

SD328B

Stepper motor drive

Product manual

V2.00, 09.2008



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.

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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, e.g. `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 Unit overview

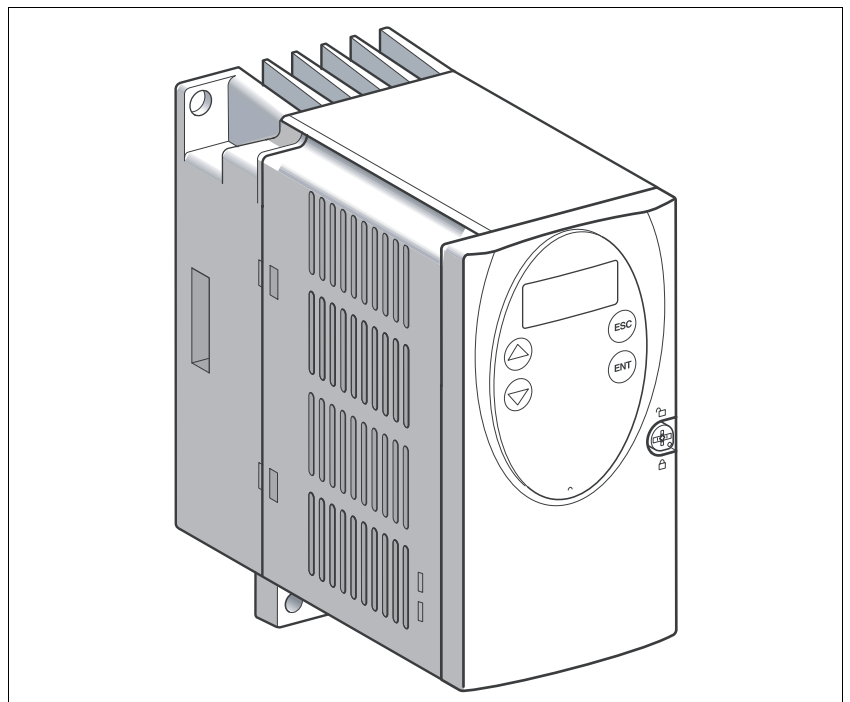


Figure 1.1 Device overview

Drive system This drive is used to control a 3-phase stepper motor. Reference values are normally provided and monitored by a master PLC or a motion controller, e.g. LMC. An input panel (HMI, **H**uman-**M**achine-**I**nterface) with display and keypad is installed in the front panel for easy parameterization.

Reference value supply The reference value can be specified via:

- Profibus fieldbus for operating modes Profile Position and Profile Velocity.
- Pulse/direction signals or A/B encoder signals for realization of an electronic gear.

Rotation monitoring / motor monitoring

If a stepper motor is connected to an integrated encoder, the following functions can be enabled:

- **Rotation monitoring:**
The calculated reference position and the actual position of the motor are compared. If a permanently defined variation is exceeded a rotation monitoring error is reported.
- **Line monitoring:**
The encoder cable is monitored. If the encoder supply is interrupted, no readiness will be signaled for the encoder.
- **Motor temperature monitoring:**
The device shuts off if the motor temperature is too high.

Holding brake output

The device has an output for direct connection of a holding brake.

Safety function

The integrated safety function STO (IEC 61800-5-2) meets the requirements of Safety Integrity Level SIL2. The safety function allows for a category 0 stop as per EN 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

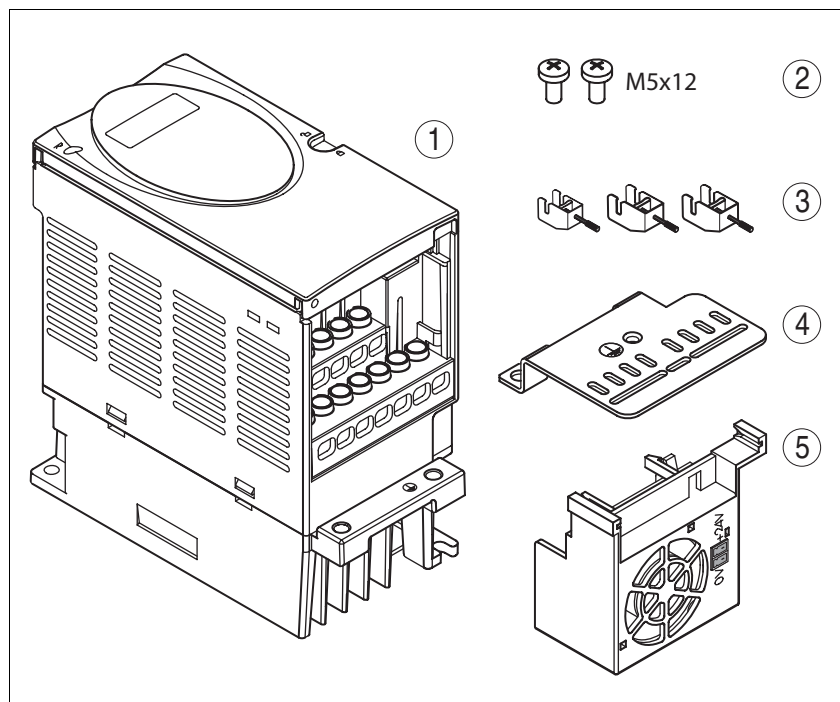


Figure 1.2 Scope of supply

- (1) SD32••
- (2) Mounting screws
- (3) EMC terminals
- (4) EMC mounting plate
- (5) Fan (SD32••U68 only)

1.4 Components and interfaces

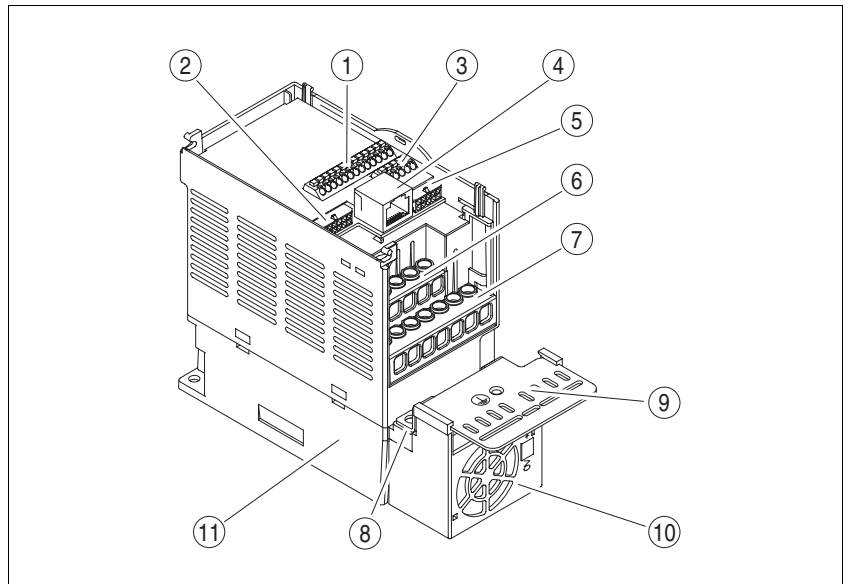


Figure 1.3 Components and interfaces

- (1) CN1, I/O signal connection (spring clamp terminals)
 - Profibus for fieldbus control
 - Eight digital inputs/outputs. The assignment depends on the selected operating mode
- (2) 12 pole CN2 female connector for motor encoder
- (3) CN3 connection for 24V power supply and holding brake
- (4) CN4, RJ45 socket for connecting
 - PC with commissioning software
 - Remote terminal
- (5) 10 pole CN5 socket for
 - Supply of of pulse/direction of A/B encoder signals in operating mode Electronic Gear
- (6) Screw terminals for connecting the mains supply
- (7) Screw terminals for connecting the motor
- (8) Base for attachment of 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 drive 3-phase					
Product type 28 = stepper motor drive for fieldbus					
Interfaces A = CANopen fieldbus, modbus fieldbus and analog input B = Profibus fieldbus					
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 panel.

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 product manuals The current product manuals are available for download from the Internet.
<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>

Additional literature We recommend the following literature for more in-depth knowledge:

- 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

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 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 (e.g. 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

ELECTRIC SHOCK, FIRE, 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.
- The system manufacturer is responsible for compliance with all applicable regulations pertaining to grounding the drive system.
- Many components, including the printed circuit board, operate with mains voltage. **Do not touch.** Do **not** touch unprotected parts or screws of the terminals when they are under voltage.
- Install all covers and close the housing doors before applying voltage.
- The motor generates voltage when the shaft is rotated. Lock the motor shaft to prevent rotation caused by external forces before starting work on the drive system.
- Before working on the drive system:
 - Disconnect the voltage supply to all connections.
 - Place a label "DO NOT SWITCH ON" on the switch and secure the switch against being switched on.
 - **Wait for 6 minutes** (discharge DC bus capacitors). Do **not** short-circuit DC bus!
 - Measure the voltage on DC bus and verify that it is <42V. (The DC bus LED is not a reliable indicator for the absence of DC bus voltage).

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**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 $\overline{\text{STO_A}}$ ($\overline{\text{PWR_A}}$) and $\overline{\text{STO_B}}$ ($\overline{\text{PWR_B}}$) to avoid an unexpected restart of the motor before switching on and configuring the drive system.
- Do NOT operate the drive system 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 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.

2.6 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", "alarm", 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 device 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 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) With use according to UL 508C, the notes in chapter 3.6 "Conditions for UL 508C" must be adhered to.

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
-------------	------	-------------

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 height with max ambient temperature 40°C, without protective film and with a side distance >50 mm	[m]	≤2000

Vibration and shock

Vibration, sinusoidal	As per IEC/EN 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/EN 60068-2-27 150 m/s ² (11 ms)

3.2.1 Degree of protection

The devices have the degree of protection IP20. The degree of protection IP40 is met for the top of the housing if the protective film on top of the device has not been removed. The protective film may need to be removed because of the ambient temperature or the device clearances, see chapter 6.2.1 "Mounting the device" page 50.

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

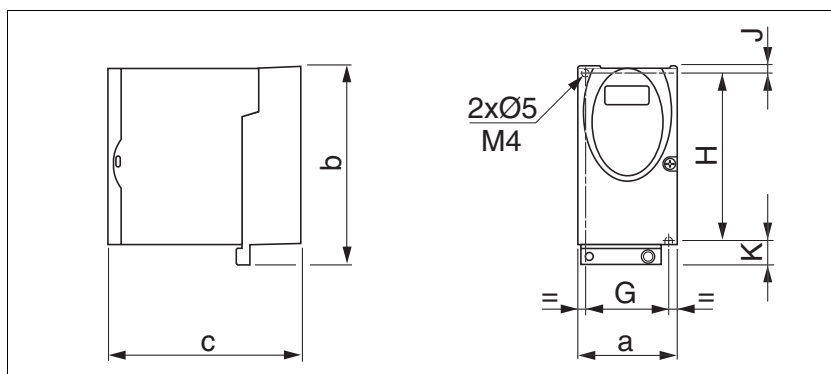


Figure 3.1 Dimensions

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 installation	[mm]	77.5 ²⁾	77.5 ²⁾

1) >1 m/s

2) Width of adapter plate

3.4 Electrical Data

3.4.1 Performance data for power amplifier

Performance data

SD32••...		U25S2	U68S2
Nominal voltage (switching)	[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) (Device power output)	[W]	180/270	280/420
Max. allowable short circuit current of 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 fuses as per UL 248-4, alternatively automatic 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 - motor cable length <10 m - as per IEC 60990, Figure 3	[mA]	<30 ¹⁾

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

Input current and impedance of the mains supply

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

Voltage against ground

The isolation of the devices is designed for a rated voltage corresponding to the value of the nominal voltage. The voltage to ground must not exceed these values.

Approved motors

Approved motor families: BRS3, ExRDM, VRDM3
Approved motor voltage: 230V_{ac} / 325V_{dc}
The product catalog contains an overview of approved motors.

3.4.2 24VDC controller power supply

Spring clamp terminals The spring clamp 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 admissible current	[A]	2

1) Mechanical conditions must be accounted for

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 %)
Current consumption ¹⁾	[A]	≤0.2
Residual ripple	[%]	<5

1) without load on outputs

3.4.3 Signals

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

24V input signals The levels of the inputs correspond when configured as "source" in EN 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 + Precision of encoder

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

2) The captured motor position is not exact during the acceleration phase and the deceleration phase.

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

Output voltage	[V]	≤30
Voltage drop at 50 mA load	[V]	≤1
Maximum switching current +BRAKE_OUT (no voltage reduction)	[A]	1.5
Maximum switching current of 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.

Motor encoder signals

Output: ENC+5V_OUT		
Supply voltage	[V]	4.75 ... 5.25
Maximum output current	[mA]	100
SENSE-controlled, short-circuit protected and overload protected		
Inputs: ENC_A, ENC_B, ENC_I		
Signal voltage	Conforming to RS422	
frequency	[kHz]	≤400

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

The levels of the inputs correspond when configured as "source" in EN 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 <u>STO_A</u> (<u>PWRR_A</u>) and <u>STO_B</u> (<u>PWRR_B</u>)	[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 (EN 13849-1) Mean Time to Dangerous Failure		3788 years
DC (EN 13849-1) Diagnostic Coverage	[%]	90

3.4.5 Fan

The fan is only installed on device type SD32●●U68.

Fan

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

3.4.6 Mains filter

Basics The EMC standards differentiate between various application cases:

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

Limit values This drive system meets the EMC requirements according to the standard IEC 61800-3, if the described measures are implemented during installation. If it is operated outside this scope, note the following:

⚠ WARNING

HIGH-FREQUENCY INTERFERENCE

In a domestic environment this product may cause high-frequency interference that may require action to suppress interference.

Better values can be achieved depending on the device and the application and also the structure, e.g. on mounting in an enclosed control cabinet.

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

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

The operator must ensure that the EMC guidelines are observed. For ordering data for external mains filters see Chapter 12 "Accessories and spare parts".

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" on 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} unloaded)	[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 and overload protected		

3.5.2 Cable

Overview of cables required

	max. cable length [m]	min. conductor cross section [mm ²]	as per PELV	shielded, both ends grounded	twisted pair
Motor cable (see chapter 12.2 "Motor cables")	10/50Length depends on required limit val- ues for line interfer- ence, see chapter 1)	4*1.5 (AWG 14)		X	
Mains supply	–	0.75 (AWG 18)			
Sensor cable (see chapter 12.3 "Encoder cable")	100	10*0.25 and 2*0.5 (AWG 22 and 18)	X	X	X
Controller supply voltage	–	0.75 (AWG 18)	X		

1) 3.4.6 "Mains filter".

Motor and encoder cable The motor cable and encoder cable are suitable for trailing and are available in various lengths. Accessories offered are listed beginning from Page 223.

Permissible voltage	[V _{AC}]	600 (UL and CSA)
Temperature range	[°C]	-40 ... +90 (fixed installation) -20 ... +80 (in motion)
Minimum bending radius		4 x diameter (fixed) 7.5 x diameter (in motion)
Sheath		Oil-resistant PUR
Shielding		Shield braiding
Overlapping of shielding	[%]	≥85

3.6 Conditions for UL 508C

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

Ambient temperature during operation

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

Pollution degree Use in an environment with pollution degree 2.

Wiring Use only 60/75 °C copper conductors.

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. It is not only one single component but the entire function chain (e.g. from the sensor through the logical processing unit to the actuator) that is considered as one single 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.

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", "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 (EN 60204-1)</i>	Stopping by immediate removal of power to the machine actuators (i.e. an uncontrolled stop).
<i>Category 1 stop (EN 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" (EN 60204-1) for category 0 stops. With an additional, approved EMERGENCY STOP module, it is also possible to implement category 1 stops.
<i>Function principle</i>	<p>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.</p> <p>The switching process must be simultaneous for both inputs (skew <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".</p> <p>The power stage is disabled and an error message is generated if only one of the two inputs is switched off or if the skew is too great. This error message can only be reset by switching off the product.</p>

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 stop is not monitored by the drive system; in the case of a power outage or an error, the stop may not be performed correctly. 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, corresponding to the required safety.

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 (EN 13849-1) Mean Time to Dangerous Failure		3788 years
DC (EN 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 always have priority.

5.1.4 Application examples STO

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

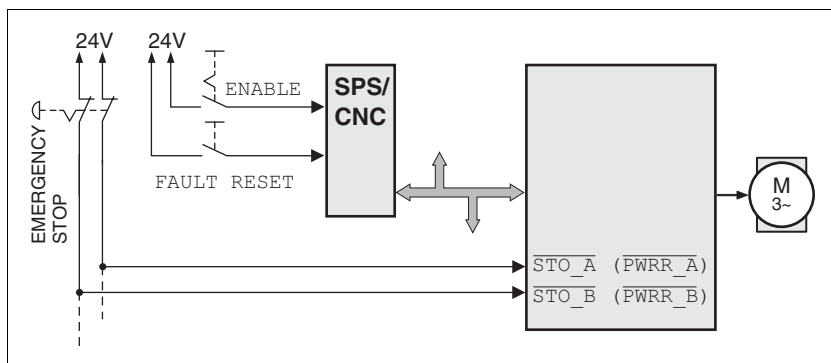


Figure 5.1 Example of category 0 stop

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.

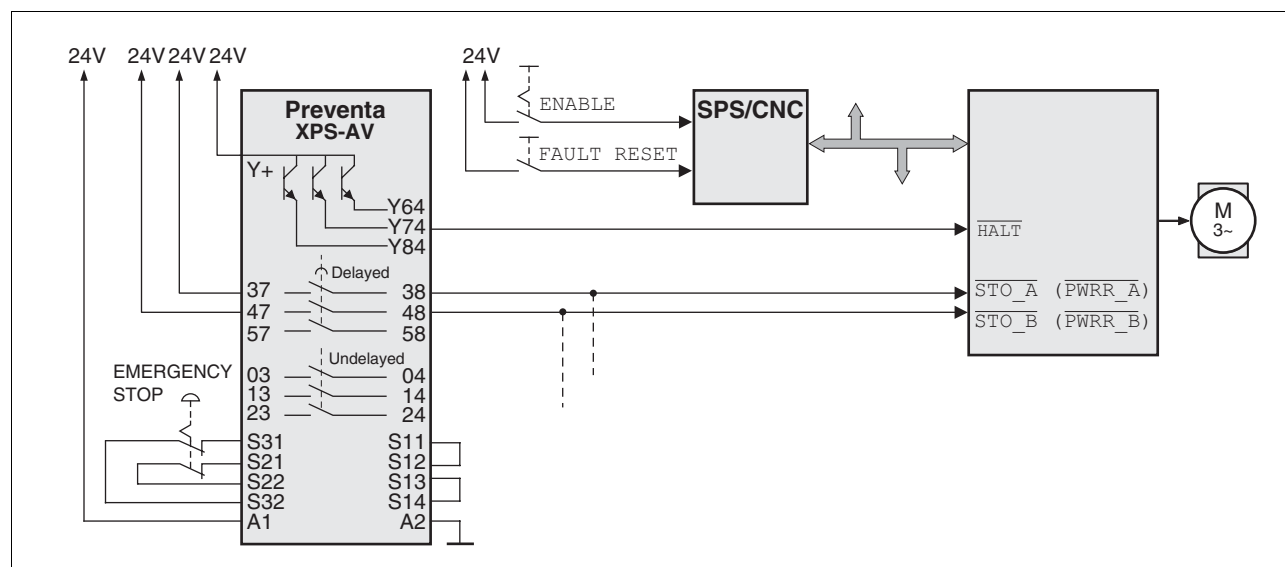


Figure 5.2 Example of category 1 stop

Please note:

- A "Halt" is initiated without a delay via the $\overline{\text{HALT}}$ input.
- The inputs $\overline{\text{STO_A}}$ ($\overline{\text{PWRR_A}}$) and $\overline{\text{STO_B}}$ ($\overline{\text{PWRR_B}}$) 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 149.

6 Installation

⚠ 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.



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 drive system complies with the EMC requirements for the second environment in accordance with IEC 61800-3 when used with the original accessories and if the measures described for installation have been implemented. When operating outside this application area note the following:

⚠ WARNING

HIGH-FREQUENCY INTERFERENCE

In a domestic environment this product may cause high-frequency interference that may require action to suppress interference.

EMC scope of supply and accessories

The scope of supply includes SK shielding terminals and an EMC plate. The number of shielding terminals depends on the device type. The shielding terminals are not strain reliefs.

For information on the pre-assembled cables, see page 223.

Switching cabinet

EMC measures	Objective
Use EMC plate or galvanized or chrome-plated mounting plates, make large contact surface connections for metal parts, remove paint from contact surfaces	Improving conductivity with surface contact.
Ground the control cabinet, door and EMC plate with ground straps or cables with a cross section area greater than 10 mm ² (AWG 6).	Reduces emissions.
Fit switching devices such as contactors, relays or solenoids with interference suppressors or spark suppressors (e.g. diodes, varistors, RC elements)	Reduction of mutual interference
Install power and control components separately.	Reduction of mutual interference

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 shield of all shielded cables to the mounting plate at the control cabinet entry.	Reduction of 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 shield on analog signal wires directly at the device (signal input), and insulate the shield at the other end of the cable or ground via a capacitor if interference occurs, e.g. 10 nF.	Reducing ripple loops due to low-frequency interference.
Use only shielded motor cables with copper braiding and at least 85% covering, ground a large surface area of the shield at each end.	Controlled discharge of interference currents, reduction of emissions

Cable installation

EMC measures	Objective
Fieldbus lines and signal lines must not be laid in one conduit with lines for DC and AC voltage over 60V. (Fieldbus cables can be laid in one conduit with signal and analog lines)	Reduction of mutual interference
Recommendation: use separate cable ducts at least 20 cm apart.	
Keep cables as short as possible. Do not install unnecessary cable loops, use short cables from the star point in the control cabinet to the external ground connection.	Reduces capacitive and inductive interference.
Use equipotential bonding conductors in systems with <ul style="list-style-type: none"> - wide-area installations - different voltage supplies - networking across several buildings 	Reduces current on cable shield, reduces emissions.
Use fine-core bonding conductors	Deflect even high-frequency interference currents
If motor and machine are not conductively connected, e.g. by an insulated flange or a non-flat connection, earth the motor with an earth wire >10 mm ² (>6 AWG) or ground strap.	Reduction of emissions, increase in resistance to interference
Lay connections of the 24 V _{DC} supply voltage as twisted pair.	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 the IT mains).	Enabling the effectiveness of the mains filter.
Circuit breaker if there is danger of overvoltage.	Reduce risk of damage by overvoltage.

Motor and encoder cable Motor leads and encoder cables are especially critical signal circuits. Use the recommended cables.

EMC measures	Objective
Do not install switching elements in motor cables or encoder cables.	Reduction of interference.
Install motor cable at a distance of at least 20 cm to the signal cable or insert shields between motor cables and signal cables.	Reduction of mutual interference
Insert equipotential bonding conductors for long lines.	Reduce current on cable shield.
Install the motor cable and encoder cable without separation point. ¹⁾	Reduce perturbing radiation.

1) If a cable must be cut for installation, the cut points of the cables must be connected with shield connections and metal housing

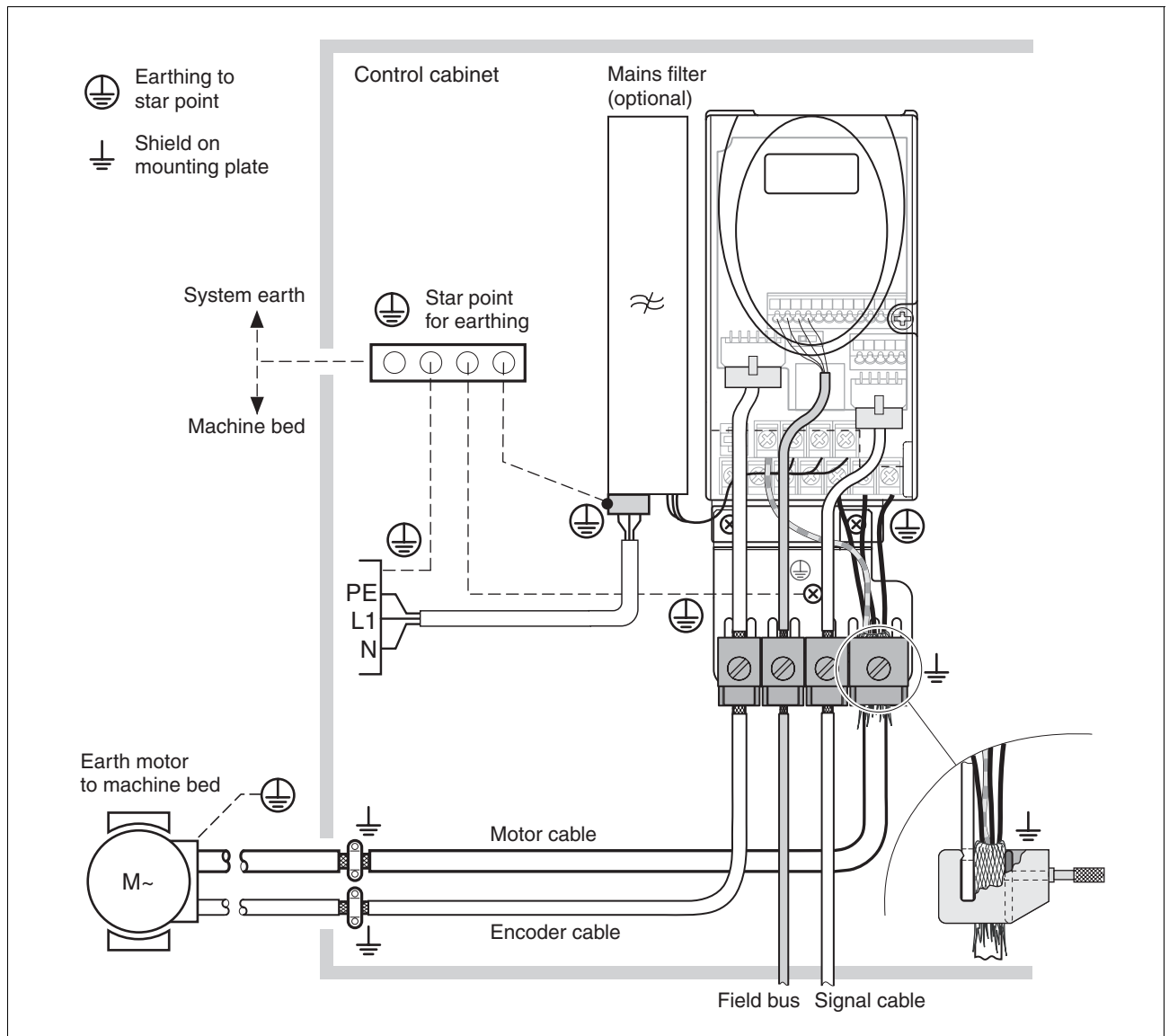
Other measures for the improvement of the EMC An EMC-compliant design is required to meet the specified limit values. Depending on the application, better results can be achieved with the following measures:

EMC measures	Objective
Upstream mains reactors	Improvement of EMC limit values
External upstream mains filter	Improvement of EMC limit values
Particularly EMC-compliant design, e.g. in a closed control cabinet with 15dB damping of radiated interference	Improvement of 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 shielding terminals depending on device type.

6.1.1 Operation in an IT mains

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

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

If the earth connection to the Y-capacitors is removed, the specifications for the transmission of electromagnetic interference will no longer be maintained (specific categories see chapter 3.4.6 "Mains filter" page 32)! Separate measures are required to comply with national regulations and standards.

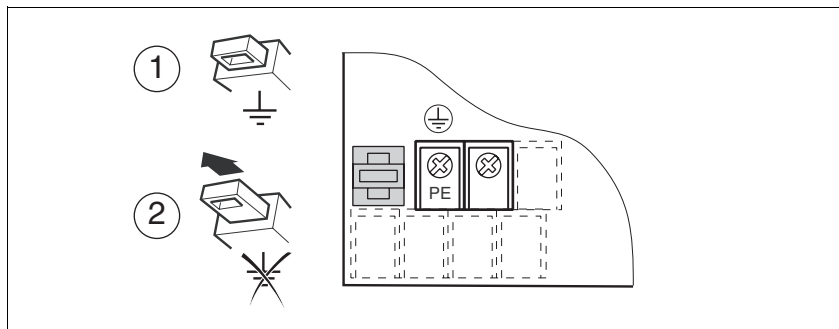


Figure 6.2 Operation in an IT mains

Isolation monitoring error

- (1) Y-capacitors of the internal filter effective (standard)
- (2) Y-capacitors of the internal filter disabled (IT mains)

6.2 Mechanical installation

DANGER

ELECTRIC SHOCK FROM FOREIGN BODIES OR DAMAGE

Conductive foreign objects in the product or serious damage can 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.

- You may 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 atn the product may heat up to over 100 °C (212 °F) depending on the operating mode.

- 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 be dimensioned so all devices and accessories can be fixed in place and wired to meet EMC standards.

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

Installation spacing, ventilation When selecting the position of the device in the control cabinet, note the following:

- Install the device in a vertical position ($\pm 10^\circ$). This is important for cooling the device
- Adhere to the minimum installation distances for required cooling. Avoid heat accumulations.
- Do not install the device close to heat sources.
- Do not mount the device on flammable materials.
- Make sure that the heated airflow from other devices and components does not heat the air used for cooling the device.
- The device will switch off as a result of overtemperature when operated above the thermal limits.
- When planning installation clearances the dimensions of a mains filter must also be considered, see also notes on page 53

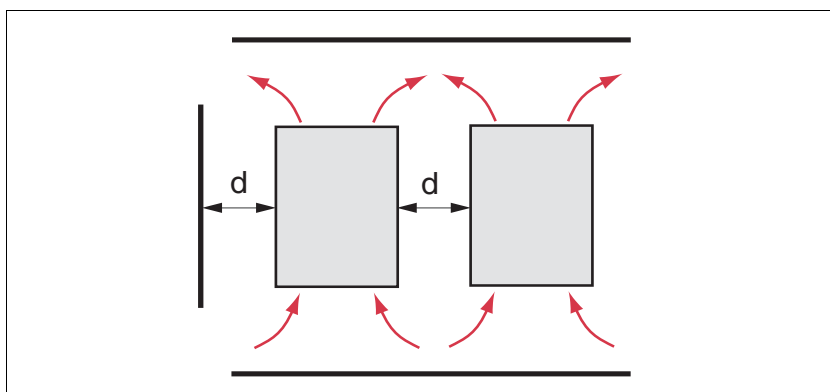


Figure 6.3 Installation spacing and air circulation

Temperature ¹⁾	Distance ²⁾	Implementation without protective film ³⁾	Implementation with protective 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 not possible

1) maximum operating temperature when used in accordance with 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 protective film on completion of the installation

4) by 2.2 % per °C above 40 °C (by 1.22 % per °F above 104 °F)

At least 10 mm of free space is required in front of the device.
 At least 50 mm of free space is required above the device.
 The connecting cables are routed out of the housing at the bottom. At least 200mm free space under the device is required so that wiring can be installed without bending.

Mounting the device

For the dimensions of the fastening holes see Chapter 3.3.1 "Dimensions" from page 27.

- ▶ Install the device in a vertical position ($\pm 10^\circ$). This is particularly important for cooling the device.
- ▶ Attach the EMC plate at the bottom of the device, see also Figure 6.1, or use alternative attaching elements (comb bars, shield clamps, bus bars).

Attach plate with safety instructions

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

An alternative to fastening the unit directly to the control cabinet mounting plate consists of adapter plates for DIN rail mounting, see chapter 3.3.1 "Dimensions".

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



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

Mounting fans

A fan is included with device type SD32••U68. The fan must be mounted and connected.

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

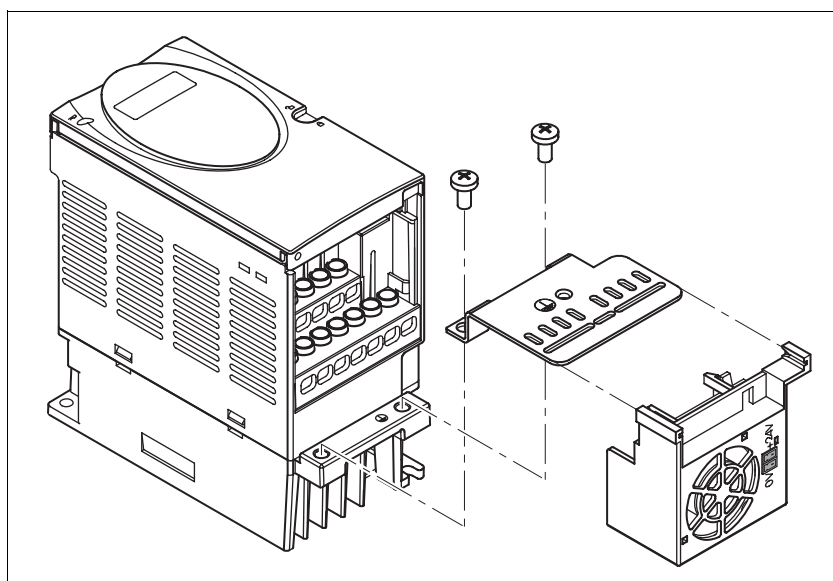


Figure 6.4 Mounting fans

Remove the protective film

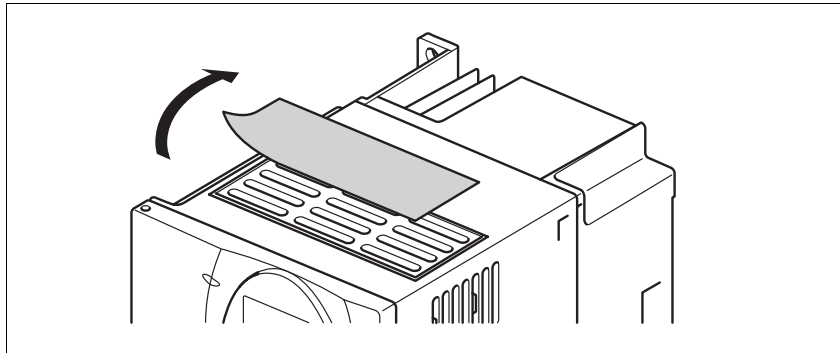


Figure 6.5 Removing protective film

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

6.2.2 Mounting mains filters

For specifications of external mains filters see page 32.

For notes on electrical installation see mains supply from page 63.

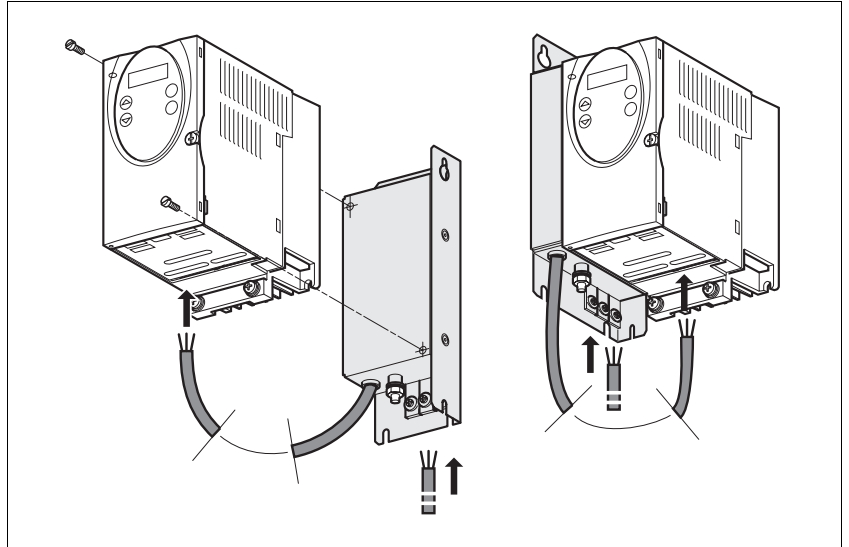


Figure 6.6 Mounting of mains filters

- 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 will not be accessible after installation of the EMC plate.

If you are using the DIN rail mounting plates, the mains filter cannot be mounted directly beside or behind the device.

6.3 Electrical installation

⚠ DANGER

ELECTRIC SHOCK, FIRE, 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.
- The system manufacturer is responsible for compliance with all applicable regulations pertaining to grounding the drive system.
- Many components, including the printed circuit board, operate with mains voltage. **Do not touch.** Do **not** touch unprotected parts or screws of the terminals when they are under voltage.
- Install all covers and close the housing doors before applying voltage.
- The motor generates voltage when the shaft is rotated. Lock the motor shaft to prevent rotation caused by external forces before starting work on the drive system.
- Before working on the drive system:
 - Disconnect the voltage supply to all connections.
 - Place a label "DO NOT SWITCH ON" on the switch and secure the switch against being switched on.
 - **Wait for 6 minutes** (discharge DC bus capacitors). Do **not** short-circuit DC bus!
 - Measure the voltage on DC bus and verify that it is <42V. (The DC bus LED is not a reliable indicator for the absence of DC bus voltage).

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

⚠ DANGER

ELECTRIC SHOCK FROM FOREIGN BODIES OR DAMAGE

Conductive foreign objects in the product or serious damage can 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 BECAUSE OF INSUFFICIENT GROUNDING**

With insufficient grounding there is a danger of electric shock.

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

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

⚠ WARNING**THIS PRODUCT MAY CAUSE DIRECT CURRENT IN THE PROTECTIVE CONDUCTOR**

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

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

Conditions for use of a residual current device

Where the installation regulations require upstream protection by means of a residual current device (residual current device, RCD), a residual current device of "Type A" can be used on a single-phase drive with connection between N and L. In all other cases, "Type B" must be used.

The following characteristics must be taken into consideration here:

- Filtering of high-frequency currents.
- Delay against triggering as a result of interference capacitance which may be present when the unit is switched on. This delay is not possible with 30-mA residual current devices. In this case, use residual current devices which are not sensitive to unintended triggering, for example a series s.i (super-immunized) residual current device with increased noise immunity (brand Merlin Gerin).

If the system consists of several drives, it is necessary to use a residual current device for each drive.

Suitability of wiring

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

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

6.3.1 Overview of procedure

- ▶ Observe the basic settings described in chapter 5 "Engineering" from page 37.
 - Chapter 5.1 "Safety function STO ("Safe Torque Off")" from page 37
 - ▶ Unlock the front panel of the device and open it.
 - ▶ Connect the earth terminal of the device or the EMC plate to the earthing star point of the system.
 - ▶ Connect the required terminal corresponding to the sequence of the following table. If a different connection sequence is followed, terminals may be covered by other lines.
- Follow the EMC requirements, see page 44.
- ▶ Then lock the front panel.

Chapter	from page
6.3.3 "Connection of motor phases"	59
6.3.4 "Connection of DC bus"	62
6.3.5 "Connection:Mains supply"	63
6.3.6 "Connection of rotation monitoring (CN2)"	65
6.3.7 "Connection of holding brake and controller supply voltage (CN3)"	68
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6.3.9 "Connecting encoder signals A, B, I (CN5)"	71
6.3.10 "PULSE (CN5) connection"	72
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6.3.13 "Connection to PC or peripheral remote terminal (CN4)"	80



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

6.3.2 Overview of all connections

Power connections

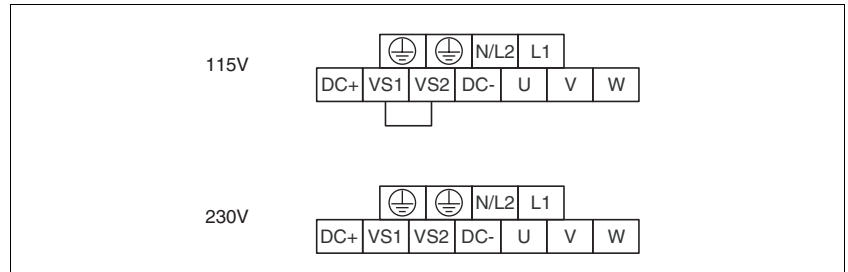


Figure 6.7 Power connections

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

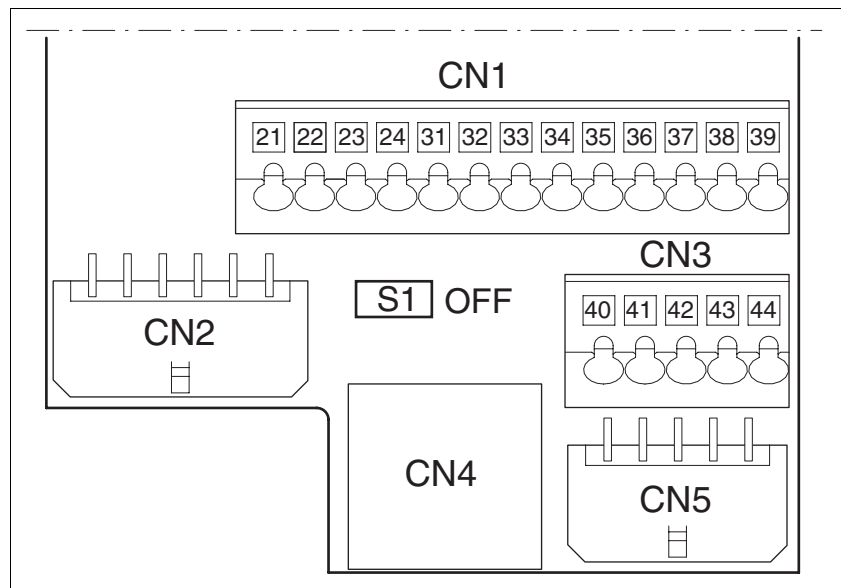
Signal connections

Figure 6.8 Overview of signal connections

Connection/ switch	Assignment
-----------------------	------------

CN1	Profibus, pin 21-24
	Digital inputs/outputs, pin 31-39
CN2	motor encoder
CN3	holding brake connection, pin 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) depending 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. Lock the motor shaft to prevent rotation before starting work on the drive system.
- AC voltages may jump over unused wires in the motor cable. Isolate unused wires at both ends of the motor cable.
- It is the system manufacturer's responsibility to ensure compliance with all applicable regulations on grounding the drive system. Extend the ground through the motor cable with an additional ground at the motor housing.

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

Cable specifications and terminal

- Shielded cable
- Grounding of the shield at both ends

Maximum cable length ¹⁾	[m]	10/50
Minimum conductor cross section	[mm ²]	1.5 (AWG 14)
Maximum connection cross section	[mm ²]	1.5 (AWG 16)
Tightening torque	[mm ²]	0.5 ... 0.6 (0.36 ... 0.44 lb·ft)

1) Length depends on the required limit values for line related malfunctions, see chapter 3.4.6 "Mains filter"

- For more information see chapter 3.5.2 "Cable".
- Use pre-assembled cables to reduce the risk of wiring errors (page 223).
- 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}

The product catalog contains an overview of approved motors.

Assembling cables

Note the dimensions specified when assembling cables. The specified dimensions refer to a cable arrangement as shown in the figure "EMC measures" on page 46.

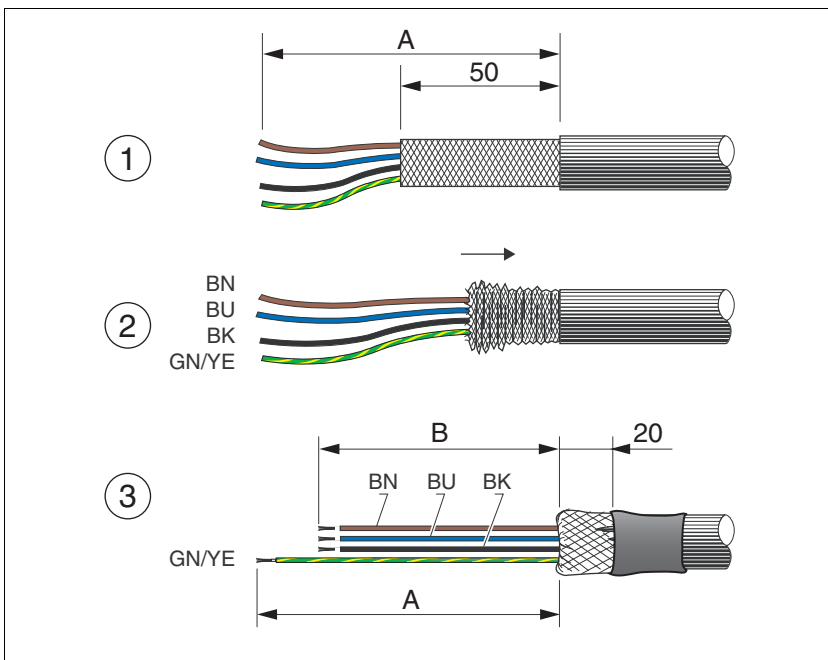


Figure 6.9 Steps (1-3) for assembling the motor cable

(A) 130 mm

(B) 75 mm

- ▶ (1) Sheath the cable to length A and reduce the shield braiding to approx. 50mm.
- ▶ (2) Slide the shield braiding back over the cable sheath and fix the shield braiding, e.g. with shrink wrap. Note that approx. 20 mm of the shield braiding must not be isolated for the required wide-area attachment of the shield braiding on the EMC plate.
- ▶ (3) Shorten the three wires (U, V, W) of the motor line to length B. The protective conductor has length A.

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

Monitoring

The motor lines are monitored for:

- short circuit between the motor phases
- short circuit against ground

- Connecting the motor cable*
- ▶ Follow the EMC requirements for motor cables, see page 46.
 - ▶ Connect the motor wires and protective conductor to terminals U, V, W and PE. The cable assignment at the motor and device sides must match.
 - ▶ Fix the cable shielding flat on the EMC plate.

Wiring diagram

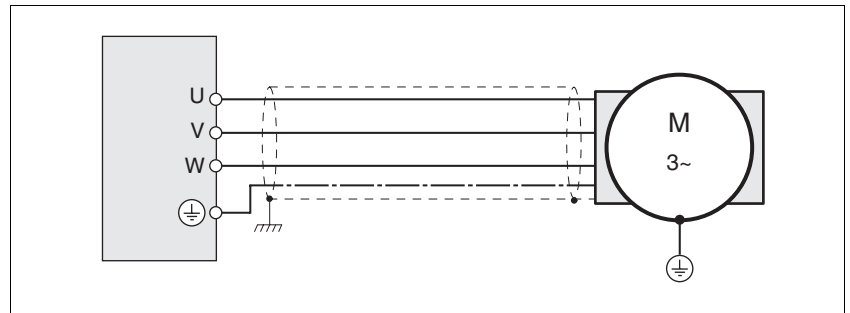


Figure 6.10 Wiring diagram motor

Connection	Meaning	Color ¹⁾
U	Motor lead	brown (BN)
V	Motor lead	blue (BU)
W	Motor lead	black (BK)
PE	Protective conductor	green/yellow (GN/YE)

1) Color specifications refer to the cables available as accessories

6.3.4 Connection of DC bus

CAUTION**NON-APPROVED PARALLEL CONNECTION**

Operation with a parallel connection of the DC bus may destroy the drive systems immediately or after a delay.

- Never connect the DC bus to multiple drive systems.

Failure to follow these instructions can result in equipment damage.

External capacitors

The device can save excess braking energy temporarily in an external electrolytic capacitor via the DC bus. This can be used to reduce the DC bus voltage during frequent braking.

Only use capacitors with the following specifications:

SD32••...U25	...U68
Dielectric strength	[V]	≥450	≥450
external capacity	[μF]	<500	<1000

Cable specifications and terminal

- Shielded cable
- Grounding of the shield at both ends

Maximum cable length	[m]	3
Minimum conductor cross section	[mm ²]	1.5 (AWG 14)
Maximum connection cross section	[mm ²]	1.5 (AWG 16)
Tightening torque	[mm ²]	0.5 ... 0.6 (0.36 ... 0.44 lb·ft)

Connection

- Connect the cable from the DC bus to the connections of the capacitor.
Make sure the polarity is correct:
DC+ to "+" and DC- to "-".
Otherwise the device and capacitor may be destroyed.

6.3.5 Connection:Mains supply

⚠ DANGER

ELECTRIC SHOCK BECAUSE OF INSUFFICIENT GROUNDING

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

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

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 BY INCORRECT MAINS VOLTAGE

The 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.

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]	0.5 ... 0.6 (0.36 ... 0.44 lb·ft)

- For more information see chapter 3.5.2 "Cable" on page 33.

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

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

In addition, note the suitability of the wiring, see page 55 and the EMC-compliant connection, see page 45.

Assembling cables

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

Wiring diagram

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

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

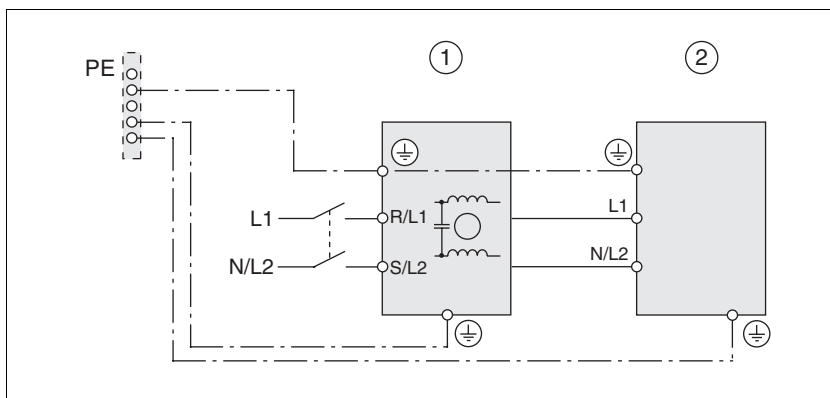


Figure 6.11 Wiring diagram of mains supply for single phase device.

- (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: 115V

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

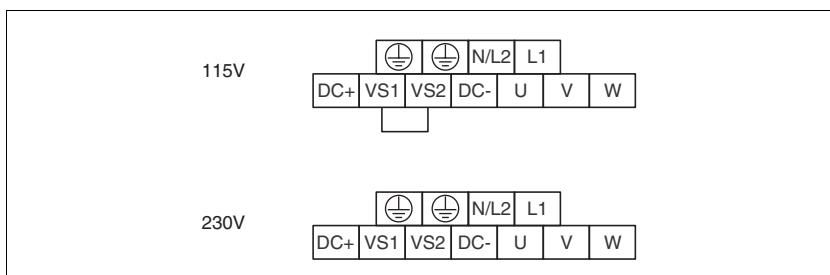


Figure 6.12 Setting the voltage range

Connecting mains supply

Observe the following notes:

- The device must be set to the correct voltage range.
- For devices with external mains filter the mains power cable must be shielded from 200mm length between the external mains filter and the device and grounded at both ends.
- Observe the EMC requirements. If necessary, use surge protectors and mains filters, see page 53.
- Follow the requirements for design of corresponding UL, see page 34.
- Connect the power cables. Note the exact terminal assignment of your device, see chapter 6.3.2 "Overview of all connections".

6.3.6 Connection of rotation monitoring (CN2)

It is not really necessary to connect rotation monitoring. Observe the corresponding parameters.

Function and type of encoder

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

Cable specifications

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

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

- For more information see chapter 3.5.2 "Cable" on page 33.

- Preparing cables*
- Use prefabricated cables to minimise the risk of a wiring error. Step 5 in the diagram below must be carried out even with prefabricated cable. The dimensions for positioning the shield on the housing are applicable when the included EMC plate is used.
 - If you are not using prefabricated wiring, follow the procedure below.

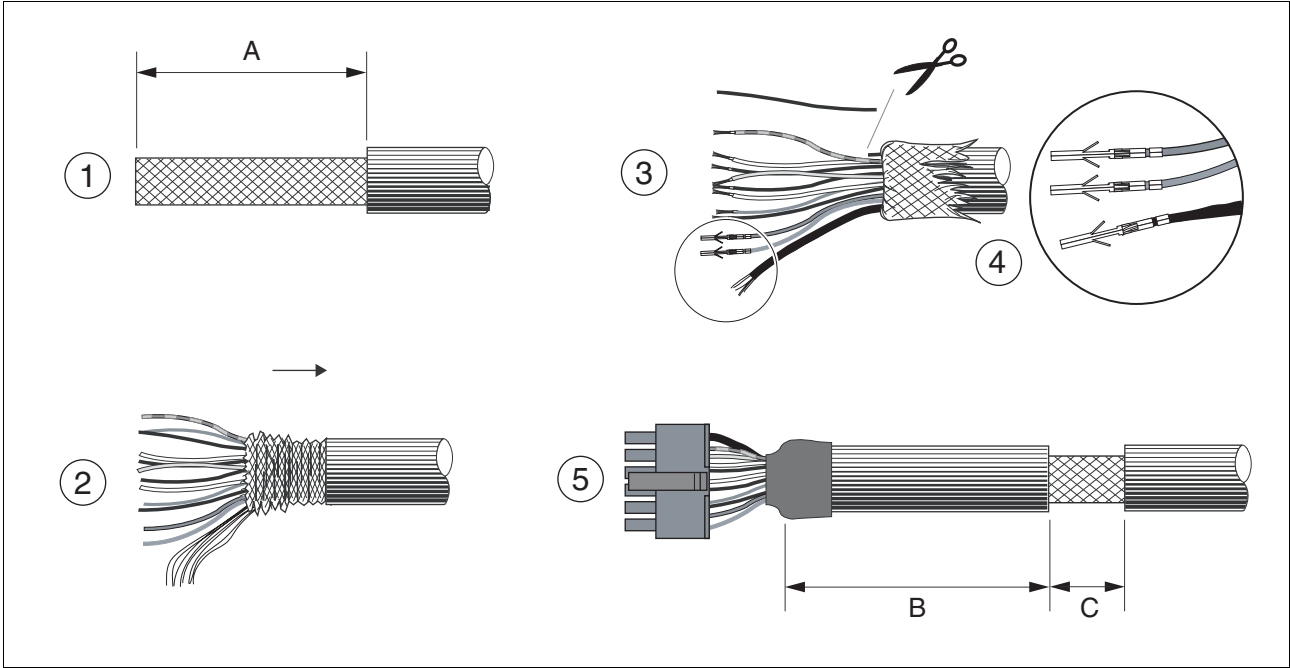


Figure 6.13 Steps (1-5) for assembly of the encoder cable

- (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) Remove the cable sheath to length A.
- (2) Slide the shield braiding back over the cable sheath. The shield braided filler wire is required as the connection.
- (3) The blue and red braided wires are not required and can be cut off. Isolate the shield braided wire with shrink wrap.
- (4) Crimp the plug contacts on the remaining braided wires and on the insulated shield braided wire. Insulate the shield braiding with shrink wrap. Plug the crimp contacts into the connector shell.
- (5) Sheath the cable to length C on the position shown, the cable is fastened there at the EMC plate with a clamp (shield-ground connection).

- Connecting the motor encoder*
- ▶ Verify that wiring, cables and connected interfaces meet the PELV requirements.
 - ▶ Note the EMC specification for motor encoder cables starting at page 46, and 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.

Wiring diagram

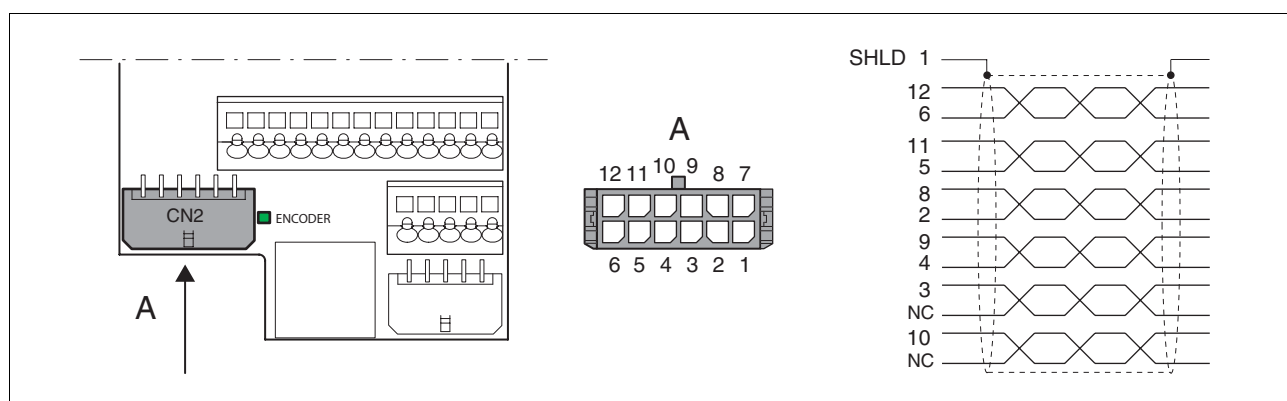


Figure 6.14 Wiring diagram of rotation monitoring

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	5 V _{DC} power 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	$\overline{\text{T_MOT}}$	11	Gray/pink		temperature sensor PTC	I
1	SHLD				Shielding braid	

1) Color specifications refer to the cables available as accessories

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

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.

⚠ CAUTION

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 is supply voltage present.

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

Wiring diagram

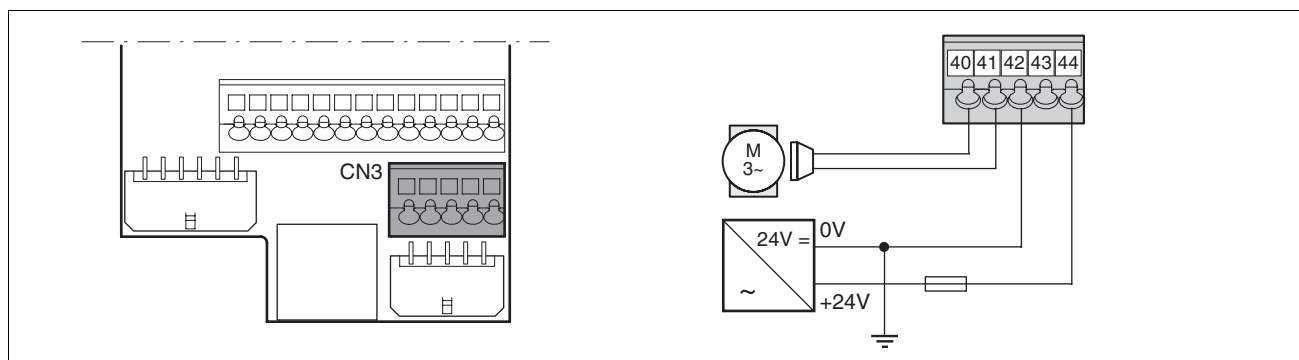


Figure 6.15 Wiring diagram CN3

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

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

Connecting holding brake

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

- Connect the holding brake directly.

6.3.8 Fan connection

The connection is only required with device type SD32●●U68.

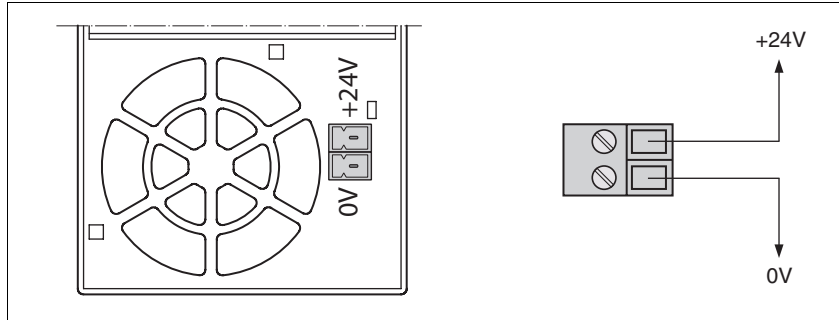


Figure 6.16 Fan wiring diagram

Connecting power supply

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

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

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

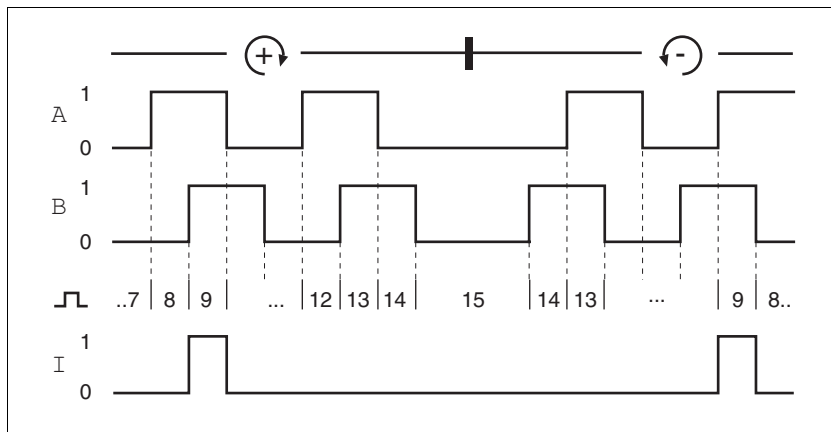


Figure 6.17 Timing diagram with A, B and index pulse signal, counting forwards and backwards

Cable specifications

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

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

- ▶ Use equipotential bonding conductors, see page 46.
- ▶ Use pre-assembled cables to reduce the risk of wiring errors (page 223).

Connect the sensor

- ▶ Connect the plug to CN5. If you are not using prefabricated wiring, make sure the pin assignment is correct.
- ▶ Make the appropriate settings during commissioning. See "First Setup", page 96

Wiring diagram

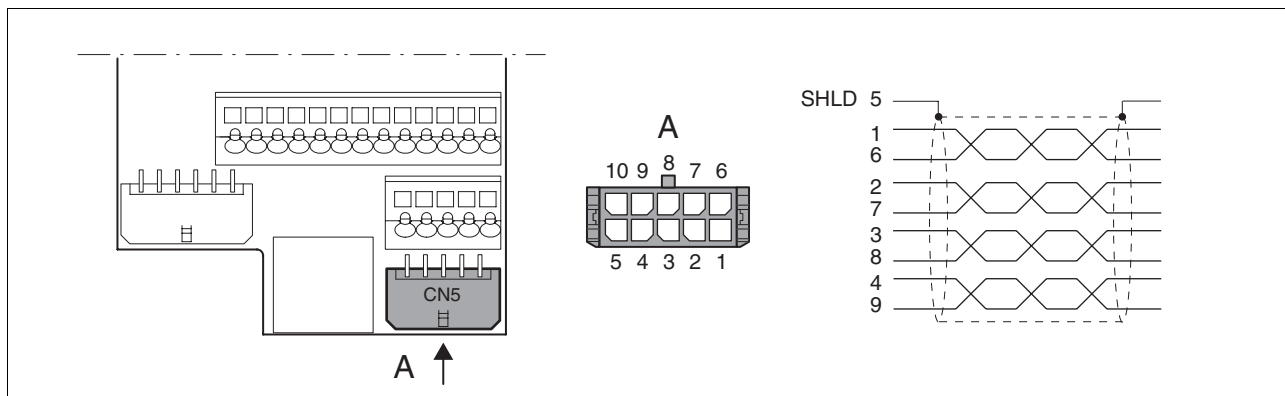


Figure 6.18 Wiring diagram, Encoder to CN5

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) Information on the color refers to the cables available as accessories.

6.3.10 PULSE (CN5) connection

⚠ WARNING

UNEXPECTED MOVEMENT

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

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

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

⚠ CAUTION

DESTRUCTION OF THE PRODUCT AND LOSS OF CONTROL

The inputs at this connection are only designed for 5V. Excessive voltage can cause destruction of the product either immediately or at a later time.

- Verify correct wiring before switching on.

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

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

The signal interface is used for positioning the motor. Operation readiness and a possible breakdown are reported.

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

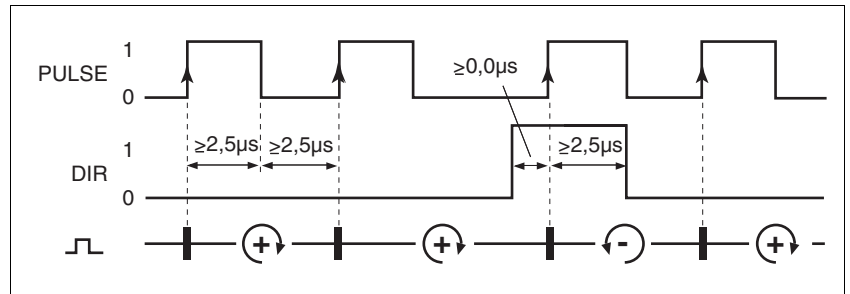


Figure 6.19 Pulse direction signal

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

The maximum frequency of PULSE and DIR is 200 kHz.

If there is no operating fault, the output ACTIVE2_OUT displays ready for operation for about 100 ms after the power stage is enabled.

ACTIVE2_OUT

ACTIVE2_OUT is an open collector output and switches against 0 V. The output shows that the unit is ready for operation.

Circuit of the signal inputs

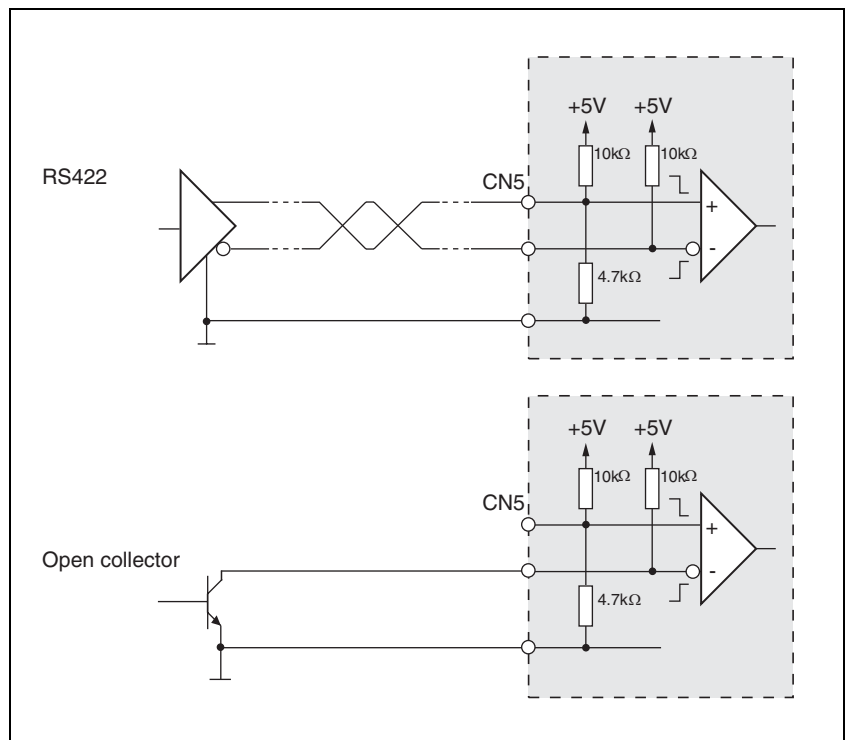


Figure 6.20 Circuit of the signal inputs

Cable specifications

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

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

- ▶ Use equipotential bonding conductors, see page 46.
- ▶ Use pre-assembled cables to reduce the risk of wiring errors (page 224).

Connecting PULSE

- ▶ Connect the plug to CN5. If you are not using prefabricated wiring, make sure the pin assignment is correct.
- ▶ Make the appropriate settings during commissioning. See "First Setup", page 96.

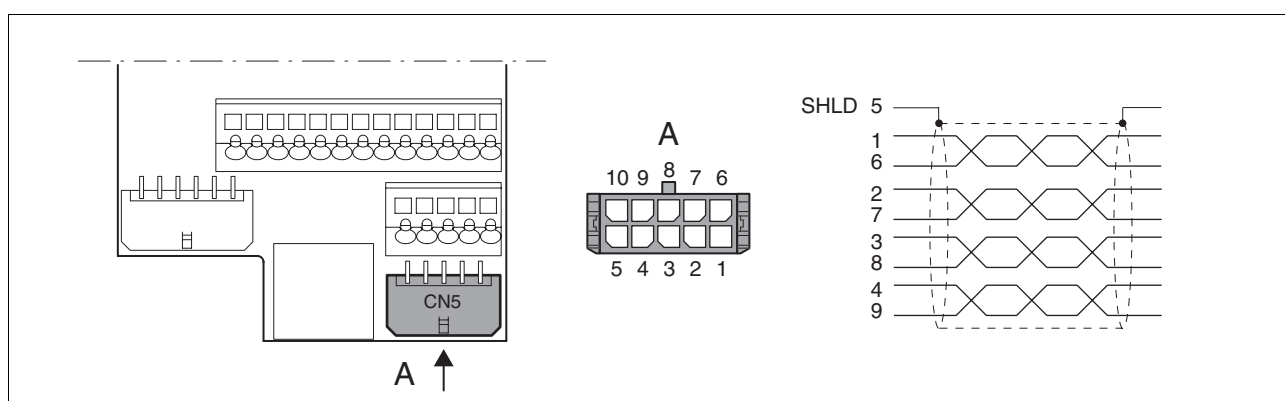
Wiring diagram

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) Information on the color refers to the cables available as accessories.

6.3.11 Connection of 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 operation 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 set the same for all devices in the fieldbus; the product detect the baud rate automatically.

For additional information see the fieldbus manual, order number, see page 223.

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 46.
- ▶ 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 end of the network with a switch.

The diagram below shows the layout of the integrated resistance combination.

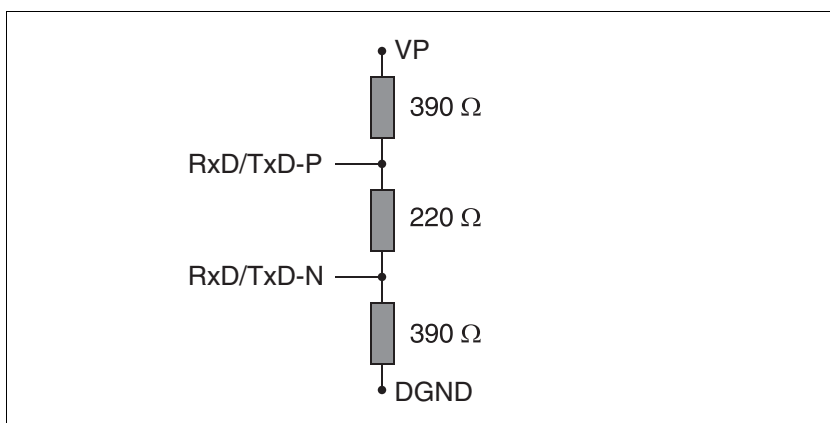


Figure 6.22 Profibus terminating resistor

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

Wiring diagram

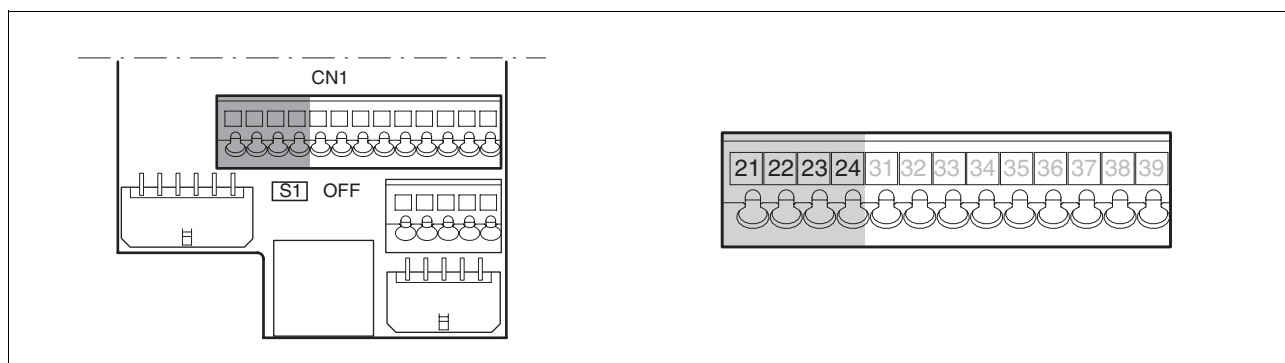


Figure 6.23 Wiring diagram, Profibus on CN1

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. While the terminating resistor has not been enabled, 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 enabled, no signals can be received at CN1.23 and CN1.24.

6.3.12 Connection of digital inputs/outputs (CN1)

⚠ CAUTION

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 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 injury or equipment damage.

Cable specifications and terminal

Maximum cable length with 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.

Notes on the safety signals $\overline{\text{STO_A}}$ ($\overline{\text{PWRR_A}}$) and $\overline{\text{STO_B}}$ ($\overline{\text{PWRR_B}}$) can also be found in chapter 5.1 "Safety function STO ("Safe Torque Off")" and in the chapter 3.4.4 "Safety function STO "Safe Torque Off" (IEC/EN 61800-5-2)".

The following signals must always be connected.

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

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

Connecting digital inputs/outputs

- ▶ Wire the digital connections to CN1.
- ▶ Connect the limit switch that limits the work stroke in clockwise rotation to $\overline{\text{LIMP}}$.
- ▶ Connect the limit switch that limits the work stroke in counterclockwise rotation to $\overline{\text{LIMN}}$.
- ▶ Earth the shield with low resistance and over a wide area at both ends of the cable.

Wiring diagram, local control mode

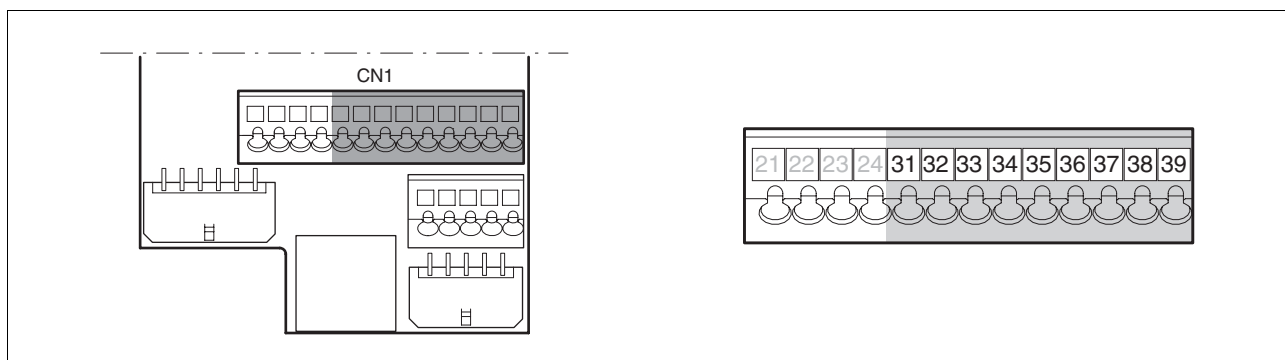


Figure 6.24 Wiring diagram, digital inputs/outputs

Pin	Signal	Meaning	I/O
31	NO_FAULT_OUT	Error output	24V, O
32	ACTIVE1_OUT	0: Motor without current 1: Motor with current	24V, O
33	REF	Reference switch signal (factory setting: disable)	24V, I
34	LIMN	Limit switch signal negative	24V, I
34	CAP2	fast position capture channel 2	24V, I
35	LIMP	Limit switch signal positive	24V, I
35	CAP1	fast position capture channel 1	24V, I
36	HALT	"Halt" function	24V, I
37	STO_B (PWRR_B)	Safety function STO "Safe Torque Off" (IEC/EN 61800-5-2)	24V, I
38	STO_A (PWRR_A)	Safety function STO "Safe Torque Off" (IEC/EN 61800-5-2)	24V, I
39	+24VDC	Only for jumping pin 37 and 38 if STO safety function is not used	-

6.3.13 Connection to PC or peripheral remote terminal (CN4)

CAUTION**DAMAGE TO PC**

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

- Never connect an Ethernet interface directly to this product.

Failure to follow these instructions can result in equipment damage.

Function of the control terminal

The remote terminal with LCD display and keypad can be connected directly to CN4 with the supplied RJ-45 cable, see accessories, starting on page 223. This allows the device to be operated at a distance from the system. The functions and display of the control terminal are identical to those of the HMI.

Cable specifications and terminal

- Shielded cable
- Twisted pair lines
- Grounding of the shield 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)

PC connection

An RS485 to RS232 converter is required for the PC, see accessories from page 223. The converter is powered by the device.

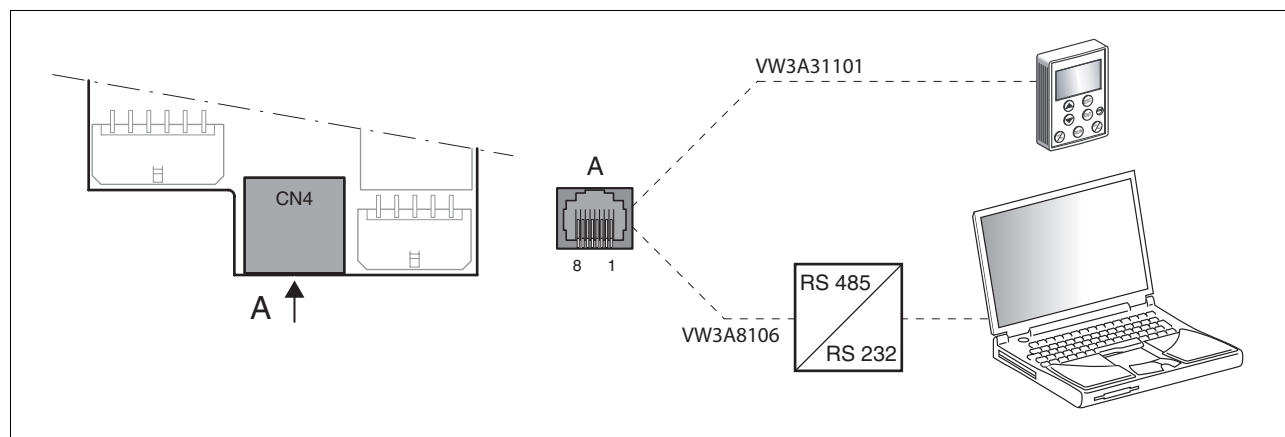
Wiring diagram

Figure 6.25 Wiring diagram of PC or remote terminal

Pin	Signal	Description	I/O
4	MOD_D1	Bidirectional send/receive signal	RS485 level
5	MOD_D0	Bidirectional send/receive signal, inverted	RS485 level
7	MOD+10V_OUT	10V power supply, max. 150mA	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). ¹ available for the encoder. The correct power supply is shown by a "5VSE" LED.

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

Connecting RVA reference value adapter

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

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

Up to five devices that evaluate the specified reference signals can be connected to CN1 to CN5.

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

Connection CN1..5	Switch setting S1
connected devices on CN1...CN5	corresponding switch 1...5 at "OFF", signal $\overline{\text{ACTIVE2_OUT}}$ of the corresponding device is evaluated
unconnected devices CN1...CN5	corresponding switches 1-5 at "ON", $\overline{\text{ACTIVE2_OUT}}$ signal is simulated

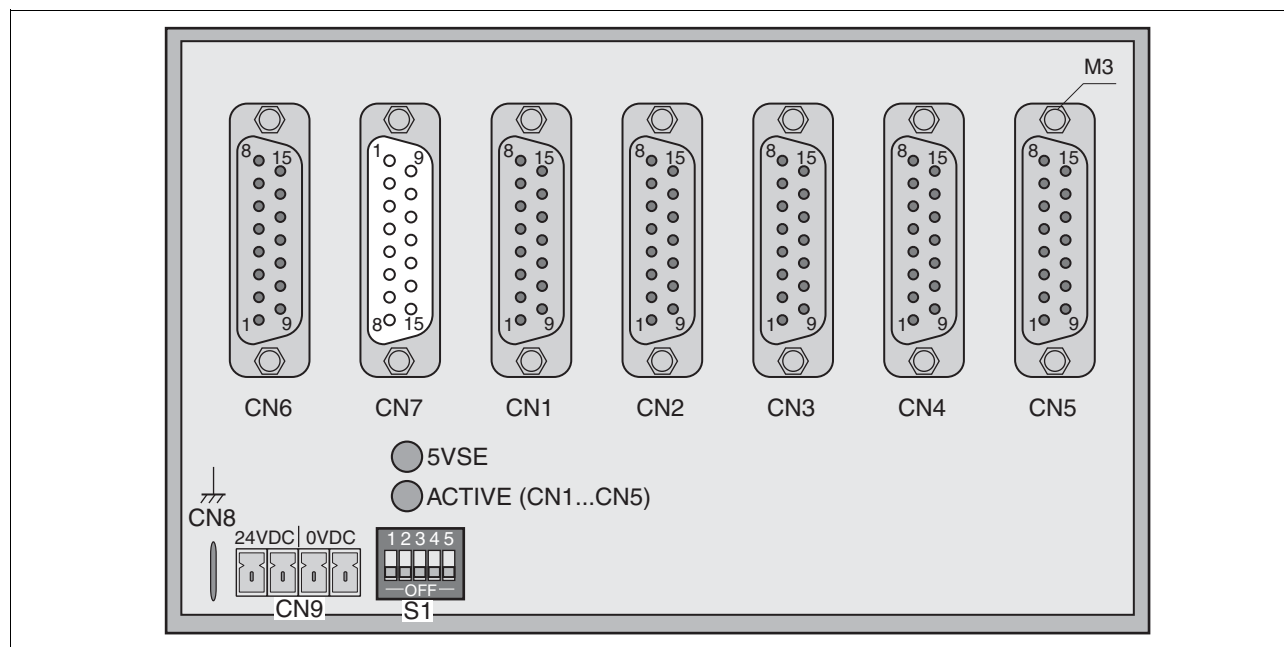


Figure 6.26 Reference value adapter

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

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

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	ACTIVE_2 / 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	ACTIVE2_OUT / 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 the motor encoder supply ¹⁾	I
11	SENSE-	Reference potential to 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 side) the signal line CN7.2 (5VDC_OUT) is to be connected with CN7.10 (SENSE+)

2) At the end of the encoder cable (motor side)) the signal line CN7.3 (POS_0V) must be connected with CN7.11 (SENSE-)

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

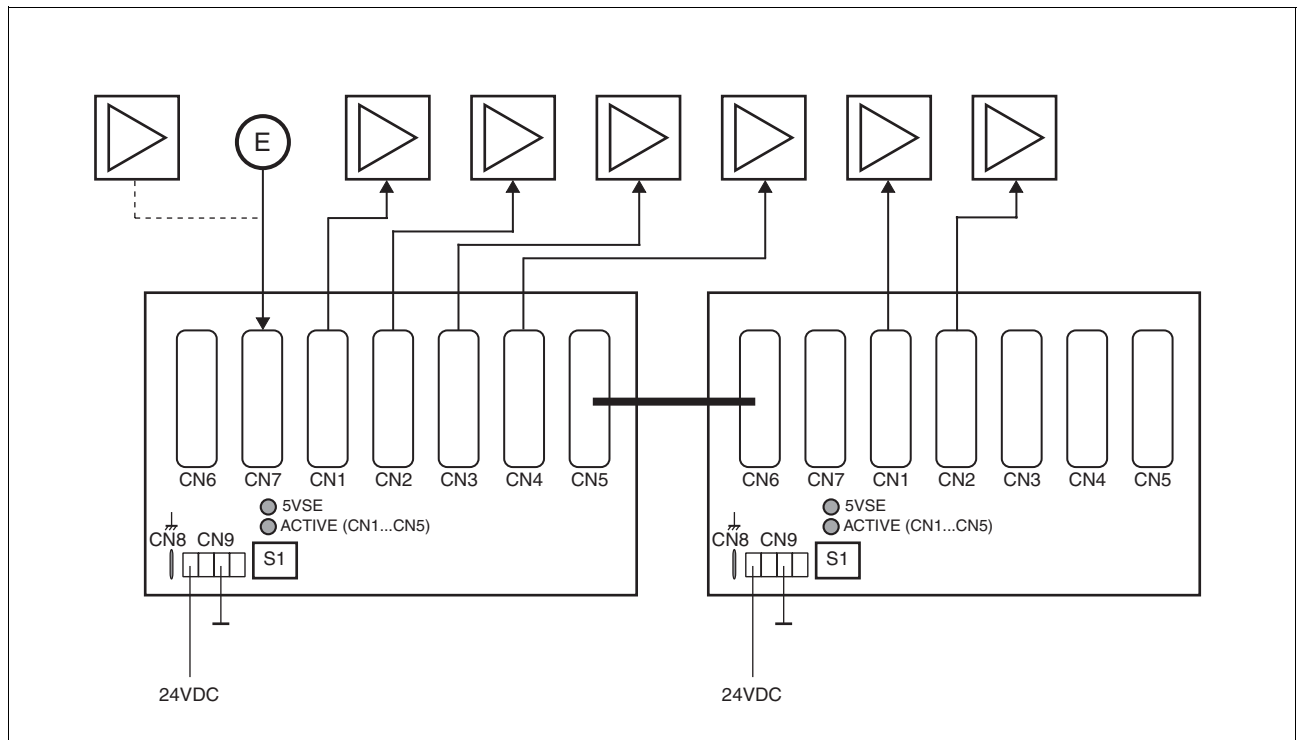


Figure 6.27 Wiring example: Encoder signals A/B/I (at CN7) are forwarded to six devices through two cascaded Reference Value Adapters

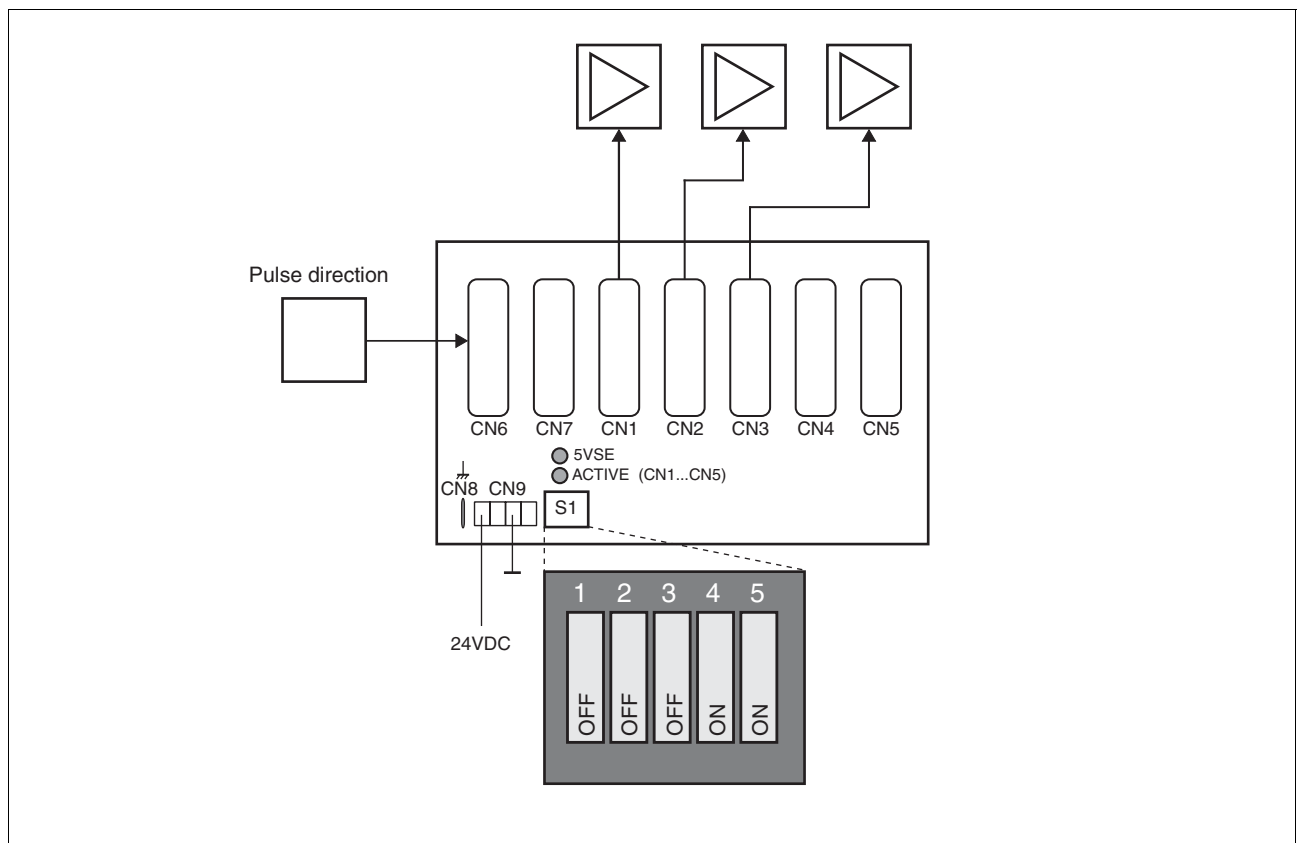


Figure 6.28 Wiring example: pulse direction signals (at CN6) are sent to three devices.

6.4 Checking installation

Check the following:

- ▶ Make sure the drive system is correctly installed and wired up.
Check especially the basic connections such as the power stage supply voltage and controller supply voltage.
- ▶ Check in detail:
 - Are all protective conductors connected?
 - Are all fuses correct?
 - Are any live cable ends exposed?
 - Did you properly install and connect all cables and connectors?
 - Did you properly connect the signal wires?
 - 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.
- ▶ Remove the protective film if required
(see chapter 6.2.1 "Mounting the device").

7 Commissioning



*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.*

⚠ DANGER

ELECTRIC SHOCK, FIRE, 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.
- The system manufacturer is responsible for compliance with all applicable regulations pertaining to grounding the drive system.
- Many components, including the printed circuit board, operate with mains voltage. **Do not touch.** Do **not** touch unprotected parts or screws of the terminals when they are under voltage.
- Install all covers and close the housing doors before applying voltage.
- The motor generates voltage when the shaft is rotated. Lock the motor shaft to prevent rotation caused by external forces before starting work on the drive system.
- Before working on the drive system:
 - Disconnect the voltage supply to all connections.
 - Place a label "DO NOT SWITCH ON" on the switch and secure the switch against being switched on.
 - **Wait for 6 minutes** (discharge DC bus capacitors). Do **not** short-circuit DC bus!
 - Measure the voltage on DC bus and verify that it is <42V. (The DC bus LED is not a reliable indicator for the absence of DC bus voltage).

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

⚠ 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**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 brake.

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 atn the product may heat up to over 100 °C (212 °F) depending on the operating mode.

- 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



The following commissioning steps are also required if you want to use a configured device under changed operating conditions.

What must be done

Chapter	from page
Checking installation	Page 84
Making "First Setup"	Page 96
Check and set critical device parameters	Page 102
Set, test digital signals	Page 104
Limit switch function, tests the signals $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$	Page 106
Check the STO safety function signals, even if you don't use the STO safety function.	Page 107
Checking the direction of rotation of the motor	Page 108

7.2 Tools for commissioning

7.2.1 Overview

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

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

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

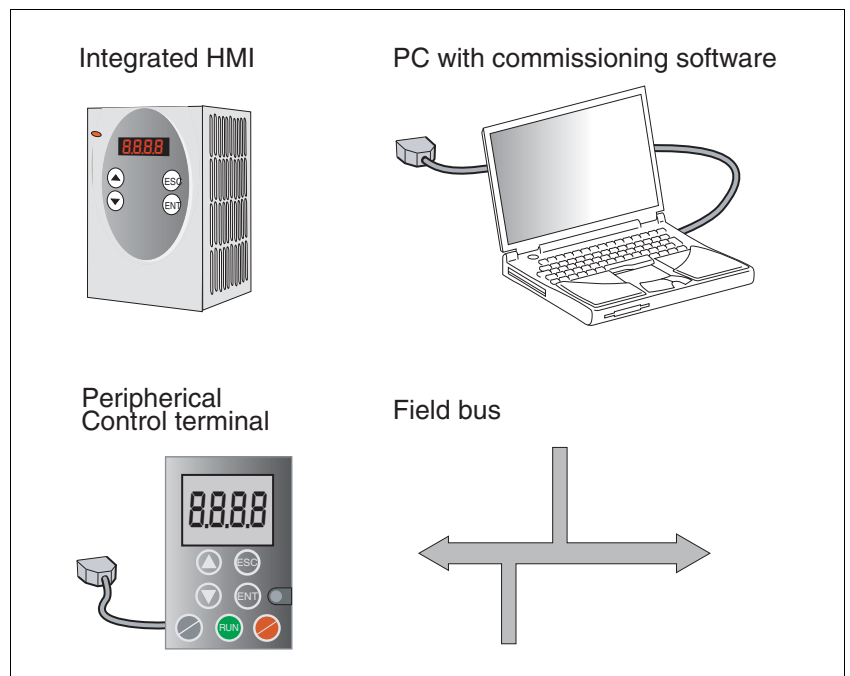


Figure 7.1 Commissioning tools

7.2.2 HMI: Human-Machine Interface

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

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

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

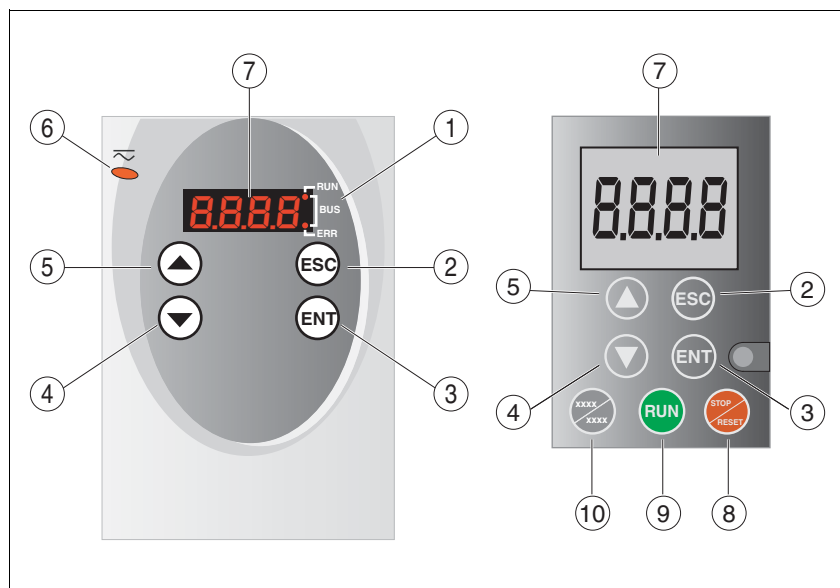


Figure 7.2 HMI and remote terminal

- (1) Status LEDs
- (2) ESC:
 - Close a menu or parameter
 - Return from displayed to last saved value
- (3) ENT:
 - Call up a menu or parameter
 - Save the displayed value in the EEPROM
- (4) Down arrow:
 - Change to next menu or parameter
 - Reduce the displayed value
- (5) Up arrow:
 - Switch to previous menu or parameter
 - Increase the displayed value
- (6) Red LED on: DC bus under power
- (7) Status display
- (8) Quick Stop (Software Stop)
- (9) 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 on the HMI display for the parameter view. Upper and lower case are only distinguished for the letter "C".

O	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
R	b	c	d	E	F	G	h	i	J	K	L	M	n	o	P	q	r
S	T	U	V	W	X	Y	Z	1	2	3	4	5	6	7	8	9	0
S	t	u	v	w	X	y	Z	1	2	3	4	5	6	7	8	9	0

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

Figure 7.3 shows an example of calling a parameter (second level) and input or selection of a parameter value (third level).

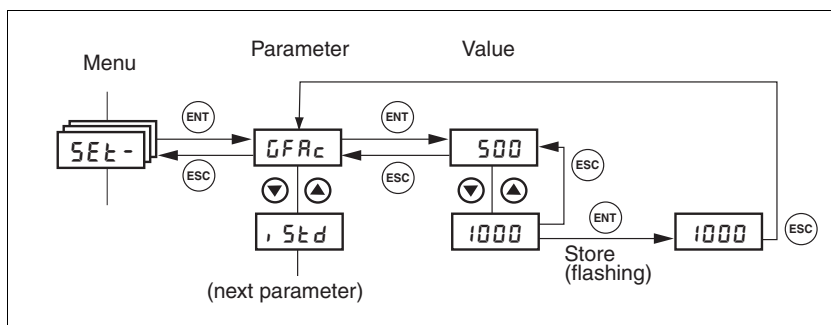


Figure 7.3 HMI, example of parameter setting

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

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

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

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

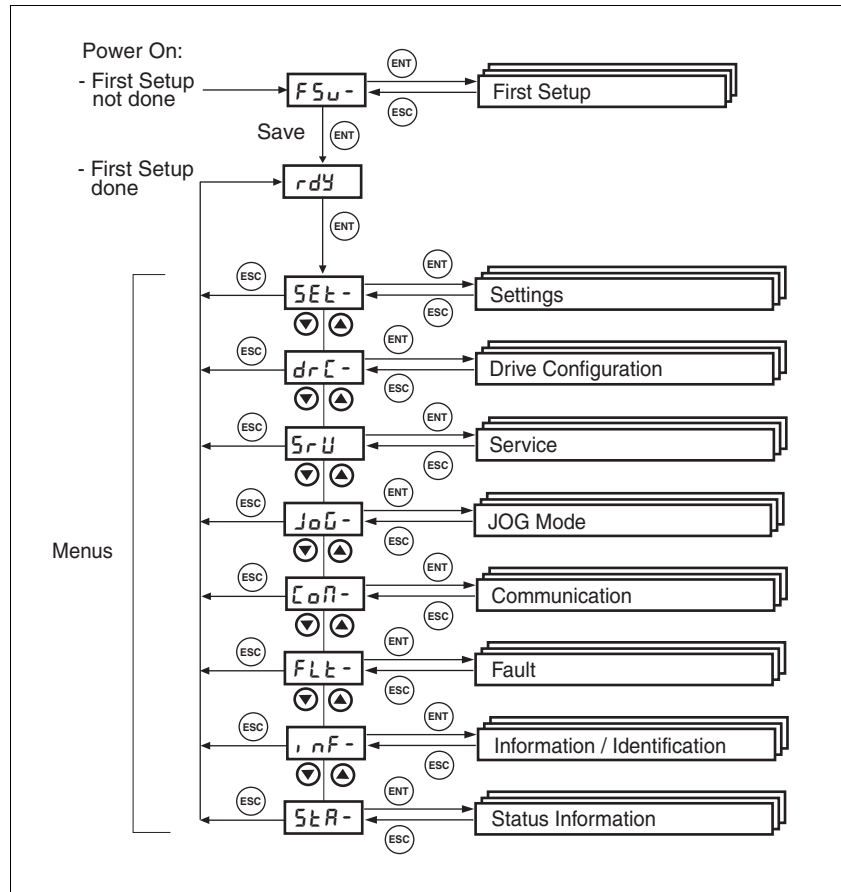


Figure 7.4 HMI menu structure

HMI menu		Description
FSU-	FSU-	First setup (F irst S et U p),
	ntYP	Motor selection
	EnCn	Processing of motor encoder position
	oPi	Signal selection position interface
	PbAd	Profibus address
	SAUE	Saving the settings
SET-	SEt-	Device settings (S ETtings)
	GFRC	Selection of special gear ratios
	Std	Phase current standstill component
	rnP	Phase current acceleration / deceleration component
	cns	Phase current component at constant movement
DRC-	drC-	Device configuration (D Rive C onfiguration)
	ntYP	Motor selection
	EnCn	Processing of motor encoder position
	oPi	Signal selection position interface
	ProR	Definition of direction of rotation

HMI menu		Description
	<i>FLS</i>	Restore factory settings (default values)
	<i>bEL</i>	Time delay when setting the brake
	<i>bErE</i>	Time delay for applying/releasing the brake
	<i>SuPU</i>	HMI display when motor rotates
SRV-	<i>SrU-</i>	S ervice department
	<i>brRH</i>	Releasing/applying the brake (requirement: power stage supply is off)
JOG-	<i>JoG-</i>	Jog (J OG Mode)
	<i>StEt</i>	Start jog
	<i>nSLu</i>	Speed for slow jog
	<i>nFSt</i>	Speed for fast jog
COM-	<i>CoM-</i>	Communication (COM munication)
	<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>Mbuo</i>	Modbus word sequence for double words (32 bit values) (commissioning software)
FLT-	<i>FLt-</i>	Error indication (FauLT)
	<i>StPF</i>	Error number of last stop fault
INF-	<i>i nF-</i>	Information/identification (IN formation / Identification)
	<i>dEUt</i>	Current selection of 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>	Motor nominal current
STA-	<i>StR-</i>	Observation/monitoring of device, motor and travel data (STA tus Information)
	<i>i oRC</i>	Status of digital inputs and outputs
	<i>nREt</i>	Actual speed of motor
	<i>PRCu</i>	Actual position of the motor in user units
	<i>Pd, F</i>	Current deviation between reference and actual positions
	<i>i REt</i>	Total motor current
	<i>udCR</i>	DC bus voltage of the power stage supply voltage
	<i>t dEU</i>	Device temperature
	<i>tPR</i>	Power stage temperature
	<i>brnS</i>	Saved warnings, bit-coded
	<i>S, tS</i>	Saved status of monitoring signals
	<i>oPh</i>	Operating hours counter

Status display The status display in its default setting shows the current operating status, see page 111. You can specify the following with the menu item *drcl / SUPU*:

- *StRt* shows the current operating status by default
- *nRcl* shows the current motor speed by default
- *iRcl* shows the current motor current by default

A change is only imported with the power amplifier disabled.

7.2.3 Lexium CT commissioning software

	The commissioning software has a graphic user interface and is used for commissioning, diagnostics and testing settings.
<i>Source commissioning software</i>	The latest version of the commissioning software is available for download from the internet: http://www.schneider-electric.com
<i>Functions of the commissioning software</i>	The functions of the commissioning software include: <ul style="list-style-type: none"> • 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 and output signals • Record, evaluate and archive motion and signals • Error diagnostics • Optimize control behavior (servo motors only)
<i>System requirements</i>	The minimum hardware requirements for installation and operation of the software are: <ul style="list-style-type: none"> • 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 newer • Internet connection (for initial installation and updates)
<i>Online help</i>	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"

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

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

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

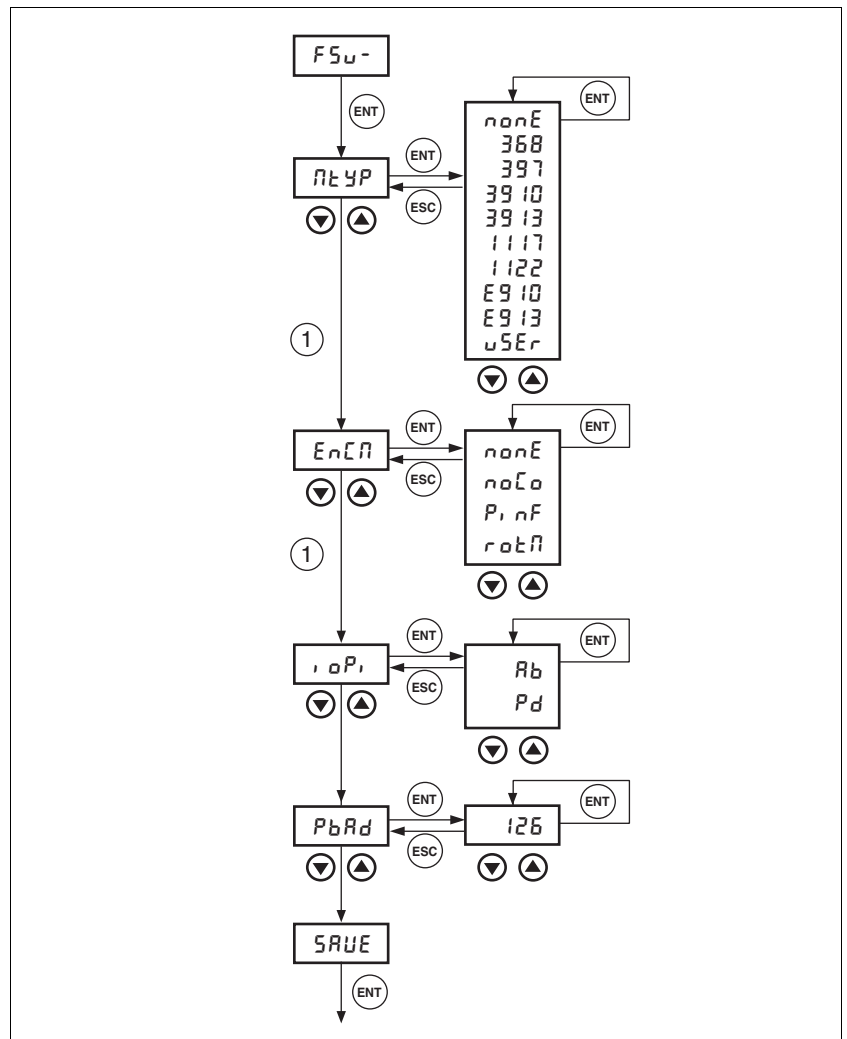


Figure 7.5 "First Setup" via HMI

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

Motor type ► Specify the motor that is connected to the device with parameter `SM_Type` (`nL4P`).

The motor-specific identification data are automatically fixed on selection of a defined motor type.

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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SM_Type	Motor type	-	UINT32	Modbus 3588
DRC- - MTYP	0 / none / none : No motor selected (default)	-	UINT32	Profibus 3588
drc- - ntyp	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 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.	-	R/W per.	

Motor encoder ► Specify whether a motor encoder is connected to the device and what its function will be with the `CTRLS_MotEnc` parameter (`Encn`).

If a motor encoder is not connected, select `none`. If `PnF` or `rotEn` is selected, a sensor must be connected for trouble-free operation. The temperature monitoring for the motor encoder is also enabled. `PnF` returns position information only, the rotation monitoring is not active. Select `rotEn` to enable rotation monitoring.

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

When the rotation monitoring is activated and the device is switched on, the "ENCODER" LED lights up.

Parameter Name HMI menu	Description	Unit Minimum value Default value 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 - - EnL	1 / NoEncCon / noLo : No motor encoder connected	0	R/W	
	2 / ShowEncPos / P, nF : Motor encoder connected, rotation monitoring inactive, only position info	3	per.	
	3 / RotMonOn / rotL : 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>).			

Function of the RS422 interface ► Set the assignment for the RS422 interface with the `IOposInterfac (i oP,)` parameter.

Parameter Name HMI menu	Description	Unit Minimum value Default value 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
drL - - i oP,	1 / PInput / Pd : Input PULSE, DIR, ENABLE2	0	R/W	
	RS422 I/O interface (Pos)	1	per.	
	NOTE: Changed settings do not become active until the unit is switched on the next time.			

Profibus fieldbus ► Set the fieldbus address with the parameter `PBadr (PbAd)`.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PBadr	Profibus address	-	R/W	
COM- - PbAD	Valid addresses: 1 to 126	1	per.	
L oP - - 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 on completion.
HMI: Save your settings with *SAVE*
Commissioning software: Save your settings with the menu path "Configuration - Save in EEPROM"
 - ◁ The device saves all set values in the EEPROM and displays the status *ready*, *rdy* or *dis* on the HMI.
- A restart of the device is required to allow the changes to be accepted.

Further steps

- ▶ Stick a label on the unit with all important information required in case of service, e.g. fieldbus type, address and baud rate.
- ▶ Make the settings described below for commissioning.

Note that you can only return to the "First Setup" by restoring the factory settings, see 8.6.11.2 "Restore factory settings" page 171.

7.3.2 Operating state (state diagram)

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

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

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

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

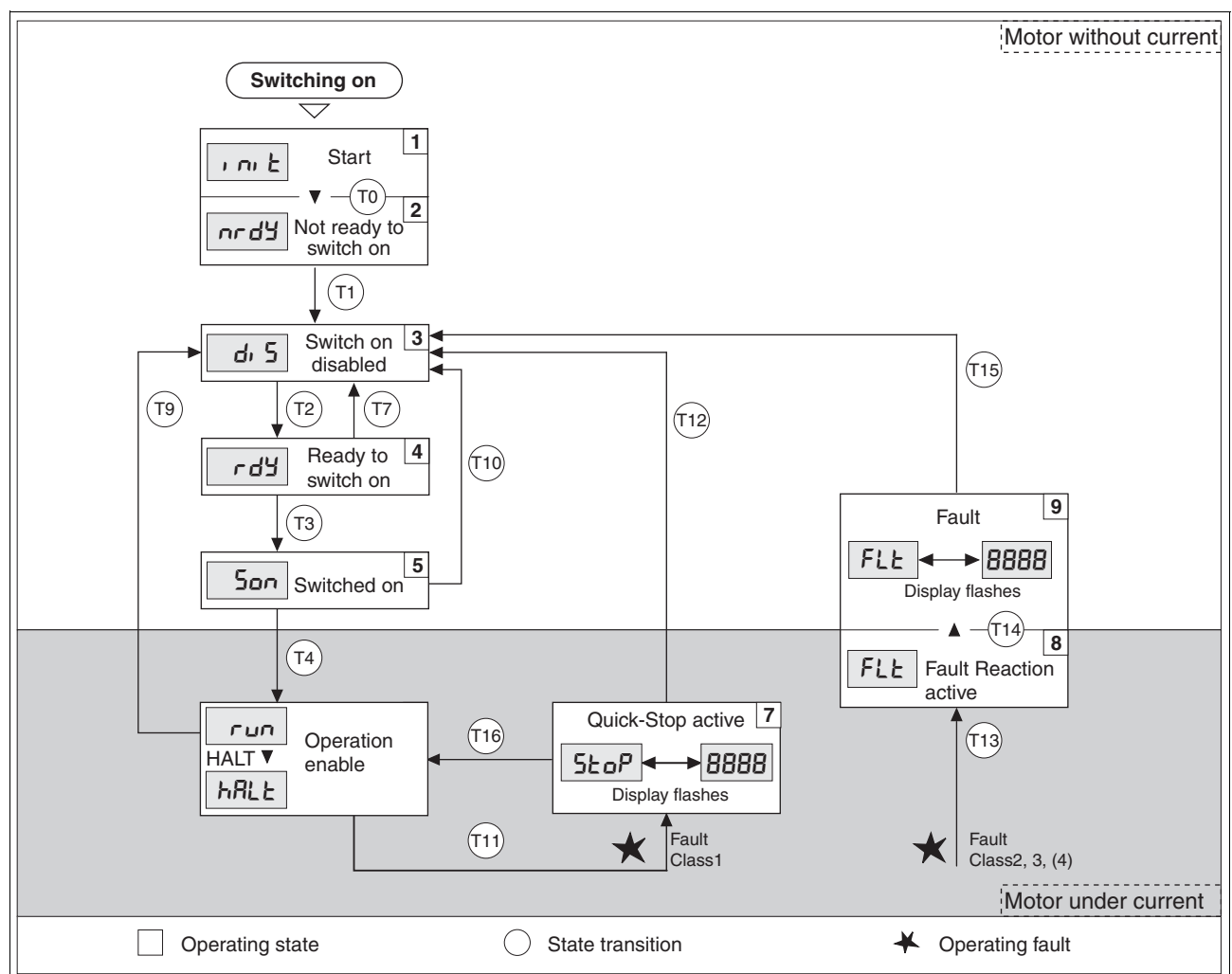


Figure 7.6 State diagram

Operating states and mode transitions

For detailed information on operating states and mode transitions, see Chapter 8.3 "Operating states".

Release and set brake with HMI

The brake can also manually be released and set with the HMI. The power amplifier must not be switched on. Note that the axis may drop if the brake of a vertical axis (Z-axis) is released!

To release/set the brake in the HMI menu **5rU-** select the submenu **brRH**.

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 thresholds

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

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

Ramp for "Quick Stop" and "Halt"

Acceleration and deceleration are limited by ramp functions in operating modes profile position mode, profile velocity, oscillator mode and homing.

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

Parameter Name HMI menu	Description	Unit Minimum value Default value 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	UINT32	Profibus 1572
-		3000000	R/W per. -	
RAMPdecel	Deceleration of profile generator	min ⁻¹ /s 200	UINT32	Modbus 1558
-		750	UINT32	Profibus 1558
-		3000000	R/W per. -	

Limitation of reference speed

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

- Set the maximum reference speed with the parameter `RAMPn_max`.

Parameter Name HMI menu	Description	Unit Minimum value Default value 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	UINT16 UINT16	Modbus 1554 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 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 with the HMI, but they cannot be modified.

- Call up the menu point *SEtR / I, ORe*.
- ◁ You see the digital inputs bit-coded.
- Press the "up arrow".
- ◁ You see the digital outputs bit-coded.

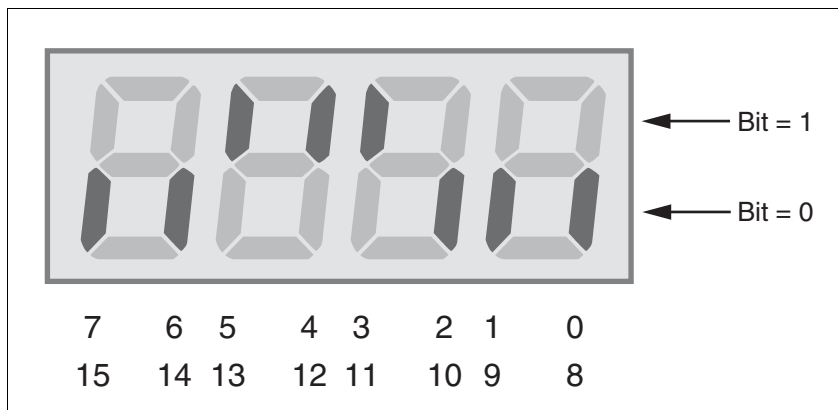


Figure 7.7 HMI, status display of the digital inputs/outputs

Bit	Signal	I/O
0	$\overline{\text{REF}}$	I
1	$\overline{\text{LIN}}$	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 displayed bit-coded in the parameter `_IO_act`. The values 1 and 0 indicate whether an input or output is active.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
<code>_IO_act</code>	Physical status of the digital inputs and outputs	- - 0	UINT16 R/W UINT16	Modbus 2050 Profibus 2050
<code>STA- - ioAC</code>	Assignment of the 24 V inputs:	-	-	
<code>5tR- - , aRL</code>	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			

7.3.5 Testing limit switches signals in fieldbus devices

⚠ CAUTION**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 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 injury or equipment damage.

► Set up the limit switches so the motor cannot traverse through the limit switch.

► Trigger the limit switches manually.

◁ The HMI shows an error message, see Diagnostics from page 179

The release of the input signals $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$ and $\overline{\text{REF}}$ and the evaluation at active 0 or active 1 can be changed with the parameters of the same name, see page 149.



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

7.3.6 Testing safety function STO

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

- Power stage supply voltage is switched off.
Controller supply voltage is switched off.
- ▶ Check 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 be connected.
- 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 at the same time.
- ◁ 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 in error states.
- ▶ 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:

- ▶ Check 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 direction of rotation

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

- ▶ Start the jog operating mode.
(HMI: `JOG- / Start`)
- ◁ The HMI shows `JG`.
- ▶ Start a movement with clockwise direction of rotation.
(HMI: "up arrow")
- ◁ The motor rotates with clockwise direction of rotation.
The HMI shows `JG-`
- ▶ Start a movement with counterclockwise direction of rotation.
(HMI: "Down arrow")
- ◁ The motor rotates with counterclockwise direction of rotation.
The HMI shows `- JG`

If the motor phases are reversed unexpected movements may occur.

- ▶ 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 170.

7.3.8 Check fan

Check that the fan operates correctly on SD32••U68 devices. The air-flow must be directed from bottom to top.

7.3.9 Optimize travel behavior

A linear ramp shape for acceleration and deceleration is set at the factory.

Alternatively a motor-optimized ramp for the acceleration and deceleration phase is available. This compensates for the typical stepper motor torque drop on increasing speed by reducing the acceleration, see chapter 8.6.4 "Motion profile" on page 160.

When motors are selected in "First Setup" or in parameter `SM_Type`, motor-specific values are automatically transferred as fixed values. On selection of the "USER" motor type, these values must be input into parameters, see page 96.

8 Operation

The "Operation" section 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 following table shows the interrelationships between reference value interface, control loop and the use of the profile generator for 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 131
Profile Velocity	Fieldbus commands	Position controller	X	Page 134
Homing	Fieldbus commands	Position controller	X	Page 136

8.2 Access monitor

8.2.1 via HMI

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

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

Parameter Name HMI menu	Description	Unit Minimum value Default value 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 the case of fieldbus control mode, the parameter `AccessLock` can be used to limit the access monitoring to the fieldbus.

Parameter Name HMI menu	Description	Unit Minimum value Default value 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	
-		1	-	
	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.			

8.2.3 via commissioning software

The commissioning software receives access control via the "Access" button. Access via HMI or fieldbus is then not possible.

8.2.4 via hardware input signals

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

8.3 Operating states

8.3.1 State diagram

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

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

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

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

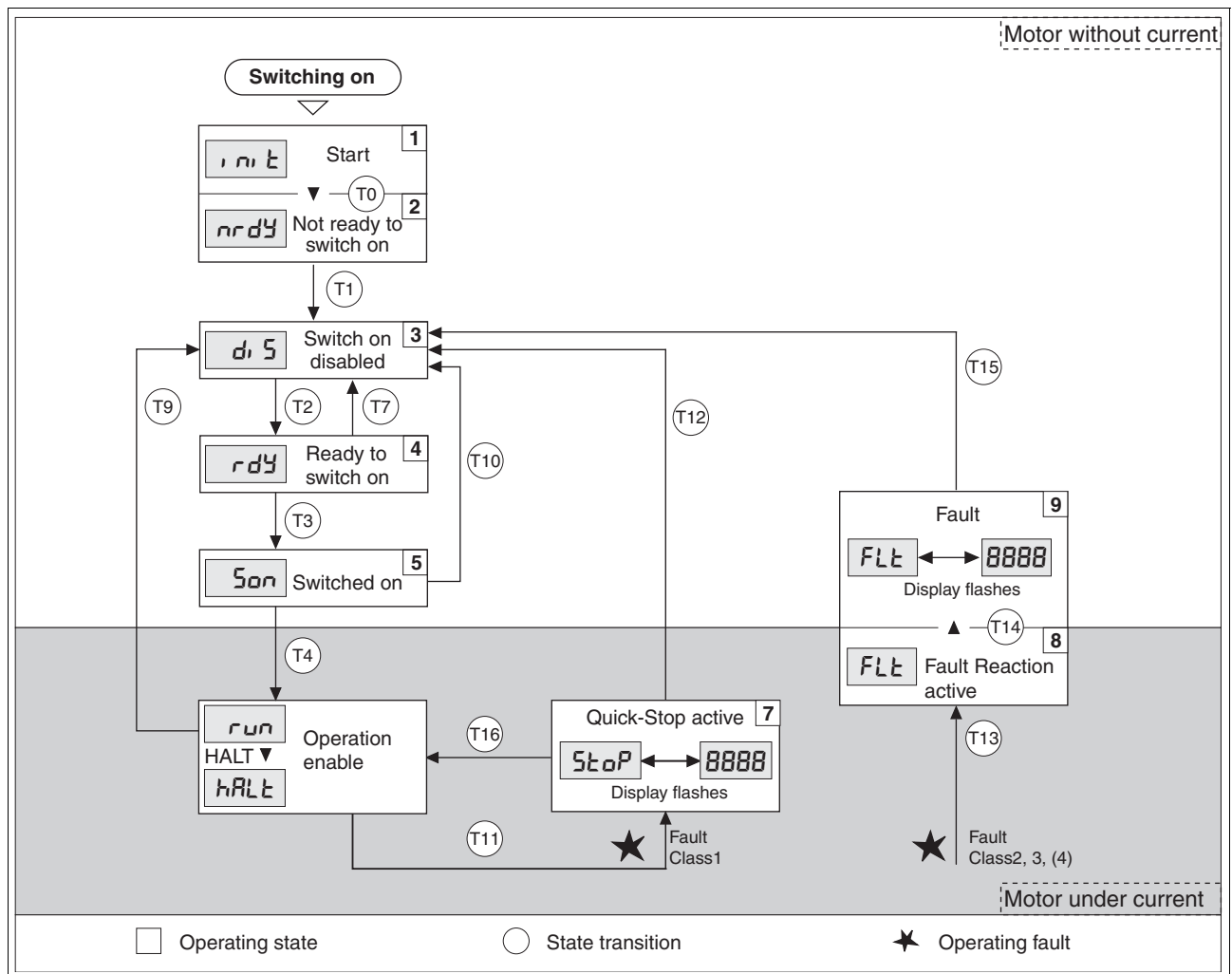


Figure 8.1 State diagram

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

Display	Status	State description
init	1 Start	Controller supply voltage, electronics is initialised
nrDY	2 Not ready to switch on	The power amplifier is not ready to switch on
dis	3 Switch on disabled	Switching on the power amplifier is locked
rdY	4 Ready to switch on	The power amplifier is ready to switch on
son	5 Switched on	Motor not under current Power amplifier ready No operating mode active
run halt	6 Operation enable	run: The device is working in the selected mode halt: The motor is stopped with active power amplifier
stop	7 Quick Stop active	"Quick Stop" is executed
FLT	8 Fault Reaction active	Error detected, error response is enabled
FLT	9 Fault	device is in fault condition

Error class The product triggers an error response in the event of a fault. Depending upon the severity of the fault, the device responds in accordance with one of the following error classes:

Error class	Reaction	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. Error response can only be reset by switching off the device.

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

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

An operating error can be triggered by a temperature sensor, for example. The device cancels the motion command and starts the error response, e.g. 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)}	Reaction
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 $\overline{\text{STO_A}} (\text{PWRR_A})$ and $\overline{\text{STO_B}} (\text{PWRR_B}) = +24\text{V}$	
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 • $\overline{\text{STO_A}} (\text{PWRR_A})$ and $\overline{\text{STO_B}} (\text{PWRR_B}) = 0\text{V}$ • Actual speed: >1000 min ⁻¹ (e.g. 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	• Errors Class 2, 3 or 4	Error response is carried out, see "Error response"
T14	8 -> 9	• Error response terminated (error from class 2) • Errors Class , 3 or 4	

Transition	Operating state	Condition / event ^{1) 2)}	Reaction
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 state transition it is sufficient if one condition is met

2) Fieldbus commands only with control mode fieldbus

Special feature when switching on (transition T4) The stepper motor executes a short movement with activated parameter CTRLS_Toggle so that the stepper motor is not at an unstable position.

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

8.3.2 Displaying 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

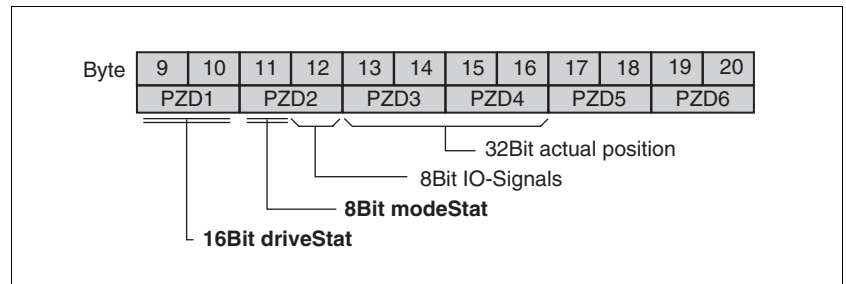


Figure 8.2 Receive data in the process data channel: slave to master

Bytes 9 and 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

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. They do not indicate any time consistency with bytes 9...16.

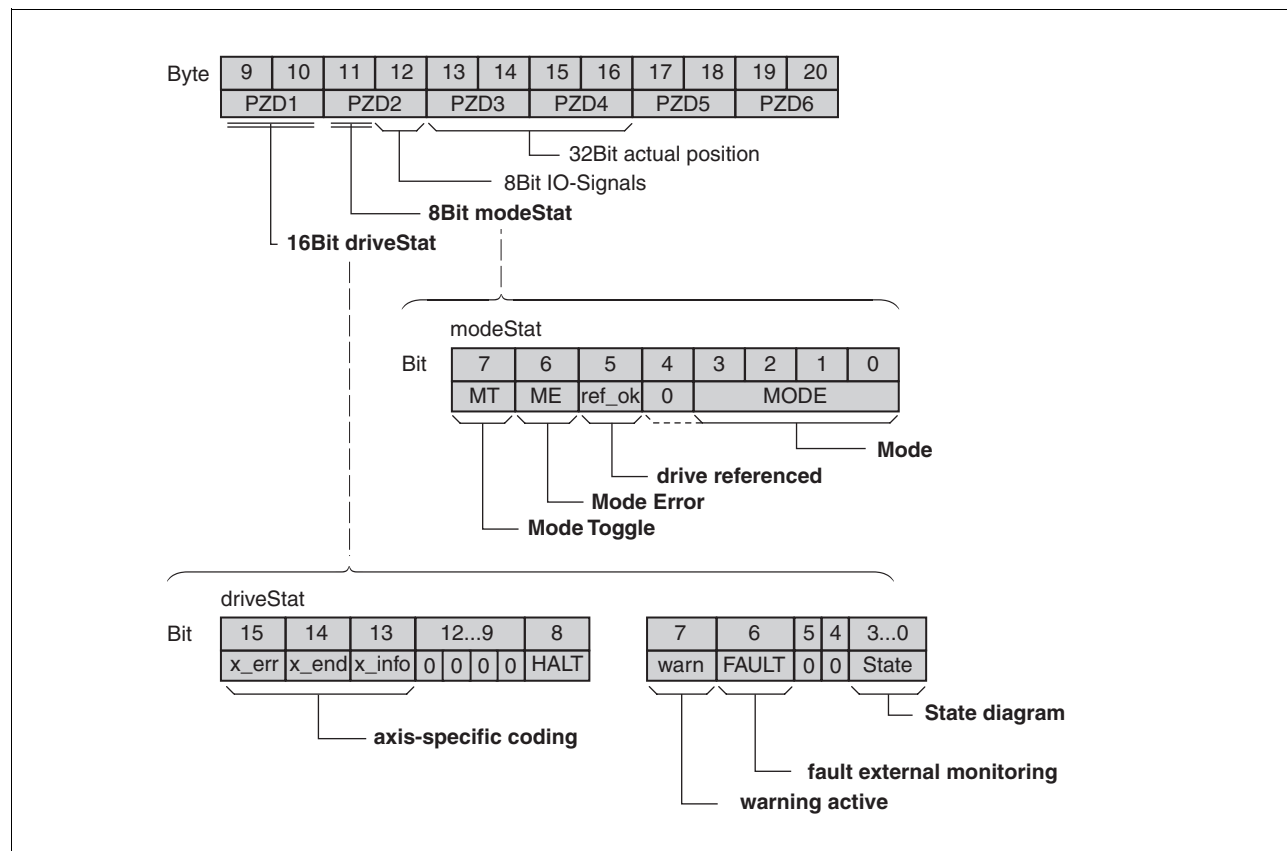


Figure 8.3 Structure of receive data in the process data channel

Description of driveStat The driveStat status word has the following structure

Bit	Name	Description
0...3	State	State diagram, state
6	FAULT	Fault detection, fault 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	End label of operating mode
15	x_err	Error identifier of operating mode

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

Bit	Name	Description
0...3	mode	Currently specified operating mode as with transmit data
5	ref_ok	Set if the product was successfully homed by a reference movement or position setting. If a motor with encoder is connected, the valid reference point remains active when the power stage is deactivated.
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 accordingly.

Description of I/O signal (byte 12) The current levels of the inputs are contained in byte 12:

Bit	Meaning
Bit 0	Level of reference switch $\overline{\text{REF}}$
Bit 1	Level of negative limit switch $\overline{\text{LIMN}}$
Bit 2	Level of positive limit switch $\overline{\text{LIMP}}$
Bit 3	Level of $\overline{\text{HALT}}$
Bit 4	Level of safety input STO_B ($\overline{\text{PWRR_B}}$)
Bit 5	Level of safety input STO_A ($\overline{\text{PWRR_A}}$)
Bit 6	Not assigned
Bit 7	Not assigned

8.3.3 Changing operating states

The master can control the operating states 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 the operating states and enabling the operating modes must be executed separately. An operating mode can generally only be enabled if the operating status is already "OPERATION-ENABLE".

In the process data channel control is via driveCtrl, 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:

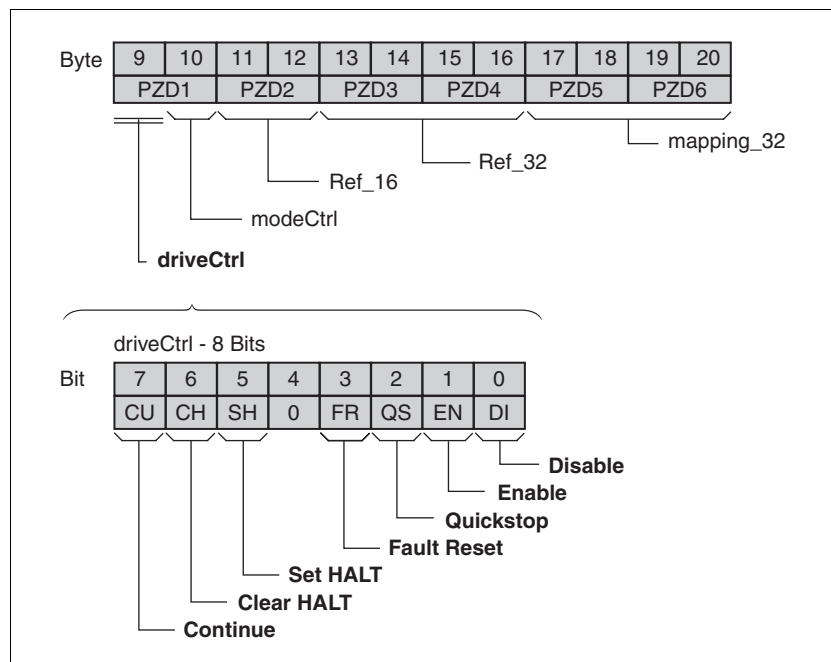


Figure 8.4 Transmit data in the process data channel: driveCtrl

The operating status is changed via the process data channel or the parameter channel.

During access via the process data channel these bits are edge-selective, i.e. the function is triggered with a rising edge.

During access via the parameter channel a write access with a set bit value is sufficient.

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

Change of operating states ^{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: Quickstop	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 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, e.g. if the target position of a positioning process is reached or if the drive is stopped by a "Quick Stop" or "Halt". If 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 Start operating mode

In the fieldbus the operating mode is set and started in one write process. This is done in the process data channel with modeCtrl.

Description modeCtrl:

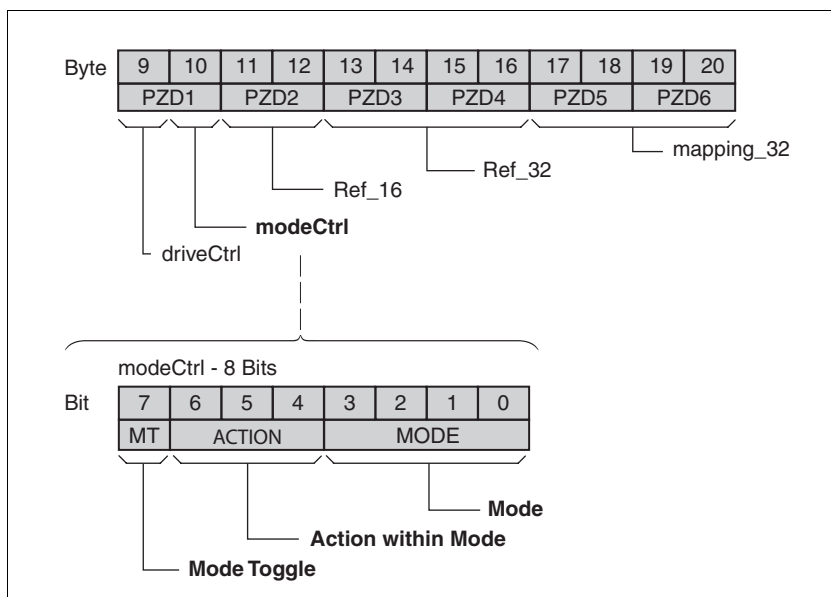


Figure 8.5 Transmit data in the process data channel: modeCtrl

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)
- modeCtrl, Bit 7 Toggle (MT)

The possible operating modes, operating actions and the associated reference values are shown in Table 6.4.

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	-

Operating mode	modeCtrl ¹⁾	Description	Reference value ref_16, PZD2	Reference value ref_32, PZD3+4
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)

With simultaneous transmission of operating mode, reference position and reference speed in 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 a rising or a falling edge has been detected since the last transmission.

Bit 7 is mirrored in the receive data set; allows the master to detect that the data was accepted by the slave.

8.4.2 Changing the operating mode

The operating modes can be changed whilst the operation is in process. For this purpose, the current process must be completed or explicitly discontinued. The drive must be at a standstill. Proceed then as shown under "Starting the Operating Mode".

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.

Start operating mode

The operating mode can be started via the HMI. The power amplifier becomes active and the motor is under current by calling up the `JOG- / Start`. Pressing the "Up arrow" or "Down arrow" button rotates the motor. You can change between slow and fast movement by simultaneously pushing the ENT-button.

The operating mode is set in the process data channel in modeCtrl via the fieldbus. The writing of the parameter value simultaneously causes the start of the operating mode.

With the start signal for the jog, the motor first moves over a defined travel unit `JOGstepusr`. If the start signal is still pending after a specified wait time `JOGtime`, the device switches to continuous operation until the start signal is cancelled.

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

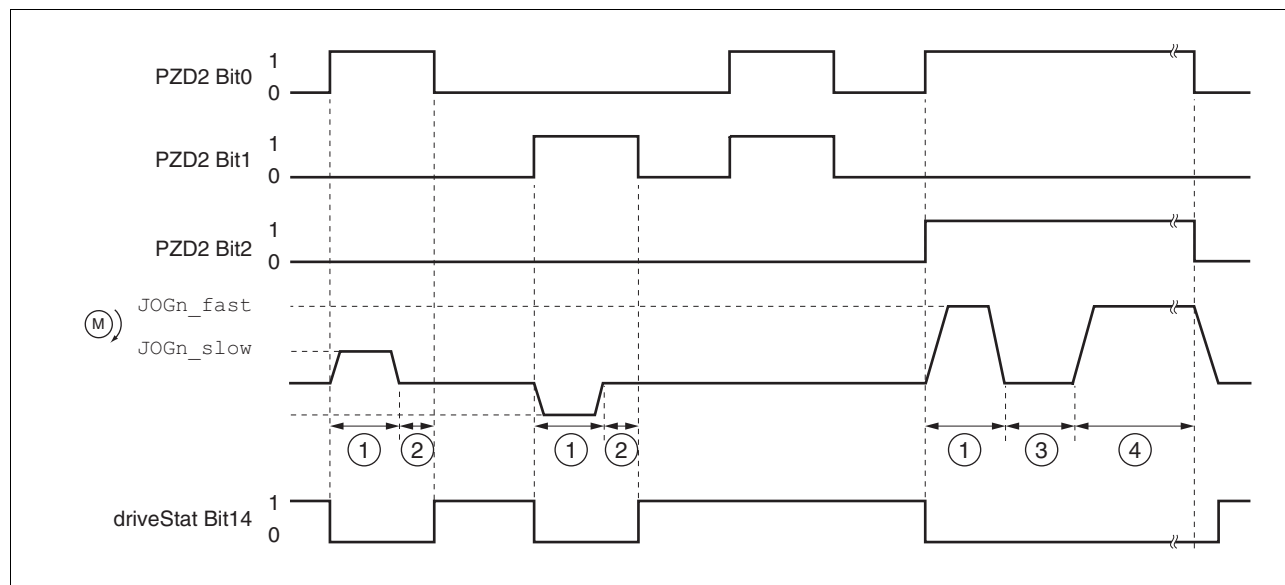


Figure 8.6 Jog, slow and fast

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

The inching distance, delay and jog speeds can be set. If the inching distance is zero, jog starts directly with continuous movement irrespective of the delay.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
JOGn_slow	Speed for slow jog	min ⁻¹ 1 60 3000	UINT16 UINT16 R/W per. -	Modbus 10504 Profibus 10504
JOG- - NSLW JOG- - nSLW	The adjustable value is internally limited to the current parameter setting in RAMPn_max.			
JOGn_fast	Speed for fast jog	min ⁻¹ 1 180 3000	UINT16 UINT16 R/W per. -	Modbus 10506 Profibus 10506
JOG- - NFST JOG- - nFSt	The adjustable value is internally limited to the current parameter setting in RAMPn_max.			
JOGstepusr	Jog distance prior to continuous run	usr 0 20 -	INT32 INT32 R/W per. -	Modbus 10510 Profibus 10510
-	0: Direct activation of continuous run			
-	>0: Positioning distance per jog cycle			
JOGtime	Wait time prior to continuous run	ms 1 500 32767	UINT16 UINT16 R/W per. -	Modbus 10512 Profibus 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.			
-				

End operating mode Jog is finished when the motor has stopped and

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

Further options For further settings and functions for the operating mode, see page 148.

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 specification whether A/B signals or pulse/direction signals should be processed depends on the setting of the parameter `IOposInterfac`.

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

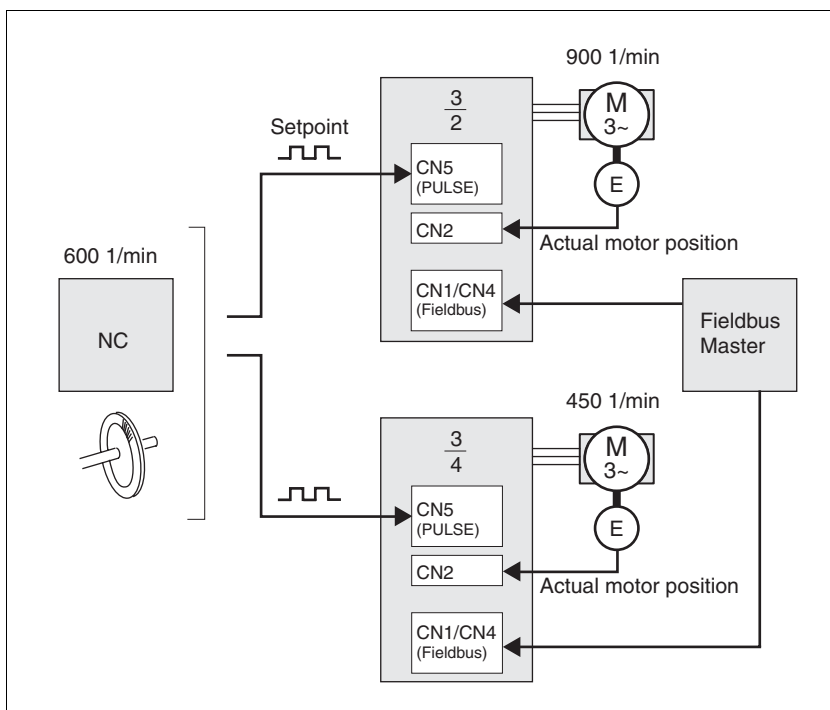


Figure 8.7 Reference value preset via NC controller

The type of synchronisation is set and the gear processing is started by a write command on the parameter `GEARreference`. If positioning changes at the reference signals are stored, then the unit computes these with the gear factor and positions the motor to the new set position.

Positioning values are given in internal units. The unit performs the changes immediately.

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 effectiveness of the parameters which can be set for the operating mode electronic gear.

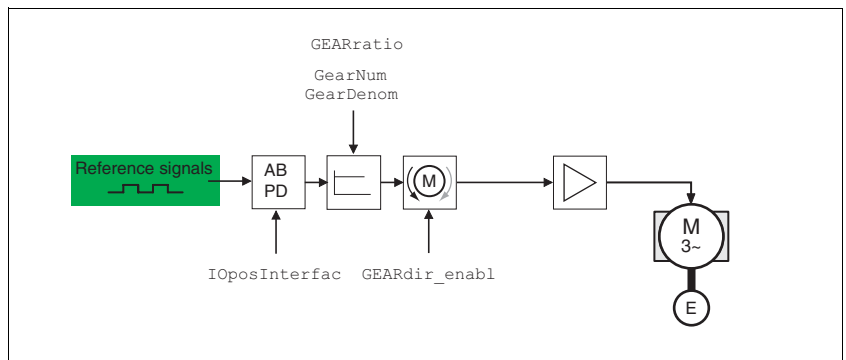


Figure 8.8 Operating mode electronic gear, effect of settable parameters

The resulting positioning movement is dependent upon the current motor resolution. It amounts to 131072 motor increments per revolution.

The setting values for the electronic gear, independent of the type of synchronisation, are:

- Gear ratio (predefined value or intrinsic gear ratio)
- Release of the direction of rotation

Synchronization

The device operates synchronously with other devices, e.g. other drives. If the device temporarily interrupts processing, synchronism 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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
GEARposChgMode	Consideration of position changes with inactive power amplifier	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 9750 Profibus 9750
-	0 / off: Position changes in states with inactive power amplifier are discarded.			
-	1 / on: Position changes in states with inactive power amplifier 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 motor increments and the externally supplied reference increments for the movement of the motor.

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

The parameter `GEARratio` 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 for numerator and denominator. A negative numerator value reverses the motor's direction of rotation. The gear ratio is preset to 1:1.

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

Example At a setting of 1000 reference increments the motor is to rotate 2000 motor increments. This results in a gear ratio of 2.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
GEARratio	Selection of special gear ratios	- 0 0 11	UINT16 UINT16 R/W per. -	Modbus 9740 Profibus 9740
SET- - GFAC	0 / GearFactor / FFL: Usage of gear ratio adjusted with <code>GEARnum</code> / <code>GEARdenom</code>			
SET- - GFAC	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.			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
GEARnum	Numerator of gear ratio	-	INT32	Modbus 9736
-	GEARnum	-2147483648	INT32	Profibus 9736
-	Gear ratio= ----- GEARdenom	1 2147483647	R/W 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, limitation of speed of rotation and acceleration must be activated for Electronic Gear.

- Reference signals generated: `GEARcontrol = 0` (inactive)
The user must preset the external reference signals in such a way that the motor can always follow them. For example, this is the case when generating the reference value via 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 when the reference value are supplied via pulse packets. Limiting the speed of rotation (`GEAR_n_max`) and the acceleration (`GEARramp`) keeps the motor from stalling.
The motor is no longer position-synchronized during this period. The position deviation that can be read out via `_p_difGEAR` is reduced as quickly as possible after the reference signals fall below the limit value.

Parameter Name HMI menu	Description	Unit Minimum value Default value 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 prevents 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. -	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
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 always 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 clockwise or counterclockwise rotation. Release of direction is set with the parameter GEARdir_enabl.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
GEARdir_enabl	Enabled movement direction of gear processing	-	UINT16	Modbus 9738
-		1	UINT16	Profibus 9738
-		3	R/W	
-	1 / positive: Pos. direction	3	per.	
-	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 148.

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.

An absolute positioning or relative positioning is set with via modeCtrl.

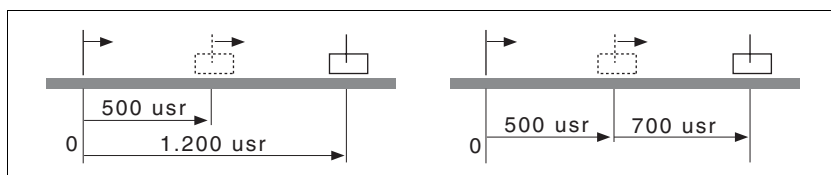


Figure 8.9 Absolute positioning (left) and relative positioning (right)

Requirements The unit must be in the "Operation status" operating mode.
See chapter .

8.5.3.1 parameterization

The profile position operating mode can be set and executed with parameters or the process data channel. For settings and examples see the fieldbus manual.

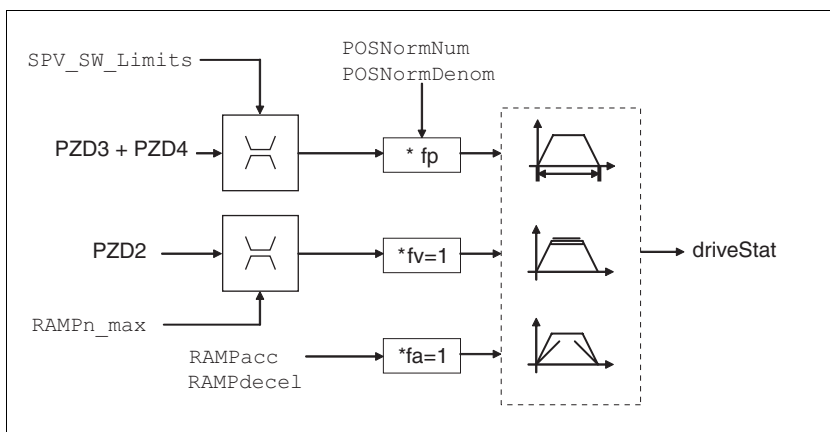


Figure 8.10 Profile position operating mode, effect of settable parameters

PZD2	corresponds to parameter <code>PPn_target</code>
PZD3 + PZD4	Absolute: corresponds to parameter <code>PPp_absusr</code> Relative: corresponds to parameter <code>PPp_relprefusr</code> or parameter <code>PPp_relpactusr</code>

At an absolute positioning the positioning path is specified absolutely with reference to the zero point of the axis.

At a relative positioning the positioning path is specified relative to the momentary axis position or the target position.

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

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PPp_relactusr	Target position relative to current motor position	usr	R/W	
-		-	-	
-	Min./max values depend on: - Position normalization factor - Software limit switches (if they are activated)	0	-	
	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.			
PPp_relprefusr	Target position relative to the current target position	usr	R/W	
-		-	-	
-	Min./max values depend on: - Position normalization factor - Software limit switches (if they are activated)	0	-	
	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.			

Current position The current position is determined by using the 2 parameters p_actusr and p_actRAMPusr.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
<u>p_actusr</u>	Actual motor position in user units	usr	INT32	Modbus 7706
STA- - PACu		-	INT32	Profibus 7706
5LR- - PREu		0	R/-	
		-	-	
<u>p_actRAMPusr</u>	Actual position of motion profile generator	usr	INT32	Modbus 7940
-	In user units	-	INT32	Profibus 7940
-		0	R/-	
		-	-	

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.

Requirements The unit must be in the "Operation status" operating mode.

See chapter .

8.5.4.1 parameterization

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

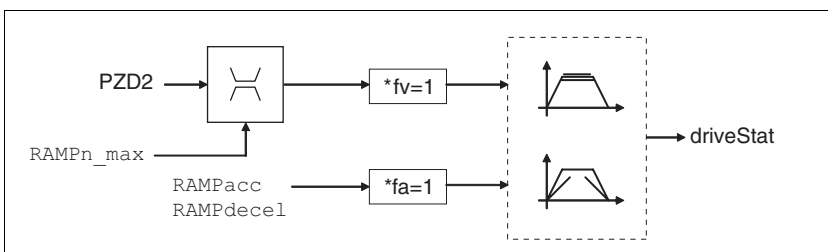


Figure 8.11 Operating mode Profile Velocity, effect of parameter settings

PZD2 corresponds to parameter PVn_target

Reference speed The set speed is transferred via the in the process data channel corresponding to the parameter PVn_target in rpm and can be changed during the movement. The operating mode is not limited by range limits of the positioning. New speed values are accepted immediately during a travel command.

Parameter Name HMI menu	Description	Unit Minimum value Default value 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 R/W	Modbus 9218 Profibus 9218
-	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	- 3000	- -	

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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
<code>_n_act</code> STA- - NACT StR- - nRLt	Actual motor speed	min^{-1} - 0 -	INT16 INT16 R/- -	Modbus 7696 Profibus 7696
<code>_n_actRAMP</code> - -	Actual speed of motion profile generator	min^{-1} - 0 -	INT32 INT32 R/- -	Modbus 7948 Profibus 7948

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 positionings 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 you can switch to a new operating mode.

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 specifications 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 counterclockwise direction of rotation
- Movement to reference switch $\overline{\text{REF}}$ with clockwise direction of rotation

Reference movements are possible with or without index pulse.

- Reference movement without index pulse
Movement from the switching edge to a distance 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 Default value 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
drC- - EnCn	1 / NoEncCon / noLo : No motor encoder connected	0	R/W	
	2 / ShowEncPos / P, nF : Motor encoder connected, rotation monitoring inactive, only position info	3	per.	
	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>).			

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

Operating mode terminated

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

If a motor with encoder is connected, the valid reference point remains active when the power stage is deactivated.

8.5.5.1 Setting by parameters, general

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

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus

The evaluation at `active_0` or `active_1` of the reference switch `REF` can be set in parameter `IOsigREF`. A release of the switch is not required.

The evaluation is set to `active_0` or `active_1` and the release of the limit switch is set with the parameters `IOsigLimN` and `IOsigLimP`.



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

Parameter Name HMI menu	Description	Unit Minimum value Default value 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	1	R/W	
		2	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 for setting the speeds for the reference movement.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMn	Reference speed for searching the switch	min ⁻¹	UINT16	Modbus 10248
-	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	1	UINT16	Profibus 10248
-		60	R/W	
-		3000	per.	
			-	
HMn_out	Reference speed for moving away from switch	min ⁻¹	UINT16	Modbus 10250
-	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	1	UINT16	Profibus 10250
-		6	R/W	
-		3000	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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMp_homeusr	Position at reference point	usr	INT32	Modbus 10262
-	After a successful reference movement, this position is automatically set at the reference point.	-2147483648	INT32	Profibus 10262
-		0	R/W	
-		2147483647	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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMoutdisusr	Maximum run-out distance	usr	INT32	Modbus 10252
-	0: Run-out monitoring inactive	0	INT32	Profibus 10252
-	>0: Run-out in user-defined units	0	R/W	
	The switch must be disabled again during this run-out, otherwise the reference movement is aborted.	2147483647	per.	
			-	
HMsrchdisusr	Max. search distance after overrun of switch	usr	INT32	Modbus 10266
-	0: Search distance processing disabled	0	INT32	Profibus 10266
-	>0: Search distance in user units	0	R/W	
	The switch must be activated again within this search distance, otherwise the reference movement is canceled.	2147483647	per.	
			-	

Preferred method The `SaveHomeMethod` parameter can be used to store a preferred method for the reference movement. The importance of the values of the `SaveHomeMethod` parameter corresponds with the importance of the value of the `HMmethod` parameter.

When the device is switched on, the value in the `HMmethod` parameter is overwritten with the value that was set for the `SaveHomeMethod` parameter.

The function is available from software version V 1.501.

Parameter Name HMI menu	Description	Unit Minimum value Default value 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, for bit assignment see parameter *HMmethod*.

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

Parameter Name HMI menu	Description	Unit Minimum value Default value 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).

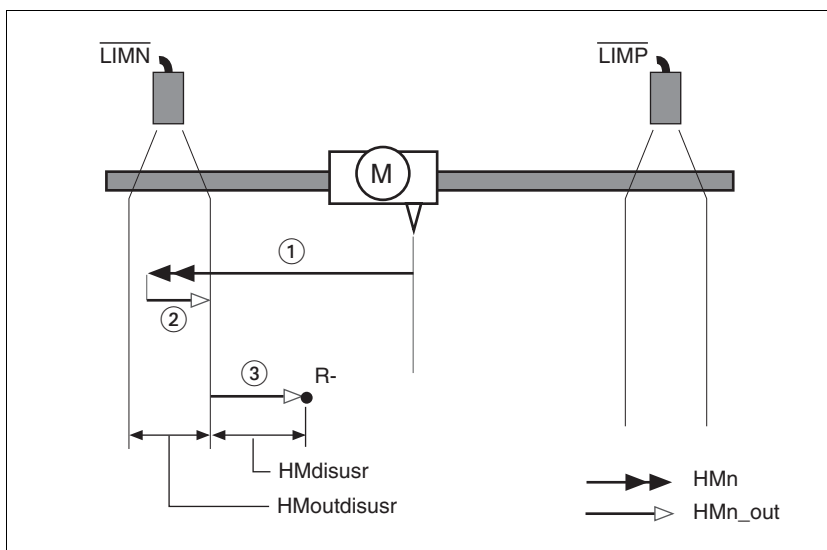


Figure 8.12 Reference movement to the negative limit switch

- (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 (HMmethod =27 to 30).

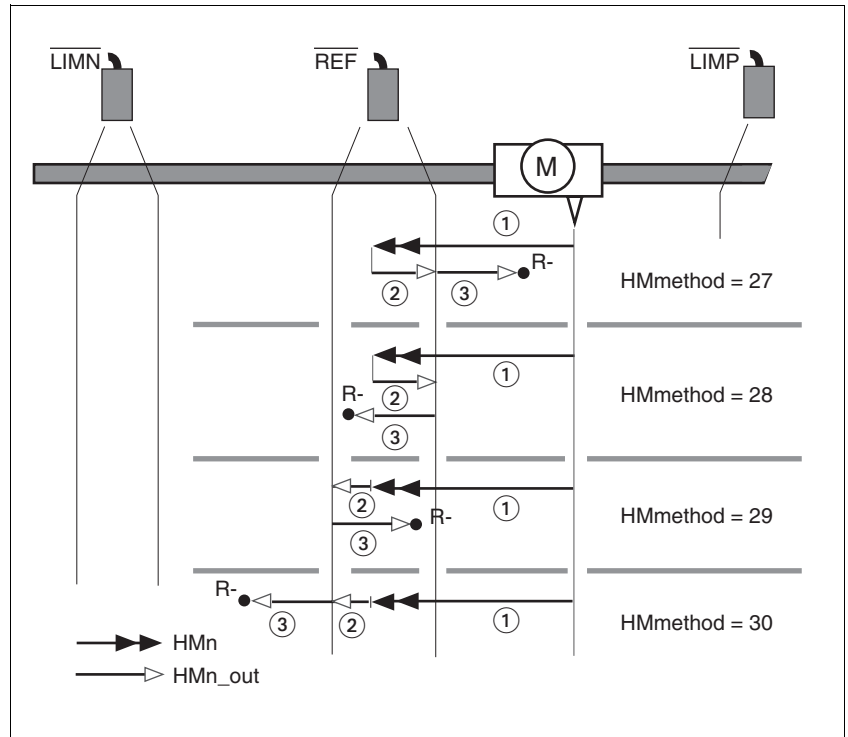


Figure 8.13 Reference movements to the reference switch

- (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 ($HM_{method}=27$). 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).

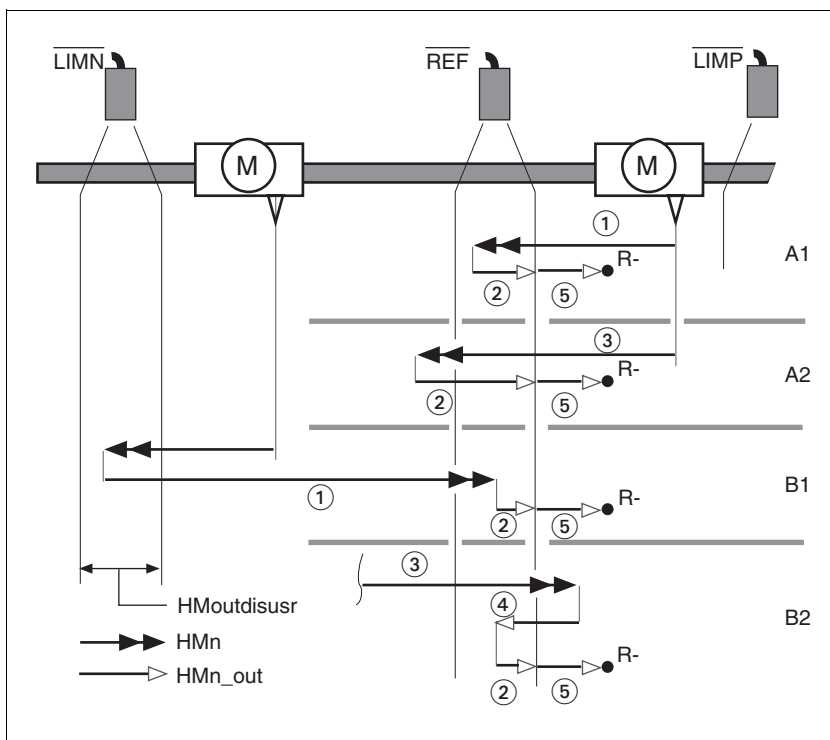


Figure 8.14 Reference movements to the reference switch

- (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 Default value 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
drc- - EnEn	1 / NoEncCon / noCo : No motor encoder connected	0	R/W	
	2 / ShowEncPos / PnF : Motor encoder connected, rotation monitoring inactive, only position info	3	per.	
	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>).			

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

First, the defined reference switch is approached and finally a search movement is made 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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMdisREFtoIDX	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.	0.0000	R/-	
	In increments of 1/10000 revolutions	-	-	

Reference movement towards limit switch

A reference movement to the positive limit switch with movement to the first index pulse is shown below ($HMmethod = 2$).

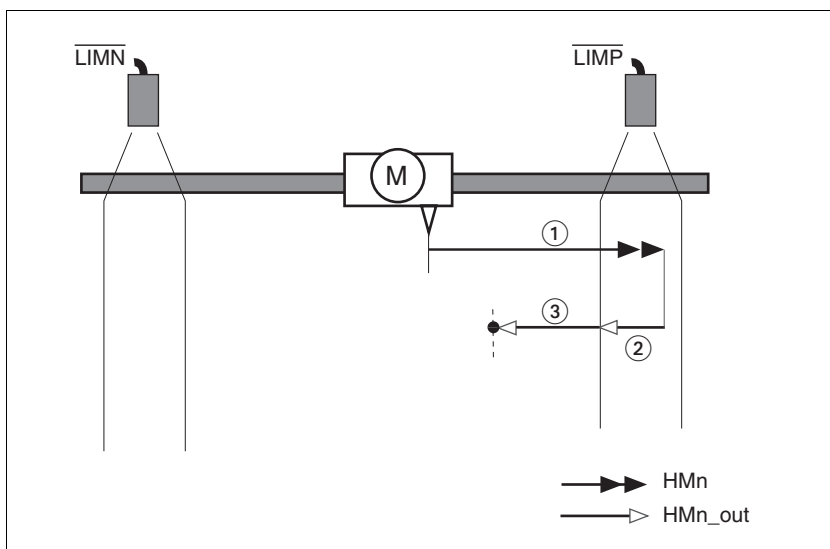


Figure 8.15 Reference movement to the positive limit switch

- (1) Movement to limit switch at search speed
- (2) Movement to switching edge with clearance speed
- (3) Special movement to index pulse

Reference movement to reference switch

Reference movements to the reference switch with movement to the first index pulse are shown below ($HMmethod = 11$ to 14).

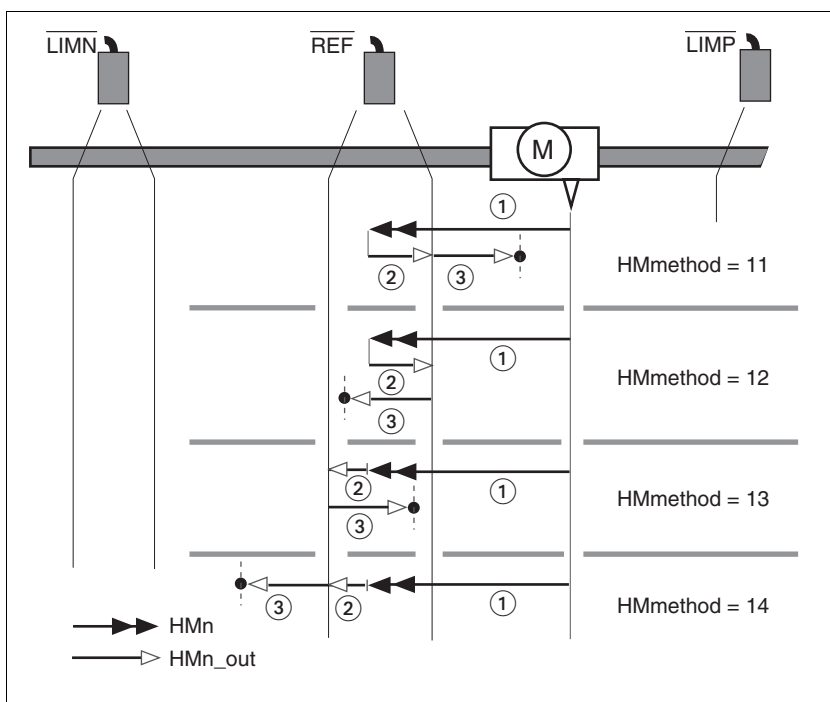


Figure 8.16 Reference movements to the reference switch

- (1) Movement to reference switch at search speed
- (2) Movement to switching edge with clearance speed
- (3) Special movement to index pulse

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

- Movement to the reference switch with first movement in the negative direction, reference switch is once before (A1, A2) and once behind the start point (B1, B2).
- Additional movements when travelling through switching window (A2, B2).

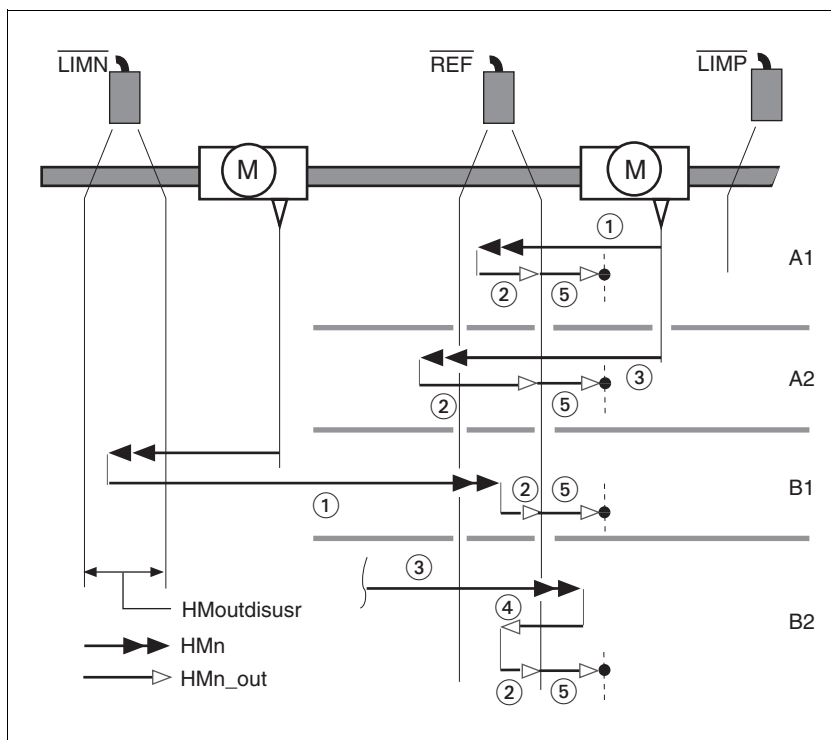


Figure 8.17 Reference movements to the reference switch

- (1) Movement to reference switch at search speed
- (2) Movement to switching edge with clearance speed
- (3) Excessively fast movement to reference switch with search speed
- (4) Return movement to switch area at clearance speed
- (5) Special movement to index pulse

Special movement to index pulse

The movement to the index pulse is shown abstractly in the above diagrams. The position of the index pulse is actually overrun at clearance speed, then the direction of rotation is inverted and the exact position of the index pulse found at search speed.

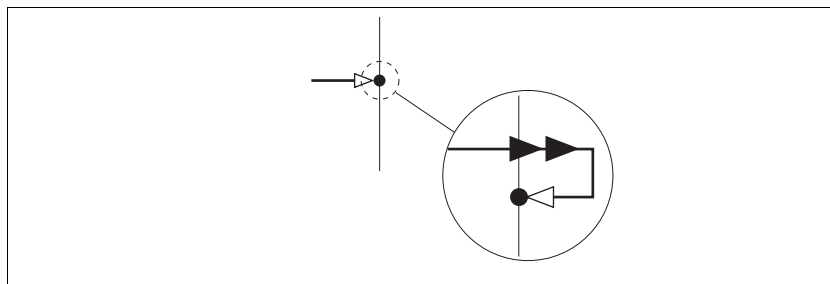


Figure 8.18 Detailed sequence of movement to index pulse

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`).

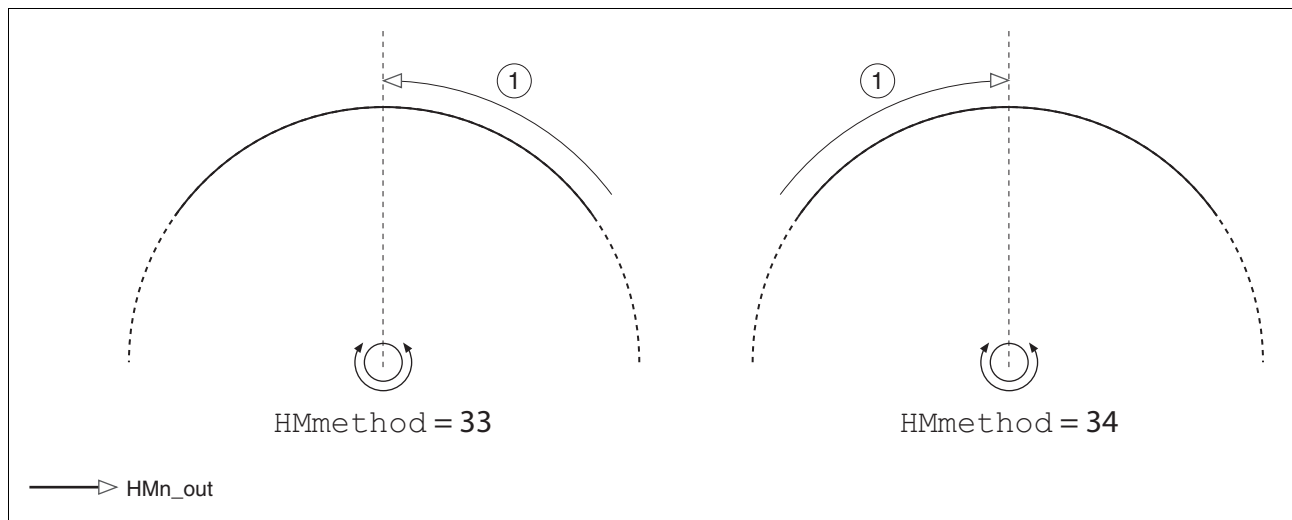


Figure 8.19 Reference movements to the index pulse

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

8.5.5.5 Homing by position setting

Description A homing by dimension setting is set via PZD2 = 35, for bit assignment see parameter `HMmethod`.

The current motor position is set at the position value in the parameter `Hmp_setpusr` by set dimensions. This also defines the zero point.

Homing by dimension setting can only be carried out when the motor is at a standstill. Any active position deviation is retained and can still be compensated by the position controller after dimension setting has taken place.

Parameter Name HMI menu	Description	Unit Minimum value Default value 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.

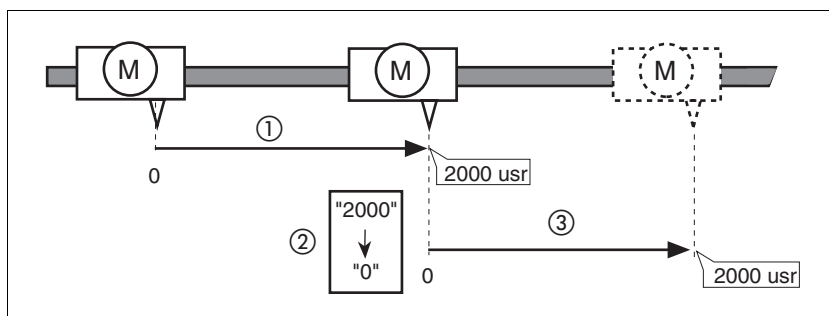


Figure 8.20 Positioning by 4000 usr units with position setting

- (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 Default value 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 motor phase current

The motor phase current (and thus the torque) can be set to between 0% and 100% of the nominal motor current `CTRLS_I_Nom`. This setting can be set individually, for motor standstill with parameter `CTRLS_I_Stand%`, for acceleration and deceleration with `CTRLS_I_Ramp%` and for constant movement with parameter `CTRLS_I_Const%` depending on system requirements.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
<code>CTRLS_I_nom</code>	Used nominal current	A_{rms}	UINT16	Modbus 5122
-	Corresponds to the lower value of <code>SM_I_nom</code> and <code>PA_I_nom</code> .	-	UINT16	Profibus 5122
-	The value is updated when a motor is selected or the motor type changed.	0.00	R/-	
-	The value corresponds to the motor current at a setting of 100% in phase current percentage for the different movement states.	-	-	
<code>CTRLS_I_Stand%</code>	Percentage of phase current at standstill	%	UINT16	Modbus 5140
SET- - iStd	100% correspond to the value in <code>CTRLS_I_nom</code>	-	UINT16	Profibus 5140
SEt - - , Std		-	R/W	
			per.	
			-	
<code>CTRLS_I_Ramp%</code>	Percentage of phase current during acceleration/deceleration	%	UINT16	Modbus 5142
SET- - irMP	100% correspond to the value in <code>CTRLS_I_nom</code>	-	UINT16	Profibus 5142
SEt - - , rMP		-	R/W	
			per.	
			-	
<code>CTRLS_I_Const%</code>	Percentage of phase current during constant movement	%	UINT16	Modbus 5144
SET- - icnS	100% correspond to the value in <code>CTRLS_I_nom</code>	-	UINT16	Profibus 5144
SEt - - , cnS		-	R/W	
			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 in movement mode

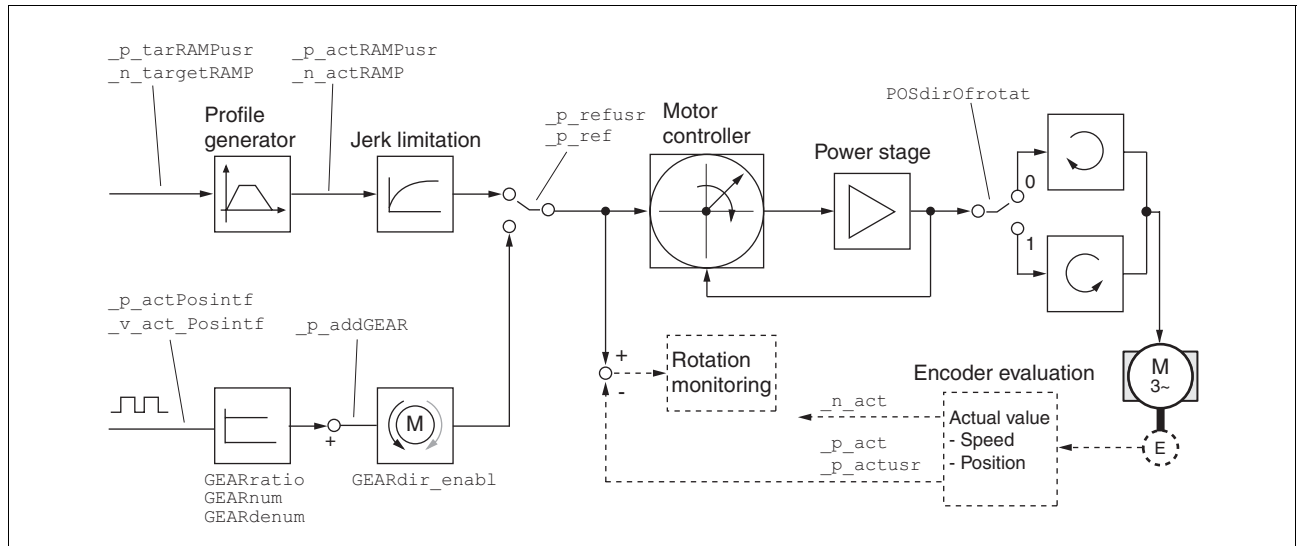


Figure 8.21 Status monitoring of the control loops

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`.

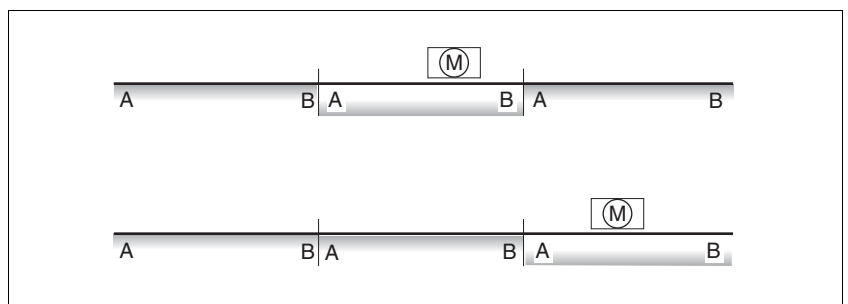


Figure 8.22 Positioning range

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 ($\text{ref_ok} = 1$). 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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPVswLimPusr	Positive position limit for software limit switch	usr	INT32	Modbus 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.	-	INT32	Profibus 1544
-		2147483647	R/W	
-		-	per.	
-		-	-	
SPVswLimNusr	Negative position limit for software limit switch	usr	INT32	Modbus 1546
-		-	INT32	Profibus 1546
-	Refer to description 'SPVswLimPusr'	-2147483648	R/W	
-		-	per.	
-		-	-	
SPV_SW_Limits	Monitoring of software limit switches	-	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 ($\text{ref_ok} = 1$).			

Limit switch

⚠ CAUTION

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 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 injury or equipment damage.

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

The enabling of the input signals $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$ and the evaluation at active 0 or active 1 can be changed with parameters IOsigLimP and IOsigLimN .



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

Parameter Name HMI menu	Description	Unit Minimum value Default value 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 Jog operating mode.

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 Default value 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
5tR- - tdev		0	R/-	
		-	-	
			-	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_Temp_act_PA	Power amplifier temperature	°C	INT16	Modbus 7200
STA- - TPA		-	INT16	Profibus 7200
5tR- - tPR		0	R/-	
		-	-	
PA_T_max	Maximum permissible power amplifier temperature	°C	INT16	Modbus 4110
-		-	INT16	Profibus 4110
-		0	R/-	
		-	per.	
PA_T_warn	Temperature warning threshold of power amplifier	°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 Default value 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 Default value 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
StR- - StGS	0: Not activated	0	R/-	
	1: Activated	-	-	
	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: Low voltage DC bus Bit 15: High voltage 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 amplifier, 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.	-	UINT16	Profibus 7190
-		0	R/-	
		-	-	

Parameter Name HMI menu	Description	Unit Minimum value Default value 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
StR- - 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 amplifier high Bit 2: Temperature of motor high Bit 3: Reserved Bit 4: Power amplifier overload (I^2t) Bit 5: Motor overload (I^2t) Bit 6: Braking resistor overload (I^2t) 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:	-	UINT16	Profibus 7176
-	0: not activated	0	R/-	
-	1: activated	-	-	
	Bit0: Error class 0 Bit1: Error class 1 Bit2: Error class 2 Bit3: Error class 3 Bit4: Error class 4 Bit5: Reserved Bit6: Drive is at standstill (Actual speed $_n_act$ [1/min] < 9) Bit7: Drive rotates clockwise Bit8: Drive rotates counter-clockwise Bit9: Reserved Bit10: Reserved Bit11: Profile generator idle (reference speed is 0) Bit12: Profile generator decelerates Bit13: Profile generator accelerates Bit14: Profile generator moves at constant speed Bit15: Reserved			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_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

Functional principle With the power amplifier active, the device continuously checks the motor phases for earth fault and short circuit. An earth fault or short circuit on one or more motor phases is detected. An earth fault of the DC bus is not detected.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus

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.

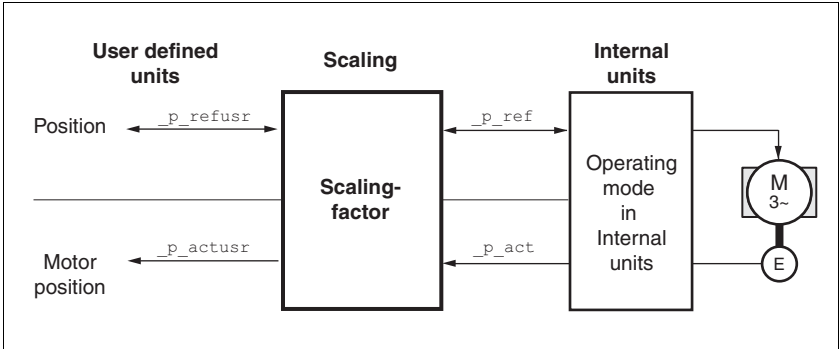


Figure 8.23 Scaling

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

Scaling factor

=

Motor revolution [rev]

Change of the user position [usr]

Figure 8.24 Calculation 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.

0198441113706, V2.00, 09.2008

Parameter Name HMI menu	Description	Unit Minimum value Default value 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	
	-----		per.	
	Change of user position [usr]		-	
	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

There are 3 cases for the setting of the user units.

- Scaling corresponds to default scaling
1 motor revolution = 16384 user-defined units
=> every 8nd 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 lower than the default scaling
1 motor revolution = 4096 user-defined units
=> every 32nd motor position can be approached.

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

If the parameters are not adjusted, this can cause problems such an error during the reference movement, because the distance to the switching edge of the limit or reference switch is no longer sufficient for safely leaving 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 8.25 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 8.26 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 8.27 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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMP_TypeSel	Selection of ramp type	-	INT16	Modbus 1574
-	0 / linear: Linear ramp	-	INT16	Profibus 1574
-	-1 / motoroptimized: Motor-optimized 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.

The start/stop speed can be set up to 60 min^{-1} depending on the external load. 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 Default value 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. It can be set for the acceleration ramp via the parameter RAMPacc and for the deceleration ramp via RAMPdecel.

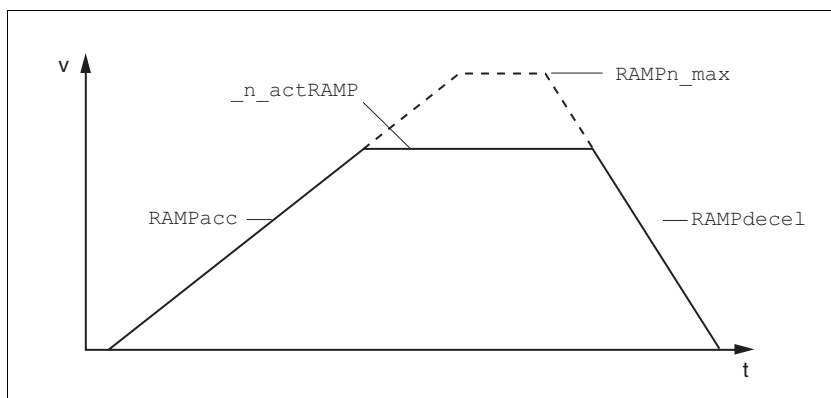


Figure 8.28 Acceleration and deceleration ramps

Parameter Name HMI menu	Description	Unit Minimum value Default value 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	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.			

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

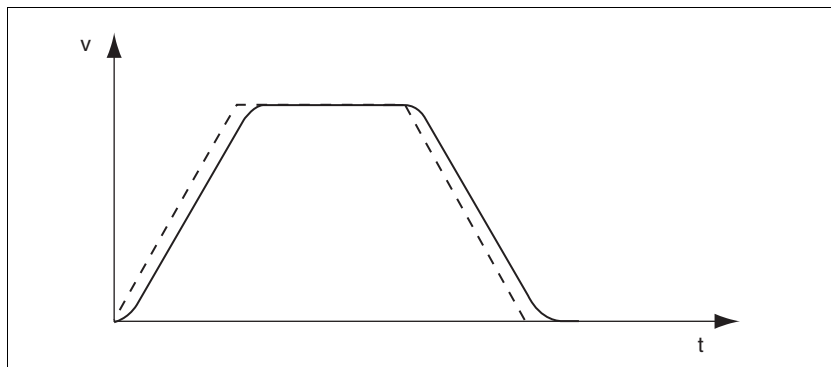


Figure 8.29 Speed curve with and without (dotted) jerk limitation

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 Default value 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 a fault 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 during "Quick Stop" frequently shuts off with "DC bus overvoltage", the maximum braking current must be reduced, the drive load reduced or an external capacitor installed.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMPquickstop	Deceleration ramp for Quick Stop	min ⁻¹ /s	UINT32	Modbus 1572
-	Deceleration of the drive when a software stop is triggered or if an error of error class 1 has occurred.	200	UINT32	Profibus 1572
-		6000	R/W	
		3000000	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 "Halt" function brakes the motor with a moment ramp. The parameter `LIM_I_maxHalt` specifies the current for the moment ramp.

After drive standstill an internal position compensation is run, the position control is enabled and the motor is stopped with the power amplifier active.

After cancellation of all "Halt" requests the interrupted movement is continued. If the `HALT` signal is cancelled during the braking procedure, the drive still runs down to standstill and only 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 Default value 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 one of the two capture inputs.. For example, this function can be used for detection of registration marks.

Settings Two 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 two possible functions for capture can be selected for each capture input:

- Position capture at rising or falling edge at the capture input, adjustable with parameters Cap1Config and Cap2Config.
- One-time or continuous position capture with multiple edges at the capture input with parameters Cap1Activate and Cap2Activate.

Continuous capture means that the motor position is captured anew at every defined edge while the former captured value is lost.

Enable fast position capture Enable single position capture

- For CAP1: Write value 1 to parameter Cap1Activate
- For CAP2: Write value 1 to parameter Cap2Activate

Enable continuous position capture

- For CAP1: Write value 2 to parameter Cap1Activate
- For CAP2: Write value 2 to parameter Cap2Activate

End position capture With single position capture the "fast position capture" function is ended when the first signal edge is detected.

With continuous position capture or no edge the capture can be stopped by writing the parameter Cap1Activate, value 0 or Cap2Activate, value 0.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Cap1Activate	Capture unit 1 start/stop	-	UINT16	Modbus 2568
-	0 / Capture stop: Cancel capture function	0	UINT16	Profibus 2568
-	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 Type".			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Cap1Config	Capture unit 1 configuration	-	UINT16	Modbus 2564
-	0 / 1->0: Position capture at 1->0 change	0	UINT16	Profibus 2564
-	1 / 0->1: Position capture at 0->1 change	0	R/W	
		1	-	
Cap1Count	Capture unit 1 event counter	-	UINT16	Modbus 2576
-	Counts the capture events.	-	UINT16	Profibus 2576
-	The counter is reset when capture unit 1 is activated.	0	R/-	
		-	-	
Cap1Pos	Capture unit 1 captured position	usr	INT32	Modbus 2572
-	Captured position at the time of the "capture signal".	-	INT32	Profibus 2572
-	The captured position is calculated again after "Position Setting" or "Homing".	0	R/-	
		-	-	
Cap2Activate	Capture unit 2 start/stop	-	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 Type".			
Cap2Config	Capture unit 2 configuration	-	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	-	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	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 Velocity window

The reference speed is considered to be reached when the speed of the drive is within the speed of rotation 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 Default value 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 Braking function

Holding brake The holding brake in the motor is used to block the motor when it is not under current (e.g. with a vertical axis). The holding brake must not be used as a service brake for braking motion.

Settable parameters A time delay for release of the holding brake (BRK_trelease) and setting the holding brake (BRK_tclose) can be configured.

Release and set brake with HMI The brake can also manually be released and set with the HMI. The power amplifier must not be switched on. Note that the axis may drop if the brake of a vertical axis (Z-axis) is released!
To release/set the brake in the HMI menu *5rU*- select the submenu *brRH*.

Delayed release When the power amplifier is activated the parameter BRK_trelease implements a delayed response of the drive against the release (opening) of the holding brake.

The setting of the parameter BRK_trelease depends on the motor type and can be found in the motor data sheet.

The stepper motor executes a short movement with activated parameter CTRLS_Toggle to ensure that the stepper motor is not at an unstable position.

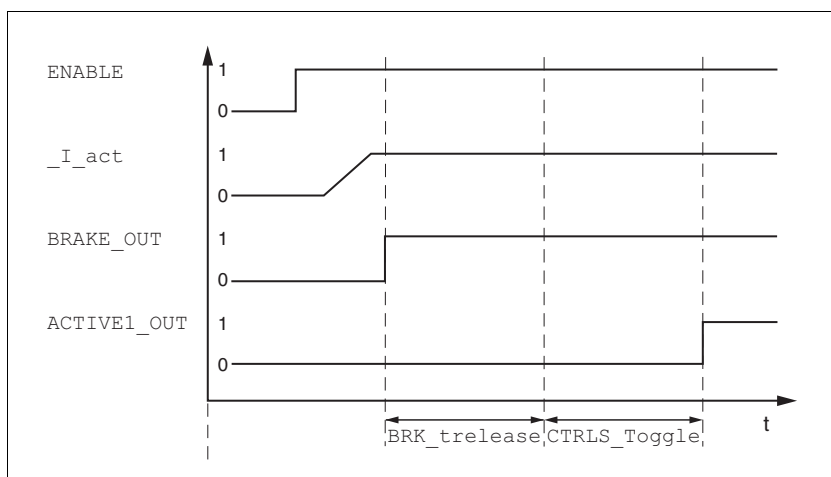


Figure 8.30 Releasing the holding brake

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_I_act STA- - iACT 5tR- - , R[t	Total motor current In 0.01Arms	A _{rms} - 0.00 -	INT16 INT16 R/- -	Modbus 7720 Profibus 7720
BRK_trelease DRC- - BTRE dr[- - btrE	Time delay during opening/releasing the holding brake	ms 0 0 1000	UINT16 UINT16 R/W per. -	Modbus 1294 Profibus 1294

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRLS_toggle	Toggle of motor when power amplifier 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 considerably. In the case of temperature-critical applications, a holding brake control with voltage reduction can be used to reduce the heat build-up, see also motor manual. The holding brake control integrated in the device has no voltage reduction.

Delayed application

The holding brake is set when the power amplifier is disabled. The motor remains under current, however, for the time set on the parameter BRK_tclos.

The setting of the parameter BRK_tclos 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.

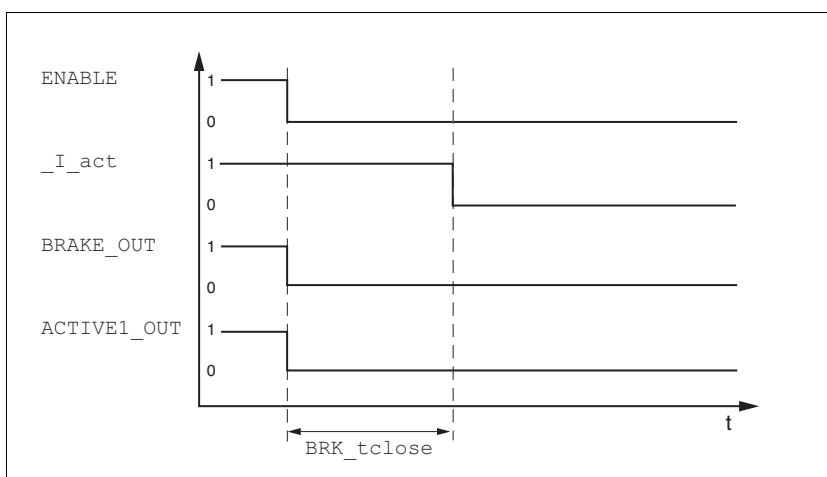


Figure 8.31 Applying the holding brake

Parameter Name HMI menu	Description	Unit Minimum value Default value 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- - , RCL		0.00	R/-	
		-	-	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
BRK_tclose	Time delay during closing of holding brake	ms	UINT16	Modbus 1296
DRC- - BTCL		0	UINT16	Profibus 1296
drL - - bLlL		100	R/W	
		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. The value of `_p_act` or `_p_actusr` changes the advance sign.

The limit switch that limits the working range with clockwise rotation must be connected to `LIMP`. The limit switch that limits the working range with counterclockwise rotation must be connected to `LIMN`.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
POSdirOfRotat	Definition of direction of rotation	-	UINT16	Modbus 1560
DRC- - PRoT	0 / clockwise / LL : Clockwise	0	UINT16	Profibus 1560
drL - - PrOt	1 / counter clockwise / LL : Counter-clockwise	0	R/W	
		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 imported unchanged.

Reversal of the direction of rotation changes the actual position `_p_actusr` sent by the device.

- The direction of rotation should therefore be set at commissioning to the state which will be required later for the 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 Restore status after "First Setup"

The parameter `PARuserReset` is used to restore the status after "First Setup". Apart from the communications parameters all parameter values are reset to the default values. The data is deleted from the memory, but not saved in the EEPROM. Particularly in fieldbus mode this enables a defined start condition without any changes made by HMI.

Parameter Name HMI menu	Description	Unit Minimum value Default value 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 Restore factory settings

The parameter `PARfactorySet` is used to restore the factory settings. All parameter values are reset to the default values.

- Remove the connection to the fieldbus in order to avoid conflicts by simultaneous access.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PARfactorySet	Restore factory settings (default values)	-	R/W	
DRC- - FCS	0 / No / no : No	0	-	
drL- - FL5	1 / Yes / YES : 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 setting via HMI* ► Set d_{rL} and then F_{L5} on the HMI and confirm your selection with y_{E5} .

All parameter values are reset to the default values. See "First Setup", page 96.

The new settings only become effective after switching off and switching on the device again.

Factory settings via commissioning software

The factory settings are set via the menu points Configuration => Factory Settings. All parameter values are reset to the default values. See "First Setup", page 96.

The new settings only become effective after switching off and switching on the device again.

8.6.11.3 Duplicating 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 should have the same settings, e.g. when devices are replaced.
 - "First setup" does not need to be carried out using the HMI.
- Prerequisites*
- Device type, motor type and device firmware must be identical. The tool is the Windows-based commissioning software. The controller supply voltage for the device must be on.
- Device settings: saving*
- The commissioning software can save the settings of a device as a configuration file.
- Save the configuration of the device in "File - Save".
- Device settings: open*
- 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 "File - Open" and load the desired configuration.

9 Examples

9.1 Wiring

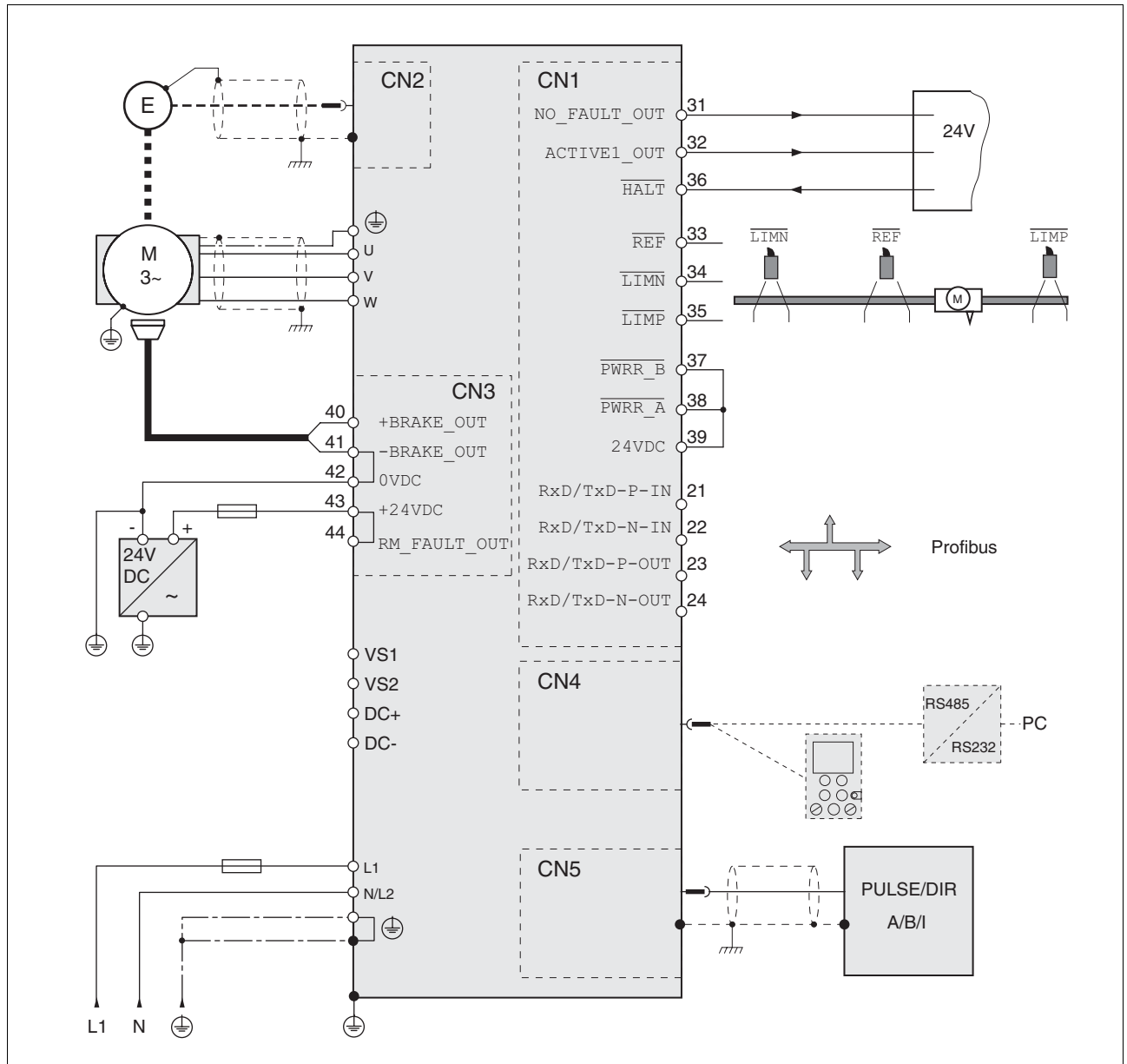


Figure 9.1 Wiring example

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

DANGER

ELECTRIC SHOCK, FIRE, 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.
- The system manufacturer is responsible for compliance with all applicable regulations pertaining to grounding the drive system.
- Many components, including the printed circuit board, operate with mains voltage. **Do not touch.** Do **not** touch unprotected parts or screws of the terminals when they are under voltage.
- Install all covers and close the housing doors before applying voltage.
- The motor generates voltage when the shaft is rotated. Lock the motor shaft to prevent rotation caused by external forces before starting work on the drive system.
- Before working on the drive system:
 - Disconnect the voltage supply to all connections.
 - Place a label "DO NOT SWITCH ON" on the switch and secure the switch against being switched on.
 - **Wait for 6 minutes** (discharge DC bus capacitors). Do **not** short-circuit DC bus!
 - Measure the voltage on DC bus and verify that it is <42V. (The DC bus LED is not a reliable indicator for the absence of DC bus voltage).

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

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 in the event of a fault. Depending upon the severity of the fault, the device responds in accordance with one of the following error classes:

Error class	Reaction	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. Error response can only be reset by switching off the device.

The occurrence of an event is signalled by the device as follows:

Event	Status	HMI-display	Entry for last interruption cause (<code>_StopFault</code>)	Entry in error memory
Halt	Operation Enabled	<code>hRLt</code>	-	-
Software-Stop	Quick Stop active	<code>StoP A306</code>	E A306	-
Hardware limit switch (e.g. <code>LIMP</code>)	Quick Stop active	<code>StoP A302</code>	E A302	E A302
Error of class 1	Quick Stop active	<code>StoP A320</code>	E A320	E A320
Error of class>1	Fault	<code>FLt A320</code>	E A320	E A320

10.3 Error display

The last cause of interruption and the last 10 error messages are stored. The HMI allows the last cause of interruption to be displayed; the commissioning software and the fieldbus allow, in addition to the last cause of interruption, the last 10 error messages can also to be displayed. A description of all the error numbers can be seen from page 186.

10.3.1 State diagram

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

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

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

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

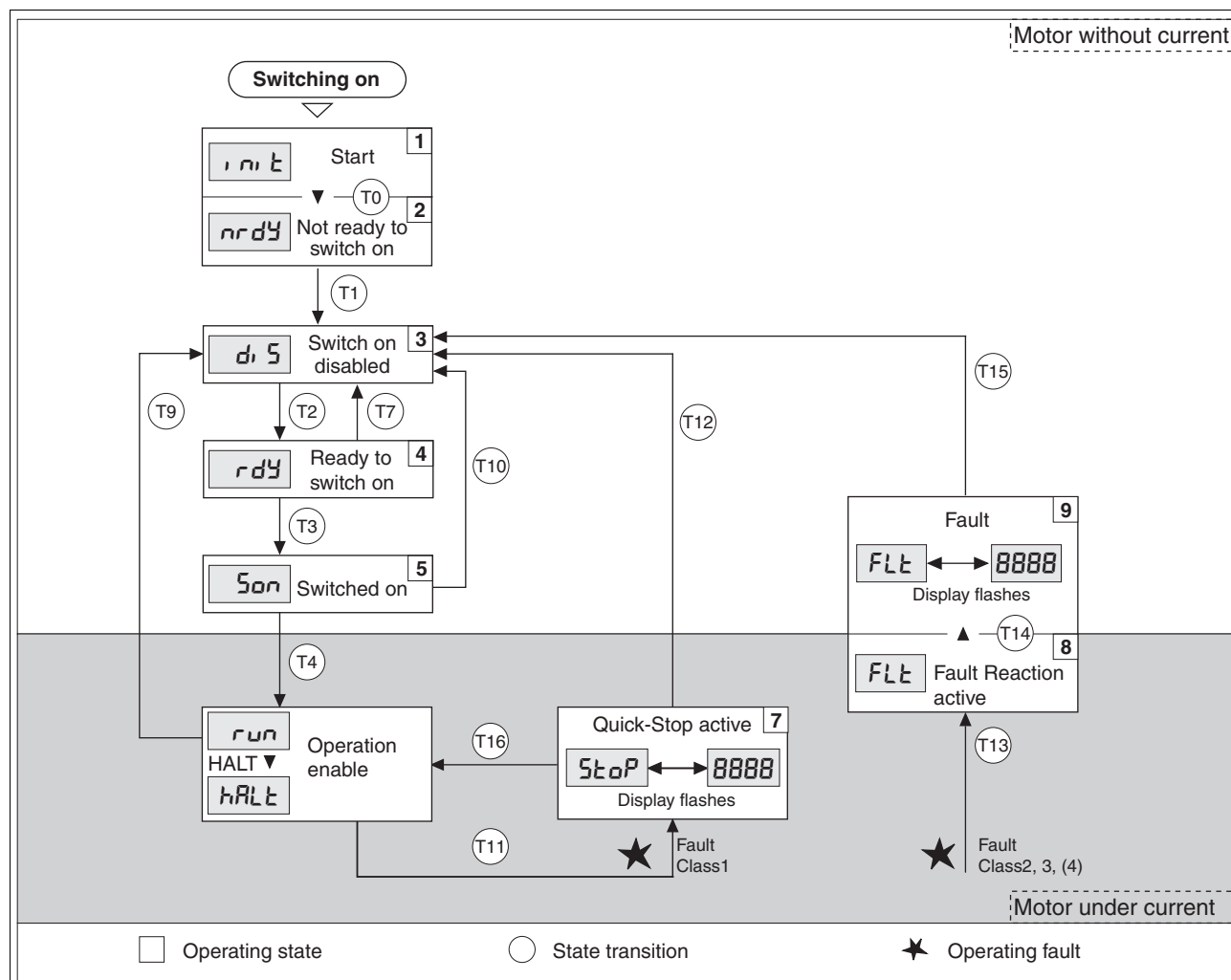


Figure 10.1 State diagram

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

Display	Status	State description
i n i t	1 Start	Controller supply voltage, electronics is initialised
n r d y	2 Not ready to switch on	The power amplifier is not ready to switch on
d i s	3 Switch on disabled	Switching on the power amplifier is locked
r d y	4 Ready to switch on	The power amplifier is ready to switch on
S o n	5 Switched on	Motor not under current Power amplifier ready No operating mode active
r u n h A L T	6 Operation enable	r u n: The device is working in the selected mode h A L T: The motor is stopped with active power amplifier
S t o P	7 Quick Stop active	"Quick Stop" is executed
F L T	8 Fault Reaction active	Error detected, error response is enabled
F L T	9 Fault	device is in fault condition

State transitions Status 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)}	Reaction
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 $\overline{\text{STO_A}} (\text{PWRR_A})$ and $\overline{\text{STO_B}} (\text{PWRR_B}) = +24\text{V}$	
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 • $\overline{\text{STO_A}} (\text{PWRR_A})$ and $\overline{\text{STO_B}} (\text{PWRR_B}) = 0\text{V}$ • Actual speed: >1000 min ⁻¹ (e.g. 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	• Errors Class 2, 3 or 4	Error response is carried out, see "Error response"
T14	8 -> 9	• Error response terminated (error from class 2) • Errors Class , 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 control mode fieldbus

10.3.2 Error display on HMI

<i>State display</i> $uL\alpha L$	<p>The display shows $uL\alpha L$ (ULOW) when initialised. The voltage of the control supply is too low .</p> <ul style="list-style-type: none"> ► Check the control supply.
<i>State display</i> $nr dY$	<p>The product persists in switch-on state $nr dY$ (NRDY).</p> <ul style="list-style-type: none"> ► After "First Setup", you need to switch the unit off and switch it on again. ► Check the installation. If the installation is correct, then there is an internal fault. To diagnose, read the error memory using the commissioning software. If you cannot resolve the fault yourself please contact your local sales partner.
<i>Status indication</i> $dI 5$	<p>If the product remains in the state $dI 5$ (DIS), there is no DC bus voltage or the STO safety function was activated.</p> <ul style="list-style-type: none"> ► Check the following: <ul style="list-style-type: none"> • Is the STO safety function enabled? • Check the installation of the signal connections. Pay particular attention to the minimum assignment, see page 6.3.12 "Connection of digital inputs/outputs (CN1)". • Is the mains supply to the power stage switched on and does the voltage correspond to the details in the technical data?
<i>Status display</i> FLt	<p>The display flashes alternately with FLt (FLT) and a 4 digit error number. The error number can also be found in the error memory list. The meaning of the error number is explained in Chapter 10.5 "Table of error numbers".</p>
<i>Status indication</i> $St\alpha P$	<p>The HMI displays $St\alpha P$ (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.</p> <ul style="list-style-type: none"> ► Remove the cause of the error and acknowledge the error.
<i>State display</i> $WDOG$	<p>The display shows $WDOG$ (WDOG) when initialised. The internal monitor has sensed a fault by means of the Watchdog.</p> <ul style="list-style-type: none"> ► Contact the Technical Support of your local sales partner. Advise the peripheral conditions (operating mode, application event) when the fault occurs: ► The error can be reset by switching the unit off and on again.
<i>Cause of the last interruption</i>	<ul style="list-style-type: none"> ► Press the ENT button on the HMI to acknowledge the current error message. ► Change to the FLt menu. The last cause of interruption (Parameter <code>_StopFault</code>) is shown as an error number, see chapter 10.5 "Table of error numbers".

10.3.3 Error display with commissioning software

- You will need a PC with the commissioning software and a functional connection to the product, see chapter 6.3.13 "Connection to PC or peripheral remote terminal (CN4)" from page 80.
- 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 an "E" in front.

Error messages are displayed showing status, error class, time when error occurred and a short description. Under "additional information" you can verify the exact conditions when the error occurred.

- Remedy the error and acknowledge the current error message with the "Reset" button in the command bar of the program.
In the case of class 4 errors, you will need to switch off the controller supply voltage and switch it on again.

10.3.4 Error display over the fieldbus

Error display via process data

Errors are displayed through the process data PZD1, `driveStat`. The display takes place by setting the error bit Bit 15 `x_err`.

If request of an operating mode sent via the transmission protocol cannot be processed, the slave rejects the process and sets `modeStat`, Bit 6 (`ModeError`) in the receive protocol. 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 the error number and the last cause of interruption. If there is no error, the value of the parameter is 0. If an error occurs, the error is written to the error memory together 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 and is maintained even if the device is switched off. The following parameters allow the error memory to be controlled:

Parameter Name HMI menu	Description	Unit Minimum value Default value 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	1. Error entry, oldest message
2	2. Error entry, later message, if present
...	...
10	10. error entry. In the case of 10 error entries the most current error value is 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 Default value 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 Default value 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 -> status 7)	-	R/-	
-	2: Error (Quick Stop -> status 8, 9)	4	-	
	3: Fatal error (status 9, can be acknowledged)	-	-	
	4: Fatal error (status 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

Problem	Cause	Correction
Motor not turning	Motor blocked by brake	Release holding brake, check wiring
Break in the motor cable	Check motor cable and connection. One or more motor phases are not connected.	
No torque	Set parameter for current setting greater than zero	
Incorrect operating mode selected	Set the input signal and parameters for the operating mode you want	
Drive system switched off	Switch on drive system, generate enable signal	
Motor mechanically blocked	Check ancillary devices	
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 on the motor and device sides
motor temperature too high	incorrect motor type set	select correct motor type; reduce maximum motor current; for motors with brake use holding brake controller with voltage reduction, see motor manual
brief motor movement with shut-down of rotation monitoring	Motor phases reversed	Check motor cable and connection: Connect motor phases U, V and W in the same way on the motor and device sides
Encoder malfunction	Check encoder cable	
Error message communication error	Drive system switched off	Switch on the drive system
Wiring error	Check wiring	
Wrong PC interface selected	Select correct interface	
Error message temperature	Poor or no air circulation, fan (only with SD32●●U68) defective, blocked or not connected, overload	Check air circulation, replace or connect fan with SD32●●U68, reduce make time for peak current, load or peak torque,

10.4.2 Error resolution sorted by error bit

To provide improved visibility when troubleshooting, all error numbers are categorized with so-called error bits. The error bits can be read using the parameter `_SigLatched`. The signal state "1" marks an error or warning message.

Error bit	Meaning	Error class	Cause	Troubleshooting
0	General error	0		
1	Limit switch (LIMP/LIMN/REF)	1	Limit switch is or was activated, wire interrupted	Traverse drive into movement range, match positioning data to axis range, special message in error memory
2	area of travel exceeded (software limit switch)	1	Motor outside area of travel	Check area of travel, re-reference the drive
3	"Quick Stop" by fieldbus	1	Fieldbus command	
4	Inputs <code>STO_A</code> (<code>PWRR_A</code>) and <code>STO_BPWRR_B</code> are "0"	3	STO safety function was triggered	Check safety guard, wiring
5	Reserved			
6	Error in fieldbus RS485, Modbus		Interruption of the fieldbus communication, only with RS485 e.g. modbus	Check communication cable, check fieldbus, check communication parameters, see also fieldbus manual
8	Reserved			
9	Reference signals faulty (frequency too high)		frequency too high, error	EMC measures, maintain maximum frequency (Technical data)
10	Error in processing of the current operating mode	2	Processing error in operating modes Electronic Gear, Homing or Jog.	Detailed information see under additional information in the error memory
11	Reserved			
12	Fault in fieldbus Profibus	0	Interruption in fieldbus communication, only with Profibus	Check communication cable, check fieldbus, check communication parameters, see also fieldbus manual
13	Reserved			
14	DC Bus undervoltage	2	DC bus voltage under threshold value for "Quick Stop"	Check or increase mains voltage
		3	DC bus voltage under threshold value for switch-off of the drive	Check for power failure
15	DC bus overvoltage	3	DC bus overvoltage, deceleration too fast	Extend the deceleration process
17	Connection to motor (motor phase interrupted, ground fault, commutation)	3	Short circuit or ground fault in the motor wiring or encoder wiring. Defective motor. External moment exceeds the motor moment (preset motor current too low).	Check connections, change motor cable or encoder cable. Change motor. Reduce external moment or increase the setting of the motor current.
18	Motor overload (phase current too high)	3	I^2t monitoring for motor	Reduce load, use a motor with a higher nominal power
20	Undervoltage controller supply voltage		Controller supply voltage has fallen below the minimum value	Check controller supply voltage. Check short-term voltage failures during load changes

Error bit	Meaning	Error class	Cause	Troubleshooting
21	Temperature too high (power stage or motor)	3	The power stage is overheating Motor overheated Temperature sensor not connected	Fan defective or blocked, switch on time for peak current, reduce load or peak torque allow motor to cool, reduce load, use motor with higher nominal power, temperature sensor faulty, check or replace motor encoder cable; for motors with brake use holding brake controller with voltage reduction, see motor manual
22	Rotation monitoring error	3	Rotation monitoring error	Reduce external load or acceleration
24	Inputs $\overline{\text{STO_A}}$ (PWRR_A) and $\overline{\text{STO_B}}$ (PWRR_B) are different	4	Interruption of the signal wiring	Signal cable/connection to be checked, check signal encoder or change
25..28	Reserved			
29	Error in EEPROM	3-4	Checksum in EEPROM incorrect	"Initial settings" to be carried out, user parameters to be stored in the EEPROM, consult your local sales partner
30	System start-up faulty (hardware or parameter fault)	3-4	Cause of error in accordance with error display	Resolution dependent upon error display
31	Internal system error (e. g. Watchdog)	4	Internal system error System error, e.g. division by 0 or time-out checks, inadequate EMC	Switch device off and on, replace device Comply with EMC protective measures, switch device off and on, contact your local service representative

10.5 Table of error numbers

The cause of error for each error message is coded as an error number and stored in the parameter `FLT_err_num`. The following table shows all the error numbers and their meaning. If "par." is shown under the error class, then the error class can be set as a parameter. Please note that in the HMI, the error number is shown without the preceding "E".

The error numbers are structured:

Error number	Error in area
E 1xxx	General errors
E 2xxx	Excess current error
E 3xxx	Voltage error
E 4xxx	Temperature error
E 5xxx	Hardware error
E 6xxx	Software error
E 7xxx	Interface error, wiring error
E Axxx	Drive error, movement error
E Bxxx	Communication errors

Information on error class can be found on page 176.

Information on error bits and measures for correcting errors can be found on page 184.

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 amplifier is active Command not allowed while the power amplifier is enabled (status "OperationEnable" or "QuickStopActive"). Disable the power amplifier 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.

Error number	Class	Bit	Description, cause and correctives
E 110B	3	30	<p>Initialization error (additional info=Modbus register address)</p> <p>Error detected at power enable parameter check e.g. reference speed value for profile position is greater than max. allowed speed of drive.</p> <p>Value in additional error info shows the Modbus register address of the parameter where the initialization error was detected.</p>
E 110C	-	-	Write access only allowed for a motor specified by the user
E 110D	1	0	<p>Basic configuration of controller required after factory setting</p> <p>The "First Setup" (FSU) was not run at all or not completed.</p>
E 110E	-	-	<p>Parameter changed that requires a restart of the drive</p> <p>Only displayed by the commissioning software.</p> <p>A parameter modification requires the drive to be switched off and on.</p> <p>Restart the drive to activate the parameter functionality.</p> <p>Check the parameter chapter for the parameter that required a restart of the drive.</p>
E 1300	3	4	<p>Safety function STO activated</p> <p>The safety function STO was activated in "Operation enable" status.</p> <p>Reset the fault; check the wiring of the STO inputs.</p>
E 1301	4	24	<p>STO_A (PWRR_A) and STO_B (PWRR_B) different level</p> <p>The levels of the inputs STO_A (PWRR_A) and STO_B (PWRR_B) were different for more than 1 second.</p> <p>The drive has to be switched off and the reason fixed (e.g.: check emergency stop active) before it is switched on.</p>
E 1310	3	9	<p>Reference signal frequency too high</p> <p>The frequency of the pulse signal (A/B, Pulse/Direction, CW/CCW) is higher than the allowed value.</p> <p>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).</p>
E 1312	-	-	<p>Limit or reference switch signal in I/O functions not defined</p> <p>Reference movements require limit switches. These limit switches are not assigned to inputs.</p> <p>Assign the LIMP, LIMN and REF functions to the inputs.</p>
E 2300	3	18	<p>Power amplifier overcurrent</p> <p>Motor short circuit and deactivation of the power amplifier.</p> <p>Check the motor power connection.</p>
E 3200	3	15	<p>DC bus overvoltage</p> <p>Excessive regeneration during braking.</p> <p>Check deceleration ramp, check dimensioning of drive and braking resistor.</p>
E 3201	3	14	<p>DC bus undervoltage (switch-off threshold)</p> <p>Power supply loss, poor power supply.</p>
E 3202	2	14	<p>DC bus undervoltage (Quick Stop threshold)</p> <p>Power supply loss, poor power supply.</p>
E 3206	0	11	<p>DC bus undervoltage, no mains phase (warning)</p> <p>Power supply loss, poor power supply.</p>

Error number	Class	Bit	Description, cause and correctives
E 4100	3	21	Power amplifier overtemperature Transistors overtemperature: ambient temperature is too high, fan is faulty, dust. Remove the protective foil, improve the heat dissipation in the cabinet.
E 4101	0	1	Warning power amplifier overtemperature Transistors overtemperature: ambient temperature is too high, fan is faulty, dust. Remove the protective foil, improve the heat dissipation in the cabinet.
E 4102	0	4	Power amplifier 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); faulty 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 amplifier data Amplifier 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 status '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, malfunction 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, malfunction of limit switch or signal disturbance. Check application. Check limit switch function and connection.
E A305	-	-	Power amplifier cannot be activated in the current operating status (status diagram) Fieldbus: trying to enable the amplifier in status "Not ready to switch on". Refer to the status 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 status "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 status 'Fault'</p> <p>Error with error class 2 or higher occurred.</p> <p>Check error code (HMI or PS2), remove error condition and clear error status with command Fault Reset.</p>
E A309	-	-	<p>Drive not in status 'Operation Enable'</p> <p>A command which requires the status "Operation enable" was sent (e.g.: opmode change).</p> <p>Set drive to status "OperationEnable" and repeat the command.</p>
E A310	-	-	<p>Power amplifier not active</p> <p>Command is not possible because the power amplifier is not enabled (status "Operation Enabled" or "Quick Stop").</p> <p>Set drive to a status with the amplifier enabled, refer to the status 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 status 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 big</p> <p>External load or acceleration are too big .</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:</p> <p>EA325</p> <p>EA326</p> <p>EA327</p> <p>EA328</p> <p>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	<p>Reference movement to REF without direction reversal, overrun of LIM or REF not permissible</p> <p>Search of REF without direction reversal and REF or LIM overtravel.</p> <p>Reduce homing speed ('HMn') or increase deceleration ('RAMPdecel').</p> <p>Check the function and wiring of LIMP, LIMN and REF switch.</p>
E A329	1	10	<p>More than one signal LIMP/LIMN/REF active</p> <p>REF or LIM not connected correctly or supply voltage for switches too low.</p> <p>Check the wiring and 24VDC supply voltage.</p>
E A32A	1	10	<p>Ext. monitoring signal LIMP with neg. direction of rotation</p> <p>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).</p> <p>Check correct connection and function of limit switch.</p> <p>Activate a jog movement with negative direction of rotation (target limit switch must be connected to the inputs LIMN).</p>
E A32B	1	10	<p>Ext. monitoring signal LIMN with pos. direction of rotation</p> <p>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).</p> <p>Check correct connection and function of limit switch.</p> <p>Activate a jog movement with positive direction of rotation (target limit switch must be connected to the inputs LIMP).</p>
E A32C	1	10	<p>REF error (switch signal briefly enabled or switch overtraveled)</p> <p>Switch signal disturbance.</p> <p>Motor subjected to vibration or shock when stopped after activation of the switch signal.</p> <p>Check supply voltage, cabling and function of switch.</p> <p>Check motor reaction after stopping and optimize controller settings.</p>
E A32D	1	10	<p>LIMP error (switch signal briefly enabled or switch overtraveled)</p> <p>Switch signal disturbance.</p> <p>Motor subjected to vibration or shock when stopped after activation of the switch signal.</p> <p>Check supply voltage, cabling and function of switch.</p> <p>Check motor reaction after stopping and optimize controller settings.</p>
E A32E	1	10	<p>LIMN error (switch signal briefly enabled or switch overtraveled)</p> <p>Switch signal disturbance.</p> <p>Motor subjected to vibration or shock when stopped after activation of the switch signal.</p> <p>Check supply voltage, cabling and function of switch.</p> <p>Check motor reaction after stopping and optimize controller settings.</p>
E A330	-	-	<p>Reference movement to index pulse cannot be reproduced. Index pulse is too close to the switch</p> <p>The position difference between the change of the switch signal and the occurrence of the index pulse is too low.</p> <p>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).</p>
E A332	1	10	<p>Jog error (additional info = detailed error number)</p> <p>Jog movement was stopped by error.</p> <p>For additional info, check the detailed error number in the error buffer.</p>

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 mode</p> <p>Reference movement started in local control type (homing not possible if 'DEVcmdinterf' is not set to fieldbus device, no limit switches). 'DEVcmdinterf' must be set to 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	-	-	No processing of motor encoder selected or fast position detection motor index pulse active
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. 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. 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. Check AK and data type of parameter.</p>
E B303	1	12	<p>Profibus: faulty processing of process data channel</p> <p>Error while processing PZD: PZD1-4 contains invalid value. Check PZD content (application).</p>

Error number	Class	Bit	Description, cause and correctives
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: faulty 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 respective 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 parameters 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

Note that the parameters are input in the fieldbus without decimal point. All decimal places must be entered.

Input examples:

Maximum value	Commissioning software	Fieldbus
2.0	2.0	20
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 Default value 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 / RbC 1: Explanation 1	3.00	per.	
	2 / Selection value2 / RbC 2: Explanation 2	300.00	-	
	Further description and details			

The most important terms in the heading line of a parameter table are explained in the following.

<i>Parameter Name</i>	The parameter name clearly identifies a parameter.
<i>HMI menu</i>	The HMI menu shows the sequence of menus and commands by which the parameter is called up via the HMI.
<i>Description</i>	<p>Brief description (cross-reference)</p> <p>The brief description contains some information on the parameter and a cross-reference to the page that describes the function of the parameter.</p> <p>Selection values</p> <p>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.</p> <p>1 = Value via fieldbus</p> <p>Selection value1 = Selection value via commissioning software</p> <p>RbC 1 = Selection value via HMI</p> <p>Further description and details</p> <p>Provides further information on the parameter.</p>
<i>Unit</i>	The unit of the value.
<i>Minimum value</i>	The minimum value which can be entered.
<i>Default value</i>	Factory setting.
<i>Maximum value</i>	The maximum value which can be entered.
<i>Data type</i>	The data type determines the valid range of values, especially if minimum and maximum values are not explicitly indicated for a parameter.

Data type	Byte	Min value	Max 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

<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. You can use the parameter address to access the parameter with the fieldbus.

11.2 List of all parameters

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_acc_pref	Acceleration of reference value generation	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 (155)	-	UINT16	Modbus 7176
-	Signal status:	-	UINT16	Profibus 7176
-	0: not activated	0	R/-	
-	1: activated	-	-	
	Bit0: Error class 0			
	Bit1: Error class 1			
	Bit2: Error class 2			
	Bit3: Error class 3			
	Bit4: Error class 4			
	Bit5: Reserved			
	Bit6: Drive is at standstill			
	(Actual speed _n_act [1/min] < 9)			
	Bit7: Drive rotates clockwise			
	Bit8: Drive rotates counter-clockwise			
	Bit9: Reserved			
	Bit10: Reserved			
	Bit11: Profile generator idle			
	(reference speed is 0)			
	Bit12: Profile generator decelerates			
	Bit13: Profile generator accelerates			
	Bit14: Profile generator moves at constant speed			
	Bit15: Reserved			
_I_act	Total motor current (168)	A _{rms}	INT16	Modbus 7720
STA- - iACT	In 0.01Arms	-	INT16	Profibus 7720
5tR- - , RCL		0.00	R/-	
		-	-	
			-	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_IO_act	Physical status of the digital inputs and outputs (105)	-	UINT16	Modbus 2050
STA- - ioAC		-	UINT16	Profibus 2050
5tR- - , oRt	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 (135)	min ⁻¹	INT16	Modbus 7696
STA- - NACT		-	INT16	Profibus 7696
5tR- - nRt		0	R/-	
		-	-	
_n_actRAMP	Actual speed of motion profile generator (135)	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 [1/min] Low word: Actual current [Arms]	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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_p_actPosintf	Actual position at position interface	Inc	INT32	Modbus 2058
-	Counted position increments at RS 422 signal interface CN5 if signal direction is defined as input (see parameter IOposInterface)	-2147483648	INT32	Profibus 2058
-		-	R/-	
-		2147483647	-	-
_p_actRAMPusr	Actual position of motion profile generator (133)	usr	INT32	Modbus 7940
-		0	INT32	Profibus 7940
-	In user units	-	R/-	
-		-	-	-
_p_actusr	Actual motor position in user units (133)	usr	INT32	Modbus 7706
STA- - PACu		-	INT32	Profibus 7706
5tR- - PRCu		0	R/-	
-		-	-	-
_p_addGEAR	Initial position electronic gear	Inc	INT32	Modbus 7942
-		-	INT32	Profibus 7942
-	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'.	0	R/-	
-		-	-	-
_p_dif	Current deviation between reference and actual position	revolution	INT32	Modbus 7716
STA- - PDiF		-214748.3648	INT32	Profibus 7716
5tR- - Pd, F	Corresponds to the current deviation between reference and actual motor position.	-	R/-	
-		214748.3647	-	-
_p_difGear	Position difference in electronic gear caused by limitation (130)	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	-	-
-		-	-	-
_p_ref	Reference position in internal units	Inc	INT32	Modbus 7698
-		-	INT32	Profibus 7698
-		0	R/-	
-		-	-	-
_p_refusr	Reference position in user units (147)	usr	INT32	Modbus 7704
-		-	INT32	Profibus 7704
-		0	R/-	
-		-	-	-
_p_tarRAMPusr	Target position of motion profile generator	usr	INT32	Modbus 7938
-		-	INT32	Profibus 7938
-	Absolute position value of the profile generator, calculated on the basis of the relative and absolute position values received.	0	R/-	
-		-	-	-
-	In user units	-	-	-

Parameter Name HMI menu	Description	Unit Minimum value Default value 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 (152)	-	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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_SigLatched	Saved status of monitoring signals (153)	-	UINT32	Modbus 7184
STA- - SiGS	Signal status:	-	UINT32	Profibus 7184
StR- - StGS	0: Not activated	0	R/-	
	1: Activated	-	-	
	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: Low voltage DC bus Bit 15: High voltage 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 amplifier, 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 (156)	-	UINT16	Modbus 7178
FLT- - STPF		-	UINT16	Profibus 7178
FLt- - StPF		0	R/-	
		-	-	
		-	-	
_Temp_act_DEV	Device temperature (151)	°C	INT16	Modbus 7204
STA- - TDEV		-	INT16	Profibus 7204
StR- - tDEU		0	R/-	
		-	-	
		-	-	
_Temp_act_PA	Power amplifier temperature (152)	°C	INT16	Modbus 7200
STA- - TPA		-	INT16	Profibus 7200
StR- - tPR		0	R/-	
		-	-	
		-	-	

Stepper motor drive

0198441113706, V2.00, 09.2008

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
AccessLock	Locking other access channels (110)	-	UINT16	Modbus 316
-	0: Release other access channels	0	UINT16	Profibus 316
-	1: Lock other access channels	-	R/W	
		1	-	
	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.			
BRK_tclos	Time delay during closing of holding	ms	UINT16	Modbus 1296
DRC- - BTCL	brake (170)	0	UINT16	Profibus 1296
drL - - btLL		100	R/W	
		1000	per.	
			-	
BRK_trelease	Time delay during opening/releasing the	ms	UINT16	Modbus 1294
DRC- - BTRE	holding brake (168)	0	UINT16	Profibus 1294
drL - - btrE		0	R/W	
		1000	per.	
			-	
Cap1Activate	Capture unit 1 start/stop (165)	-	UINT16	Modbus 2568
-	0 / Capture stop: Cancel capture function	0	UINT16	Profibus 2568
-	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 Type".			
Cap1Config	Capture unit 1 configuration (166)	-	UINT16	Modbus 2564
-	0 / 1->0: Position capture at 1->0 change	0	UINT16	Profibus 2564
-	1 / 0->1: Position capture at 0->1 change	0	R/W	
		1	-	
			-	
Cap1Count	Capture unit 1 event counter (166)	-	UINT16	Modbus 2576
-	Counts the capture events.	-	UINT16	Profibus 2576
-	The counter is reset when capture unit 1 is activated.	0	R/-	
		-	-	
			-	
Cap1Pos	Capture unit 1 captured position (166)	usr	INT32	Modbus 2572
-	Captured position at the time of the "capture signal".	-	INT32	Profibus 2572
-	The captured position is calculated again after "Position Setting" or "Homing".	0	R/-	
		-	-	
			-	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Cap2Activate	Capture unit 2 start/stop (166)	-	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 Type".			
Cap2Config	Capture unit 2 configuration (166)	-	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 (166)	-	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 (166)	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 (166)	-	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 (148)	%	UINT16	Modbus 5144
SET- - ichS		-	UINT16	Profibus 5144
5Et - - i cn5	100% correspond to the value in CTRLS_I_nom	-	R/W	
	The setting has no effect in the following operating modes (in these modes, 'CTRLS_I_Ramp%' is used): - Electronic gear		per.	-
CTRLS_I_nom	Used nominal current (148)	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 Default value 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 (148) 100% correspond to the value in CTRLS_I_nom	% - - -	UINT16 UINT16 R/W per. -	Modbus 5142 Profibus 5142
CTRLS_I_Stand% SET- - iStd 5Et- - , 5td	Percentage of phase current at standstill (148) 100% correspond to the value in CTRLS_I_nom	% - - -	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 (99) 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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRLS_toggle	Toggle of motor when power amplifier is activated (114)	-	UINT16	Modbus 5136
-		-	UINT16	Profibus 5136
-	0 / inactive: Inactive 1 / active: Active (default)	-	R/W per. -	
DEVcmdinterf	Specification of the control mode	-	R/W	
- - DEVC	0 / none / none: Undefined	0	per.	
- - dEUC	4 / ProfibusDevice / PbdP: Profibus	0 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 (182)	-	UINT16	Modbus 15364
-	0: Warning (no response)	0	UINT16	Profibus 15364
-	1: Error (Quick Stop -> status 7)	-	R/-	
-	2: Error (Quick Stop -> status 8, 9)	4	-	
	3: Fatal error (status 9, can be acknowledged)		-	
	4: Fatal error (status 9, cannot be acknowledged)			
FLT_del_err	Clear error memory (181)	-	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_err_num	Error number (181)	-	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
-	In addition, the read pointer of the error memory is automatically set to the next error entry.	-	R/-	
		65535	-	
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 (181)	-	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/-	
		-	-	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
FLT_powerOn	Number of power on cycles	-	UINT32	Modbus 15108
INF- - PoWo		0	UINT32	Profibus 15108
INF- - PoWo		-	R/-	
		4294967295	-	
		-	-	
FLT_Qual	Error additional information (182)	-	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	-	
		-	-	
FLT_Temp_DEV	Temperature of device at error time	°C	INT16	Modbus 15382
-		-	INT16	Profibus 15382
-		0	R/-	
		-	-	
		-	-	
FLT_Temp_PA	Temperature of power amplifier at error time	°C	INT16	Modbus 15380
-		-	INT16	Profibus 15380
-		0	R/-	
		-	-	
		-	-	
FLT_Time	Error time (182)	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
-		-	UINT16	Profibus 15370
-	Number of power on cycles from the time the power supply (control voltage) was switched on to the time the error occurred.	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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
GEARcontrol	Activate speed and acceleration limitations (129)	- 0	UINT16 UINT16	Modbus 9744 Profibus 9744
-	0 / off: Inactive	0	R/W	
-	1 / on: Active	1	per. -	
	<p>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 prevents the motor from stalling.</p> <p>If the limitation is activated, this causes a deviation of the calculated reference position and the internally effective reference position which is compensated for.</p> <p>The maximum deviation is limited to 400 revolutions. If this value is exceeded, the unit cancels with a fault.</p>			
GEARdenom	Denominator of gear ratio (129)	- 1	INT32 INT32	Modbus 9734 Profibus 9734
-	See description GEARnum	1	R/W	
-		2147483647	per. -	
GEARdir_enabl	Enabled movement direction of gear processing (130)	- 1	UINT16 UINT16	Modbus 9738 Profibus 9738
-	1 / positive: Pos. direction	3	R/W	
-	2 / negative: Neg. direction	3	per. -	
	3 / both: Both directions			
	This allows you to activate a return movement lock function.			
GEARnum	Numerator of gear ratio (129)	- -2147483648	INT32 INT32	Modbus 9736 Profibus 9736
-	GEARnum	1	R/W	
-	Gear ratio= ----- GEARdenom	2147483647	per. -	
	The new gear ratio is applied when the numerator value is supplied.			
GEARposChgMode	Consideration of position changes with inactive power amplifier (128)	- 0	UINT16 UINT16	Modbus 9750 Profibus 9750
-	0 / off: Position changes in states with inactive power amplifier are discarded.	0	R/W	
-	1 / on: Position changes in states with inactive power amplifier are considered.	1	per. -	
	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	UINT32 UINT32	Modbus 9748 Profibus 9748
-	This function is only available if the limitation via GEARcontrol is active.	600	R/W	
-	This value is effective both in the acceleration and the deceleration phase. The system always uses a linear ramp. The start/stop speed has no effect.	3000000	per. -	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
GEARratio	Selection of special gear ratios (128)	-	UINT16	Modbus 9740
SET- - GFAC	0 / GearFactor / FRL: Usage of gear ratio adjusted with GEARnum/GEARdenom	0	UINT16	Profibus 9740
SEt - - GFAC	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	0 0 11	R/W per. -	
	A change of the reference value by the specified value causes one motor revolution.			
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 (143)	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 (140)	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	
-	The parameter is only effective during reference movements without index pulse search.	2147483647	per. -	
HMIDispPara	HMI display when motor rotates	-	UINT16	Modbus 14852
DRC- - SuPV	0 / DeviceStatus / SLR: Device status (default)	0	UINT16	Profibus 14852
drC - - SuPU	1 / n_act / nRL: Current speed (n_act)	0	R/W	
	2 / I_act / IRL: Current motor current	2	per. -	

Parameter Name HMI menu	Description	Unit Minimum value Default value 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	Reference movement type	-	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	Reference speed for moving away from switch (138)	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	Reference speed for searching the switch (138)	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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMoutdisusr - -	Maximum run-out distance (139) 0: Run-out monitoring inactive >0: Run-out in user-defined units The switch must be disabled again during this run-out, otherwise the reference movement is aborted.	usr 0 0 2147483647	INT32 INT32 R/W per. -	Modbus 10252 Profibus 10252
HMp_homeusr - -	Position at reference point (138) 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 (139) 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 drC- - , oPi	Signal selection position interface (99) 0 / ABinput / Ab : Input ENC_A, ENC_B, ENC_I (index pulse) quadruple evaluation 1 / PDinput / 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 (138) 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 (138) 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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOsigRef	Signal evaluation REF (138)	-	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- - nFSt		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- - nSLW		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	
		-	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- - nBAd		1	R/W	
		247	per.	
			-	
MBbaud	Modbus Baud rate	-	UINT16	Modbus 5638
COM- - MBBD	9600 / 9.6KB / 95: 9600 Baud	9600	UINT16	Profibus 5638
CoM- - nBBd	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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MBdword_order COM- - MBWo COP - PBLD	Modbus word sequence for double words (32 bit values) 0 / HighLow / hL : HighWord-LowWord 1 / LowHigh / Lh : 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 COP - PBFo	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 INF - PIno	Nominal current of power amplifier Current in increments of 10mA	A _{rms} - 0.00 -	UINT16 UINT16 R/- per. -	Modbus 4118 Profibus 4118
PA_T_max - -	Maximum permissible power amplifier temperature (152)	°C - 0 -	INT16 INT16 R/- per. -	Modbus 4110 Profibus 4110
PA_T_warn - -	Temperature warning threshold of power amplifier (152)	°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

Parameter Name HMI menu	Description	Unit Minimum value Default value 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	V	UINT16	Modbus 4104
-		-	UINT16	Profibus 4104
-	Voltage in increments of 100mV	-	R/- per. -	
PA_U_minStopDC	DC bus voltage low threshold for Quick Stop	V	UINT16	Modbus 4116
-	If this threshold is reached, the drive performs a Quick Stop.	-	UINT16	Profibus 4116
-	Voltage in increments of 100mV	-	R/- per. -	
PAReepSave	Save parameter values to EEPROM	-	UINT16	Modbus 1026
-	Bit 0 = 1: Save all persistent parameters	-	UINT16	Profibus 1026
-	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.	-	R/W - -	
PARfactorySet	Restore factory settings (default values) (171)	-	R/W	
DRC- - FCS		0	-	
drL - - FL5	0 / No / na: No 1 / Yes / YE: 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.			
PARuserReset	Reset user parameters (171)	-	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!			
PBadr	Profibus address (99)	-	R/W	
COM- - PbAD	Valid addresses: 1 to 126	1	per.	
Lan - - PbRd	NOTE: Changed settings do not become active until the unit is switched on the next time	126	-	
		126		

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PBFItPpo - -	Error response to process data channel processing fault 0 / none: No error response 1 / ErrorClass1: Error class 1	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 6158 Profibus 6158
PBMapIn - -	Mapping of PZD5+6 to master Parameter number of the object that is mapped to the PPO2 during the data transfer from the drive to the master. By default, no mapping is active. Possible values: 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	- 0 0 65535	UINT32 UINT32 R/W per. -	Modbus 6150 Profibus 6150
PBMapIn2 - -	Mapping of PZD5 to master Parameter number of the object that is mapped to the PPO2 during the data transfer from the master. You can only set read values with 16 bit data length. The setting is only possible if a 16 bit value was also set for PBMapIn. By default, no mapping is active.	- 0 0 65535	UINT32 UINT32 R/W per. -	Modbus 6174 Profibus 6174
PBMapOut - -	Mapping of PZD5+6 to drive Parameter number of the object that is mapped to the PPO2 during the data transfer from the master to the drive. By default, reference acceleration is mapped. Possible values: 0: No mapping active 1556: Acceleration of profile generator 1558: Deceleration of profile generator 1538: Symmetrical ramp	- 0 0 65535	UINT32 UINT32 R/W per. -	Modbus 6148 Profibus 6148
PBPkInhibit - -	Inhibit time during read tasks in the parameter channel In the case of a static read task, the reader value is cyclically updated according to the wait time defined with this parameter. 0: No wait time >0: Wait time in ms	ms 0 1000 65535	UINT16 UINT16 R/W per. -	Modbus 6152 Profibus 6152
PBSafeState - -	Safe state 0 / NoError: No response 1 / ErrorClass2: Error of class 2, drive switches to FAULT if the power stage was active Response of the drive in state 'Clear' of the ProfibusDP master and response to termination of the watchdog.	- 0 1 1	UINT16 UINT16 R/W per. -	Modbus 6154 Profibus 6154

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
POSdirOfRotat	Definition of direction of rotation (170)	-	UINT16	Modbus 1560
DRC- - PRoT	0 / clockwise / \llcorner : Clockwise	0	UINT16	Profibus 1560
<i>dr\llcorner - Pr o t</i>	1 / counter clockwise / \llcorner : Counter-clockwise	0 1	R/W 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.			
POSScaleDenom	Denominator of position scaling (158)	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 2147483647	R/W per. -	
POSScaleNum	Numerator of position scaling (158)	revolution	INT32	Modbus 1552
-	Specification of the scaling factor:	1	INT32	Profibus 1552
-	Motor revolutions [U]	1 2147483647	R/W per. -	
	----- Change of user position [usr]			
	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 (132)	min ⁻¹	UINT16	Modbus 8970
-		1	UINT16	Profibus 8970
-	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	60 3000	R/W - -	
PPp_absusr	Target position absolute of operating mode profile position (132)	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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PPp_relpactusr - -	<p>Target position relative to current motor position (133)</p> <p>Min./max values depend on:</p> <ul style="list-style-type: none"> - Position normalization factor - Software limit switches (if they are activated) <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 (133)</p> <p>Min./max values depend on:</p> <ul style="list-style-type: none"> - Position normalization factor - Software limit switches (if they are activated) <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 (134)</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 Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMP_TAUjerk	Jerk limitation (162)	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 (160)	-	INT16	Modbus 1574
-	0 / linear: Linear ramp	-	INT16	Profibus 1574
-	-1 / motoroptimized: Motor-optimized ramp	-	R/W	
			per.	
			-	
RAMPacc	Acceleration of profile generator (161)	min ⁻¹ /s	UINT32	Modbus 1556
-		1	UINT32	Profibus 1556
-		600	R/W	
		3000000	per.	
			-	
RAMPdecel	Deceleration of profile generator (102)	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 (103)	min ⁻¹	UINT16	Modbus 1554
-		60	UINT16	Profibus 1554
-	The parameter is active in the following operating modes: - Profile position - Profile velocity - Homing - Jog	3000	R/W	
		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 easy to perform.			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMPnstart0	Start/stop speed (160)	min ⁻¹	UINT16	Modbus 1570
-	Start and end speed of profile	-	UINT16	Profibus 1570
-		-	R/W	
		-	per.	
			-	
RAMPquickstop	Deceleration ramp for Quick Stop (102)	min ⁻¹ /s	UINT32	Modbus 1572
-	Deceleration of the drive when a software stop is triggered or if an error of error class 1 has occurred.	200	UINT32	Profibus 1572
-		6000	R/W	
		3000000	per.	
			-	
RAMPsym	Symmetrical ramp	usr	UINT16	Modbus 1538
-	Acceleration and deceleration of the profile generator (16 bit value) in 10 (1/min)/s	-	UINT16	Profibus 1538
-		0	R/W	
		-	-	
	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.			
SaveHomeMethod	Default homing method (139)	-	INT16	Modbus 6968
-		1	INT16	Profibus 6968
-		18	R/W	
		35	per.	
			-	
SM_I_nom	Nominal motor current	A _{rms}	UINT16	Modbus 3596
INF - MiNo	Current in increments of 10mA	-	UINT16	Profibus 3596
INF - MiNo		-	R/W	
		-	per.	
			expert	
SM_L_UV	Motor inductance	mH	UINT16	Modbus 3600
-	Inductance terminal-terminal	-	UINT16	Profibus 3600
-		-	R/W	
		-	per.	
			expert	
SM_n_20%	Speed at which 20% of the standstill torque is still available	min ⁻¹	UINT16	Modbus 3608
-		-	UINT16	Profibus 3608
-		-	R/W	
	This value is automatically set if you select a defined motor. In this case, the value is only available as a read-only value.	-	per.	
	If you select a "user-defined" motor, you can set and change the value.		expert	
SM_n_50%	Speed at which 50% of the standstill torque is still available	min ⁻¹	UINT16	Modbus 3606
-		-	UINT16	Profibus 3606
-		-	R/W	
	This value is automatically set if you select a defined motor. In this case, the value is only available as a read-only value.	-	per.	
	If you select a "user-defined" motor, you can set and change the value.		expert	

Parameter Name HMI menu	Description	Unit Minimum value Default value 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	Modbus 3604
-		-	UINT16	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.	-	R/W per. expert	
SM_Polepair	Number of pole pairs of motor	-	UINT16	Modbus 3598
-		-	UINT16	Profibus 3598
-		-	R/W per. expert	
SM_R_UV	Motor resistance	Ω	UINT16	Modbus 3602
-	Resistance terminal-terminal	-	UINT16	Profibus 3602
-		-	R/W per. expert	
SM_Type	Motor type (98)	-	UINT32	Modbus 3588
DRC- - MTyp	0 / none / none : No motor selected (default)	-	UINT32	Profibus 3588
drc- - ntyp	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 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.	-	R/W per. -	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPV_SW_Limits	Monitoring of software limit switches (150)	-	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 (167)	min ⁻¹	UINT16	Modbus 1576
-		1	UINT16	Profibus 1576
-		30	R/W	
-		65535	per.	
			-	
SPVn_winTime	Speed window, time (167)	ms	UINT16	Modbus 1578
-	Value = 0: speed window monitoring deactivated	0	UINT16	Profibus 1578
-		0	R/W	
	Changing the value causes a restart of speed monitoring, feedback for reaching the reference speed is set to 0.	16383	per.	
			-	
SPVswLimNusr	Negative position limit for software limit switch (150)	usr	INT32	Modbus 1546
-		-	INT32	Profibus 1546
-	Refer to description 'SPVswLimPusr'	-2147483648	R/W	
		-	per.	
			-	
SPVswLimPusr	Positive position limit for software limit switch (150)	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 control 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 or pulse/direction signals to 5 devices with 24V DC power supply device to 5V DC sensor power supply	VW3M3101
Fan set 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 cable

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 RS 422: Pulse/direction and A/B

Designation	Order no.
Cable pulse/direction, ESIM, A/B, device end 10 pole connector, other end open, 0.5m	VW3M8201R05
Cable pulse/direction, ESIM, A/B, device end 10 pole connector, other end open, 1.5m	VW3M8201R15
Cable pulse/direction, ESIM, A/B, device end 10 pole connector, other end open, 3m	VW3M8201R30
Cable pulse/direction, ESIM, A/B, device end 10 pole connector, other end open, 5m	VW3M8201R50
Cable pulse/direction, ESIM, AB to Premium CFY, 10 pole connector, + 15-pin SubD, 0.5m	VW3M8204R05
Cable pulse/direction, ESIM, AB to Premium CFY, 10 pole connector, + 15-pin SubD, 1.5m	VW3M8204R15
Cable pulse/direction, ESIM, AB to Premium CFY, 10 pole connector + 15-pin SubD, 3m	VW3M8204R30
Cable pulse/direction, ESIM, AB to Premium CFY, 10 pole connector + 15-pin SubD, 5m	VW3M8204R50
Cable pulse/direction, ESIM, AB to Siemens S5 IP247, 10 pole connector, 3m	VW3M8205R30
Cable pulse/direction, ESIM, AB to Siemens S5 IP267, 10 pole connector, 3m	VW3M8206R30
Cable pulse/direction, ESIM, AB to Siemens S7 300 FM353, 10 pole connector, 3m	VW3M8207R30
Cable pulse/direction, ESIM, AB on RVA, USIC or WP/WPM311, 0.5m	VW3M8209R05
Cable pulse/direction, ESIM, AB on RVA, USIC or WP/WPM311, 1.5m	VW3M8209R15
Cable pulse/direction, ESIM, AB on RVA, USIC or WP/WPM311, 3m	VW3M8209R30
Cable pulse/direction, ESIM, AB on RVA, USIC or WP/WPM311, 5m	VW3M8209R50
Cable pulse/direction, USIC, 15 pole SubD, other end open, 0.5m	VW3M8210R05
Cable pulse/direction, USIC, 15 pole SubD, other end open, 1.5m	VW3M8210R15
Cable pulse/direction, USIC, 15 pole SubD, other end open, 3m	VW3M8210R30
Cable pulse/direction, USIC, 15 pole SubD, other end open, 5m	VW3M8210R50
Cascader cable for RVA, 0.5m	VW3M8211R05
Connector kit with 5 Molex connectors 10 pole with crimp contacts	VW3M8212

12.5 Mains filter

Designation	Order no.
Mains filter 1~; 9A; 115/230V _{ac}	VW3A31401

12.6 Installation material

Designation	Order no.
Adapter plate for DIN rail installation, width 77.5mm	VW3A11851

13 Service, maintenance and disposal

⚠ DANGER

ELECTRIC SHOCK, FIRE, 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.
- The system manufacturer is responsible for compliance with all applicable regulations pertaining to grounding the drive system.
- Many components, including the printed circuit board, operate with mains voltage. **Do not touch.** Do **not** touch unprotected parts or screws of the terminals when they are under voltage.
- Install all covers and close the housing doors before applying voltage.
- The motor generates voltage when the shaft is rotated. Lock the motor shaft to prevent rotation caused by external forces before starting work on the drive system.
- Before working on the drive system:
 - Disconnect the voltage supply to all connections.
 - Place a label "DO NOT SWITCH ON" on the switch and secure the switch against being switched on.
 - **Wait for 6 minutes** (discharge DC bus capacitors). Do **not** short-circuit DC bus!
 - Measure the voltage on DC bus and verify that it is <42V. (The DC bus LED is not a reliable indicator for the absence of DC bus voltage).

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



The product may only be repaired by a certified 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, depending on the way you use it.

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.

- 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 device is shown in the format DD.MM.YY, e.g. 31.12.07. (December 31, 2007). This means: Do not use the safety function after December 31, 2027.

13.3 Replacing units

⚠ 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.

- ▶ Store all parameter settings in your PC with the commissioning software, see chapter 8.6.11.3 "Duplicating device settings" page 172.
- ▶ 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 that you are installing was previously used in a different part of the system, the factory settings must be reset before commissioning. See chapter 8.6.11.2 "Restore factory settings" from page 171.
- ▶ Commission the product as per chapter 7 "Commissioning". Note that with the same motor setting the motor position will no longer match when the device is replaced. This also changes the position of the virtual index point. The motor position associated with the motor installation must be redefined, see parameter ENC_pabsusr.

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 specified in chapter 6 "Installation".
- ▶ Commission the product as per chapter 7 "Commissioning".

13.5 Shipping, storage, disposal

Note the ambient conditions on page 25!

<i>Shipping</i>	The product must be protected against shocks during transportation. If possible, use the original packaging for shipping.
<i>Storage</i>	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.
<i>Disposal</i>	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

This extract does not replace the product manual. The chapter provides keywords for installation and commissioning.

- Read the entire product manual before you begin.

14.1 Extract for installation

*Minimum terminal assignment with
fieldbus control mode:*

Pin	Signal	Description	I/O
36	$\overline{\text{HALT}}$	HALT function, 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

Connection of 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".

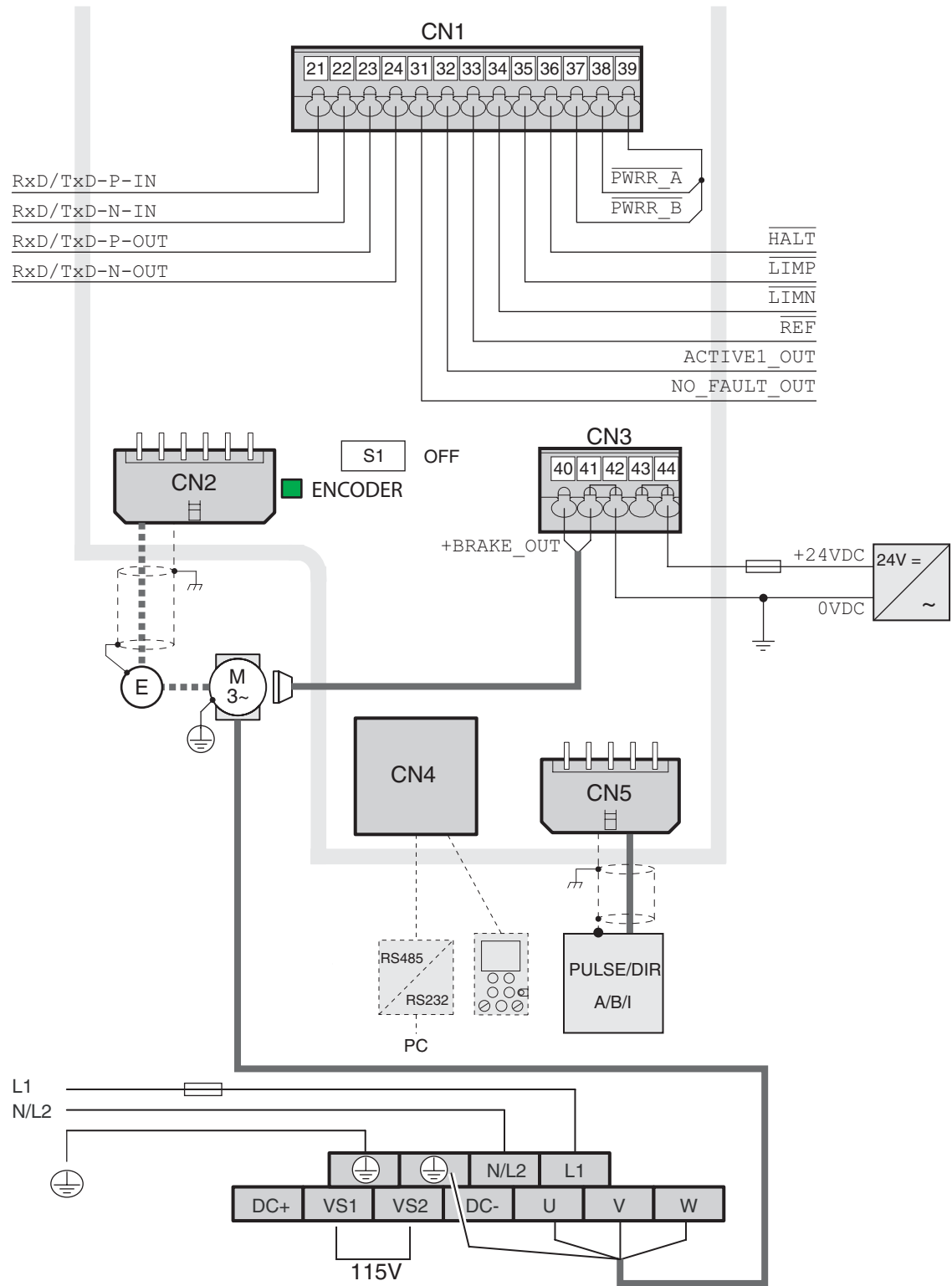



Figure 14.1 Wiring overview

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 lights up: Voltage on DC bus is live
(2)	Status indicator
(3)	LEDs for fieldbus
	<ul style="list-style-type: none">• Closing a menu or parameter• Return from displayed to last stored value
	<ul style="list-style-type: none">• Calling a menu or parameter• Save the displayed value in the EEPROM
	<ul style="list-style-type: none">• Switch to previous menu or parameter• Increase the displayed value
	<ul style="list-style-type: none">• Switch to next menu or parameter• Reduce the displayed value

14.2.1 HMI menu structure

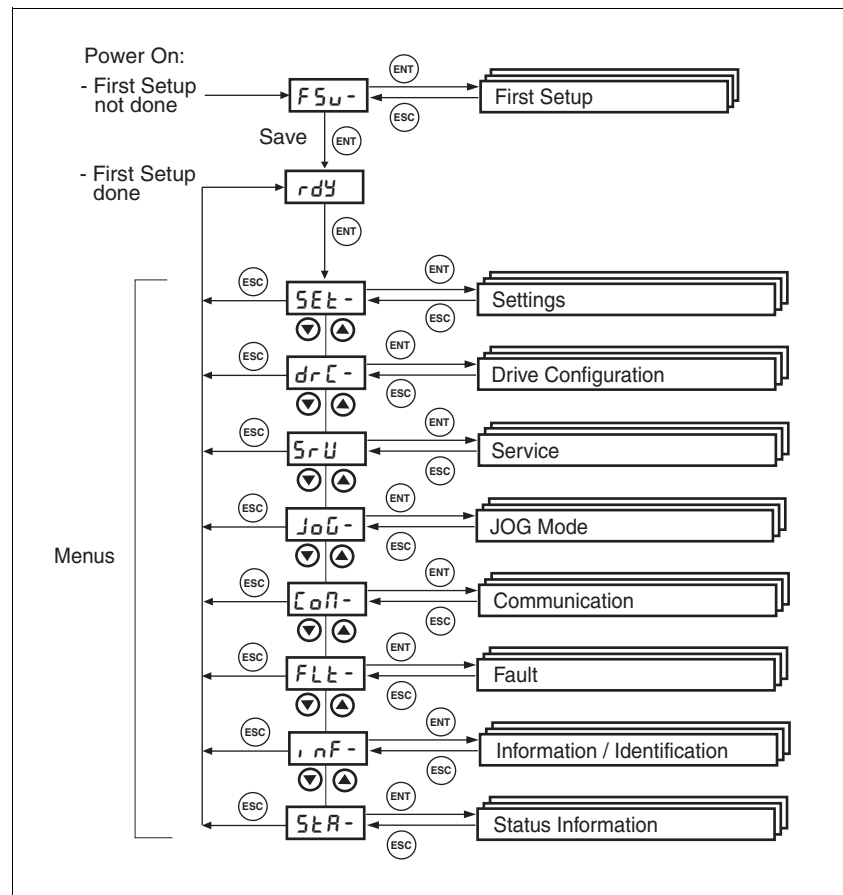
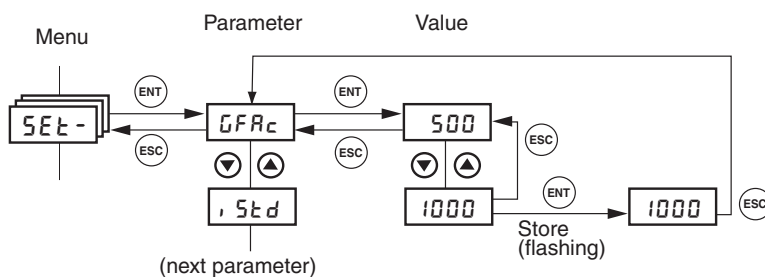


Figure 14.2 HMI menu structure

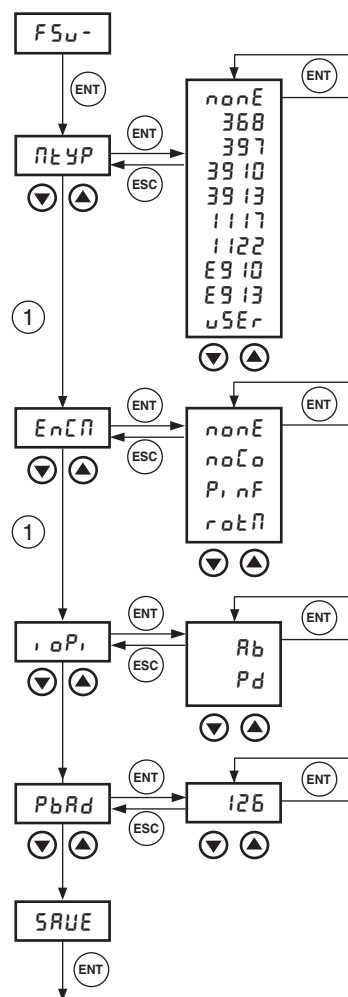
HMI, example of parameter setting



The adjacent figure shows an example for calling a parameter (second level) and the input or selection of a parameter value (third level).

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

14.2.2 "first setup" (FSU) via HMI



Restore factory setting with HMI

For "First setup" via the HMI, carry out the following steps and make selections corresponding to the application.

For more information see chapter "Commissioning".

► **nLTP**: Select connected motor type (VRDM/ExRDM3xx) (only the last 4 digits are displayed):
368, 397, 3910, 3913, 1117, 1122 or user-specific motor u5Er

► **EnLl**: Select rotation monitoring setting

noLd no rotation monitoring connected

P, nF rotation monitoring connected, position information only

rotl Rotation monitoring enabled

► **i oPi**: Select interface mode for electronic gear mode (CN5):
A/B signals (Rb) or pulse/direction signals (Pd)

► Set fieldbus address of device PbdP

Set unique fieldbus address of device (1-126)

► Save settings.

SRUE Save settings in device.

◁ The device saves all set values in the EEPROM and displays the status *ndY*, *rdY* or *di 5* on the HMI.

► Switch controller supply voltage off and on again.

Proceed as follows to restore the factory settings:

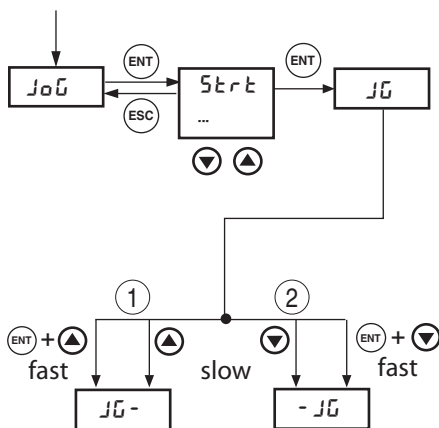
► Set *drL* and then *FL5* on the HMI and confirm your selection with *YES*.

The new settings only become effective after switching off and switching on the device again.

14.2.3 Jog

For a 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 checked 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 on motor), the initial setting of the controller parameter may result in an unstable controller



► Start the jog operating mode. (HMI: $Jog - / Start$)

◁ HMI display: Jog

► Start a movement with clockwise direction of rotation (1)
(HMI: "up arrow")

◁ The motor rotates in clockwise rotation. HMI display $Jog+$

► Start a movement with counterclockwise direction of rotation (2)
(HMI: "Down arrow")

◁ The motor rotates in counterclockwise rotation. HMI display: $-Jog$

You can change from slow to fast movement by simultaneously pushing the ENT-button.

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 *ready*?
- Did you run a "First Setup" been conducted or import device settings? Did you switched 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 tripped?

14.2.4 Duplicating device settings

<i>Application and advantage</i>	<ul style="list-style-type: none">• 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.
<i>Requirements</i>	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.
<i>Export device settings</i>	<p>The commissioning software installed on a PC can apply the settings of a device as configuration.</p> <ul style="list-style-type: none">▶ Load the configuration of the device into the commissioning software with "Action - Transfer".▶ Highlight the configuration and select "File - Export".
<i>Import device settings</i>	<p>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.</p> <ul style="list-style-type: none">▶ 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 m / 0.9144 = 5.468 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*10 ⁻³	* 0.02834952	* 28.34952
slug	/ 0.03108095	/ 1.942559*10 ⁻³	-	* 14.5939	* 14593.9
kg	/ 0.453592370	/ 0.02834952	/ 14.5939	-	* 1000
g	/ 453.592370	/ 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*10 ⁻³
dyne	/ 444822.2	/ 27801	/ 980.7	-	/ 100*10 ³
N	/ 4.448222	/ 0.27801	/ 9.807*10 ⁻³	* 100*10 ³	-

15.1.4 Power

	HP	W
HP	-	* 745.72218
W	/ 745.72218	-

15.1.5 Rotation

	min^{-1} (RPM)	rad/s	deg./s
min^{-1} (RPM)	-	$\ast \pi / 30$	$\ast 6$
rad/s	$\ast 30 / \pi$	-	$\ast 57.295$
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	$\ast 16$	$\ast 0.112985$	$\ast 0.011521$	$\ast 1.1521$	$\ast 1.129 \ast 10^6$
lb-ft	$\ast 12$	-	$\ast 192$	$\ast 1.355822$	$\ast 0.138255$	$\ast 13.8255$	$\ast 13.558 \ast 10^6$
oz-in	/ 16	/ 192	-	$\ast 7.0616 \ast 10^{-3}$	$\ast 720.07 \ast 10^{-6}$	$\ast 72.007 \ast 10^{-3}$	$\ast 70615.5$
Nm	/ 0.112985	/ 1.355822	/ 7.0616 $\ast 10^{-3}$	-	$\ast 0.101972$	$\ast 10.1972$	$\ast 10 \ast 10^6$
kp-m	/ 0.011521	/ 0.138255	/ 720.07 $\ast 10^{-6}$	/ 0.101972	-	$\ast 100$	$\ast 98.066 \ast 10^6$
kp-cm	/ 1.1521	/ 13.8255	/ 72.007 $\ast 10^{-3}$	/ 10.1972	/ 100	-	$\ast 0.9806 \ast 10^6$
dyne-cm	/ 1.129 $\ast 10^6$	/ 13.558 $\ast 10^6$	/ 70615.5	/ 10 $\ast 10^6$	/ 98.066 $\ast 10^6$	/ 0.9806 $\ast 10^6$	-

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	$\ast 16$
lb-ft ²	$\ast 144$	-	$\ast 0.04214$	$\ast 421.4$	$\ast 0.429711$	$\ast 2304$
kg-m ²	$\ast 3417.16$	/ 0.04214	-	$\ast 10 \ast 10^3$	$\ast 10.1972$	$\ast 54674$
kg-cm ²	$\ast 0.341716$	/ 421.4	/ 10 $\ast 10^3$	-	/ 980.665	$\ast 5.46$
kp-cm-s ²	$\ast 335.109$	/ 0.429711	/ 10.1972	$\ast 980.665$	-	$\ast 5361.74$
oz-in ²	/ 16	/ 2304	/ 54674	/ 5.46	/ 5361.74	-

15.1.8 Temperature

	°F	°C	K
°F	-	$(^{\circ}\text{F} - 32) \ast 5/9$	$(^{\circ}\text{F} - 32) \ast 5/9 + 273.15$
°C	$^{\circ}\text{C} \ast 9/5 + 32$	-	$^{\circ}\text{C} + 273,15$
K	$(\text{K} - 273.15) \ast 9/5 + 32$	$\text{K} - 273.15$	-

15.1.9 Conductor cross section

AWG	1	2	3	4	5	6	7	8	9	10	11	12	13
mm ²	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
mm ²	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

<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>Default value</i>	Factory setting.
<i>Direction of rotation</i>	Rotation of the motor shaft in a clockwise or counterclockwise direction of rotation. Clockwise rotation is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft.
<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>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. The motor encoder shows the angular position of the rotor.
<i>Error class</i>	Classification of errors into groups. The different error classes allow for specific responses to faults, e.g. by severity.
<i>Fatal error</i>	In the case of fatal error, the drive is not longer able to control the motor, so that an immediate switch-off of the drive is necessary.
<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 fault is cleared by removing the cause of the fault so that the fault is no longer active (transition from state "Fault" to state "Operation Enable").
<i>Holding brake</i>	The holding brake in the motor is used to block the motor when it is not under current (e.g. with a vertical axis). The holding brake must not be used as a service brake for braking motion.
<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�� terre (French), isolated ground. Opposite: Grounded mains, see TT/TN mains

<i>Limit switch</i>	Switch that signals overtravel of the permissible range of travel.
<i>Parameter</i>	Device data and values that can be set by the user.
<i>Parameter switch</i>	Small switches adjacent to each other
<i>PC</i>	Personal Computer
<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 currents 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 used to enable fast deceleration of the motor via a command or in the event of a malfunction.
<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 not used within the context of safety instructions, a warning alerts to a potential problem detected by a monitoring function. A warning is not a fault and does not cause a transition of the operating state. Warnings belong to error class 0.
<i>Watchdog</i>	Unit that monitors cyclic basic functions in the product. Power stage and outputs are switched off in the event of faults.

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