 / Capture stop: Cancel capture function	0	UINT16	Profibus 2570
-	1 / Capture once: Start one-time capture	-	R/W	
-	2 / Capture continuous: Start continuous capture	2	-	
	In the case of one-time capture, the function is terminated when the first value is captured. In the case of continuous capture, the function continues to run. Position capture can only be activated in "fieldbus control mode".			
Cap2Config	Capture unit 2 configuration (168)	-	UINT16	Modbus 2566
-	0 / 1->0: Position capture at 1->0 change	0	UINT16	Profibus 2566
-	1 / 0->1: Position capture at 0->1 change	0	R/W	
-		1	-	
Cap2Count	Capture unit 2 event counter (168)	-	UINT16	Modbus 2578
-	Counts the capture events.	-	UINT16	Profibus 2578
-	The counter is reset when capture unit 2 is activated.	0	R/-	
-		-	-	
Cap2Pos	Capture unit 2 captured position (169)	usr	INT32	Modbus 2574
-	Captured position at the time of the "capture signal".	-	INT32	Profibus 2574
-	The captured position is calculated again after "Position Setting" or "Homing".	0	R/-	
-		-	-	
CapStatus	Status of the capture units (169)	-	UINT16	Modbus 2562
-	Read access:	-	UINT16	Profibus 2562
-	Bit 0: position capture via input CAP1 carried out	0	R/-	
-	Bit 1: position capture via input CAP2 carried out	-	-	
-	Bit 2: position capture via index pulse actual position encoder carried out (used internally)	-	-	
CTRLS_I_Const%	Percentage of phase current during constant movement (151)	%	UINT16	Modbus 5144
SET- - icnS	100% correspond to the value in CTRLS_I_nom	1	UINT16	Profibus 5144
5Et - - , cn5		80	R/W	
		100	per.	
	The setting has no effect in the following operating modes (in these modes, 'CTRLS_I_Ramp%' is used): - Electronic gear		-	
CTRLS_I_nom	Used nominal current (151)	A _{rms}	UINT16	Modbus 5122
-	Corresponds to the lower value of SM_I_nom and PA_I_nom.	-	UINT16	Profibus 5122
-	The value is updated when a motor is selected or the motor type changed. The value corresponds to the motor current at a setting of 100% in phase current percentage for the different movement states.	0.00	R/-	
-		-	-	

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRLS_I_Ramp% SET- - irMP 5Et- - , rMP	Percentage of phase current during acceleration/deceleration (151) 100% correspond to the value in CTRLS_I_nom	% 1 100 100	UINT16 UINT16 R/W per. -	Modbus 5142 Profibus 5142
CTRLS_I_Stand% SET- - iStd 5Et- - , 5td	Percentage of phase current at standstill (151) 100% correspond to the value in CTRLS_I_nom	% 1 50 100	UINT16 UINT16 R/W per. -	Modbus 5140 Profibus 5140
CTRLS_KPi_nHigh - -	Current controller P-term at high speed The value is calculated on the basis of motor parameters. In increments of 0.1V/A	V/A 0.5 - 2000.0	UINT16 UINT16 R/W per. expert	Modbus 5128 Profibus 5128
CTRLS_KPi_nLow - -	Current controller P-term at low speed The value is calculated on the basis of motor parameters. In increments of 0.1V/A	V/A 0.5 - 2000.0	UINT16 UINT16 R/W per. expert	Modbus 5124 Profibus 5124
CTRLS_MotEnc DRC- - ENCM drC- - Encn	Processing of motor encoder position (98) 0 / undefined / nonE : Undefined (default) 1 / NoEncCon / noCo : No motor encoder connected 2 / ShowEncPos / P, nF : Motor encoder connected, rotation monitoring inactive, only position info 3 / RotMonOn / rotn : Motor encoder connected, rotation monitoring active If you select "Motor encoder connected", temperature monitoring of the encoder is also activated. If you select "No motor encoder connected", the reference values _p_refusr and _n_pref are output as motor position (_p_actusr) and motor speed (_n_act).	- 0 0 3	UINT16 UINT16 R/W per. -	Modbus 5138 Profibus 5138
CTRLS_nHigh - -	Speed for CTRLS_KPi_nHigh High speed for current controller P term CTRLS_KPi_nHigh. The value is calculated on the basis of motor parameters.	min ⁻¹ 1 360 3000	UINT16 UINT16 R/W per. expert	Modbus 5132 Profibus 5132
CTRLS_nLow - -	Speed for CTRLS_KPi_nLow Low speed for current controller P term CTRLS_KPi_nLow. The value is calculated on the basis of motor parameters.	min ⁻¹ 0 30 3000	UINT16 UINT16 R/W per. expert	Modbus 5130 Profibus 5130
CTRLS_TNi - -	Current controller setting time The value is calculated on the basis of motor parameters. The value is speed-independent. 327.67ms is interpreted as infinite and thus completely switches off the I term.	ms 0.26 - 327.67	UINT16 UINT16 R/W per. expert	Modbus 5126 Profibus 5126

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRLS_toggle	Toggle of motor when power stage is activated (114)	-	UINT16	Modbus 5136
-	-	-	UINT16	Profibus 5136
-	0 / inactive: Inactive	-	R/W	
-	1 / active: Active (default)	-	per.	
-		-	-	
DEVcmdinterf	Specification of the control mode	-		
-- DEVC	0 / none / none: Undefined	0	R/W	
-- dEUE	4 / ProfibusDevice / PbdP: Profibus	0	per.	
		4	-	
	NOTE: Changed settings do not become active until the unit is switched on the next time (exception: change of value 0, for "Initial settings").			
FLT_class	Error class (185)	-	UINT16	Modbus 15364
-	0: Warning (no response)	0	UINT16	Profibus 15364
-	1: Error (Quick Stop -> state 7)	-	R/-	
-	2: Error (Quick Stop -> state 8, 9)	4	-	
	3: Fatal error (state 9, can be acknowledged)		-	
	4: Fatal error (state 9, cannot be acknowledged)			
FLT_del_err	Clear error memory (184)	-	UINT16	Modbus 15112
-	1: Delete all entries in the error memory	0	UINT16	Profibus 15112
-		-	R/W	
-	The clearing process is completed if a 0 is returned after a read access.	1	-	
FLT_err_num	Error number (184)	-	UINT16	Modbus 15362
-	Reading this parameter copies the entire error entry (error class, time of occurrence of error, ...) to an intermediate memory from which all elements of the error can then be read.	0	UINT16	Profibus 15362
-		-	R/-	
-		65535	-	
	In addition, the read pointer of the error memory is automatically set to the next error entry.			
FLT_Idq	Motor current at error time	A	UINT16	Modbus 15378
-	In increments of 10mA	-	UINT16	Profibus 15378
-		0.00	R/-	
-		-	-	
FLT_MemReset	Reset error memory read pointer (184)	-	UINT16	Modbus 15114
-	1: Set error memory read pointer to oldest error entry.	0	UINT16	Profibus 15114
-		-	R/W	
-		1	-	
FLT_n	Speed at error time	min ⁻¹	INT16	Modbus 15376
-		-	INT16	Profibus 15376
-		0	R/-	
-		-	-	
FLT_powerOn	Number of power on cycles	-	UINT32	Modbus 15108
INF-- PoWo		0	UINT32	Profibus 15108
INF-- Poldo		-	R/-	
		4294967295	-	
			-	

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
FLT_Qual	Error additional information (185)	-	UINT16	Modbus 15368
-	This entry contains additional information on the error, depending on the error number. Example: a parameter address	0	UINT16	Profibus 15368
-		-	R/-	
-		65535	-	
-			-	
FLT_Temp_DEV	Temperature of device at error time	°C	INT16	Modbus 15382
-		-	INT16	Profibus 15382
-		0	R/-	
-		-	-	
-			-	
FLT_Temp_PA	Temperature of power stage at error time	°C	INT16	Modbus 15380
-		-	INT16	Profibus 15380
-		0	R/-	
-		-	-	
-			-	
FLT_Time	Error time (185)	s	UINT32	Modbus 15366
-	With reference to operating hours counter	0	UINT32	Profibus 15366
-		-	R/-	
-		536870911	-	
-			-	
FLT_UDC	DC bus voltage at error time	V	UINT16	Modbus 15374
-	In increments of 100mV	-	UINT16	Profibus 15374
-		0.0	R/-	
-		-	-	
-			-	
FLTAmpOnCyc	ENABLE cycles up to the time of error	-	UINT16	Modbus 15370
-	Number of power on cycles from the time the power supply (control voltage) was switched on to the time the error occurred.	-	UINT16	Profibus 15370
-		0	R/-	
-		-	-	
-			-	
FLTAmpOnTime	Time of error after ENABLE	s	UINT16	Modbus 15372
-		-	UINT16	Profibus 15372
-		0	R/-	
-		-	-	
-			-	
GEAR_n_max	Maximum speed in gearing (130)	min ⁻¹	UINT16	Modbus 9746
-	This function is only available if the limitation via GEARcontrol is active.	1	UINT16	Profibus 9746
-		3000	R/W	
-		3000	per.	
-			-	

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
GEARcontrol	Activate speed and acceleration limitations (130)	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 9744 Profibus 9744
-	0 / off: Inactive			
-	1 / on: Active			
	If GEARcontrol is active, the reference value for acceleration/deceleration is limited to the value of parameter GEARramp and the reference speed value to the value of parameter GEAR_n_max. This helps to keep the motor from stalling. If the limitation is activated, this causes a deviation of the calculated reference position and the internally effective reference position which is compensated for. The maximum deviation is limited to 400 revolutions. If this value is exceeded, the unit cancels with a fault.			
GEARdenom	Denominator of gear ratio (129)	- 1 1 2147483647	INT32 INT32 R/W per. -	Modbus 9734 Profibus 9734
-	See description GEARnum			
GEARdir_enabl	Enabled movement direction of gear processing (131)	- 1 3 3	UINT16 UINT16 R/W per. -	Modbus 9738 Profibus 9738
-	1 / positive: Pos. direction			
-	2 / negative: Neg. direction			
-	3 / both: Both directions			
	This allows you to activate a return movement lock function.			
GEARnum	Numerator of gear ratio (129)	- -2147483648 1 2147483647	INT32 INT32 R/W per. -	Modbus 9736 Profibus 9736
-	GEARnum			
-	----- = Gear ratio			
-	GEARdenom			
	The new gear ratio is applied when the numerator value is supplied.			
GEARposChgMode	Consideration of position changes with inactive power stage (128)	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 9750 Profibus 9750
-	0 / off: Position changes in states with inactive power stage are discarded.			
-	1 / on: Position changes in states with inactive power stage are considered.			
	This setting has an effect only if gear processing is started in the mode 'Synchronization with compensation movement'.			
GEARramp	Maximum acceleration in gearing (130)	min ⁻¹ /s 30 600 3000000	UINT32 UINT32 R/W per. -	Modbus 9748 Profibus 9748
-	This function is only available if the limitation via GEARcontrol is active.			
-	This value is effective both in the acceleration and the deceleration phase. The system uses a linear ramp. The start/stop speed has no effect.			

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
GEARratio	Selection of special gear ratios (129)	-	UINT16	Modbus 9740
SET- - GFAC	<p>0 / GearFactor / FACt: Usage of gear ratio adjusted with GEARnum/GEARdenom</p> <p>1 / 200 / 200: 200</p> <p>2 / 400 / 400: 400</p> <p>3 / 500 / 500: 500</p> <p>4 / 1000 / 1000: 1000</p> <p>5 / 2000 / 2000: 2000</p> <p>6 / 4000 / 4000: 4000</p> <p>7 / 5000 / 5000: 5000</p> <p>8 / 10000 / 10000: 10000</p> <p>9 / 4096 / 4096: 4096</p> <p>10 / 8192 / 8192: 8192</p> <p>11 / 16384 / 16384: 16384</p> <p>A change of the reference value by the specified value causes one motor revolution.</p>	0	UINT16	Profibus 9740
SEt - - GFAC		11	R/W	
				per.
				-
GEARreference	Gear synchronization type in fieldbus control mode	-	UINT16	Modbus 9730
-		0	UINT16	Profibus 9730
-	0 / inactive: Deactivated	0	R/W	
-	1 / immediate gear: Immediate synchronization	2	-	
-	2 / compensated gear: Synchronization with compensation movement		-	
HMdisREFtoIDX	Distance from switching edge to index pulse (145)	revolution	INT32	Modbus 10264
-		-	INT32	Profibus 10264
-	This read value delivers the difference between the index pulse position and the position at the switching edge of the limit or reference switch.	0.0000	R/-	
-	It allows to check the distance between the index pulse and the switching edge and serves as a criterion for determining whether the reference movement with index pulse processing can be reproduced.	-	-	
-	In increments of 1/10000 revolutions		-	
HMdisusr	Distance from switching edge to reference point (142)	usr	INT32	Modbus 10254
-		1	INT32	Profibus 10254
-	After the drive 'leaves' the switch, it is positioned into the working area by a defined distance. This target point is defined as the reference point.	200	R/W	
-		2147483647	per.	
-			-	
-	The parameter is only effective during reference movements without index pulse search.			
HMIDispPara	HMI display when motor rotates	-	UINT16	Modbus 14852
DRC- - SuPV	0 / DeviceStatus / StARt: Device status (default)	0	UINT16	Profibus 14852
drL - - SuPL	1 / n_act / nARt: Current speed (n_act)	0	R/W	
	2 / I_act / IARt: Current motor current	2	per.	
			-	

019844113706, V2.03, 07.2010

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMIlocked	Lock HMI (109)	-	UINT16	Modbus 14850
-	0 / not locked: HMI not locked	0	UINT16	Profibus 14850
-	1 / locked: HMI locked	0	R/W	
-	The following functions can no longer be started when the HMI is locked: - Parameter change - Jog - Fault reset	1	per. -	
HMmethod	Homing method	-	UINT16	Modbus 10242
-	0 / deactivate: Deactivated	0	UINT16	Profibus 10242
-	1 / LIMN indexpuls: LIMN with index pulse	-	R/W	
-	2 / LIMP indexpuls: LIMP with index pulse	35	-	
-	7 / REFpos indexpuls: REF+ with index pulse, inv., outside		-	
-	8 / REFneg indexpuls: 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: LIMN			
-	18 / LIMP: LIMP			
-	23 / REFpos: REF+, inv., outside			
-	24: REF+, inv., inside			
-	25: REF+, not inv., inside			
-	26: REF+, not inv., outside			
-	27 / REFneg: 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			
-	Abbreviations: REF+: Search movement in pos. direction REF-: Search movement in pos. direction inv.: Invert direction in switch not inv.: Direction not inverted in switch outside: Index pulse / distance outside switch inside: Index pulse / distance inside switch			
HMn_out	Speed of rotation for moving away from switch (140)	min ⁻¹	UINT16	Modbus 10250
-		1	UINT16	Profibus 10250
-	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	6	R/W	
-		3000	per. -	
HMn	Speed of rotation for search of switch (139)	min ⁻¹	UINT16	Modbus 10248
-		1	UINT16	Profibus 10248
-	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	60	R/W	
-		3000	per. -	

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMoutdisusr - -	Maximum distance for search for switching edge (140) 0: Monitoring of distance inactive >0: Maximum distance in user-defined units After detection of the switch, the drive starts to search for the defined switching edge. If it is not found within the distance defined here, the reference movement is canceled with an error.	usr 0 0 2147483647	INT32 INT32 R/W per. -	Modbus 10252 Profibus 10252
HMp_homeusr - -	Position at reference point (140) After a successful reference movement, this position is automatically set at the reference point.	usr -2147483648 0 2147483647	INT32 INT32 R/W per. -	Modbus 10262 Profibus 10262
HMp_setpusr - -	Position setting to position setting position Action object: write access triggers position setting. Only possible if the motor is at standstill. Position scaling is not considered.	usr -2147483648 - 2147483647	INT32 INT32 R/W - -	Modbus 10246 Profibus 10246
HMsrchdisusr - -	Max. search distance after overrun of switch (140) 0: Search distance processing disabled >0: Search distance in user units The switch must be activated again within this search distance, otherwise the reference movement is canceled.	usr 0 0 2147483647	INT32 INT32 R/W per. -	Modbus 10266 Profibus 10266
IODirPosintf - -	Direction of counting at position interface 0 / clockwise: Clockwise 1 / counter clockwise: Counter-clockwise	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 2062 Profibus 2062
IOposInterfac DRC- - ioPi dr[- - , aPi	Signal selection position interface (98) 0 / Ainput / Ab: Input ENC_A, ENC_B, ENC_I (index pulse) quadruple evaluation 1 / Pinput / Pd: Input PULSE, DIR, ENABLE2 RS422 I/O interface (Pos) NOTE: Changed settings do not become active until the unit is switched on the next time.	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 1284 Profibus 1284
IOSigLimN - -	Signal evaluation LIMN (139) 0 / inactive: Inactive 1 / normally closed: Normally closed NC 2 / normally open: Normally open NO	- 0 1 2	UINT16 UINT16 R/W per. -	Modbus 1566 Profibus 1566
IOSigLimP - -	Signal evaluation LIMP (139) 0 / inactive: Inactive 1 / normally closed: Normally closed NC 2 / normally open: Normally open NO	- 0 1 2	UINT16 UINT16 R/W per. -	Modbus 1568 Profibus 1568

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOsigRef	Signal evaluation REF (139)	-	UINT16	Modbus 1564
-	1 / normally closed: Normally closed NC	1	UINT16	Profibus 1564
-	2 / normally open: Normally open NO	1	R/W	
-		2	per.	
	The reference switch is only activated (to REF) while homing is processed.		-	
JOGactivate	Activation of jog	-	UINT16	Modbus 10498
-	Bit0 : Positive direction of rotation	0	UINT16	Profibus 10498
-	Bit1 : Negative direction of rotation	0	R/W	
-	Bit2 : 0=slow 1=fast	7	-	
	If both bits for the direction of rotation are activated at the same time, no movement is started. If a jog movement is running, the simultaneous activation of the bits for the direction of rotation has no effect.			
JOGn_fast	Speed for fast jog (124)	min ⁻¹	UINT16	Modbus 10506
JOG- - NFST	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	1	UINT16	Profibus 10506
JoG- - nF5t		180	R/W	
		3000	per.	
			-	
JOGn_slow	Speed for slow jog (124)	min ⁻¹	UINT16	Modbus 10504
JOG- - NSLW	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	1	UINT16	Profibus 10504
JoG- - n5Lb		60	R/W	
		3000	per.	
			-	
JOGstepusr	Jog distance prior to continuous run (124)	usr	INT32	Modbus 10510
-	0: Direct activation of continuous run	0	INT32	Profibus 10510
-	>0: Positioning distance per jog cycle	20	R/W	
		2147483647	per.	
			-	
JOGtime	Wait time prior to continuous run (124)	ms	UINT16	Modbus 10512
-	This time is only effective if you have set a jog distance not equal to 0, otherwise the drive immediately starts a continuous run.	1	UINT16	Profibus 10512
-		500	R/W	
		32767	per.	
			-	
MBadr	Modbus address	-	UINT16	Modbus 5640
COM- - MBAD	Valid addresses: 1 to 247	1	UINT16	Profibus 5640
CoM- - MbAd		1	R/W	
		247	per.	
			-	
MBbaud	Modbus Baud rate	-	UINT16	Modbus 5638
COM- - MBBD	9600 / 9.6KB / 96: 9600 Baud	9600	UINT16	Profibus 5638
CoM- - MbBd	19200 / 19.2KB / 192: 19200 Baud	19200	R/W	
	38400 / 38.4KB / 384: 38400 Baud	38400	per.	
			-	
	NOTE: Changed settings do not become active until the unit is switched on the next time			

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
MBdword_order COM- - MBWo [0] - [1]bLo	Modbus word sequence for double words (32 bit values) 0 / HighLow / hLo : HighWord-LowWord 1 / LowHigh / Loh : LowWord-HighWord High word first or low word first High word first -> Modicon Quantum Low word first -> Premium, HMI (Telemecanique)	- 0 0 1	R/W per. -	
MBformat COM- - MBFo [0] - [1]bFo	Modbus data format 1 / 8Bit NoParity 1Stop / Bn1 : 8 bits, no parity bit, 1 stop bit 2 / 8Bit EvenParity 1Stop / BE1 : 8 bits, even parity bit, 1 stop bit 3 / 8Bit OddParity 1Stop / Bo1 : 8 bits, odd parity bit, 1 stop bit 4 / 8Bit NoParity 2Stop / Bn2 : 8 bits, no parity bit, 2 stop bits NOTE: Changed settings do not become active until the unit is switched on the next time	- 1 2 4	R/W per. -	
MBnode_guard - -	Modbus node guard Node guard 0: Inactive (default) >0: Monitoring time	ms 0 0 10000	R/W - -	
ModeError - -	Error code for synchronous errors (ME flag) Manufacturer-specific error code that caused the ModeError flag to be set. Usually, this is an error that was caused by the activation of an operating mode.	- - 0 -	UINT16 UINT16 R/- -	Modbus 6962 Profibus 6962
PA_I_nom INF- - PiNo [0] - [1]no	Nominal current of power stage Current in increments of 10mA	A _{rms} - 0.00 -	UINT16 UINT16 R/- per. -	Modbus 4118 Profibus 4118
PA_T_max - -	Maximum permissible power stage temperature (155)	°C - 0 -	INT16 INT16 R/- per. -	Modbus 4110 Profibus 4110
PA_T_warn - -	Temperature warning threshold of power stage (155)	°C - 0 -	INT16 INT16 R/- per. -	Modbus 4108 Profibus 4108
PA_U_maxDC - -	Maximum permissible DC bus voltage Voltage in increments of 100mV	V - - -	UINT16 UINT16 R/- per. -	Modbus 4102 Profibus 4102

019844113706, V2.03, 07.2010

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PA_U_minDC - -	DC bus voltage low threshold for switching off the drive Voltage in increments of 100mV	V - -	UINT16 UINT16 R/- per. -	Modbus 4104 Profibus 4104
PA_U_minStopDC - -	DC bus voltage low threshold for Quick Stop If this threshold is reached, the drive performs a Quick Stop. Voltage in increments of 100mV	V - -	UINT16 UINT16 R/- per. -	Modbus 4116 Profibus 4116
PAReepSave - -	Save parameter values to EEPROM Bit 0 = 1: Save all persistent parameters The currently set parameters are saved to the non-volatile memory (EEPROM). The saving process is complete when the parameter is read and 0 is returned.	- - -	UINT16 UINT16 R/W - -	Modbus 1026 Profibus 1026
PARfactorySet DRC- - FCS drL - - FLS	Restore factory settings (default values) (174) 0 / No / no: No 1 / Yes / YES: Yes All parameters are set to their default values, these are saved to the EEPROM. Restoring the factory settings is possible via the HMI or the commissioning software. The saving process is complete when the parameter is read and 0 is returned. NOTE: The default becomes active only when the unit is switched on the next time.	- 0 3	R/W - -	
PARuserReset - -	Reset user parameters (174) Bit 0 = 1: Set persistent parameters to default values. All parameters are reset with the exception of: - Communication parameters - Definition of the direction of rotation - Signal selection position interface - Motor type - Processing of motor encoder position NOTE: The new settings are not saved to the EEPROM!	- 0 7	UINT16 UINT16 R/W - -	Modbus 1040 Profibus 1040
PBadr COM- - PbAD LdP - - PbPd	Profibus address (99) Valid addresses: 1 to 126 NOTE: Changed settings do not become active until the unit is switched on the next time	- 1 126 126	R/W per. -	
PBfitPpo - -	Error response to process data channel processing fault 0 / none: No error response (Mode Error) 1 / ErrorClass1: Error class 1	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 6158 Profibus 6158

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PBMapIn	Mapping of PZD5+6 to master	- 0	UINT32 UINT32	Modbus 6150 Profibus 6150
-	A parameter with a data length of 32 bits can be used for mapping the PZD5+6 from the drive to the master.	0 65535	R/W per.	-
-	The following parameters can be used: 0: No mapping active 7178: Error number of last cause of interruption 2050: Digital inputs/outputs 7200: Temperature power stage 7198: DC bus voltage of power stage supply 7720: Current motor current 7176: Action word			
PBMapIn2	Mapping of PZD5 to master	- 0	UINT32 UINT32	Modbus 6174 Profibus 6174
-	A parameter with a data length of 16 bits can be used for mapping the PZD5 from the drive to the master.	0 65535	R/W per.	-
-	The setting is only possible if a 16 bit value was also set for PBMapIn.			
PBMapOut	Mapping of PZD5+6 to drive	- 0	UINT32 UINT32	Modbus 6148 Profibus 6148
-	A parameter with a data length of 32 bits can be used for mapping the PZD5+6 from the master to the drive.	0 65535	R/W per.	-
-	The following parameters can be used: 0: No mapping active 1556: Acceleration of profile generator 1558: Deceleration of profile generator 1538: Symmetrical ramp			
PBPkInhibit	Inhibit time during read tasks in the parameter channel	ms 0	UINT16 UINT16	Modbus 6152 Profibus 6152
-	In the case of a static read task, the reader value is cyclically updated according to the wait time defined with this parameter.	1000 65535	R/W per.	-
-	0: No wait time >0: Wait time in ms			
PBSafeState	Safe state	- 0	UINT16 UINT16	Modbus 6154 Profibus 6154
-	0 / NoError: No response	1	R/W	-
-	1 / ErrorClass2: Error of class 2, drive switches to FAULT if the power stage was active	1	per.	-
-	Response of the drive in state 'Clear' of the ProfibusDP master and response to termination of the watchdog.			

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
POSdirOfRotat	Definition of direction of rotation (173)	-	UINT16	Modbus 1560
DRC- - PRoT	0 / clockwise / \lll : Clockwise	0	UINT16	Profibus 1560
<i>drL - Prot</i>	1 / counter clockwise / \lll : Counter-clockwise	0	R/W	
	Meaning: At positive speeds, the drive rotates clockwise (looking at the motor shaft at the flange).	1	per.	
	NOTE: If you use limit switches, you must interchange the limit switch connections after changing the settings. The limit switch which is reached with a jog movement in positive direction must be connected to the LIMP input and vice versa.		-	
POSScaleDenom	Denominator of position scaling (160)	usr	INT32	Modbus 1550
-	Refer to numerator (POSScaleNum) for a description.	1	INT32	Profibus 1550
-	A new scaling is activated when the numerator value is supplied.	16384	R/W	
		2147483647	per.	
			-	
POSScaleNum	Numerator of position scaling (160)	revolution	INT32	Modbus 1552
-	Specification of the scaling factor:	1	INT32	Profibus 1552
-	Motor revolutions [U]	1	R/W	
	----- Change of user position [usr]	2147483647	per.	
	A new scaling is activated when the numerator value is supplied.		-	
	User limit values may be reduced due to the calculation of an internal factor.			
PPn_target	Reference speed in operating mode profile position (133)	min ⁻¹	UINT16	Modbus 8970
-		1	UINT16	Profibus 8970
-	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	60	R/W	
		3000	-	
			-	
PPp_absusr	Target position absolute of operating mode profile position (133)	usr	-	R/W
-	Min./max values depend on:	-	0	-
-	- Scaling factor	-	-	-
	- Software limit switches (if they are activated)			

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PPp_relpactusr - -	<p>Target position relative to current motor position (134)</p> <p>Min./max values depend on: - Position normalization factor - Software limit switches (if they are activated)</p> <p>In the case of active positioning in Profile Position mode, relative positioning refers to the current motor position. The absolute user position limits can only be overrun if the drive is at standstill when the movement starts (x_end=1). In this case, implicit position setting to position 0 is performed.</p>	usr - 0 -	R/W - -	
PPp_relprefusr - -	<p>Target position relative to the current target position (134)</p> <p>Min./max values depend on: - Position normalization factor - Software limit switches (if they are activated)</p> <p>In the case of active positioning in operating mode Profile Position, relative positioning refers to the target position of the current movement. The absolute user position limits can only be overrun if the drive is at standstill when the movement starts (x_end=1). In this case, implicit position setting to position 0 is performed.</p>	usr - 0 -	R/W - -	
PVn_target - -	<p>Reference speed of operating mode profile velocity (135)</p> <p>The adjustable value is internally limited to the current parameter setting in RAMPn_max.</p>	min ⁻¹ -3000 - 3000	INT32 INT32 R/W -	Modbus 9218 Profibus 9218

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMP_TAUjerk	Jerk limitation (164)	ms	UINT16	Modbus 1562
-	0 / off: Off	0	UINT16	Profibus 1562
-	1 / 1: 1 ms	0	R/W	
-	2 / 2: 2 ms	128	per.	
	4 / 4: 4 ms		-	
	8 / 8: 8 ms			
	16 / 16: 16 ms			
	32 / 32: 32 ms			
	64 / 64: 64 ms			
	128 / 128: 128 ms			
	Limits the acceleration change (jerk) of the reference position generation during the positioning transitions: Standstill - acceleration Acceleration - constant speed Constant speed - deceleration Deceleration - standstill			
	Processing in the following operating modes: - Profile velocity - Profile position - Jog - Homing			
	Adjustments can only be made if the operating mode is inactive (x_end=1).			
RAMP_TypeSel	Selection of ramp type (162)	-	INT16	Modbus 1574
-	-1 / motoroptimized: Motor-optimized ramp	-	INT16	Profibus 1574
-	0 / linear: Linear ramp	-	R/W	
			per.	
			-	
RAMPacc	Acceleration of profile generator (163)	min ⁻¹ /s	UINT32	Modbus 1556
-		1	UINT32	Profibus 1556
-		600	R/W	
		3000000	per.	
			-	
RAMPdecel	Deceleration of profile generator (101)	min ⁻¹ /s	UINT32	Modbus 1558
-		200	UINT32	Profibus 1558
-		750	R/W	
		3000000	per.	
			-	
RAMPn_max	Limitation of ref. speed for op. modes with profile generation (102)	min ⁻¹	UINT16	Modbus 1554
-		60	UINT16	Profibus 1554
-		3000	R/W	
	The parameter is active in the following operating modes: - Profile position - Profile velocity - Homing - Jog	3000	per.	
			-	
	If a greater reference speed is set in one of these operating modes, it is automatically limited to RAMPn_max. This way, commissioning at limited speed is easier to perform.			

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMPnstart0 - -	Start/stop speed (162) Start and end speed of profile	min ⁻¹ - -	UINT16 UINT16 R/W per. -	Modbus 1570 Profibus 1570
RAMPquickstop - -	Deceleration ramp for Quick Stop (101) Deceleration of the drive when a software stop is triggered or if an error of error class 1 has occurred.	min ⁻¹ /s 200 6000 3000000	UINT32 UINT32 R/W per. -	Modbus 1572 Profibus 1572
RAMPsym - -	Symmetrical ramp Acceleration and deceleration of the profile generator (16 bit value) in 10 (1/min)/s Write access changes the values under RAMPacc and RAMPdecel. The limit values are checked on the basis of the values indicated for these parameters. Read access returns the greater value from RAMPacc/RAMPdecel. If the currently set value cannot be represented as 16 bit value, the max, UINT16 value is written.	usr - 0 -	UINT16 UINT16 R/W - -	Modbus 1538 Profibus 1538
SaveHomeMethod - -	Default homing method (141)	- 1 18 35	INT16 INT16 R/W per. -	Modbus 6968 Profibus 6968
SM_I_nom INF - MiNo INF - MiNo	Nominal motor current Current in increments of 10mA	A _{rms} - -	UINT16 UINT16 R/W per. expert	Modbus 3596 Profibus 3596
SM_L_UV - -	Motor inductance Inductance terminal-terminal	mH - -	UINT16 UINT16 R/W per. expert	Modbus 3600 Profibus 3600
SM_n_20% - -	Speed at which 20% of the standstill torque is still available This value is automatically set if you select a defined motor. In this case, the value is only available as a read-only value. If you select a "user-defined" motor, you can set and change the value.	min ⁻¹ - -	UINT16 UINT16 R/W per. expert	Modbus 3608 Profibus 3608
SM_n_50% - -	Speed at which 50% of the standstill torque is still available This value is automatically set if you select a defined motor. In this case, the value is only available as a read-only value. If you select a "user-defined" motor, you can set and change the value.	min ⁻¹ - -	UINT16 UINT16 R/W per. expert	Modbus 3606 Profibus 3606

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
SM_n_90%	Speed at which 90% of the standstill torque is still available	min ⁻¹ -	UINT16 UINT16 R/W per. expert	Modbus 3604 Profibus 3604
-	This value is automatically set if you select a defined motor. In this case, the value is only available as a read-only value. If you select a "user-defined" motor, you can set and change the value.	-	-	-
SM_Polepair	Number of pole pairs of motor	- - -	UINT16 UINT16 R/W per. expert	Modbus 3598 Profibus 3598
SM_R_UV	Motor resistance	Ω - -	UINT16 UINT16 R/W per. expert	Modbus 3602 Profibus 3602
-	Resistance terminal-terminal	-	-	-
SM_Type	Motor type (97)	- - -	UINT32 UINT32 R/W per. -	Modbus 3588 Profibus 3588
DRC- - MTYP	0 / none / none : No motor selected (default)	-	-	-
drc - fltYP	368 / VRDM368/50LW / 368 : VRDM368/50LW 397 / VRDM397/50LW / 397 : VRDM397/50LW 3910 / VRDM3910/50LW / 3910 : VRDM3910/50LW 3913 / VRDM3913/50LW / 3913 : VRDM3913/50LW 5368 / BRS 368W / b368 : BRS 368W 5397 / BRS 397W / b397 : BRS 397W 31117 / VRDM31117/50LW / 1117 : VRDM3117/50LW 31122 / VRDM31122/50LW / 1122 : VRDM31122/50LW 43910 / ATEX ExRDM3910/50 / E910 : ATEX ExRDM3910/50 43913 / ATEX ExRDM3913/50 / E913 : ATEX ExRDM3913/50 51117 / BRS 3ACW / b3AC : BRS 3ACW 51122 / BRS 3ADW / b3Ad : BRS 3ADW 53910 / BRS 39AW / b39A : BRS 39AW 53913 / BRS 39BW / b39b : BRS 39BW 54910 / ATEX BRS 39AA / E39A : ATEX BRS 39AA 54913 / ATEX BRS 39BA / E39b : ATEX BRS 39BA 99999999 / user defined motor / u5Er : User-defined	-	-	-
	After selection of a motor type from the list, the motor-specific parameters are automatically set. When you select 'user-defined', you must set the motor-specific parameters via the commissioning software or the fieldbus.			

Parameter name HMI menu	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
SPV_SW_Limits	Monitoring of software limit switches (153)	-	UINT16	Modbus 1542
-	0 / none: None (default)	0	UINT16	Profibus 1542
-	1 / SWLIMP: Activation of software limit switches positive direction	0	R/W	
-	2 / SWLIMN: Activation of software limit switches negative direction	3	per.	
-	3 / SWLIMP+SWLIMN: Activation of software limit switches both directions		-	
	Monitoring of software limit switches only works in case of successful homing (ref_ok = 1).			
SPVn_win	Speed window, permissible speed deviation (170)	min ⁻¹	UINT16	Modbus 1576
-		1	UINT16	Profibus 1576
-		30	R/W	
-		65535	per.	
-			-	
SPVn_winTime	Speed window, time (170)	ms	UINT16	Modbus 1578
-	Value = 0: speed window monitoring deactivated	0	UINT16	Profibus 1578
-		0	R/W	
-		16383	per.	
-	Changing the value causes a restart of speed monitoring, feedback for reaching the reference speed is set to 0.		-	
SPVswLimNusr	Negative position limit for software limit switch (153)	usr	INT32	Modbus 1546
-		-	INT32	Profibus 1546
-	Refer to description 'SPVswLimPusr'	-2147483648	R/W	
-		-	per.	
-			-	
SPVswLimPusr	Positive position limit for software limit switch (153)	usr	INT32	Modbus 1544
-		-	INT32	Profibus 1544
-	If a user value entered is outside of the permissible user range, the limit switch limits are automatically set to the max. user value.	2147483647	R/W	
-		-	per.	
-			-	

12 Accessories and spare parts

12.1 Optional accessories

Designation	Order no.
Remote terminal (HMI)	VW3A31101
PC connection kit, bidirectional converter RS232 to RS485	VW3A8106
USIC (Universal Signal Interface Converter), for signal adaptation to RS422 standard	VW3M3102
Reference Value Adapter RVA for distribution of A/B signals or pulse/direction signals to 5 devices 24VDC power supply unit for 5VDC encoder supply	VW3M3101
Fan kit 24 VDC	VW3S3101

12.2 Motor cables

Designation	Order no.
Motor cable for stepper motor 4x1.5, shielded, 6-pin circular plug at the motor end; other cable end = open; length= 3m	VW3S5101R30
Motor cable for stepper motor 4x1.5, shielded, 6-pin circular plug at the motor end; other cable end = open; length= 5m	VW3S5101R50
Motor cable for stepper motor 4x1.5, shielded, 6-pin circular plug at the motor end; other cable end = open; length= 10m	VW3S5101R100
Motor cable for stepper motor 4x1.5, shielded, 6-pin circular plug at the motor end; other cable end = open; length= 15m	VW3S5101R150
Motor cable for stepper motor 4x1.5, shielded, 6-pin circular plug at the motor end; other cable end = open; length= 20m	VW3S5101R200
Motor cable for stepper motor 4x1.5 shielded, both cable ends = open; length= 3m	VW3S5102R30
Motor cable for stepper motor 4x1.5 shielded, both cable ends = open; length= 5m	VW3S5102R50
Motor cable for stepper motor 4x1.5 shielded, both cable ends = open; length= 10m	VW3S5102R100
Motor cable for stepper motor 4x1.5 shielded, both cable ends = open; length= 15m	VW3S5102R150
Motor cable for stepper motor 4x1.5 shielded, both cable ends = open; length= 20m	VW3S5102R200

12.3 Encoder cables

Designation	Order no.
Encoder cable for stepper motor, shielded, motor end with 12 pole round connector; other cable end 12-pin Molex connector; Length = 3m	VW3S8101R30
Encoder cable for stepper motor; shielded; motor end with 12 pole round connector; other cable end 12-pin Molex connector; Length = 5m	VW3S8101R50
Encoder cable for stepper motor; shielded; motor end with 12 pole round connector; other cable end 12-pin Molex connector; Length = 10m	VW3S8101R100
Encoder cable for stepper motor; shielded; motor end with 12 pole round connector; other cable end 12-pin Molex connector; Length = 15m	VW3S8101R150
Encoder cable for stepper motor; shielded; motor end with 12 pole round connector; other cable end 12-pin Molex connector; Length = 20m	VW3S8101R200
Connector set, Molex connector 12 pole, with crimp contacts, 5 pieces	VW3M8213

12.4 RS422: Pulse/direction and A/B

Designation	Order no.
Cable pulse/direction, ESIM, A/B, device end 10-pin connector, other end open, 0.5m	VW3M8201R05
Cable pulse/direction, ESIM, A/B, device end 10-pin connector, other end open, 1.5m	VW3M8201R15
Cable pulse/direction, ESIM, A/B, device end 10-pin connector, other end open, 3m	VW3M8201R30
Cable pulse/direction, ESIM, A/B, device end 10-pin connector, other end open, 5m	VW3M8201R50
Cable pulse/direction, ESIM, AB to Premium CFY, 10-pin connector, + 15-pin SubD, 0.5m	VW3M8204R05
Cable pulse/direction, ESIM, AB to Premium CFY, 10-pin connector, + 15-pin SubD, 1.5m	VW3M8204R15
Cable pulse/direction, ESIM, AB to Premium CFY, 10-pin connector, + 15-pin SubD, 3m	VW3M8204R30
Cable pulse/direction, ESIM, AB to Premium CFY, 10-pin connector, + 15-pin SubD, 5m	VW3M8204R50
Cable pulse/direction, ESIM, AB to Siemens S5 IP247, 10-pin connector, 3m	VW3M8205R30
Cable pulse/direction, ESIM, AB to Siemens S5 IP267, 10-pin connector, 3m	VW3M8206R30
Cable pulse/direction, ESIM, AB to Siemens S7-300 FM353, 10-pin connector, 3m	VW3M8207R30
Cable pulse/direction, ESIM, AB to RVA, USIC or WP/WPM311, 0.5m	VW3M8209R05
Cable pulse/direction, ESIM, AB to RVA, USIC or WP/WPM311, 1.5m	VW3M8209R15
Cable pulse/direction, ESIM, AB to RVA, USIC or WP/WPM311, 3m	VW3M8209R30
Cable pulse/direction, ESIM, AB to RVA, USIC or WP/WPM311, 5m	VW3M8209R50
Cable pulse/direction, USIC, 15-pin SubD, other end open, 0.5m	VW3M8210R05
Cable pulse/direction, USIC, 15-pin SubD, other end open, 1.5m	VW3M8210R15
Cable pulse/direction, USIC, 15-pin SubD, other end open, 3m	VW3M8210R30
Cable pulse/direction, USIC, 15-pin SubD, other end open, 5m	VW3M8210R50
Cascading cable for RVA, 0.5m	VW3M8211R05
Connector kit with 5 Molex connectors 10-pin with crimp contacts	VW3M8212

12.5 Mains filter

Designation	Order no.
Mains filter 1~; 9A; 115/230V _{ac}	VW3A31401

12.6 Mains reactors

Designation	Order no.
Mains reactor 1~; 50-60Hz; 7A; 5mH; IP00	VZ1L007UM50
Mains reactor 1~; 50-60Hz; 18A; 2mH; IP00	VZ1L018UM20

12.7 Mounting material

Designation	Order no.
Adapter plate for DIN rail mounting, width 77.5mm	VW3A11851

13 Service, maintenance and disposal



The product may only be repaired by a Schneider Electric customer service center. No warranty or liability is accepted for repairs made by unauthorized persons.

13.1 Service address

If you cannot resolve an error yourself please contact your sales office. Have the following details available:

- Nameplate (type, identification number, serial number, DOM, ...)
- Type of error (such as LED flash code or error number)
- Previous and concomitant circumstances
- Your own assumptions concerning the cause of the error

Also include this information if you return the product for inspection or repair.



If you have any questions please contact your sales office. Your sales office staff will be happy to give you the name of a customer service office in your area.

<http://www.schneider-electric.com>

13.2 Maintenance

Check the product for pollution or damage at regular intervals.

13.2.1 Lifetime STO safety function

The STO safety function is designed for a lifetime of 20 years. After this period, the data of the safety function are no longer valid. The expiry date is determined by adding 20 years to the DOM shown on the nameplate of the product.

- ▶ This date must be included in the maintenance plan of the system.
Do not use the safety function after this date.

Example The DOM on the nameplate of the product is shown in the format DD.MM.YY, for example 31.12.08. (31 December 2008). This means: Do not use the safety function after December 31, 2028.

13.3 Replacing devices

⚠ WARNING

UNINTENDED BEHAVIOR

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

- Do NOT operate the drive system with unknown settings or data.
- Verify that the stored data and settings are correct.
- When commissioning, carefully run tests for all operating states and potential fault situations.
- Verify 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 obstructions in the hazardous area.

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



Prepare a list with the parameters required for the functions used.

Observe the following procedure when replacing devices.

- ▶ Save all parameter settings to your PC using the commissioning software, see chapter 8.6.11.3 "Duplicating existing device settings", page 175.
- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Label all connections and uninstall the product.
- ▶ Note the identification number and the serial number shown on the product nameplate for later identification.
- ▶ Install the new product as per chapter 6 "Installation".
- ▶ Commission the product as per chapter 7 "Commissioning".
- ▶ If the product to be installed has previously been used in a different system or application, you must restore the factory settings before commissioning the product. See chapter 8.6.11.2 "Restoring the factory settings", page 174.
- ▶ Commission the product as per chapter 7 "Commissioning". Note that the position of the virtual index pulse changes when you replace a device. The motor shaft position associated with the motor position must be redefined, see parameter `ENC_pabsusr`.

13.4 Changing the motor

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Label all connections and uninstall the product.
- ▶ Note the identification number and the serial number shown on the product nameplate for later identification.
- ▶ Install the new product as per chapter 6 "Installation".
- ▶ Commission the product as per chapter 7 "Commissioning".

13.5 Shipping, storage, disposal

Note the ambient conditions on page 25.

- Shipping* The product must be protected against shocks during transportation. If possible, use the original packaging for shipping.
- Storage* The product may only be stored in spaces where the specified permissible ambient conditions for room temperature and humidity are met. Protect the product from dust and dirt.
- 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.

14 Extract

⚠ DANGER

UNEXPECTED HAZARDS

This chapter Extract does not replace the product manual. Unexpected hazards occur during installation, commissioning and maintenance.

- You may only perform install, commission and maintain the product if you are a qualified and trained technician.
- Carefully read and understand the complete product manual.

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

14.1 Extract for installation

*Minimum connection assignment in
fieldbus control mode:*

Pin	Signal	Description	I/O
36	$\overline{\text{HALT}}$	Function HALT, interruption of movement / continue without error	I digital 24V
37	$\overline{\text{STO_A}}$ ($\overline{\text{PWRR_A}}$)	Safety function channel A, see product manual for more information	I digital 24V ¹⁾
38	$\overline{\text{STO_B}}$ ($\overline{\text{PWRR_B}}$)	Safety function channel B, see product manual for more information	I digital 24V ¹⁾

1) If the safety function is not required, these inputs must be wired with +24V.

Connecting the safety function

⚠ WARNING

LOSS OF SAFETY FUNCTION

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

- Observe the requirements for using the safety function.

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

For more information, see chapters "Basics" and "Engineering".

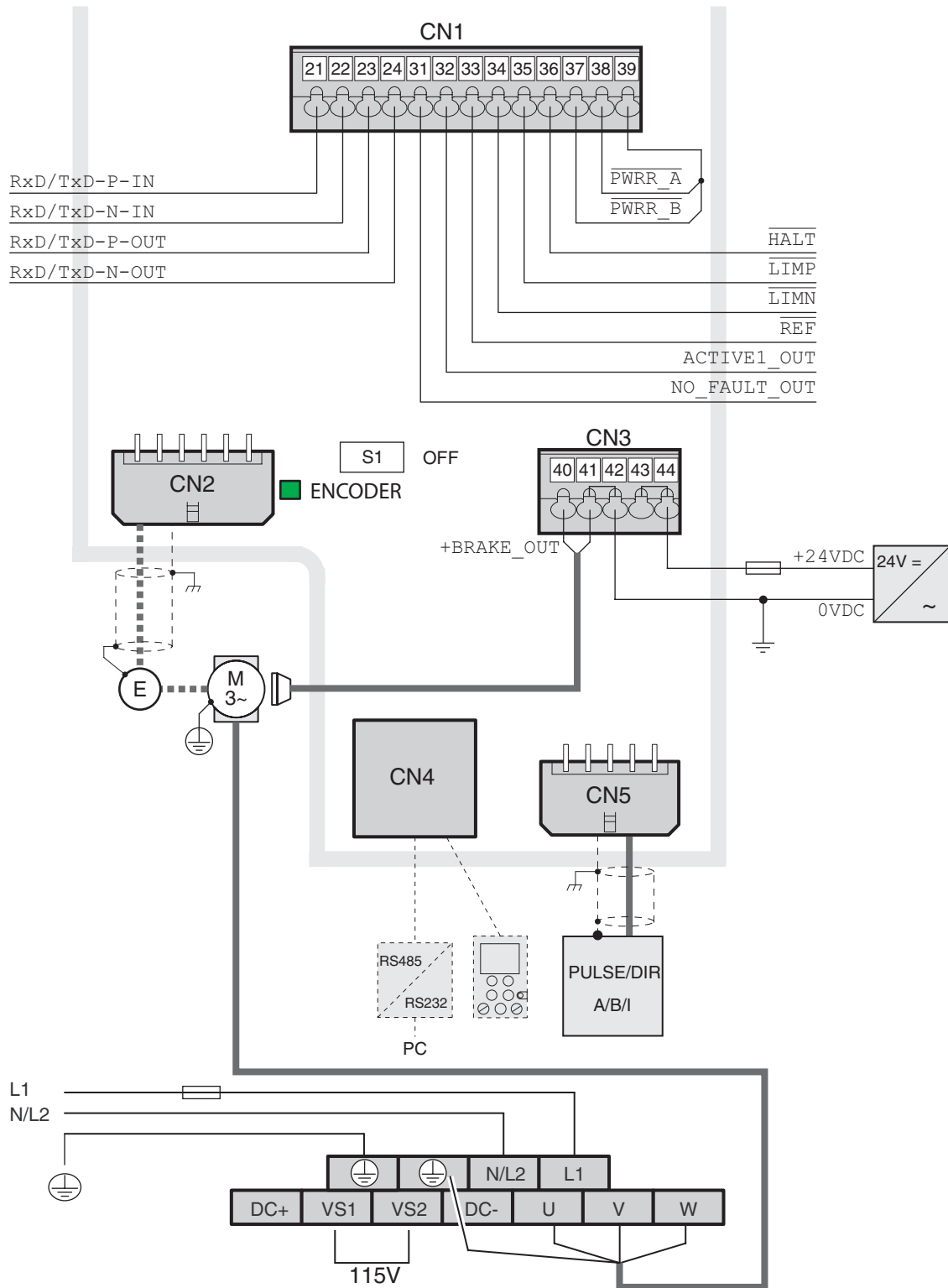


Figure 14.1 Wiring overview

14.2 Extract for commissioning

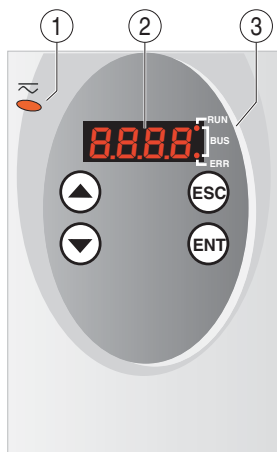
⚠ WARNING

UNEXPECTED MOVEMENT

When the drive is operated for the first time, there is a risk of unexpected movements caused by possible wiring errors or unsuitable parameters.

- Perform the first test run without coupled loads.
- Verify that a functioning button for EMERGENCY STOP is within reach.
- Anticipate movements in the incorrect direction or oscillation of the drive.
- Only start the system if there are no persons or obstructions in the hazardous area.

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



(1) Red LED on: Voltage present at DC bus

(2) Status indication

(3) LEDs for fieldbus



- Close a menu or parameter
- Return from displayed value to last saved value



- Display a menu or parameter
- Save displayed value to the EEPROM



- Return to previous menu or parameter
- Increase the displayed value



- Go to next menu or parameter
- Decrease the displayed value

14.2.1 HMI menu structure

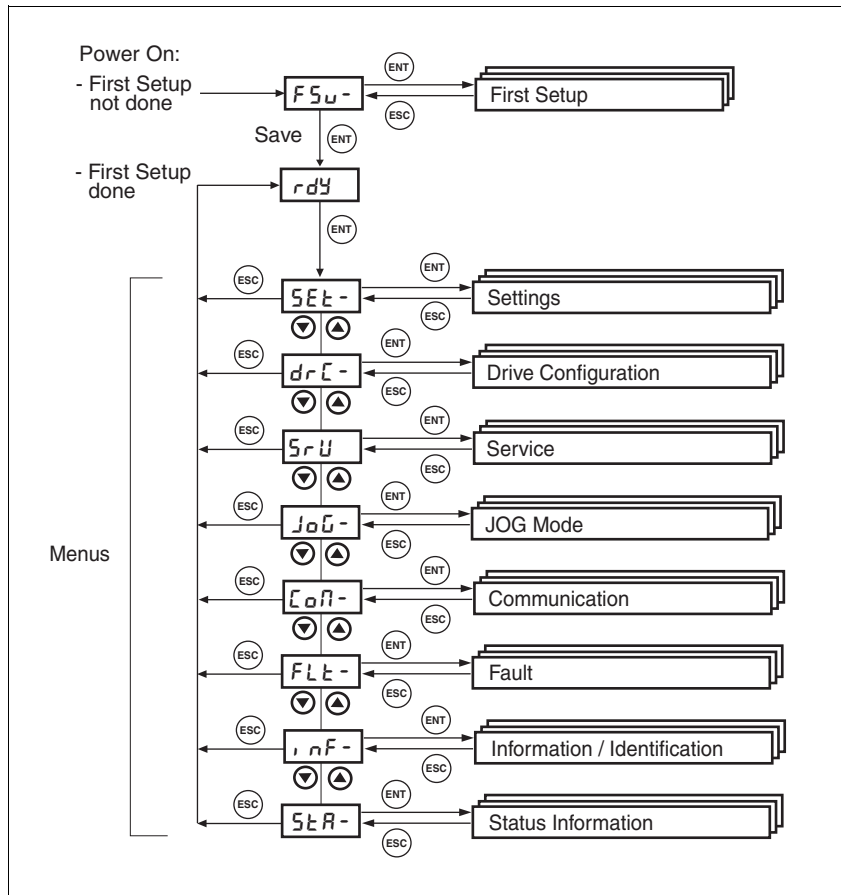
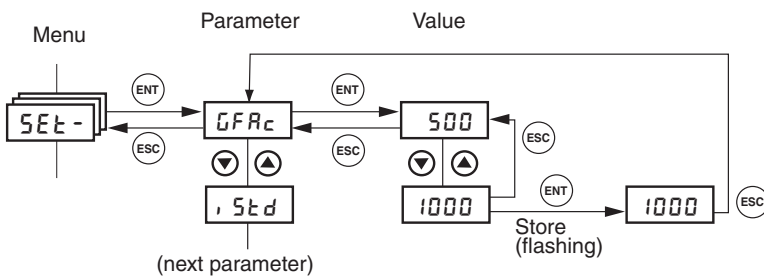


Figure 14.2 HMI menu structure

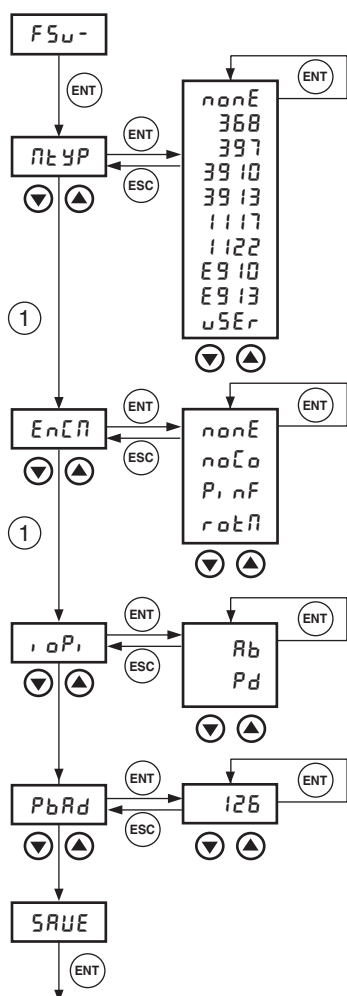
HMI, example of setting a parameter



The figure to the left shows an example of displaying a parameter (second level) and entering or selecting a parameter value (third level).

Press ENT to confirm the selected value. The display flashes once for confirmation. The modified value is immediately written to the EEPROM.

14.2.2 "First Setup" (FSU) via HMI



Restoring the factory setting via the HMI

For the "First Setup" via the HMI, perform the following steps and make the selections corresponding to your application. For more information, see chapter "Commissioning".

► **MOTOR**: Select the connected motor type (only the last 4 digits are displayed) 368, 397, 3910, 3913, 1117, 1122 or user-specific motor USER

► **ENCLN**: Select the rotation monitoring settings

noLo No rotation monitoring connected

P, nF Rotation monitoring connected, position information only

rotN Rotation monitoring activated

► **IOPi**: Select interface mode for operating mode Electronic Gear (CN5): A/B signals (Ab) or pulse/direction signals (Pd)

► Set the fieldbus address of the device **PbAd**

Set the unique fieldbus address of the device (1-126)

► Save the settings.

SAVE Save the settings to the device.

◁ The device saves all set values to the EEPROM and displays the status **ready**, **rdy** or **dis** on the HMI.

► Switch the controller supply voltage off and on again.

Proceed as follows to restore the factory settings:

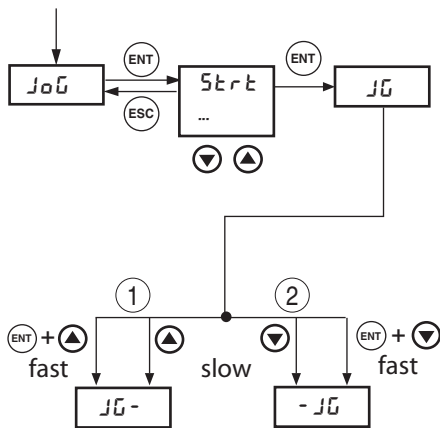
► Select **drC** and then **F5** at the HMI and confirm the selection with **YES**.

The new settings only become active until after the device is switched off and on again.

14.2.3 Jog

For simple initial commissioning the motor should not be connected to the system. If the motor is connected to the system, all limiting parameters must be verified and an EMERGENCY STOP button must be within reach before the first motor movement, see product manual.

If the inertia ratio of $J_{ext}/J_{motor} > 10$ (external load to motor), the initial setting of the control loop parameters may result in an unstable controller.



- ▶ Start the operating mode Jog. (HMI: *Jog* / *Start*)
 - ◁ The HMI displays: *JG*
 - ▶ Start a movement with positive direction of rotation (1). (HMI: "Up Arrow")
 - ◁ The motor rotates with positive direction of rotation. The HMI displays *JG-*.
 - ▶ Start a movement with negative direction of rotation (2). (HMI: "Down Arrow")
 - ◁ The motor rotates with negative direction of rotation. The HMI displays *-JG*.
- Press the ENT key and an arrow key simultaneously to switch from slow to fast movement.

If the motor does not rotate:

- Did you switch on the controller supply voltage?
- Did you switch on the power stage supply voltage?
- Is the device in state *rdy*?
- Did you run a "First Setup" or import device settings? Did you switch off and on the controller supply voltage after that?
- Did you wire the safety function correctly? Was the safety function triggered?
- Did you wire the limit switches correctly or was a limit switch triggered?

14.2.4 Duplicating 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. The controller supply voltage 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 of the device into the commissioning software with "Action - Transfer".
 - ▶ 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".

15 Glossary

15.1 Units and conversion tables

The value in the specified unit (left column) is calculated for the desired unit (top row) with the formula (in the field).

Example: conversion of 5 meters [m] to yards [yd]
 $5 \text{ m} / 0.9144 = 5.468 \text{ yd}$

15.1.1 Length

	in	ft	yd	m	cm	mm
in	-	/ 12	/ 36	* 0.0254	* 2.54	* 25.4
ft	* 12	-	/ 3	* 0.30479	* 30.479	* 304.79
yd	* 36	* 3	-	* 0.9144	* 91.44	* 914.4
m	/ 0.0254	/ 0.30479	/ 0.9144	-	* 100	* 1000
cm	/ 2.54	/ 30.479	/ 91.44	/ 100	-	* 10
mm	/ 25.4	/ 304.79	/ 914.4	/ 1000	/ 10	-

15.1.2 Mass

	lb	oz	slug	kg	g
lb	-	* 16	* 0.03108095	* 0.4535924	* 453.5924
oz	/ 16	-	* $1.942559 \cdot 10^{-3}$	* 0.02834952	* 28.34952
slug	/ 0.03108095	/ $1.942559 \cdot 10^{-3}$	-	* 14.5939	* 14593.9
kg	/ 0.45359237	/ 0.02834952	/ 14.5939	-	* 1000
g	/ 453.59237	/ 28.34952	/ 14593.9	/ 1000	-

15.1.3 Force

	lb	oz	p	dyne	N
lb	-	* 16	* 453.55358	* 444822.2	* 4.448222
oz	/ 16	-	* 28.349524	* 27801	* 0.27801
p	/ 453.55358	/ 28.349524	-	* 980.7	* $9.807 \cdot 10^{-3}$
dyne	/ 444822.2	/ 27801	/ 980.7	-	/ $100 \cdot 10^3$
N	/ 4.448222	/ 0.27801	/ $9.807 \cdot 10^{-3}$	* $100 \cdot 10^3$	-

15.1.4 Power

	HP	W
HP	-	* 746
W	/ 746	-

15.1.5 Rotation

	min ⁻¹ (RPM)	rad/s	deg./s
min ⁻¹ (RPM) -		* π / 30	* 6
rad/s	* 30 / π	-	* 57.295
deg./s	/ 6	/ 57.295	-

15.1.6 Torque

	lb-in	lb-ft	oz-in	Nm	kp-m	kp-cm	dyne-cm
lb-in	-	/ 12	* 16	* 0.112985	* 0.011521	* 1.1521	* 1.129*10 ⁶
lb-ft	* 12	-	* 192	* 1.355822	* 0.138255	* 13.8255	* 13.558*10 ⁶
oz-in	/ 16	/ 192	-	* 7.0616*10 ⁻³	* 720.07*10 ⁻⁶	* 72.007*10 ⁻³	* 70615.5
Nm	/ 0.112985	/ 1.355822	/ 7.0616*10 ⁻³	-	* 0.101972	* 10.1972	* 10*10 ⁶
kp-m	/ 0.011521	/ 0.138255	/ 720.07*10 ⁻⁶	/ 0.101972	-	* 100	* 98.066*10 ⁶
kp-cm	/ 1.1521	/ 13.8255	/ 72.007*10 ⁻³	/ 10.1972	/ 100	-	* 0.9806*10 ⁶
dyne-cm	/ 1.129*10 ⁶	/ 13.558*10 ⁶	/ 70615.5	/ 10*10 ⁶	/ 98.066*10 ⁶	/ 0.9806*10 ⁶	-

15.1.7 Moment of inertia

	lb-in ²	lb-ft ²	kg-m ²	kg-cm ²	kp-cm-s ²	oz-in ²
lb-in ²	-	/ 144	/ 3417.16	/ 0.341716	/ 335.109	* 16
lb-ft ²	* 144	-	* 0.04214	* 421.4	* 0.429711	* 2304
kg-m ²	* 3417.16	/ 0.04214	-	* 10*10 ³	* 10.1972	* 54674
kg-cm ²	* 0.341716	/ 421.4	/ 10*10 ³	-	/ 980.665	* 5.46
kp-cm-s ²	* 335.109	/ 0.429711	/ 10.1972	* 980.665	-	* 5361.74
oz-in ²	/ 16	/ 2304	/ 54674	/ 5.46	/ 5361.74	-

15.1.8 Temperature

	°F	°C	K
°F	-	(°F - 32) * 5/9	(°F - 32) * 5/9 + 273.15
°C	°C * 9/5 + 32	-	°C + 273.15
K	(K - 273.15) * 9/5 + 32	K - 273.15	-

15.1.9 Conductor cross section

AWG	1	2	3	4	5	6	7	8	9	10	11	12	13
mm²	42.4	33.6	26.7	21.2	16.8	13.3	10.5	8.4	6.6	5.3	4.2	3.3	2.6
AWG	14	15	16	17	18	19	20	21	22	23	24	25	26
mm²	2.1	1.7	1.3	1.0	0.82	0.65	0.52	0.41	0.33	0.26	0.20	0.16	0.13

15.2 Terms and Abbreviations

See chapter 2.7 "Standards and terminology" for information on the pertinent standards on which many terms are based. Some terms and abbreviations may have specific meanings with regard to the standards.

<i>AC</i>	Alternating current
<i>Actual position</i>	Current position of moving components in the drive system.
<i>Drive system</i>	System consisting of controller, power stage and motor.
<i>DC</i>	Direct current
<i>Degree of protection</i>	The degree of protection is a standardized specification for electrical equipment that describes the protection against the ingress of foreign objects and water (for example: IP 20).
<i>Direction of rotation</i>	Rotation of the motor shaft in a positive or negative direction of rotation. Positive direction of rotation is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft.
<i>DOM</i>	The Date of manufacturing on the nameplate of the device is shown in the format DD.MM.YY, for example 31.12.06 (December 31, 2006).
<i>Electronic gear</i>	Calculation of a new output speed for the motor movement based on the input speed and the values of an adjustable gear ratio; calculated by the drive system.
<i>EMC</i>	Electromagnetic compatibility
<i>Encoder</i>	Sensor for detection of the angular position of a rotating component. Installed in a motor, the encoder shows the angular position of the rotor.
<i>Error</i>	Discrepancy between a computed, observed or measured value or condition and the specified or theoretically correct value or condition.
<i>Error class</i>	Classification of errors into groups. The different error classes allow for specific responses to faults, for example by severity.
<i>Factory setting</i>	The factory setting.
<i>Fatal error</i>	In the case of fatal error, the product is no longer able to control the motor so that the power stage must be immediately disabled.
<i>Fault</i>	Operating state of the drive caused as a result of a discrepancy between a detected (computed, measured or signaled) value or condition and the specified or theoretically correct value or condition.
<i>Fault reset</i>	A function used to restore the drive to an operational state after a detected error is cleared by removing the cause of the error so that the error is no longer active (transition from operating state "Fault" to state "Operation Enable").
<i>Holding brake</i>	The motor holding brake has the task of blocking the motor shaft when no current is supplied to the motor (for example, in the case of a vertical axis). The holding brake is not a safety function.
<i>I²t monitoring</i>	Anticipatory temperature monitoring. The expected temperature rise of components is calculated in advance on the basis of the motor current. If a limit value is exceeded, the drive reduces the motor current.
<i>I/O</i>	Inputs/outputs

<i>Inc</i>	Increments
<i>Index pulse</i>	Signal of an encoder to reference the rotor position in the motor. The encoder returns one index pulse per revolution.
<i>Internal units</i>	Resolution of the power stage at which the motor can be positioned. Internal units are specified in increments.
<i>IT mains</i>	Mains in which all active components are isolated from ground or are grounded by a high impedance. IT: isol�e terre (French), isolated ground. Opposite: Grounded mains, see TT/TN mains
<i>Limit switch</i>	Switches that signal overtravel of the permissible range of travel.
<i>Parameter</i>	Device data and values that can be set by the user.
<i>PELV</i>	Protective Extra Low Voltage, low voltage with isolation. For more information: IEC 60364-4-41
<i>Persistent</i>	Indicates whether the value of the parameter remains in the memory after the device is switched off.
<i>PLC</i>	Programmable logic controller
<i>Power stage</i>	The power stage controls the motor. The power stage generates current for controlling the motor on the basis of the positioning signals from the controller.
<i>Profibus</i>	Standardized open fieldbus as per EN 50254-2 which allows drives and other devices from different manufacturers to communicate.
<i>PTC</i>	Resistor with positive temperature coefficient. Resistance value increases as the temperature rises.
<i>Pulse/direction signals</i>	Digital signals with variable pulse frequencies which signal changes in position and direction of rotation via separate signal wires.
<i>Quick Stop</i>	Function which can be used for fast deceleration of the motor via a command or in the event of an error.
<i>RCD</i>	Residual Current Device
<i>rms</i>	Root Mean Square value of a voltage (V_{rms}) or a current (A_{rms})
<i>Scaling factor</i>	This factor is the ratio between an internal unit and a user-defined unit.
<i>TT mains, TN mains</i>	Grounded mains, differ in terms of the ground connection (PE conductor connection). Opposite: Ungrounded mains, see IT mains.
<i>User-defined unit</i>	Unit whose reference to motor rotation can be determined by the user via parameters.
<i>Warning</i>	If the term is used outside the context of safety instructions, a warning alerts to a potential problem that was detected by a monitoring function. A warning is not an error and does not cause a transition of the operating state.
<i>Watchdog</i>	Unit that monitors cyclic basic functions in the product. The power stage is disabled and the outputs are switched off in the event of errors.

16 Index

A

- Abbreviations 243
- Absolute positioning in Profile Positioning operating mode 132
- Access control 109
- Accessories and spare parts 227
- ACTIVE2_OUT 73
- Air humidity 25
- Ambient conditions 25
 - Air humidity operation 25
 - Operation 25
 - Relative air humidity operation 25
 - Transportation and storage 25
- Approved motors 28, 58
- Assembling cables
 - Mains supply 62
 - Motor phases 59

B

- Before you begin
 - Safety information 19
- Brake function 171
- Braking ramp, see deceleration ramp

C

- Cable specifications
 - Digital signals 77
 - Encoder signal A, B, I 70
 - ESIM 74
 - PC 79
 - Profibus fieldbus interface 75
 - Protected cable installation 39
 - Remote terminal 79
- Cable specifications and terminal
 - Motor phase connections 58
- Cables 34
- CAP1 167
- CAP2 167
- Category 0 stop 37
- Category 1 stop 37
- Cause of stop, last 182, 183
- Certifications 25
- Change
 - Operating mode 122
- Changing the motor 231
- Changing the operating state 118
- Checking limit switches 105
- Commissioning 85
 - Checking limit switches 105
 - Digital inputs and outputs 103

- Direction of movement, test 107
- Safety function STO, test 106
- Setting basic parameters 101
- steps 95
- Tools 88
- Commissioning software 94
 - Error indication 183
 - Functions 94
 - Online help 94
 - System requirements 94
- Commissioning software Lexium CT 94
- Components and interfaces 13
- Connection
 - DC bus 60
 - Digital inputs/outputs 77
 - Encoder signals A, B, I 70
 - Mains supply 61
 - Motor phases 58
 - PC and remote terminal via RS485 79
 - Profibus DP 75
 - PULSE 72
 - Rotation monitoring (CN2) 64
- Control cabinet 49
- Control cabinet design 43
- Controller supply voltage
 - Connection 68
- Controller supply voltage 24VDC 29
- Cover film, removing 51
- Current
 - Position 134
 - Speed 136

D

- Deceleration ramp, setting 163
- Declaration of conformity 16
- Default values
 - Restoring 174
- Definition
 - STO 37
- Device
 - Mounting 49, 50
- Device overview 11
- Diagnostics 179
- Diagram
 - A/B signals 70
- Digital inputs and outputs
 - Display and modify 103
- Digital inputs/outputs
 - Connection 78
- dimensional drawing, see dimensions
- Dimensions 27
- Direction of movement, test 107
- Direction of rotation ->Direction of movement 107
- Direction reversal 173
- Disposal 229, 231

Documentation and literature references 15

E

Electrical installation 53

Electronic gear 126

EMC 43

 Cable installation 44

 Improvement 45

 Motor cable and encoder cable 45

 Power supply 44

 Scope of supply and accessories 43

 Shielding 44

Encoder 64

 Connection 70

 ConnectionMotor encoder

 Connection 66

Encoder cable

 EMC requirements 45

EPLAN Macros 15

Equipotential bonding conductors 45

Error

 Current 182

Error class 112, 179

Error indication 180

 Commissioning software 183

 Fieldbus 183

 HMI 182

Error indication HMI 182

Error response 113, 179

 Meaning 112, 179

Errors 186

Examples 177

F

Fast position capture 167

Fieldbus

 Error indication 183

 Profibus DP 75

Fieldbus interface Profibus

 Terminating resistor 76

Fieldbus interface PROFIBUS DP

 function 75

First Setup

 Preparation 96

 Via HMI 96

Function

 Encoder signals A, B, I 70

 Motor phase current, setting 151

 P/D, Pulse/Direction 72

 PROFIBUS DP fieldbus interface 75

Functional safety 24, 35

Functions 151

 Brake function 171

 direction reversal 173

 Fast position capture 167

- Halt 166
- monitoring functions 152
- Quick Stop 165
- Restoring default values 174
- scaling 159
- travel profile 162

G

- Gear ratio 128
- Glossary 241

H

- Halt 166
- Hazard categories 20
- HMI
 - Control panel 89
 - Error indication 182
 - First Setup 96
 - function 89
 - Menu structure 90, 91
- Homing 137
- Homing by position setting
 - Position setting 150
- Humidity 25

I

- Improvement of EMC 45
- Installation
 - electrical 53
 - mechanical 48
- Intended use 19
- Interface signal
 - FAULT_RESET 165
- Introduction 11
- IT mains, operation in 47

J

- Jerk limitation 164
- Jog 123

L

- Last cause of stop 182, 183
- LEDs at HMI
 - for Profibus 90
- Lexium CT commissioning software 94
- Limit switch
 - Limit switch 154
 - Moving the drive away from the switch 154
 - Reference movement without index pulse 142
- Limit values
 - Setting 101

M

- Macros EPLAN 15
- Mains filter
 - Mounting 52
- Mains supply
 - Connection 63
- Maintenance 229
- Manuals
 - Source 15
- Max. humidity operation 25
- Mechanical installation 48
- Minimum connection assignment 77
- Monitoring
 - Motor phases 59
 - Parameters 155
- Monitoring functions 41, 152
- Motor cable
 - Connection 60
 - EMC requirements 45
- Motor phase current, percentage setting 151
- Mounting distances 49
- Mounting, mechanical 49

O

- Operating mode
 - Change 122
 - electronic gear 126
 - Homing 137
 - jog 123
 - Profile Position 132
 - Profile Velocity 135
 - Start 121
- Operating modes 123
- Operating state 100
- Operating states 111
- Operation 109
- Operation ambient temperature 25
- Overview 87, 88
 - All connections 56
 - Procedure for electrical installation 55

P

- Parameter
 - Display via HMI 90
 - representation 199
- Parameters 199
- PC
 - Connection 79
- PELV power supply UL 34
- Pollution degree 25
- Position
 - Current 134
- Position setting 150
- Positioning limits 152

- Power connections
 - Overview 56
- Prerequisites
 - For setting the operating mode 120
 - For starting Profile Position 132, 135
- Profibus
 - Connection 76
 - LEDs at HMI 90
- Profibus fieldbus interface
 - cable specifications 75
- Profile generator 162
- Profile Position 132
- Profile Velocity 135
- Protected cable installation 39
- PULSE/DIR
 - Connection 74
- Pulse/Direction P/D
 - Function 72

Q

- Qualification of personnel 19
- Quick Stop 165

R

- Ramp
 - Shape 162
 - Steepness 163
- REF, see reference switch
- Reference movement with index pulse 145
- Reference movement without index pulse 142
- Reference speed 135
- Reference switch
 - Reference movement with index pulse 147
 - Reference movement without index pulse 143
- Relative air humidity 25
- Relative positioning in Profile Position operating mode 132
- Release of direction 131
- Remote terminal
 - Function 79

S

- Safe Torque Off 37
 - Definition 37
- Safety disconnect moment 37
- Safety function 37
 - Application examples 40
 - Category 0 stop 37
 - Category 1 stop 37
 - Definition 37
 - Definitions 37
 - Requirements 38
- Safety function STO, test 106
- Scaling 159
- Scope of supply 12

- Service 229
- Service address 229
- Shielding - EMC requirements 44
- Shipping 231
- Signal connections
 - Overview 57
- Signal inputs
 - Circuit diagram 73
- Software limit switches 153
- Source
 - Commissioning software 94
 - EPLAN Macros 15
 - Manuals 15
- Start
 - Operating mode 121
- State diagram 111
- State indication
 - DIS 182
 - FLT 182
 - NRDY 182
 - ULOW 182
 - WDOG 182
- State machine 100, 182
- State transitions 114, 181
- Status monitoring during operation 152
- STO 37
 - Application examples 40
 - Definitions 37
 - Requirements 38
- Storage 231
 - Ambient conditions 25

T

- Technical data 25
- Temperature during operation 25
- Temperature monitoring 155
- Terminal
 - Connection 79
- Terminal, remote
 - Function 79
- Terminating resistor
 - Fieldbus interface Profibus 76
- Terms 243
- Time chart
 - Pulse/direction signal 73
- Tools for commissioning 88
- Transportation
 - Ambient conditions 25
- Travel profile 162
- Troubleshooting 179, 186
 - Errors 186
 - Errors by bit class 187
- TÜV certificate for functional safety 17
- Type code 14

U

UL

PELV power supply 34

Wiring 34

Units and conversion tables 241

V

Ventilation 49

W

Wiring diagram

24V supply 68

Encoder A, B, I 71

Motor encoder 66

Motor phases 60

PC 80

Power stage supply voltage 62

Profibus at CN1 76

PULSE/DIR 74

Terminal 80

Wiring UL 34