LXM32C

AC servo drive
Product manual

V1.05, 12.2010

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Schneider Electric

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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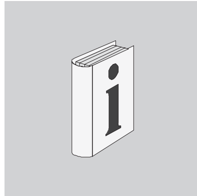
About this manual



This manual is valid for LXM32C standard products. Chapter 1 "Introduction" lists the type code for this product. The type code allows you to identify whether your product is a standard product or a customized version.

The following manuals belong to this product:

- **Product manual**, describes the technical data, installation, commissioning and the operating modes and functions.
- **Motor manual**, describes the technical characteristics of the motors, including correct installation and commissioning.

Source manuals

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

http://www.schneider-electric.com

Source EPLAN Macros

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

http://www.schneider-electric.com

Corrections and suggestions

We always try to further optimize our manuals. We welcome your suggestions and corrections.

Please get in touch with us by e-mail: techcomm@schneider-electric.com.

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.

Making work easier

Information on making work easier is highlighted by this symbol:

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

Parameters

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

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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 mm^2 (AWG 14)

Inverted signals Inverted signals are represented by an overline, for example $\overline{\text{STO\_A}}$ or $\overline{\text{STO\_B}}$.

Logic types The product supports logic type 1 and logic type 2 for digital signals. Note that most of the wiring examples show the logic type 1. The STO safety function must be wired using the logic type 1.

Glossary Explanations of special technical terms and abbreviations.

Index List of keywords with references to the corresponding page numbers.

Further reading

Recommended literature for further reading:

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

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1 Introduction

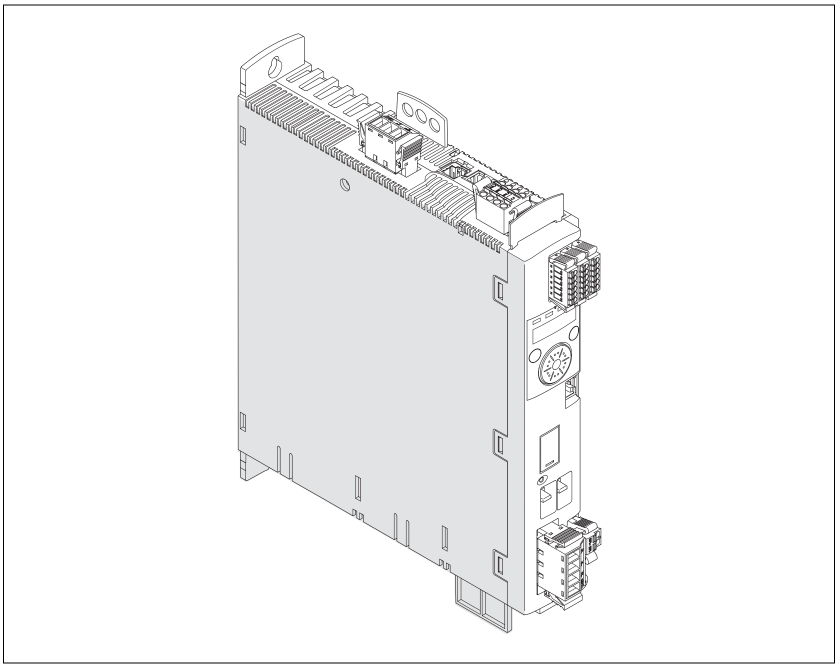
1

1.1 Device overview

The Lexium 32 product family consists of three servo drive models that cover different application areas. Together with Lexium BMH servo motors or Lexium BSH servo motors as well as a comprehensive range of options and accessories, the drives are ideally suited to implement compact, high-performance drive solutions for a wide range of power requirements.

Lexium servo drive LXM32C

This product manual describes the LXM32C servo drive.



Overview of some of the features of the LXM32C servo drive:

- Two analog inputs (+/-10V, pulse/direction) for supplying reference values
- The product is commissioned via the integrated HMI or a PC with commissioning software.
- Operating modes Jog, Electronic Gear, Profile Torque and Profile Velocity.
- A memory card slot is provided for backup and copying of parameters and fast device replacement.
- The safety function "Safe Torque Off" (STO) as per IEC 61800-5-2 is implemented on board.

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1.2 Components and interfaces

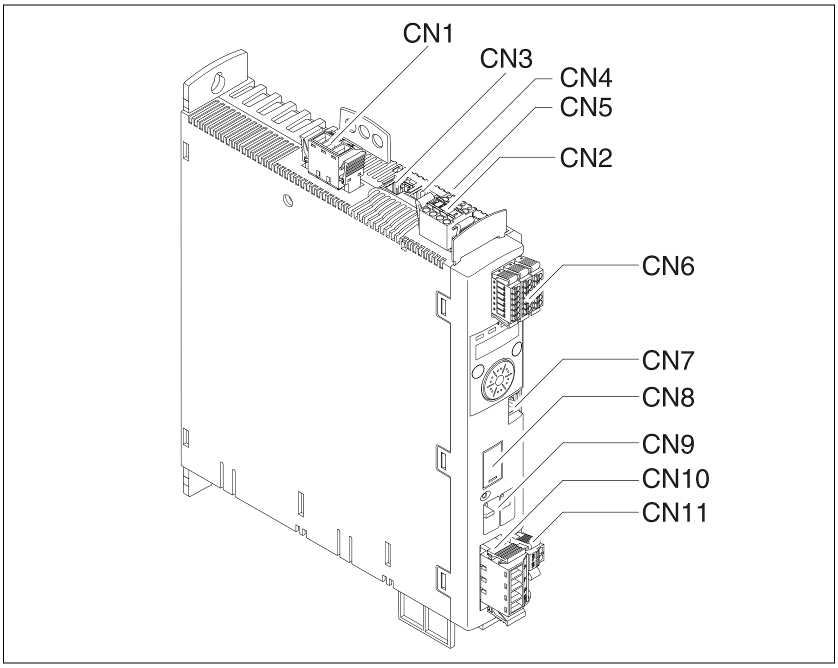

Figure 1.1 Overview of connections

(CN1) Mains connection (power stage supply)

(CN2) Connection for

- 24V controller supply voltage
- Safety function STO

(CN3) Motor encoder connection (encoder 1)

(CN4) Connection for PTO (Pulse Train Out)

- ESIM (encoder simulation)

(CN5) Connection for PTI (Pulse Train In)

- Pulse/direction
  - or -
- A/B encoder signals
  - or -
- CW/CCW pulses

(CN6) Inputs and outputs

- 2 analog reference value inputs ±10V
- 6 configurable digital inputs
- 5 configurable digital outputs

(CN7) Modbus (commissioning interface)

(CN8) Connection for external braking resistor

(CN9) DC bus connection

(CN10) Motor phases connection

(CN 11) Motor holding brake connection

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1.3 Type code

LXM 32 C D18 M2 (••••)

Product designation
LXM - Lexium

Product type
32 - AC servo drive for one axis

Interfaces
C - Compact Drive with analog inputs and Pulse Train
A - Advanced Drive with CANopen fieldbus
M - Modular Drive

Peak current
U45 - 4.5A_{rms}
U60 - 6A_{rms}
U90 - 9A_{rms}
D12 - 12A_{rms}
D18 - 18A_{rms}
D30 - 30A_{rms}
D72 - 72A_{rms}

Power stage supply [V_{ac}]
M2 - 1~, 115/200/240V_{ac}
N4 - 3~, 208/400/480V_{ac} 1)

Further options

1) 208V_{ac} (3*200V_{ac} ... 3*240V_{ac}) DOM >10.05.2010, firmware version >V01.04.00

If you have questions concerning the type code, contact your Schneider Electric sales office. Contact your machine vendor if you have questions concerning customized versions.

Customized version: Position 12 of the type code is an "S". The subsequent number defines the customized version. Example: LXM32••••S123

The device designation is shown on the nameplate.

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2 Before you begin - safety information

2

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 servo motors and intended for industrial use according to this manual.

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

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

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

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

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

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

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

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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).

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2.4 Basic information

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

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

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

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⚠ 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 $\overline{\text{ST0\_A}}$ and $\overline{\text{ST0\_B}}$ to avoid an unexpected start of the motor before switching on and configuring the product.
- Do NOT operate the product with unknown settings or data.
- Perform a comprehensive commissioning test.

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

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop, overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical functions.
- System control paths may include communication links. Consideration must be given to the implication of unanticipated transmission delays or failures of the link.
- Observe all 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 and Operation of Adjustable-Speed Drive Systems”.

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2.5 DC bus voltage measurement

Disconnect all power prior to starting work on the product.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

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

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

The DC bus voltage can exceed 800 V_{dc}. Use a properly rated voltage-sensing device for measuring. Procedure:

▶ Disconnect the voltage supply to all connections.

▶ Wait 15 minutes to allow the DC bus capacitors to discharge.

▶ Measure the DC bus voltage between the DC bus terminals to verify that the voltage is < 42 V_{dc}.

▶ If the DC bus capacitors do not discharge properly, contact your local Schneider Electric representative. Do not repair or operate the product.

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

2.6 Functional safety

Using the safety functions integrated in this product requires careful planning. See chapter 5.9 "Safety function STO ("Safe Torque Off")", page 77 for additional information.

2.7 Standards and terminology

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

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

Among others, these standards include:

- IEC 61800 series: "Adjustable speed electrical power drive systems"
- IEC 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.

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3 Technical Data

3

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

3.1 Ambient conditions

Ambient conditions transportation and storage

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

Temperature	[°C]	-25 ... 70

The following relative humidity is permissible during transportation and storage:

Relative humidity (non-condensing)	[%]	<95

Ambient conditions for operation

The maximum permissible ambient temperature during operation depends on the mounting distances between the devices and on the required power. Observe the pertinent instructions in the chapter 6 "Installation".

Ambient temperature (no icing, non-condensing)	[°C]	0 ... 50

The following relative humidity is permissible during operation:

Relative humidity (non-condensing)	[%]	5 ... 95

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The installation altitude is defined as altitude above mean sea level.

Installation altitude without derating	[m]	<1000
Installation altitude if all of the following conditions are met: • 45 °C max. ambient temperature • Reduction of the continuous power by 1% per 100 m above 1000 m	[m]	1000 ... 2000
Installation altitude above mean sea level if all of the following conditions are met: • 40 °C max. ambient temperature • Reduction of the continuous power by 1% per 100 m above 1000 m • Overvoltages of the supply mains limited to overvoltage category II as per IEC 60664-1	[m]	2000 ... 3000

Installation site and connection

For operation, the device must be mounted in a closed control cabinet. The device may only be operated with a permanently installed connection.

Pollution degree and degree of protection

Pollution degree		2
Degree of protection		IP 20

Degree of protection when the safety function is used

You must ensure that conductive substances cannot get into the product (pollution degree 2). Conductive substances may cause the safety function to become inoperative.

Vibration and shock

Vibration, sinusoidal		Tested as per IEC 60068-2-6 3.5 mm (from 2 Hz ... 8.4 Hz) 10 m/s^2 (from 8.4 Hz ... 200 Hz)
Shock, semi-sinusoidal		Tested as per IEC 60068-2-27 150 m/s^2 (for 11 ms)

3.2 Mechanical data

3.2.1 Dimensional drawings

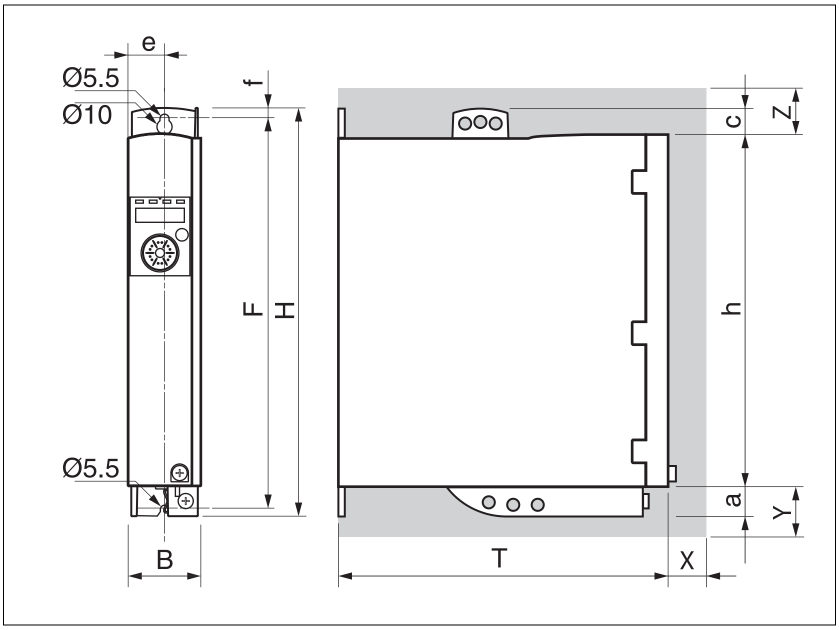

Figure 3.1 Dimensional drawing

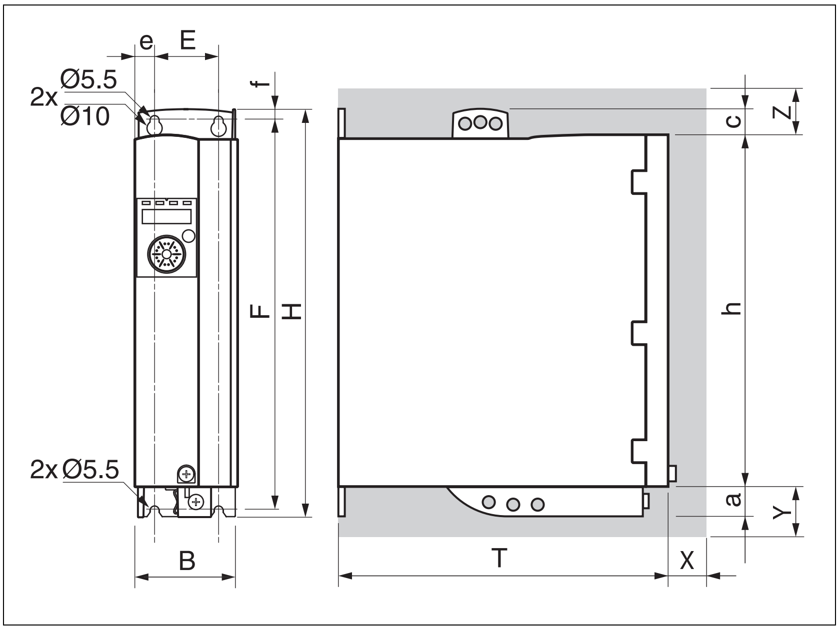

Figure 3.2 Dimensional drawing

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LXM32•...		U45•• U60•• U90••	D12•• D18•• D30M2	D30N4	D72••
Figure		Figure 3.1	Figure 3.1	Figure 3.2	Figure 3.2
B	[mm]	48 ±1	48 ±1	68 ±1	108 ±1
T	[mm]	225	225	225	225
H	[mm]	270	270	270	274
e	[mm]	24	24	13	13
E	[mm]	-	-	42	82
F	[mm]	258	258	258	258
f	[mm]	7.5	7.5	7.5	7.5
a	[mm]	20	20	20	24
h	[mm]	230	230	230	230
c	[mm]	20	20	20	20
X required free space	[mm]	60	60	60	60
Y required free space	[mm]	100	100	100	100
Z required free space	[mm]	100	100	100	100
Type of cooling		Convection [1]	Fan 40 mm	Fan 60 mm	Fan 80 mm

1) >1 m/s

The connection cables of the devices are routed to the top and to the bottom. The following distances are required in order to enable sufficient air circulation and cable installation without bends:

- At least 100 mm of free space is required above the device.
- At least 100 mm of free space is required below the device.
- At least 60 mm of free space is required in front of the device. The controls must be accessible.

Mass

LXM32•...		U45••	U60•• U90••	D12•• D18M2	D18N4 D30M2	D30N4	D72N4
Mass	kg	1.6	1.7	1.8	2.0	2.6	4.7

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3.3 Electrical Data

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

3.3.1 Power stage

Mains voltage: range and tolerance

115/230 V_{ac} single-phase	[V_{ac}]	100 -15% ... 120 +10% 200 -15% ... 240 +10%
208/400/480 V_{ac} three-phase [1)]	[V_{ac}]	200 -15% ... 240 +10% 380 -15% ... 480 +10%
Frequency	[Hz]	50 -5% ... 60 +5%

1) 208V_{ac} (3*200V_{ac} ... 3*240V_{ac}) DOM >10.05.2010, firmware version >V01.04.00

Transient overvoltages		Overvoltage category III [1)]
Rated voltage to ground	[V_{ac}]	300

1) Depends on installation altitude, see chapter 3.1 "Ambient conditions"

Type of mains (type of grounding)

TT mains, TN mains	Permitted
IT mains	Not permitted
Mains with grounded line conductor	Not permitted

Inrush current and leakage current

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

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

Harmonic currents and impedance

The harmonic currents depend on the impedance of the supply mains. This is expressed in terms of the short-circuit current of the supply mains. If the supply mains has a higher short-circuit current than indicated in the Technical Data for the device, use upstream mains reactors. See chapter 12.11 "Mains reactors" for suitable mains reactors.

Monitoring the continuous output current

The continuous output current is monitored by the device. If the continuous output current is permanently exceeded, the device reduces the output current. The continuous output current can flow if the ambient temperature is below 50°C and if the internal braking resistor does not generate heat.

Monitoring the continuous output power

The continuous output power is monitored by the device. If the continuous output power is exceeded, the device reduces the output current.

Peak output current for 1 second

The device can provide the peak output current for 1 second. If the peak output current flows when the motor is at a standstill, the higher load on a single semiconductor switch causes the current limitation to become active earlier than when the motor moves.

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PWM frequency power stage

The PWM frequency of the power stage is set to a fixed value.

PWM frequency power stage	[kHz]	8

Approved motors

The following motors can be connected to this device family: BMH, BSH. When selecting, consider the type and amount of the mains voltage and the motor inductance.

Please inquire for other motors.

Inductance of motor

The permissible minimum inductance and the maximum permissible inductance of the motor to be connected depend on the device type and the nominal mains voltage. See the tables on pages 27 to 31 for the values.

The specified minimum inductance value limits the current ripple of the peak output current. If the inductance value of the connected motor is less than the specified minimum inductance value, this may adversely affect current control and trigger motor phase current monitoring.

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3.3.1.1 Data for single-phase devices at 115V$_{ac}$

LXM32•...		U45M2•...	U90M2•...	D18M2•...	D30M2•...	
Nominal voltage	[V]	115 (1 ~)	115 (1 ~)	115 (1 ~)	115 (1 ~)	
Inrush current limitation	[A]	1.7	3.5	8	16	
Maximum fuse to be connected upstream 1)	[A]	25	25	25	25	
Short-circuit current rating (SCCR)	[kA]	5	5	5	5	
Continuous output current	[A_{rms}]	1.5	3	6	10	
Peak output current (for 1 s)	[A_{rms}]	3	6	10	15	
Minimum inductance motor (phase/ phase)	[mH]	5.5	3	1.4	0.8	
Values without mains reactor						
Nominal power 2)	[kW]	0.15	0.3	0.5	0.8	
Input current at nominal power and nominal voltage 2)	[A_{rms}]	2.9	5.4	8.5	12.9	
Total harmonic distortion THD of the input current 2)	[%]	173	159	147	135	
Power dissipation 3)	[W]	7	15	28	33	
Maximum inrush current 4)	[A]	111	161	203	231	
Time for maximum inrush current	[ms]	0.8	1.0	1.2	1.4	
Values with mains reactor						
Mains reactor	[mH]	5	2	2	2	
Nominal power	[kW]	0.2	0.4	0.8	0.8	
Input current at nominal power and nominal voltage	[A_{rms}]	2.6	5.2	9.9	9.9	
Total harmonic distortion THD of the input current	[%]	85	90	74	72	
Power dissipation 3)	[W]	8	16	32	33	
Maximum inrush current 4)	[A]	22	48	56	61	
Time for maximum inrush current	[ms]	3.3	3.1	3.5	3.7	

1) Fuses: Circuit breakers with B or C characteristic; see 3.4 "Conditions for UL 508C and CSA" for UL and CSA. Lower ratings are permissible. The fuse must be rated in such a way that the fuse does not trip at the specified input current.
2) At a mains impedance corresponding to a short-circuit current of the supply mains of 1 kA
3) Condition: internal braking resistor not active; value at nominal current, nominal voltage and nominal power; value approximately proportional with output current
4) Extreme case, off/on pulse before the inrush current limitation responds, see next line for maximum time

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3.3.1.2 Data for single-phase devices at 230V_{ac}

LXM32•...		U45M2•...	U90M2•...	D18M2•...	D30M2•...	
Nominal voltage	[V]	230 (1 ~)	230 (1 ~)	230 (1 ~)	230 (1 ~)	
Inrush current limitation	[A]	3.5	6.9	16	33	
Maximum fuse to be connected upstream 1)	[A]	25	25	25	25	
Short-circuit current rating (SCCR)	[kA]	5	5	5	5	
Continuous output current	[A_{rms}]	1.5	3	6	10	
Peak output current (for 1 s)	[A_{rms}]	4.5	9	18	30	
Minimum inductance motor (phase/ phase)	[mH]	5.5	3	1.4	0.8	
Values without mains reactor						
Nominal power 2)	[kW]	0.3	0.5	1.0	1.6	
Input current at nominal power and nominal voltage 2)	[A_{rms}]	2.9	4.5	8.4	12.7	
Total harmonic distortion THD of the input current 2)	[%]	181	166	148	135	
Power dissipation 3)	[W]	10	18	34	38	
Maximum inrush current 4)	[A]	142	197	240	270	
Time for maximum inrush current	[ms]	1.1	1.5	1.8	2.1	
Values with mains reactor						
Mains reactor	[mH]	5	2	2	2	
Nominal power	[kW]	0.5	0.9	1.6	2.2	
Input current at nominal power and nominal voltage	[A_{rms}]	3.4	6.3	10.6	14.1	
Total harmonic distortion THD of the input current	[%]	100	107	93	86	
Power dissipation 3)	[W]	11	20	38	42	
Maximum inrush current 4)	[A]	42	90	106	116	
Time for maximum inrush current	[ms]	3.5	3.2	3.6	4.0	

1) Fuses: Circuit breakers with B or C characteristic; see 3.4 "Conditions for UL 508C and CSA" for UL and CSA.
Lower ratings are permissible. The fuse must be rated in such a way that the fuse does not trip at the specified input current.
2) At a mains impedance corresponding to a short-circuit current of the supply mains of 1 kA
3) Condition: internal braking resistor not active; value at nominal current, nominal voltage and nominal power; value approximately proportional with output current
4) Extreme case, off/on pulse before the inrush current limitation responds, see next line for maximum time

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3.3.1.3 Data for three-phase devices at 208V_{ac}[1]

LXM32•...		U60N4•...	D12N4•...	D18N4•...	D30N4•...	D72N4•...
Nominal voltage	[V]	208 (3 ~)	208 (3 ~)	208 (3 ~)	208 (3 ~)	208 (3 ~)
Inrush current limitation	[A]	2.2	4.9	10	10	29
Maximum fuse to be connected upstream 1)	[A]	30/32	30/32	30/32	30/32	30/32
Short-circuit current rating (SCCR)	[kA]	5	5	5	5	
Continuous output current	[A_{rms}]	1.5	3	6	10	24
Peak output current (for 1 s)	[A_{rms}]	6	12	18	30	72
Minimum inductance motor (phase/ phase)	[mH]	8.5	4.5	3	1.7	0.7
Values without mains reactor						
Nominal power	[kW]	0.35	0.7	1.2	2.0	5
Input current at nominal power and nominal voltage	[A_{rms}]	1.8	3.6	6.2	9.8	21.9
Total harmonic distortion THD of the input current	[%]	132	136	140	128	106
Power dissipation without mains reactor 2)	[W]	13	26	48	81	204
Maximum inrush current 3)	[A]	60	180	276	341	500
Time for maximum inrush current	[ms]	0.5	0.7	0.9	1.1	1.5
Values with mains reactor						
Mains reactor	[mH]	2	2	1	1	1
Nominal power	[kW]	0.4	0.8	1.5	2.6	6.5
Input current at nominal power and nominal voltage	[A_{rms}]	1.7	3.1	6.0	9.2	21.1
Total harmonic distortion THD of the input current	[%]	97	79	78	59	34
Power dissipation 2)	[W]	13	27	51	86	218
Maximum inrush current 3)	[A]	19	55	104	126	155
Time for maximum inrush current	[ms]	1.9	2.6	2.6	3.0	3.6

1) Fuses: Circuit breakers with B or C characteristic; see 3.4 "Conditions for UL 508C and CSA" for UL and CSA.
Specification 30/32A: the maximum permissible value for UL is 30A
Lower ratings are permissible. The fuse must be rated in such a way that the fuse does not trip at the specified input current.
2) Condition: internal braking resistor not active; value at nominal current, nominal voltage and nominal power; value approximately proportional with output current
3) Extreme case, off/on pulse before the inrush current limitation responds, see next line for maximum time

1. 208V_{ac} (3*200V_{ac} ... 3*240V_{ac}) DOM >10.05.2010, firmware version >V01.04.00

3.3.1.4 Data for three-phase devices at 400V_{ac}

LXM32•...		U60N4•...	D12N4•...	D18N4•...	D30N4•...	D72N4•...
Nominal voltage	[V]	400 (3 ~)	400 (3 ~)	400 (3 ~)	400 (3 ~)	400 (3 ~)
Inrush current limitation	[A]	4.3	9.4	19	19	57
Maximum fuse to be connected upstream 1)	[A]	30/32	30/32	30/32	30/32	30/32
Short-circuit current rating (SCCR)	[kA]	5	5	5	5	
Continuous output current	[A_{rms}]	1.5	3	6	10	24
Peak output current (for 1 s)	[A_{rms}]	6	12	18	30	72
Minimum inductance motor (phase/ phase)	[mH]	8.5	4.5	3	1.7	0.7
Values without mains reactor						
Nominal power	[kW]	0.4	0.9	1.8	3.0	7
Input current at nominal power and nominal voltage	[A_{rms}]	1.4	2.9	5.2	8.3	17.3
Total harmonic distortion THD of the input current	[%]	191	177	161	148	126
Power dissipation 2)	[W]	17	37	68	115	283
Maximum inrush current 3)	[A]	90	131	201	248	359
Time for maximum inrush current	[ms]	0.5	0.7	0.9	1.1	1.4
Values with mains reactor						
Mains reactor	[mH]	2	2	1	1	1
Nominal power	[kW]	0.8	1.6	3.3	5.6	13
Input current at nominal power and nominal voltage	[A_{rms}]	1.8	3.4	6.9	11.1	22.5
Total harmonic distortion THD of the input current	[%]	108	90	90	77	45
Power dissipation 2)	[W]	19	40	74	125	308
Maximum inrush current 3)	[A]	28	36	75	87	112
Time for maximum inrush current	[ms]	1.9	2.3	2.3	2.6	3.0

1) Fuses: Circuit breakers with B or C characteristic; see 3.4 "Conditions for UL 508C and CSA" for UL and CSA. Specification 30/32A: the maximum permissible value for UL is 30A
Lower ratings are permissible. The fuse must be rated in such a way that the fuse does not trip at the specified input current.
2) Condition: internal braking resistor not active; value at nominal current, nominal voltage and nominal power; value approximately proportional with output current
3) Extreme case, off/on pulse before the inrush current limitation responds, see next line for maximum time

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3.3.1.5 Data for three-phase devices at $480V_{ac}$

LXM32•...		U60N4•...	D12N4•...	D18N4•...	D30N4•...	D72N4•...
Nominal voltage	[V]	480 (3 ~)	480 (3 ~)	480 (3 ~)	480 (3 ~)	480 (3 ~)
Inrush current limitation	[A]	5.1	11.3	23	23	68
Maximum fuse to be connected upstream 1)	[A]	30/32	30/32	30/32	30/32	30/32
Short-circuit current rating (SCCR)	[kA]	5	5	5	5	
Continuous output current	[A_{rms}]	1.5	3	6	10	24
Peak output current (for 1 s)	[A_{rms}]	6	12	18	30	72
Minimum inductance motor (phase/ phase)	[mH]	8.5	4.5	3	1.7	0.7
Values without mains reactor						
Nominal power	[kW]	0.4	0.9	1.8	3.0	7
Input current at nominal power and nominal voltage	[A_{rms}]	1.2	2.4	4.5	7.0	14.6
Total harmonic distortion THD of the input current	[%]	201	182	165	152	129
Power dissipation 2)	[W]	20	42	76	129	315
Maximum inrush current 3)	[A]	129	188	286	350	504
Time for maximum inrush current	[ms]	0.6	0.7	1.0	1.2	1.6
Values with mains reactor						
Mains reactor	[mH]	2	2	1	1	1
Nominal power	[kW]	0.8	1.6	3.3	5.6	13
Input current at nominal power and nominal voltage	[A_{rms}]	1.6	2.9	6.0	9.6	19.5
Total harmonic distortion THD of the input current	[%]	116	98	98	85	55
Power dissipation 2)	[W]	21	44	82	137	341
Maximum inrush current 3)	[A]	43	57	116	137	177
Time for maximum inrush current	[ms]	1.9	2.4	2.4	2.7	3.2

1) Fuses: Circuit breakers with B or C characteristic; see 3.4 "Conditions for UL 508C and CSA" for UL and CSA. Specification 30/32A: the maximum permissible value for UL is 30A
Lower ratings are permissible. The fuse must be rated in such a way that the fuse does not trip at the specified input current.
2) Condition: internal braking resistor not active; value at nominal current, nominal voltage and nominal power; value approximately proportional with output current
3) Extreme case, off/on pulse before the inrush current limitation responds, see next line for maximum time

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3.3.1.6 Peak output currents

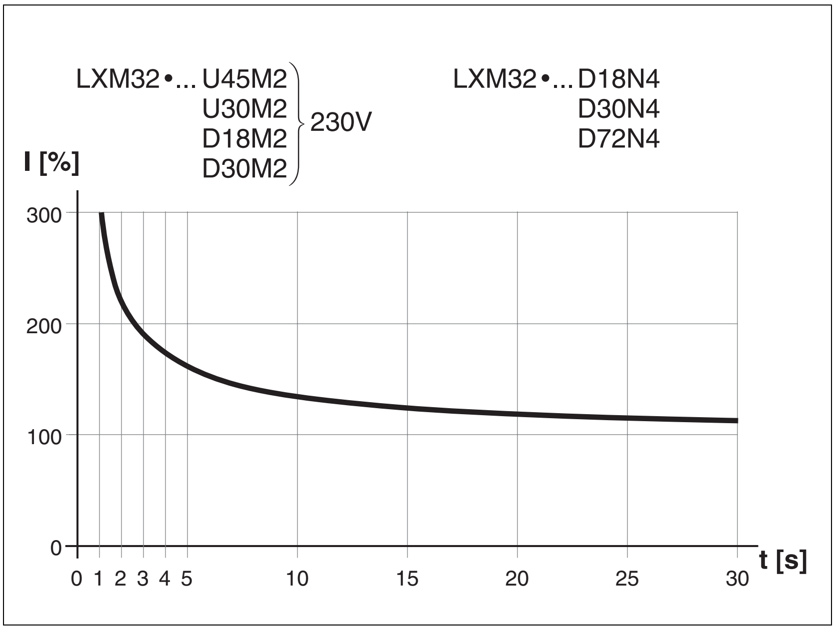

Figure 3.3 Peak output current over time (with reference to the continuous output current)

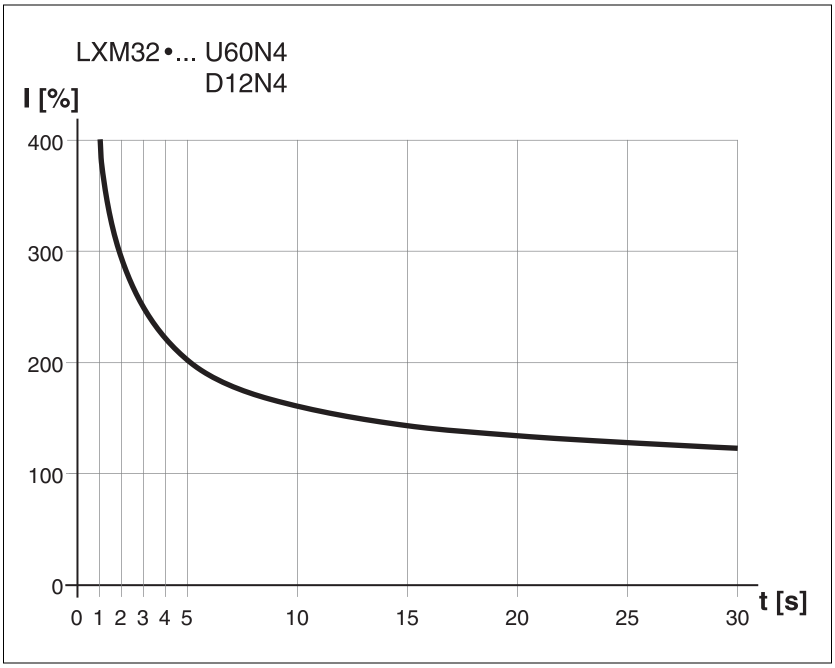

Figure 3.4 Peak output current over time (with reference to the continuous output current)

3.3.1.7 DC bus data for single-phase devices

LXM32•... (1 ~)		U45M2		U90M2		D18M2		D30M2			
Nominal voltage (1 ~)	[V]	115	230	115	230	115	230	115	230		
Nominal voltage DC bus	[V]	163	325	163	325	163	325	163	325		
Undervoltage limit	[V]	55	130	55	130	55	130	55	130		
Voltage limit: activation of Quick Stop	[V]	60	140	60	140	60	140	60	140		
Overvoltage limit	[V]	450	450	450	450	450	450	450	450		
Maximum continuous power via DC bus	[kW]	0.2	0.5	0.4	0.9	0.8	1.6	0.8	2.2		
Maximum continuous current via DC bus	[A]	1.5	1.5	3.2	3.2	6.0	6.0	10.0	10.0		

3.3.1.8 DC bus data for three-phase devices

LXM32•... (3 ~)		U60N4	D12N4	D18N4	D30N4	D72N4
Nominal voltage (3 ~) [1]	[V]	208	208	208	208	208
Nominal voltage DC bus	[V]	294	294	294	294	294
Undervoltage limit	[V]	150	150	150	150	150
Voltage limit: activation of Quick Stop	[V]	160	160	160	160	160
Overvoltage limit	[V]	820	820	820	820	820
Maximum continuous power via DC bus	[kW]	0.4	0.8	1.7	2.8	6.5
Maximum continuous current via DC bus	[A]	1.5	3.2	6.0	10.0	22.0

1) 208V_{ac} (3*200V_{ac} ... 3*240V_{ac}) DOM >10.05.2010, firmware version >V01.04.00

LXM32•... (3 ~)		U60N4		D12N4		D18N4		D30N4		D72N4	
Nominal voltage (3 ~)	[V]	400	480	400	480	400	480	400	480	400	480
Nominal voltage DC bus	[V]	566	679	566	679	566	679	566	679	566	679
Undervoltage limit	[V]	350	350	350	350	350	350	350	350	350	350
Voltage limit: activation of Quick Stop	[V]	360	360	360	360	360	360	360	360	360	360
Overvoltage limit	[V]	820	820	820	820	820	820	820	820	820	820
Maximum continuous power via DC bus	[kW]	0.8	0.8	1.6	1.6	3.3	3.3	5.6	5.6	13.0	13.0
Maximum continuous current via DC bus	[A]	1.5	1.5	3.2	3.2	6.0	6.0	10.0	10.0	22.0	22.0

3.3.2 Controller supply voltage 24V

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

Input voltage	[V_{dc}]	24 V -15% / +20% [1)]
Input current (without load)	[A]	≤1 [2)]
Residual ripple		<5%
Inrush current		Charging current for capacitor C= 1.8 mF

1) For connection of motors without holding brake; see figure below for motors with holding brake.
2) Input current: holding brake not considered.

If a motor with holding brake is connected, the 24 V_{dc} controller supply voltage must be adjusted according to the connected motor and the motor cable length. Refer to the figure below for the voltage that must be available at CN2 for releasing the holding brake. The voltage tolerance is ±5%.

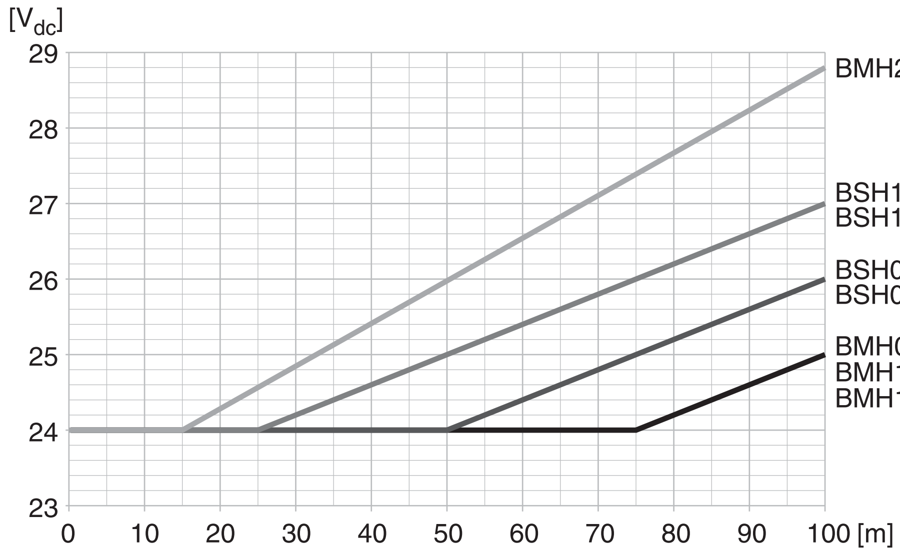

Figure 3.5 The controller supply voltage depends on the motor and the motor cable length.

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3.3.3 Signals

The digital inputs and outputs of this product can be wired for logic type 1 or logic type 2.

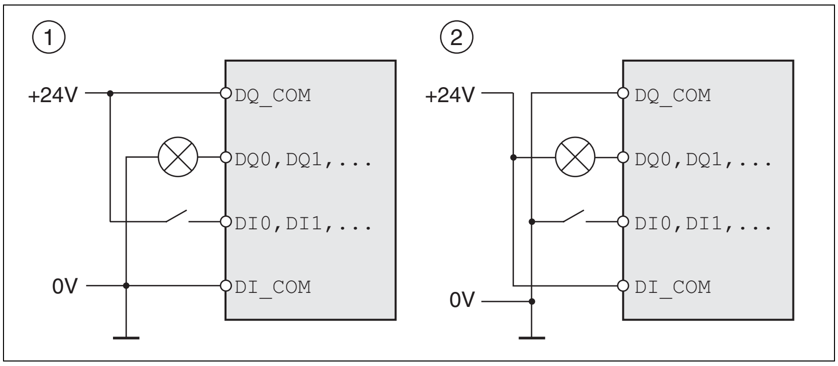

Figure 3.6 Logic type

Logic type	Active state
(1) Logic type 1	Output supplies current (Source) Current flows to the input
(2) Logic type 2	Output draws current (Sink) Current flows from the input

Signal inputs are protected against reverse polarity, outputs are short-circuit protected. The inputs and outputs are galvanically isolated.

Analog input signals

Voltage range of differential input circuit	[V]	-10 ... +10
Input resistance, typical	[kΩ]	20
Resolution	[Bit]	14
Sampling period	[ms]	0.25

Digital input signals 24 V

When wired as logic type 1, the levels of the opto-isolated inputs DI• comply with IEC 61131-2, type 1.

Level 0 with logic type 1 (U_{low})	[V_{dc}]	-3 ... +5
Level 1 with logic type 1 (U_{high})	[V_{dc}]	+15 ... +30
Input current (typical)	[mA]	5
Debounce time 1)	[ms]	1.5

1) Adjustable via parameter (sampling period 250µs)

Capture input signals 24 V

When wired as "logic type 1", the levels of the opto-isolated inputs Cap• comply with IEC 61131-2, type 1.

Level 0 with logic type 1 (U_{low})	[V_{dc}]	-3 ... +5
Level 1 with logic type 1 (U_{high})	[V_{dc}]	+15 ... +30
Input current (typical)	[mA]	5
Debounce time CAP1 and CAP2	[µs]	2
Jitter CAP1 and CAP2	[µs]	<2

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Input signals safety function STO

Level 0 with logic type 1 (U_{low})	[V_{dc}]	-3 ... +5
Level 1 with logic type 1 (U_{high})	[V_{dc}]	+15 ... +30
Input current (typical)	[mA]	5
Debounce time $\overline{\text{STO\_A}}$ and $\overline{\text{STO\_B}}$	[ms]	>1
Detection of signal differences between $\overline{\text{STO\_A}}$ and $\overline{\text{STO\_B}}$	[s]	>1
Response time of safety function STO	[ms]	≤10

24 V output signals

The levels of the digital 24 V output signals DQ• comply with IEC 61131-2.

Output voltage	[V]	≤30
Maximum switching current	[mA]	≤100
Voltage drop at 100 mA load	[V]	≤3

Encoder signals

The encoder signals comply with the Stegmann Hiperface specification.

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

The output voltage is short-circuit protected and overload protected. The transmission protocol is half duplex as per RS 485.

0198441113761, V1.05, 12.2010

3.3.3.1 Output PTO (CN4)

5 V signals are available at the PTO (Pulse Train Out, CN4) output. Depending on parameter `PTO_mode`, these signals are ESIM signals (encoder simulation) or directly transmitted PTI input signals (P/D signals, A/B signals, CW/CCW signals). The PTO output signals can be used as PTI input signals for another device. The PTO output signals have 5 V, even if the PTI input signal is a 24 V signal.

The signal level corresponds to RS422. Due to the input current of the optocoupler in the input circuit, a parallel connection of a driver output to several devices is not permitted.

The basic resolution of the encoder simulation at quadruple resolution is 4096 increments per revolution in the case of rotary motors.

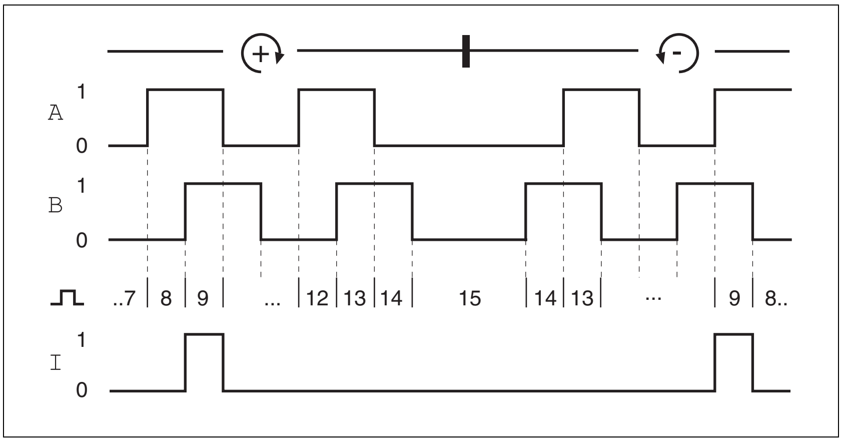

Figure 3.7 Time chart with A, B and index pulse signal, counting forwards and backwards

Output signal PTO

The PTO output signals comply with the RS422 interface specification.

Logic level		As per RS422 1)
Output frequency per signal	[kHz]	≤500
Motor increments per second	[Inc/s]	$\leq 1.6 * 10^6$

1) Due to the input current of the optocoupler in the input circuit, a parallel connection of a driver output to several devices is not permitted.

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3.3.3.2 Input PTI (CN5)

⚠ WARNING

UNEXPECTED MOVEMENT

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

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

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

5 V signals or 24 V signals can be connected to the PTI (Pulse Train In) input.

Signals can be connected:

- A/B signals (ENC_A/ENC_B)
- P/D signals (PULSE/DIR)
- CW/CCW signals (CW/CCW)

See also chapter 6.2.11 "Connection PTI (CN5, Pulse Train In)", page 115.

Signal input circuits PTI

The way the inputs are wired affects the maximum permissible input frequency and the maximum permissible line length:

Input circuit	**Maximum input frequency**	**Maximum line length**
RS422, see Figure 3.8 left	1 MHz	100 m
Push pull, see Figure 3.8 center	0.2 MHz	10 m
Open collector, see Figure 3.8 right	0.01 MHz	1 m

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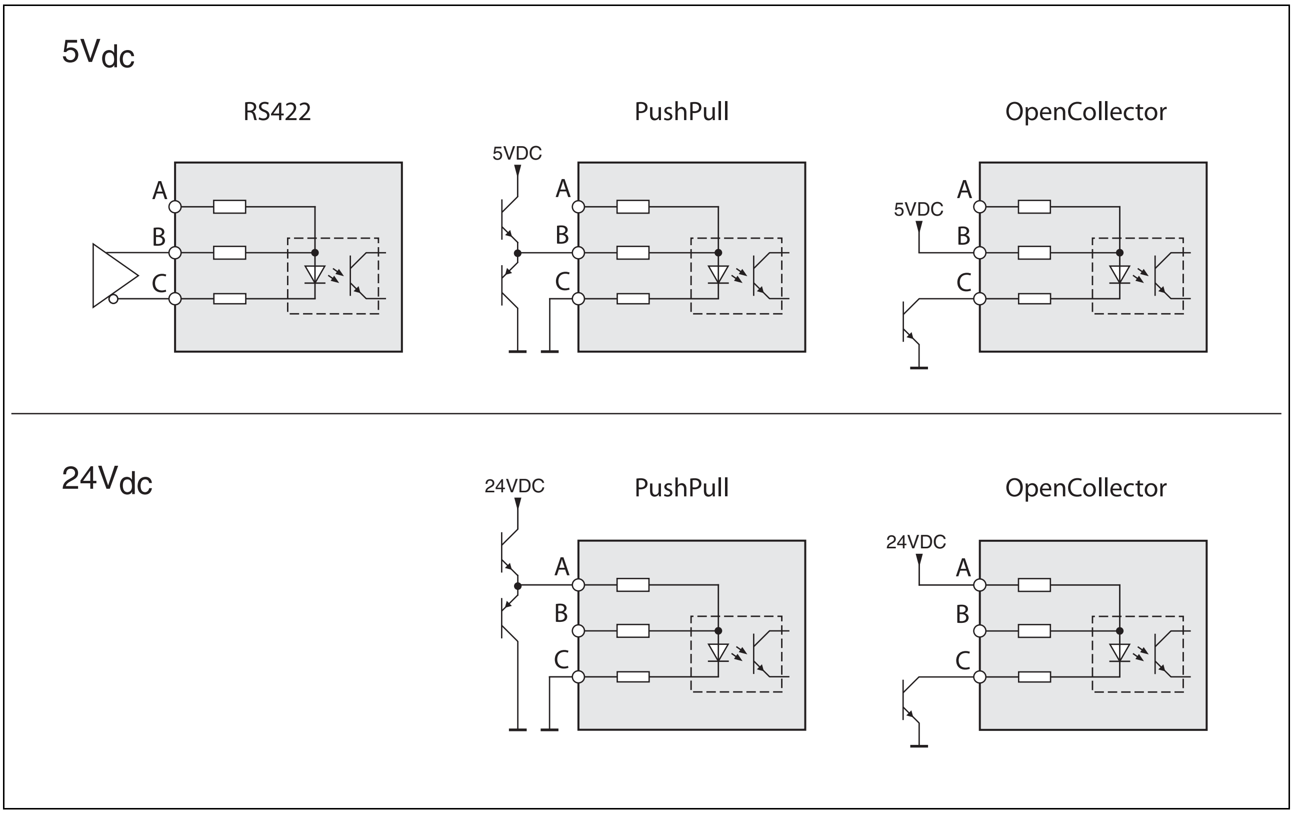

Figure 3.8 Signal input circuits: RS422, Push Pull and Open Collector

Input	Pin [1]	RS422 [2]	5V	24V

A	Pin 7	Reserved	Reserved	`PULSE(24)`
				`ENC_A(24)`
				`CW(24)`

	Pin 8	Reserved	Reserved	`DIR(24)`
				`ENC_B(24)`
				`CCW(24`

B	Pin 1	`PULSE(5)`
		`ENC_A(5)`
		`CW(5)`
			`PULSE(5)`
			`ENC_A(5)`
			`CW(5)`
				Reserved

	Pin4	`DIR(5)`
		`ENC_B(5)`
		`CCW(5)`
			`DIR(5)`
			`ENC_B(5)`
			`CCW(5)`
				Reserved

C	Pin 2	$\overline{\mathtt{PULSE}}$ $\overline{\mathtt{ENC\_A}}$ $\overline{\mathtt{CW}}$	$\overline{\mathtt{PULSE}}$ $\overline{\mathtt{ENC\_A}}$ $\overline{\mathtt{CW}}$	$\overline{\mathtt{PULSE}}$ $\overline{\mathtt{ENC\_A}}$ $\overline{\mathtt{CW}}$
	Pin 5	$\overline{\mathtt{DIR}}$ $\overline{\mathtt{ENC\_B}}$ $\overline{\mathtt{CCW}}$	$\overline{\mathtt{DIR}}$ $\overline{\mathtt{ENC\_B}}$ $\overline{\mathtt{CCW}}$	$\overline{\mathtt{DIR}}$ $\overline{\mathtt{ENC\_B}}$ $\overline{\mathtt{CCW}}$

1) Observe the different pairing in the case of twisted pair:
Pin 1 / pin 2 and pin 4 / pin 5 for RS422 and 5V;
pin 7 / pin 2 and pin 8 / pin 5 for 24V
2) Due to the input current of the optocoupler in the input circuit, a parallel connection of a driver output to several devices is not permitted.

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Function A/B signals

External A/B signals can be supplied via the PTI input as reference values in operating mode Electronic Gear.

Signal	Value	Function
Signal A before signal B		Movement in positive direction
Signal B before signal A		Movement in negative direction

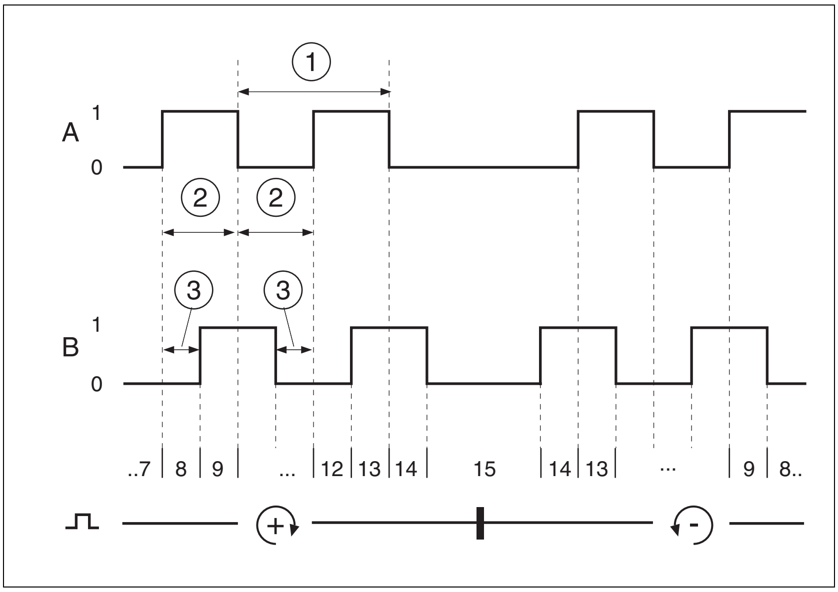

Figure 3.9 Time chart with A/B signal, counting forwards and backwards

Times for pulse/direction	Minimum value	
Cycle duration A, B	1 µs	(1)
Pulse duration	0.4 µs	(2)
Lead time (A, B)	200 ns	(3)

Function P/D

External P/D signals can be supplied via the PTI input as reference values in the operating mode Electronic Gear.

The motor performs a movement in the case of a rising edge of the `PULSE` signal. The direction is controlled with the `DIR` signal.

Signal	Value	Function
`PULSE`	0 -> 1	Motor movement
`DIR`	0 / open	Positive direction

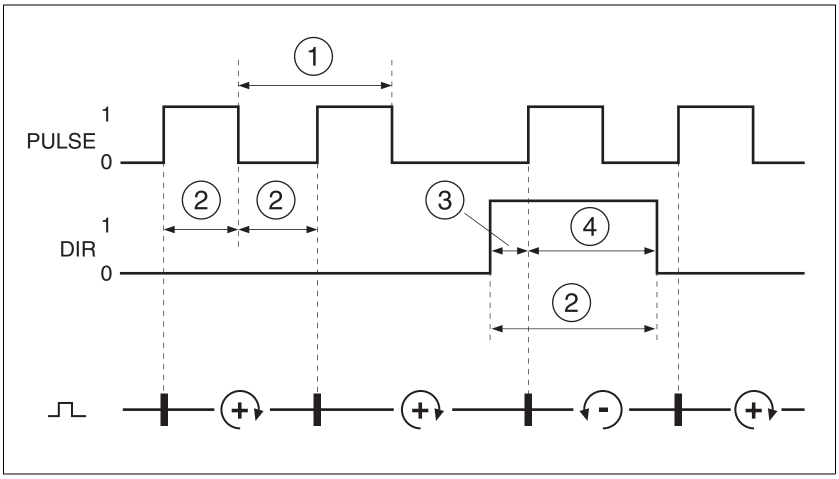

Figure 3.10 Time chart with pulse/direction signal

Times for pulse/direction	Minimum value	
Cycle duration (pulse)	1 µs	(1)
Pulse duration (pulse)	0.4 µs	(2)
Lead time (Dir-Pulse)	0 µs	(3)
Hold time (Pulse-Dir)	0.4 µs	(4)

Function CW/CCW

External CW/CCW signals can be supplied via the PTI input as reference values in operating mode Electronic Gear.

The motor performs a movement in positive direction the case of a rising edge of the `CW` signal. The motor performs a movement in negative direction the case of a rising edge of the `CCW` signal.

Signal	Value	Function
`CW`	0 -> 1	Movement in positive direction
`CCW`	0 -> 1	Movement in negative direction

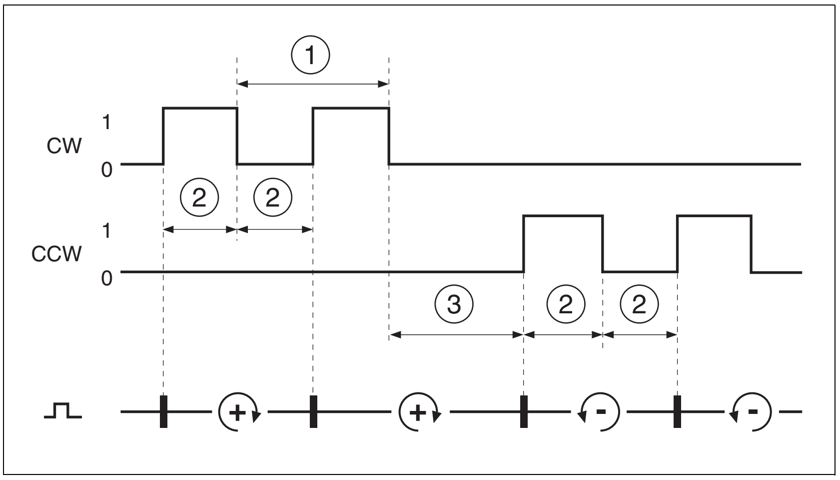

Figure 3.11 Time chart with "CW/CCW"

Times for pulse/direction	Minimum value	
Cycle duration CW, CCW	1 µs	(1)
Pulse duration	0.4 µs	(2)
Lead time (CW-CCW, CCW-CW)	0 µs	(3)

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3.3.4 Functional safety

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)	Years	20
SFF (IEC 61508) Safe Failure Fraction	[%]	80
HFT (IEC 61508) Hardware Fault Tolerance Type A subsystem		1
Safety integrity level IEC 61508 IEC 62061		 SIL3 SILCL3
PFH (IEC 61508) Probability of Dangerous Hardware Failure per Hour	[1/h] (FIT)	$1*10^{-9}$ (1)
PL (ISO 13849-1) Performance Level		e (category 3)
$MTTF_d$ (ISO 13849-1) Mean Time to Dangerous Failure	Years	1400
DC (ISO 13849-1) Diagnostic Coverage	[%]	90

3.3.5 Braking resistor

The device has an internal braking resistor. If the internal braking resistor is insufficient for the dynamics of the application, one or more external braking resistors must be used.

The resistance values for external braking resistors must not be below the specified minimum resistance. If an external braking resistor is activated by means of the appropriate parameter, the internal braking resistor is deactivated.

Further information on the subject	Page
Rating the external braking resistor	70
Mounting the external braking resistor (accessory)	89
Electrical installation of the braking resistor (accessory)	70
Setting the braking resistor parameters	168
Order data for external braking resistors (accessory)	389

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LXM32•...		U45M2	U90M2	D18M2	D30M2	
Resistance value of internal braking resistor	[Ω]	94	47	20	10	
Continuous power internal braking resistor P_{PR}	[W]	10	20	40	60	
Peak energy E_{CR}	[Ws]	82	166	330	550	
External braking resistor minimum	[Ω]	68	36	20	12	
External braking resistor maximum 1)	[Ω]	110	55	27	16	
Maximum continuous power external braking resistor	[W]	200	400	600	800	
Parameter `DCbus_compat` **= 0** (default value)						
Switch-on voltage braking resistor	[V]	430	430	430	430	
Capacitance	[µF]	390	780	1170	1560	
Energy absorption of internal capacitors E_{var} at nominal voltage 115 V +10%	[Ws]	30	60	89	119	
Energy absorption of internal capacitors E_{var} at nominal voltage 200 V +10%	[Ws]	17	34	52	69	
Energy absorption of internal capacitors E_{var} at nominal voltage 230 V +10%	[Ws]	11	22	33	44	
Parameter `DCbus_compat` **= 1** (reduced switch-on voltage)						
Switch-on voltage braking resistor	[V]	395	395	395	395	
Capacitance	[µF]	390	780	1170	1560	
Energy absorption of internal capacitors E_{var} at nominal voltage 115 V +10%	[Ws]	24	48	73	97	
Energy absorption of internal capacitors E_{var} at nominal voltage 200 V +10%	[Ws]	12	23	35	46	
Energy absorption of internal capacitors E_{var} at nominal voltage 230 V +10%	[Ws]	5	11	16	22	

1) The maximum specified braking resistor can derate the peak power of the device. Depending on the application, it is possible to use a higher ohm resistor.

Table 3.1 Data braking resistor for single-phase devices

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See chapter 3.3.1.7 "DC bus data for single-phase devices", page 33 for the DC bus data.

LXM32•...		**U60N4**	**D12N4**	**D18N4**	**D30N4**	**D72N4**
Resistance value of internal braking resistor	[Ω]	132	60	30	30	10
Continuous power internal braking resistor P_{PR}	[W]	20	40	60	100	150
Peak energy E_{CR}	[Ws]	200	400	600	1000	2400
External braking resistor minimum	[Ω]	100	47	33	15	8
External braking resistor maximum 1)	[Ω]	145	73	50	30	12
Maximum continuous power external braking resistor	[W]	200	500	800	1500	3000
Parameter `DCbus_compat` 2)						
Switch-on voltage	[V]	780	780	780	780	780
Capacitance	[μF]	110	195	390	560	1120
Energy absorption of internal capacitors E_{var} at nominal voltage 208 V +10% 3)	[Ws]	28	49	98	141	282
Energy absorption of internal capacitors E_{var} at nominal voltage 380 V +10%	[Ws]	14	25	50	73	145
Energy absorption of internal capacitors E_{var} at nominal voltage 400 V +10%	[Ws]	12	22	43	62	124
Energy absorption of internal capacitors E_{var} at nominal voltage 480 V +10%	[Ws]	3	5	10	14	28

1) The maximum specified braking resistor can derate the peak power of the device. Depending on the application, it is possible to use a higher ohm resistor.
2) Parameter DCbus_compat has no effect in the case of three-phase devices.
3) $208V_{ac}$ ($3*200V_{ac}$ ... $3*240V_{ac}$) DOM >10.05.2010, software version >V01.04.00

Table 3.2 Data braking resistor for three-phase devices

See chapter 3.3.1.8 "DC bus data for three-phase devices", page 33 for the DC bus data.

3.3.5.1 External braking resistors (accessories)

VW3A760...		**1Rxx** [1]	**2Rxx**	**3Rxx**	**4Rxx** [1]	**5Rxx**	**6Rxx**	**7Rxx** [1]
Resistance	[Ω]	10	27	27	27	72	72	72
Continuous power	[W]	400	100	200	400	100	200	400
Maximum time in braking at 115 V / 230 V	[s]	0.72	0.552	1.08	2.64	1.44	3.72	9.6
Peak power at 115 V / 230 V	[kW]	18.5	6.8	6.8	6.8	2.6	2.6	2.6
Maximum peak energy at 115 V / 230 V	[Ws]	13300	3800	7400	18100	3700	9600	24700
Maximum time in braking at 400 V	[s]	0.12	0.084	0.216	0.504	0.3	0.78	1.92
Peak power at 400V	[kW]	60.8	22.5	22.5	22.5	8.5	8.5	8.5
Maximum peak energy at 400 V	[Ws]	7300	1900	4900	11400	2500	6600	16200
Degree of protection		IP65	IP65	IP65	IP65	IP65	IP65	IP65
UL approval (file no.)			E233422	E233422		E233422	E233422	

1) Resistors with a continuous power of 400 W are NOT UL/CSA-approved.

VW3A77...		**04**	**05**					
Resistance	[Ω]	15	10					
Continuous power	[W]	2500	2500					
Maximum time in braking at 115 V / 230 V	[s]	3.5	1.98					
Peak power at 115 V / 230 V	[kW]	18.5	12.3					
Maximum peak energy at 115 V / 230 V	[Ws]	43100	36500					
Maximum time in braking at 400 V	[s]	0.65	0.37					
Peak power at 400V	[kW]	60.8	40.6					
Maximum peak energy at 400 V	[Ws]	26500	22500					
Degree of protection		IP20	IP20					
UL approval (file no.)		E221095	E221095					

3.3.6 Internal mains filter

Further information on the subject	Page
Engineering information external mains filters (accessory)	68
Mounting the external mains filter (accessory)	89
Electrical installation of external mains filters (accessory)	106
Order data external mains filters (accessory)	393

Limit values

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

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

⚠ WARNING

HIGH-FREQUENCY INTERFERENCE

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

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

Emission

The following limit values for interference are complied with if the installation is EMC-compliant and if the cables offered as accessories are used.

LXM32•	Conducted interference	Radiated emission
•••M2 up to a motor cable length of 10 m	Category C2	Category C3
•••M2 motor cable length of 10 m to 20 m	Category C3	Category C3
•••M2 motor cable length of more than 20 m	Not permitted	Not permitted
•••N4 up to a motor cable length of 20 m	Category C3	Category C3
•••N4 motor cable length of more than 20 m	Not permitted	Not permitted

External mains filters must be used if longer motor cables are used. See page 49 for the technical data of the external mains filters available as accessories.

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3.3.7 External mains filters (accessories)

If external mains filters are used, the system integrator and/or machine owner/operator is responsible for complying with the EMC directives.

Further information on the subject	Page
Engineering information external mains filters (accessory)	68
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Emission

The specified limit values are complied with if the external mains filters available as accessories are used.

The following limit values for interference are complied with if the installation is EMC-compliant and if the cables offered as accessories are used.

LXM32•	Conducted interference	Radiated emission
•••M2 up to a motor cable length of 20 m	Category C1	Category C3
•••M2 motor cable length of 20 m to 50 m	Category C2	Category C3
•••M2 motor cable length of 50 m to 100 m	Category C3	Category C3
•••M2 motor cable length of more than 100 m	Not permitted	Not permitted
•••N4 up to a motor cable length of 20 m	Category C1	Category C3
•••N4 motor cable length of 20 m to 50 m	Category C2	Category C3
•••N4 motor cable length of 50 m to 100 m	Category C3	Category C3
•••N4 motor cable length of more than 100 m	Not permitted	Not permitted

Common external mains filter

Several device can be connected to a common external mains filter. Prerequisites:

- Single-phase devices may only be connected to single-phase mains filters; three-phase devices may only be connected to three-phase devices.
- The total input current of the connected devices must be smaller than or equal to the permissible nominal current of the mains filter.

Assignment of external mains filters to device type

Device type 1 ~	Order number mains filter
LXM32•U45M2 (230 V, 1.5 A, 1 ~)	VW3A4420 (9 A, 1 ~)
LXM32•U90M2 (230 V, 3 A, 1 ~)	VW3A4420 (9 A, 1 ~)
LXM32•D18M2 (230 V, 6 A, 1 ~)	VW3A4421 (16 A, 1 ~)
LXM32•D30M2 (230 V, 10 A, 1 ~)	VW3A4421 (16 A, 1 ~)

Device type 3 ~	Order number mains filter
LXM32•U60N4 (480 V, 1.5 A, 3 ~)	VW3A4422 (15 A, 3 ~)
LXM32•D12N4 (480 V, 3 A, 3 ~)	VW3A4422 (15 A, 3 ~)
LXM32•D18N4 (480 V, 6 A, 3 ~)	VW3A4422 (15 A, 3 ~)
LXM32•D30N4 (480 V, 10 A, 3 ~)	VW3A4422 (15 A, 3 ~)
LXM32•D72N4 (480 V, 24 A, 3 ~)	VW3A4423 (25 A, 3 ~)

3.3.8 Mains reactor (accessory)

Mains reactor

Mains reactors must be connected upstream if the supply mains does not meet the requirements in terms of mains impedance. High current harmonics result in considerable load on the DC bus capacitors. Mains reactors reduce harmonics in the mains supply. The load on the DC bus capacitors has a decisive impact on the service life of the devices.

A higher continuous power of the device is an additional benefit of using an upstream mains reactor.

Further information on the subject	Page
Engineering information mains reactor (accessory)	67
Mounting the mains reactor (accessory)	89
Electrical installation of the mains reactor (accessory)	106
Order data mains reactor (accessory)	393

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3.4 Conditions for UL 508C and CSA

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

Ambient temperature during operation

Surrounding air temperature	[°C]	0 ... +50

Fuses

Use class J fuses as per UL 248-4.

Maximum fuse rating of fuse to be connected upstream for LXM32••••M2	[A]	25
Maximum fuse rating of fuse to be connected upstream for LXM32••••N4	[A]	30

Wiring

Use at least 60/75 °C copper conductors.

400/480 V three-phase devices

400/480 V three-phase devices may only be operated via 480Y/277Vac mains.

Overvoltage category

In the case of single-phase devices, a Schneider Electric surge protective device TVS230XR40 and in the case of three-phase devices, a Schneider Electric surge protective device TVS4XW100C or a UL-listed surge protective device with the following designation must be available in all phases of the mains connection of the drive in the final installation:

UL Category Code VZCA
Type 1 or 2
Operating Voltage 240V for 1-phase systems and 480Y/277V for 3-phase systems
Voltage Protection Rating (VPR) max. 4000V
Nominal Discharge Current Rating (In) min. 3kA

3.5 Certifications

Product certifications:

Certified by	**Assigned number**
TÜV Nord	SAS-192/2008TB-1
UL	E153659
CSA	2320425

3.6 Declaration of conformity

The following declaration of conformity is applicable if the product is used under the specified conditions and with the cables listed in the Accessories chapter.

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

EC DECLARATION OF CONFORMITY
YEAR 2010

☒ according to EC Directive on Machinery 2006/42/EC
☒ according to EC Directive EMC 2004/108/EC
☒ according to EC Directive Low Voltage 2006/95/EC

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

Designation:	AC Servo drive including modules
Type:	LXM32Axxxxx, LXM32Cxxxxx, LXM32Mxxxxx, VW3A3607, VW3A3608, VW3A3616, VW3A3618, VW3M3301,VW3M3401, VW3M3402, VW3M3403, VW3M3501
Applied harmonized standards, especially:	EN ISO 13849-1:2008, Performance Level "e" EN 61508:2001, SIL 3 EN 61800-5-1:2007 EN 61800-3:2004, second environment
Applied national standards and technical specifications, especially:	UL 508C CSA C22.2 No. 14-10 Product documentation

Company stamp: Schneider Electric Motion Deutschland GmbH
Postfach 11 80 • D-77901 Lahr
Breslauer Str. 7 • D-77933 Lahr

Date/Signature: 23 September 2010

Name/Department: Wolfgang Brandstätter/Development

3.7 TÜV certificate for functional safety

TÜV NORD

Certificate

TÜV NORD SysTec GmbH & Co. KG hereby certifies

Schneider Electric Motion Deutschland GmbH
Breslauer Straße 7
77933 Lahr

that the implementation of the safety function "Safe Touqe Off" (STO) of the drive

LXM32

meets the requirements listed in the following standards

- IEC 61508:2000; SIL 3
- IEC 61800-5-2:2007; SIL 3
- ISO 13849-1:2006; PL e (category 3)
- IEC 62061:2005; SIL$_{CL}$3

based on report no. SAS-0192/2008TB-1 in the valid version.
This certificate entitles the holder to use the mark

Expiry date: 2014-06-25
Certification No.: SAS-0192/08/1
Reference No: G.SCC.DL.06.007.02.SLA

Augsburg, 2009-06-25

TÜV NORD SysTec GmbH & Co. KG
Branch South
Halderstraße 27
86150 Augsburg

Gerhard M. Rieger

BA51 -10

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4 Basics

4

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.

Integrated safety function "Safe Torque Off" STO

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

IEC 61508 standard

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

SIL, Safety Integrity Level

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

PFH, Probability of a dangerous hardware failure per hour

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

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

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HFT and SFF

Depending on the SIL for the safety system, the IEC 61508 standard requires a specific hardware fault tolerance HFT in connection with a specific proportion of safe failures SFF (safe failure fraction). The hardware fault tolerance is the ability of a system to execute the required safety function in spite of the presence of one or more hardware faults. The SFF of a system is defined as the ratio of the rate of safe failures to the total failure rate of the system. According to IEC 61508, the maximum achievable SIL of a system is partly determined by the hardware fault tolerance HFT and the safe failure fraction SFF of the system.

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

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

Fault avoidance measures

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

5 Engineering

5

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

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5.1 Electromagnetic compatibility, EMC

⚠ WARNING

SIGNAL AND DEVICE INTERFERENCE

Signal interference can cause unexpected responses of device.

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

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

Limit values

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

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

⚠ WARNING

HIGH-FREQUENCY INTERFERENCE

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

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

An EMC-compliant design is required to meet the specified limit values. Note the following requirements:

Control cabinet design

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

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Shielded cables

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

Cable installation

EMC measures	Objective
Do not route fieldbus cables and signal wires in a single cable duct together with lines with DC and AC voltages of more than 60 V. (Fieldbus cables, signal lines and analog lines may be in the same cable duct) Recommendation: Use separate cable ducts at least 20 cm apart.	Reduces mutual interference
Keep cables as short as possible. Do not install unnecessary cable loops, use short cables from the central grounding point in the control cabinet to the external ground connection.	Reduces capacitive and inductive interference.
Use equipotential bonding conductors in systems with - wide-area installations - different voltage supplies - networking across several buildings	Reduces current in the cable shield, reduces emissions.
Use equipotential bonding conductors with fine wires	Diverts high-frequency interference currents.
If motor and machine are not conductively connected, for example by an insulated flange or a connection without surface contact, you must ground the motor with a ground wire > 10 mm^2 (AWG 6) or a ground strap.	Reduces emissions, increases immunity.
Use twisted pair for 24 V_{dc} signals.	Reduces interference affecting the signal cables, reduces emissions.

Power supply

EMC measures	Objective
Operate product on mains with grounded neutral point.	Enables effectiveness of mains filter.
Surge arrester if there is a risk of overvoltage.	Reduces the risk of damage caused by overvoltage.

Motor and encoder cables

Motor and encoder cables are especially critical in terms of EMC. Use only pre-assembled cables (see chapter 12 "Accessories and spare parts") or cables that comply with the specifications (see chapter 5.2 "Cables", page 62) and implement the EMC measures described below.

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

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

Additional measures for EMC improvement

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

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

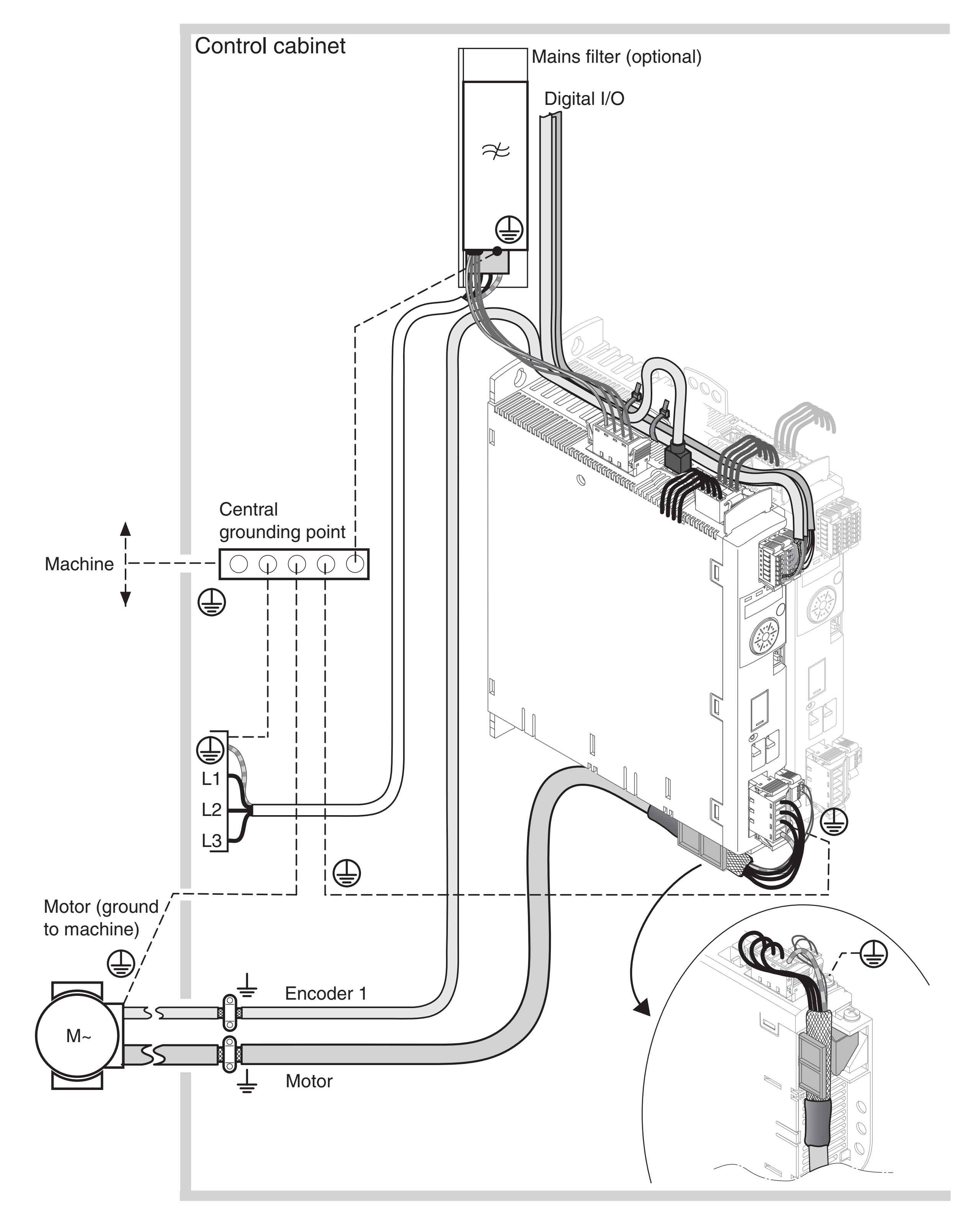

Figure 5.1 EMC measures

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5.2 Cables

Suitability of the cables

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

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

Shield connections

In terms of shield connection, there are the following possibilities:

- Motor cable: The motor cable shield is fastened in the shield clamp at the bottom of the device.
- Shields of the analog cable and the I/O wires to CN6.1 pin 5
- Other cables: The shields are connected to the shield connection at the bottom of the device.
- Alternative: Shield connection via shield clamp and rail, for example.

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 mm^2 (AWG 4) for equipotential bonding conductors up to a length of 200 m
- 20 mm^2 (AWG 4) for equipotential bonding conductors with a length of more than 200 m

Cable guides

The device features cable guides at the top and at the bottom. The cable guides do not provide strain relief. The cable guide at the bottom of the device can be used as a shield connection.

NOTE: The upper cable guide is not a shield connection.

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5.2.1 Overview of the required cables

The properties of the required cables are listed in the table below. Use pre-assembled cables to reduce the risk of wiring errors. Pre-assembled cables can be found in chapter 12 "Accessories and spare parts", page 389. If the product is used to comply with the requirements as per UL 508C, the conditions specified in chapter 3.4 "Conditions for UL 508C and CSA", page 51, must be met.

	Max. length [m]	**Min. cross section [mm²] (AWG)**	**Shielded, both ends grounded**	**Twisted pair**	**PELV**
Controller supply voltage	–	0.75 (AWG 18)			Required
STO safety function 1)	–	0.75 (AWG 18)	1)		Required
Power stage supply voltage	–	– 2)			
Motor phases	– 3)	– 4)	Required		
External braking resistor	3	As power stage supply voltage	Required		
Motor encoder	100	6*0.14 mm² and 2*0.34 mm² (6*AWG 24 and 2*AWG 20)	Required	Required	Required
A/B signals	100	0.25 (AWG 22)	Required	Required	Required
PULSE / DIR signals	100	0.14 (AWG 24)	Required	Required	Required
CW/CCW signals	100	0.14 (AWG 24)	Required	Required	Required
ESIM	100	0.14 (AWG 24)	Required	Required	Required
Analog inputs	10	0.14 (AWG 24)	Required 5)	Required	Required
Digital inputs / outputs	30	0.14 (AWG 24)			Required
PC, commissioning interface	20	0.14 (AWG 24)	Required	Required	Required

1) Note the installation requirements (protected cable installation), see page 78.
2) See 6.2.8 "Connection of power stage supply voltage (CN1)"
3) Length depends on the required limit values for conducted interference.
4) See 6.2.4 "Connecting the motor phases (CN 10, motor)"
5) Ground the shield of analog signal wires directly at the device (signal input). Insulate the shield at the other cable end or ground it via a capacitor (for example, 10 nF) in the case of interference.

Table 5.1 Cable specifications

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Motor cable and encoder cable

Motor cables		Style 20234
Motor cable outside diameter	mm	VW3M5•01: 12 ± 0.2 VW3M5•02: 14 ± 0.3 VW3M5•03: 16.3 ± 0.3
Permissible voltage motor cable	V_{ac}	600 (UL and CSA)
Encoder cables		Style 20233
Encoder cable outside diameter	mm	VW3M8••2: 6.8 ± 0.2
Temperature range	°C	-40 ... +90 (fixed) -20 ... +80 (moving)
Permissible bending radius		4 x diameter (fixed) 7.5 x diameter (moving)
Cable diameter	mm	VW3M5•01R•••: 12 ± 0.2 VW3M5•02R•••: 14 ± 0.3 VW3M5•03R•••: 16,3 ± 0.3
Cable jacket		Oil-resistant PUR
Shield		Shield braiding
Shield braiding coverage	%	≥85

Table 5.2 Data of the motor cable and encoder cable available as accessories

The motor cables and encoder cables are suitable for drag chain applications; they are available in various lengths. See page 389 for the versions available as accessories.

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5.3 Residual current device

⚠ WARNING

THIS PRODUCT MAY CAUSE DIRECT CURRENT IN THE PROTECTIVE GROUND CONDUCTOR

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

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

Conditions for use of residual current device

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

Note the following:

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

Use residual current devices that meet the following conditions:

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

When using residual current devices, consider the leakage currents of connected consumers.

5.4 Operation in an IT mains

The device is intended for operation in a TT/TN mains. The device is not suitable for operation in an IT mains.

A transformer grounded at the output turns a TT/TN mains into an IT mains. The device may be connected to this mains.

See chapter 3.3.1 "Power stage", page 25 for the approved mains types.

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5.5 Parallel connection DC bus

⚠ WARNING

DESTRUCTION OF SYSTEM COMPONENTS AND LOSS OF CONTROL

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

- Note the requirements concerning the use of a parallel DC bus connection.

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

Function principle

If several devices use the DC bus jointly, this results in energy savings. If on device decelerates, a different device can use the generated braking energy via the DC bus. This energy does not have to be taken from the mains supply and there is no need to waste is by transforming it into heat in the braking resistor.

Several devices can share a common braking resistor. This can reduce the power of the braking resistor and improve the deceleration performance without a braking resistor.

Requirements for use

The requirements and limit values for parallel connection of multiple LXM32 via the DC bus can be found on the Internet in the form of Application Note MNA01M001.

5.6 Mains reactor

Mains reactor

A mains reactor must be used under the following conditions:

- Operation via supply mains with low impedance (short-circuit current of supply mains greater than specified in chapter 3 "Technical Data", page 25).
- If the nominal power of the drive is insufficient without mains reactor.
- In the case of high demands concerning the service life of the drive (for example, 24 h continuous operation).
- In the case of operation with supply mains with reactive current compensation systems.
- For improvement of the power factor at the mains input and for reduction of mains harmonics.

A mains reactor can be used for several devices. Use a mains reactor with a properly rated current.

Low-impedance supply mains cause high current harmonics at the mains input. High current harmonics result in considerable load on the DC bus capacitors. The load on the DC bus capacitors has a decisive impact on the service life of the devices.

Further information on the subject	**Page**
Technical data mains reactor (accessory)	50
Mounting the mains reactor (accessory)	89
Electrical installation of the mains reactor (accessory)	106
Order data mains reactor (accessory)	393

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5.7 Mains filter

Limit values

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

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

⚠ WARNING
HIGH-FREQUENCY INTERFERENCE
In a residential environment this product may cause high-frequency interference that require interference suppression.
Failure to follow these instructions can result in death or serious injury.

See chapter Technical Data, page 48, for the category the device complies with.

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

The drives have an integrated mains filter.

An additional external mains filter is required in the case of long motor cables. When using external mains filters, verify compliance with all applicable EMC directives.

If the external mains filters offered in chapter 12.12 "External mains filters" are used, the limit values specified in chapter 3.3.7 "External mains filters (accessories)", page 49, are met.

Further information on the subject	**Page**
Technical data external mains filters (accessory)	49
Mounting the external mains filter (accessory)	89
Electrical installation of external mains filters (accessory)	106
Order data external mains filters (accessory)	393

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5.7.1 Deactivating the Y capacitors

The ground connections of the internal Y capacitors can be disconnected (deactivation). Usually, it is not required to deactivate the ground connection of the Y capacitors.

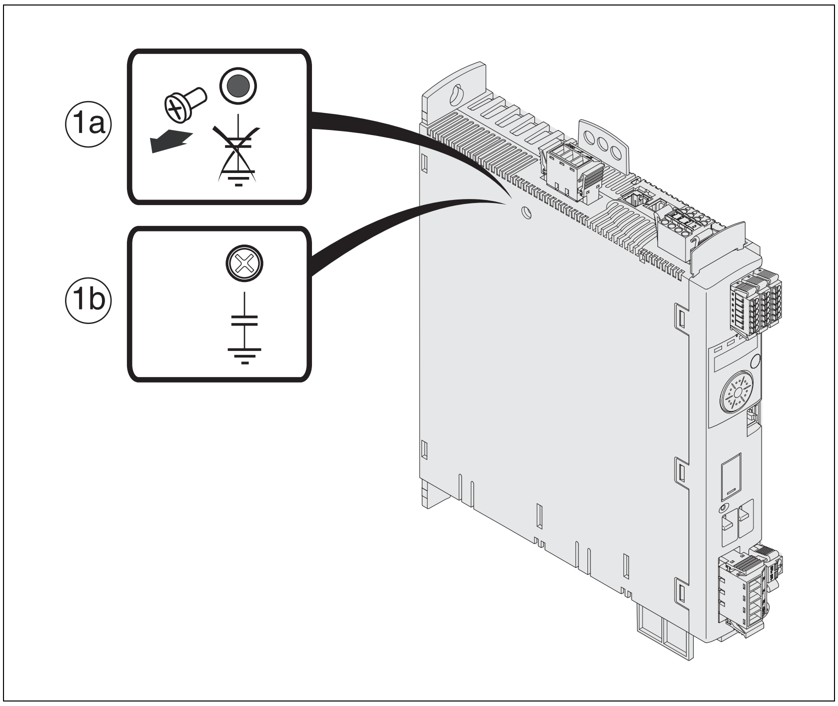

Figure 5.2 Screw for deactivating/activating the internal Y capacitors

To deactivate the Y capacitors, remove the screw, see Figure 5.2. Keep this screw so you can re-activate the Y capacitors, if required.

NOTE: The EMC limit values specified no longer apply if the Y capacitors are deactivated.

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5.8 Rating the braking resistor

⚠ DANGER

FIRE HAZARD CAUSED BY EXTERNAL DRIVING FORCES ACTING ON MOTOR

If external driving forces acting on the motor cause excessively high currents to be regenerated and supplied back to the drive, this may cause overheating and fire of the drive.

- Verify that no energy is supplied to the driving motor after an error of error classes 3 or 4.

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

⚠ WARNING

MOTOR WITHOUT BRAKING EFFECT

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

- Verify that the braking resistor has a sufficient rating.
- Check the parameter settings for the braking resistor.
- Check the I^2t value under the most critical condition by performing a test run. The device switches off at an I^2t value of 100%.
- When performing the calculation and the test run, take into account the fact that the DC bus capacitors can absorb less braking energy at higher mains voltages.

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

⚠ WARNING

HOT SURFACES

The braking resistor may heat up to over 250°C (480°F) during operation.

- Avoid contact with the hot braking resistor.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity of the braking resistor.
- Provide for good heat dissipation.
- Check the temperature of the braking resistor under the most critical condition by performing a test run.

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

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Braking resistors are required for dynamic applications. During deceleration, the kinetic energy is transformed into electrical energy in the motor. The electrical energy increases the DC bus voltage. The braking resistor is activated when the defined threshold value is exceeded. The braking resistor transforms electrical energy into heat. If highly dynamic deceleration is required, the braking resistor must be well adapted to the system.

Further information on the subject	Page
Technical data 3.3.5 "Braking resistor"	44
Mounting the "External braking resistor" (accessory)	89
Electrical installation: 6.2.7 "Braking resistor connection (CN8, Braking Resistor)" (accessory)	103
Setting the braking resistor parameters	168
5.5 "Parallel connection DC bus"	66
Order data for external braking resistors (accessory)	389

5.8.1 Internal braking resistor

A braking resistor is integrated in the drive to absorb braking energy. The device is shipped with the internal braking resistor active.

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5.8.2 External braking resistor

An external braking resistor is required for applications in which the motor must be decelerated quickly and the internal braking resistor cannot absorb the excess braking energy.

Monitoring

The device monitors the power of the braking resistor. The load on the braking resistor can be read out.
The connection of the external braking resistor is short-circuit protected. There is no protection in the case of a ground fault.

Selection of the external braking resistor

The rating of an external braking resistor depends on the required peak power and continuous power with which the braking resistor can be operated.

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

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

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

Figure 5.3 Calculating the resistance R of an external braking resistor

If 2 or more braking resistors are connected to one drive, note the following criteria:

- The braking resistors must be connected in parallel or in series so the required resistance is reached. Only connect resistors with identical resistance in parallel in order to evenly distribute the load to all braking resistors.
- The total resistance of all external braking resistors connected to one drive must not fall below a lower limit, see chapter 3.3.5 "Braking resistor".
- The continuous power of the network of connected braking resistors must be calculated. The result must be greater than or equal to the actually required continuous power.

Use only resistors that are specified as braking resistors. For suitable braking resistors, see Accessories, page 392.

Connection of braking resistor

A parameter is used to switch between the internal and an external braking resistor. Test the function of the braking resistor under realistic conditions during commissioning, see page 150.

Braking resistors with degree of protection IP65 may be installed outside the control cabinet in an appropriate environment.

The external braking resistors listed in the Accessories chapter are shipped with an information sheet that provides details on installation.

For information on the function and the electrical installation, see page 70.

Wire ferrules: If you use wire ferrules, use only wire ferrules with collars for these connection terminals.

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5.8.3 Rating information

To rate the braking resistor, calculate the proportion contributing to absorbing braking energy.

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

Internal energy absorption

Braking energy is absorbed internally by the following mechanisms:

- DC bus capacitor E_{var}
- Internal braking resistor E_I
- Electrical losses of the drive E_{el}
- Mechanical losses of the drive E_{mech}

The energy E_{var} is the square difference between the voltage before the deceleration process and the response threshold.

The voltage prior to the deceleration process depends on the mains voltage. The energy absorption by the DC bus capacitors is lowest when the mains voltage is highest. In the calculation, use the values for the highest mains voltage.

Internal braking resistor

Two characteristic values determine the energy absorption of the internal braking resistor.

- The continuous power P_{PR} is the amount of energy that can be continuously absorbed without overloading the braking resistor.
- The maximum energy E_{CR} limits the maximum short-term power that can be absorbed.

If the continuous power was exceeded for a specific time, the braking resistor must remain without load for a corresponding period.

The characteristic values P_{PR} and E_{CR} of the internal braking resistor can be found on page 44.

Electrical losses E_{el}

The electrical losses E_{el} of the drive system can be estimated on the basis of the peak power of the drive. The maximum power dissipation is approximately 10% of the peak power at a typical efficiency of 90%. If the current during deceleration is lower, the power dissipation is reduced accordingly.

Mechanical losses E_{mech}

The mechanical losses result from friction during operation of the system. Mechanical losses are negligible if the time required by the system to coast to a stop without a driving force is considerably longer than the time required to decelerate the system. The mechanical losses can be calculated from the load torque and the velocity from which the motor is to stop.

Example

Deceleration of a rotary motor with the following data:

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

Calculation of the energy to be absorbed:

$E_B = 1/2 * J * (2*\pi*n * 1/60)^2$

to 88 Ws

Electrical and mechanical losses are ignored.

In this example, the DC bus capacitors absorb 23 Ws (the value depends on the device type, see chapter 3.3.5 "Braking resistor").

The internal braking resistor must absorb the remaining 65 Ws. It can absorb a pulse of 80 Ws. If the load is decelerated once, the internal braking resistor is sufficient.

If the deceleration process is repeated cyclically, the continuous output must be considered. If the cycle time is longer than the ratio of the energy to be absorbed E_B and the continuous power P_{PR}, the internal braking resistor is sufficient. If the system decelerates more frequently, the internal braking resistor is not sufficient.

In the example, the ratio E_B/P_{PR} is 1.3 s. If the cycle time is shorter, an external braking resistor is required.

Rating the external braking resistor

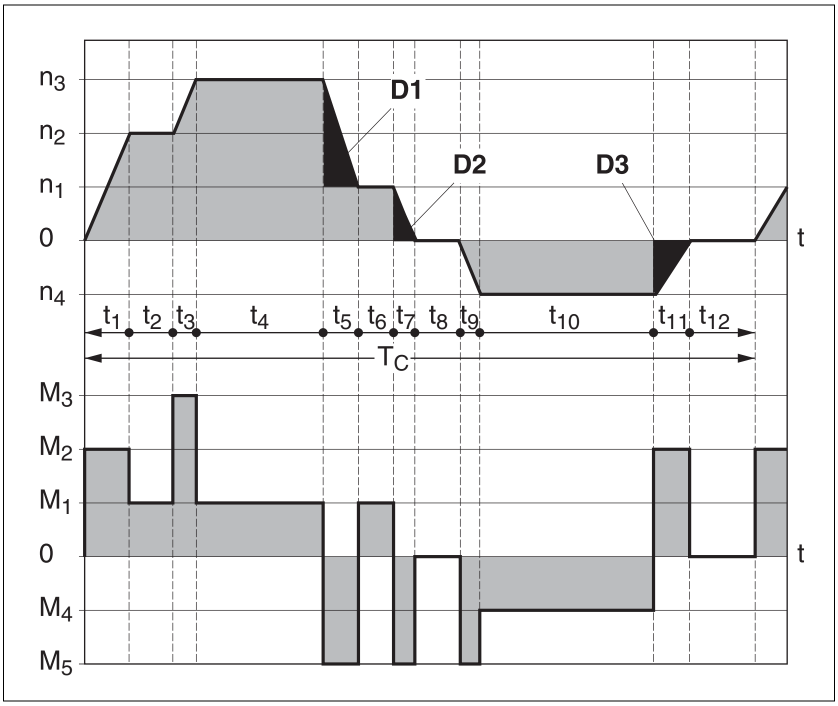

Figure 5.4 Characteristic curves for rating the braking resistor

These two characteristics are also used for the rating the motor. The segments of the characteristic curves in which the motor decelerates are designated by (D_i); these segments must be considered.

Calculation of the energy at constant deceleration:

The total inertia (J_t) must be known.

J_t with:

$J_t = J_m + J_c$

J_m: Motor inertia with or without holding brake

J_c: Load inertia

The energy for each deceleration segment is calculated as follows:

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

Calculation for the segments (D_1) … (D_3):

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

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

Units: E_i in Ws (wattseconds), J_t in kgm^2, ω in rad and n_i in min^{-1}.

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See the technical data for the energy absorption E_{var} of the devices (without consideration of an internal or external braking resistor).

In the next calculation steps, only consider those segments D_i, whose energy E_i exceeds the energy absorption of the device (see chapter 3.3.5 "Braking resistor"). These excess energies E_{Di} must be diverted by means of the braking resistor (internal or external).

E_{Di} is calculated using the following formula:

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

The continuous power P_c is calculated for each machine cycle:

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

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

The selection is made in two steps:

- The maximum energy during deceleration must be less than the peak energy that the braking resistor can absorb: $(E_{Di})<(E_{Cr})$. In addition, the continuous power of the internal braking resistor must not be exceeded: $(P_C)<(P_{Pr})$. If these conditions are met, then the internal braking resistor is sufficient.
- If one of the conditions is not met, you must use an external braking resistor. The braking resistor must be rated in such a way that the conditions are met. The resistance of the braking resistor must be between the specified minimum and maximum values, since otherwise the load can no longer be decelerated or the product might be destroyed.

For order data for the external braking resistors, see chapter Accessories, page 393.

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5.9 Safety function STO ("Safe Torque Off")

See chapter 55 for information on using the IEC 61508 standard.

5.9.1 Definitions

Safety function STO (IEC 61800-5-2)

The safety function STO ("Safe Torque Off") shuts off the motor torque safely. It is not necessary to interrupt the supply voltage. There is no monitoring for standstill.

Category 0 stop (IEC 60204-1)

Stopping by immediate removal of power to the machine actuators (i.e. an uncontrolled stop).

Category 1 stop (IEC 60204-1)

Controlled stop with power available to the machine actuators to achieve the stop. Power is not interrupted until the stop is achieved.

5.9.2 Function

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

Function principle

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

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

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

5.9.3 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.

The inputs for the STO safety function (inputs $\overline{\texttt{STO\_A}}$ and $\overline{\texttt{STO\_B}}$) are permanently set to logic type 1.

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 power outage or an error, a controlled stop is impossible. Final shutoff of the motor is achieved by switching off the two inputs of the STO safety function. The shutoff is usually controlled by a standard EMERGENCY STOP safety relay 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. Check whether additional measures have to be taken; for example, this may cause the load of vertical axes to lower.

Vertical axes, external forces

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

Unintended restart

To avoid unintended restart of the motor after restoration of power (for example, after power outage), the parameter `IO_AutoEnable` must be set to "off". Note that a master controller must not trigger an unintended restart.

Degree of protection when the safety function is used

You must ensure that conductive substances cannot get into the product (pollution degree 2). Conductive substances may cause the safety function to become inoperative.

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Protected cable installation

If short circuits and cross circuits can be expected in connection with safety-related signals and if they are not detected by upstream devices, protected cable installation as per ISO 13849-2 is required.

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

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)	Years	20
SFF (IEC 61508) Safe Failure Fraction	[%]	80
HFT (IEC 61508) Hardware Fault Tolerance Type A subsystem		1
Safety integrity level IEC 61508 IEC 62061		 SIL3 SILCL3
PFH (IEC 61508) Probability of Dangerous Hardware Failure per Hour	[1/h] (FIT)	$1*10^{-9}$ (1)
PL (ISO 13849-1) Performance Level		e (category 3)
$MTTF_d$ (ISO 13849-1) Mean Time to Dangerous Failure	Years	1400
DC (ISO 13849-1) Diagnostic Coverage	[%]	90

Hazard and risk analysis

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

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

5.9.4 Application examples STO

Example of category 0 stop

Use without EMERGENCY STOP safety relay module, category 0 stop.

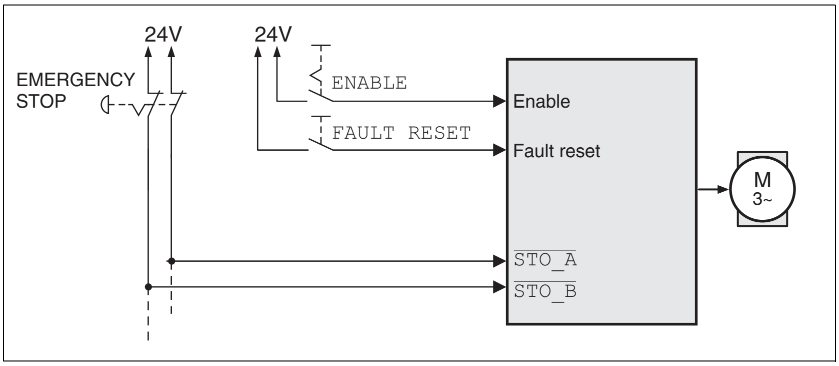

Figure 5.5 Example of category 0 stop

An EMERGENCY STOP is requested. This request leads to a category 0 stop

- The power stage is immediately disabled via the inputs STO_A and STO_B of the STO safety function. Power can no longer be supplied to the motor. If the motor has not yet stopped at this point in time, it coasts down in an uncontrolled way (uncontrolled stop).

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Example of category 1 stop Use with EMERGENCY STOP safety relay module, category 1 stop.

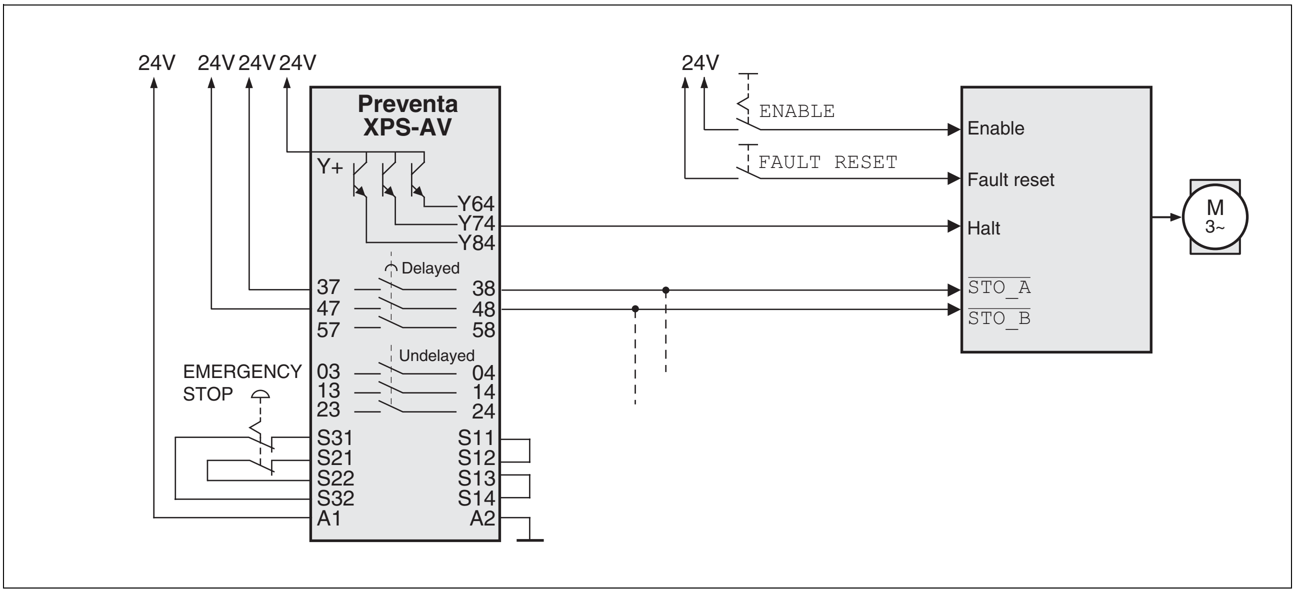

Figure 5.6 Example of category 1 stop with external Preventa XPS-AV EMERGENCY STOP safety relay module

An EMERGENCY STOP is requested. This request leads to a category 1 stop

- The function "Halt" is immediately started (undelayed) via the input HALT (single-channel, not monitored). Any active movement is decelerated via the adjusted ramp.
- The power stage is disabled via the inputs ST0_A and ST0_B of the STO safety function after the delay time set in the EMERGENCY STOP safety relay module has elapsed. Power can no longer be supplied to the motor. If the motor has not yet stopped when the delay time has elapsed, it coasts down in an uncontrolled way (uncontrolled stop).

NOTE: The specified minimum current and the permissible maximum current of the relay outputs of the EMERGENCY STOP safety relay module must be observed.

5.10 Logic type

⚠ WARNING

UNINTENDED OPERATION

If logic type 2 is used, a ground fault of a signal is detected as an On state.

- Use great care in wiring to exclude the possibility of ground faults.

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

The digital inputs and outputs of this product can be wired for logic type 1 or logic type 2.

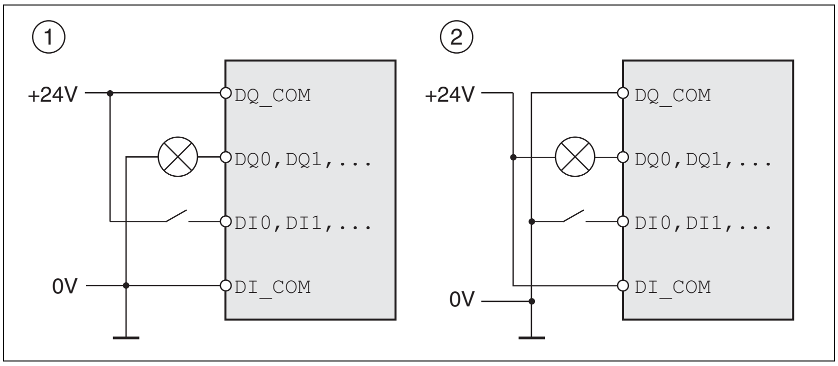

Figure 5.7 Logic type

Logic type	Active state
(1) Logic type 1	Output supplies current (Source) Current flows to the input
(2) Logic type 2	Output draws current (Sink) Current flows from the input

Signal inputs are protected against reverse polarity, outputs are short-circuit protected. The inputs and outputs are galvanically isolated.

The logic type is determined by the way `DI_COM` and `DQ_COM` are wired, see Figure 5.7. The logic type affects wiring and control of the sensors; therefore, you should determine the required value in the engineering phase in view of the application.

Special case: Safety function STO

The inputs for the STO safety function (inputs $\overline{\texttt{STO\_A}}$ and $\overline{\texttt{STO\_B}}$) are permanently set to logic type 1.

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5.11 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 connection	Error response if the link becomes inoperative
Limit switch signals	Monitors for permissible movement range
Position deviation	Monitors for difference between actual position and reference position
Motor overload	Monitors for excessively high current in the motor phases
Overvoltage and undervoltage	Monitors for overvoltage and undervoltage of the power stage supply and the DC bus
Overtemperature	Monitors the device for overtemperature
I^2t limitation	Power limitation in the case of overloads for the motor, the output current, the output power and the braking resistor.
Commutation	Plausibility check of motor acceleration and effective torque
Mains phases	Monitoring for missing mains phases
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 8.8 "Functions for monitoring internal device signals".

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5.12 Configurable inputs and outputs

⚠ WARNING

LOSS OF CONTROL

The use of limit switches can provide some protection against hazards (for example, collision with mechanical stop caused by incorrect reference values).

- If possible, use the limit switches.
- Verify correct connection of the limit switches.
- Verify the correct installation of the limit switches. The limit switches must be mounted in a position far enough away from the mechanical stop to allow for an adequate stopping distance.
- You must release the limit switches before you can use them.
- Verify the correct function of the limit switches.

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

This product has digital inputs and outputs that can be configured. The inputs and outputs have a defined standard assignment depending on the operating mode. This assignment can be adapted to the requirements of the customer's installation. See chapter 8.5.2 "Setting the digital signal inputs and signal outputs" for additional information.

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6 Installation

6

An engineering phase is mandatory prior to mechanical and electrical installation. See chapter 5 "Engineering", page 57, for basic information.

⚠ 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 all 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 and Operation of Adjustable-Speed Drive Systems”.

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6.1 Mechanical installation

⚠ DANGER

ELECTRIC SHOCK CAUSED BY FOREIGN OBJECTS OR DAMAGE

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

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

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 safety functions to become inoperative.

- Do not use the a 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.

⚠ WARNING

HOT SURFACES

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

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

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

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6.1.1 Mounting the device

Attaching a label with safety instructions

▶ Select the label suitable for the target country.
Observe the safety regulations in the target country.

▶ Attach the label to the front of the device so that it is clearly visible.

Control cabinet

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

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

Mounting distances, ventilation

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

- Mount the device in a vertical position (±10°). This is required for cooling the device.
- Adhere to the minimum installation distances for required cooling. Avoid heat accumulations.
- Do not mount the device close to heat sources.
- Do not mount the device on flammable materials.
- The heated airflow from other devices and components must not heat up the air used for cooling the device.
- If the thermal limits are exceeded during operation, the drive switches off (overtemperature).
- Comply with the specifications in chapter 6.1.2 "Mounting mains filter, mains reactor and braking resistor", page 89, for mounting additional components (external mains filters, mains reactor, external braking resistor).

The connection cables of the devices are routed to the top and to the bottom. The minimum distances must be adhered to for air circulation and cable installation.

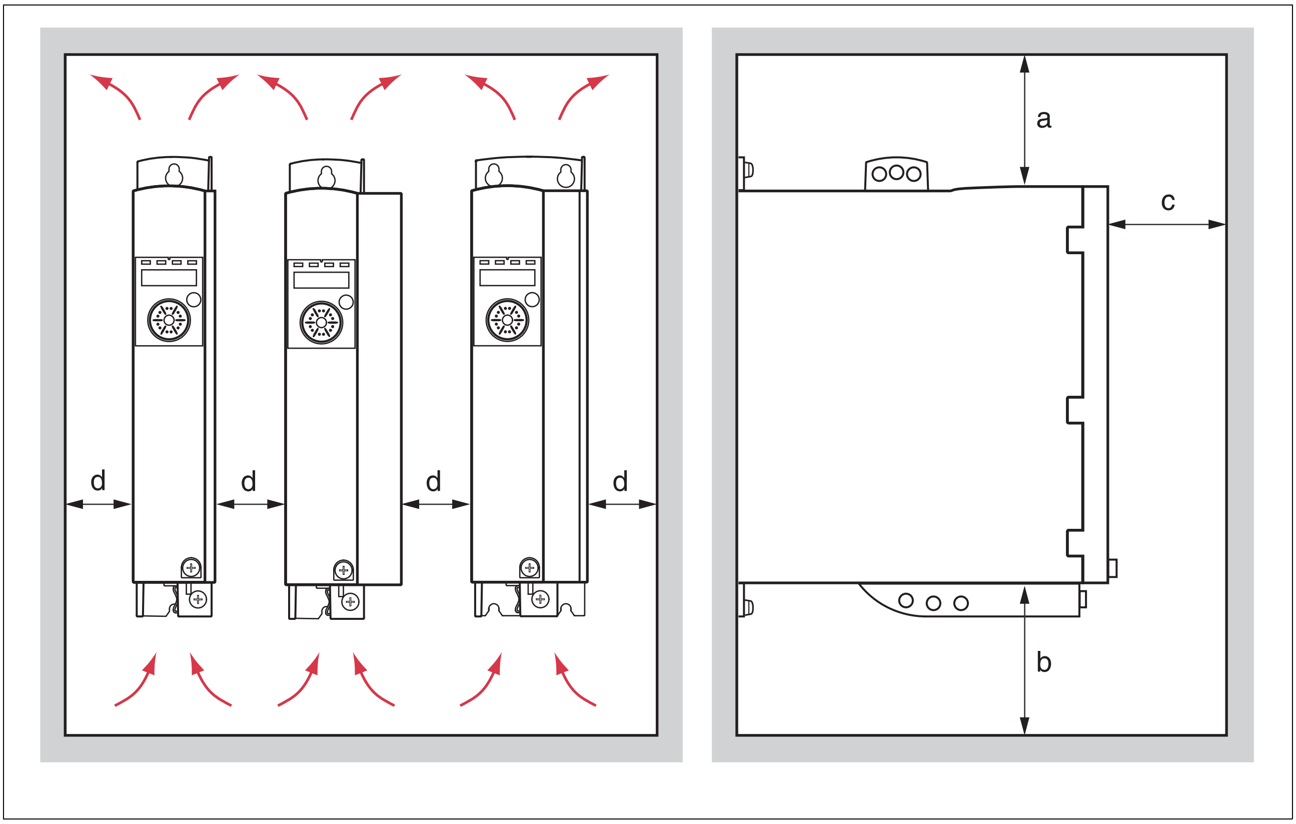

Figure 6.1 Mounting distances and air circulation

Distance	
a ≥ 100 mm (a ≥ 40 in.)	Free space above the device
b ≥ 100 mm (b ≥ 40 in.)	Free space below the device
c ≥ 60 mm (c ≥ 23.5 in.)	Free space in front of the device
d ≥0 mm (d ≥0 in.)	Space between devices for ambient temperature during operation: 0 °C ... +50 °C (32 °F ... 122 °F)

Mounting the device

See chapter 3.2.1 "Dimensional drawings", page 23 for the dimensions of the mounting holes.

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

▶ Note the ambient conditions in chapter 3 "Technical Data", page 21.

▶ Mount the device in a vertical position (±10°).

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6.1.2 Mounting mains filter, mains reactor and braking resistor

External mains filter

The drives have an integrated mains filter.

An additional external mains filter is required in the case of long motor cables. When using external mains filters, verify compliance with all applicable EMC directives.

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▶ Mount the external mains filter above the device.

Mains reactor

A mains reactor must be used under specific conditions as outlined in chapter 5.6 "Mains reactor", page 67. The mains reactor is shipped with an information sheet that provides details on mounting. Information on the electrical installation can be found in chapter 6.2.8 "Connection of power stage supply voltage (CN1)", page 106.

If you install a mains reactor, the power provided by the device is increased, see chapter 3.3.1 "Power stage", page 25. Increased power is only available if the corresponding parameter is set during commissioning.

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External braking resistor

⚠ WARNING
HOT SURFACES
The braking resistor may heat up to over 250°C (480°F) during operation.
• Avoid contact with the hot braking resistor. • Do not allow flammable or heat-sensitive parts in the immediate vicinity of the braking resistor. • Provide for good heat dissipation. • Check the temperature of the braking resistor under the most critical condition by performing a test run.
Failure to follow these instructions can result in death, serious injury or equipment damage.

Braking resistors with degree of protection IP65 may be installed outside the control cabinet in an appropriate environment.

The external braking resistors listed in the Accessories chapter are shipped with an information sheet that provides details on installation.

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6.2 Electrical installation

⚠ DANGER

ELECTRIC SHOCK CAUSED BY FOREIGN OBJECTS OR DAMAGE

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

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

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

⚠ DANGER

ELECTRIC SHOCK CAUSED BY INSUFFICIENT GROUNDING

Insufficient grounding causes the hazard of electric shocks.

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

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

⚠ WARNING

THIS PRODUCT MAY CAUSE DIRECT CURRENT IN THE PROTECTIVE GROUND CONDUCTOR

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

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

See chapter 5.3 "Residual current device", page 65 for conditions for using a residual current device.

Logic types

The product supports logic type 1 and logic type 2 for digital signals. Note that most of the wiring examples show the logic type 1. The STO safety function must be wired using the logic type 1.

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6.2.1 Overview of procedure

- ▶ Take into account the information provided in chapter 5 "Engineering". The selected settings affect the entire installation.
- ▶ The entire installation procedure must be performed without voltage present.

Sequence of installation steps:

Connection	Connection to	Page
Ground connection	Grounding screw	94
Motor phases	CN10	95
Holding brake	CN11	101
DC bus connection	CN9	102
External braking resistor	CN8	103
Power stage supply	CN1	106
Motor encoder (encoder 1)	CN3	111
PTO: Encoder simulation ESIM	CN4	113
PTI: Pulse/Direction P/D	CN5	115
PTI: A/B signals	CN5	115
PTI: CW/CCW	CN5	115
Safety function STO	CN2	118
24V controller supply voltage	CN2	118
Analog inputs	CN6	121
Digital inputs / outputs	CN6	123
Commissioning interface (PC)	CN7	125

Table 6.1 Installation overview

Finally, verify proper installation.

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6.2.2 Connection overview

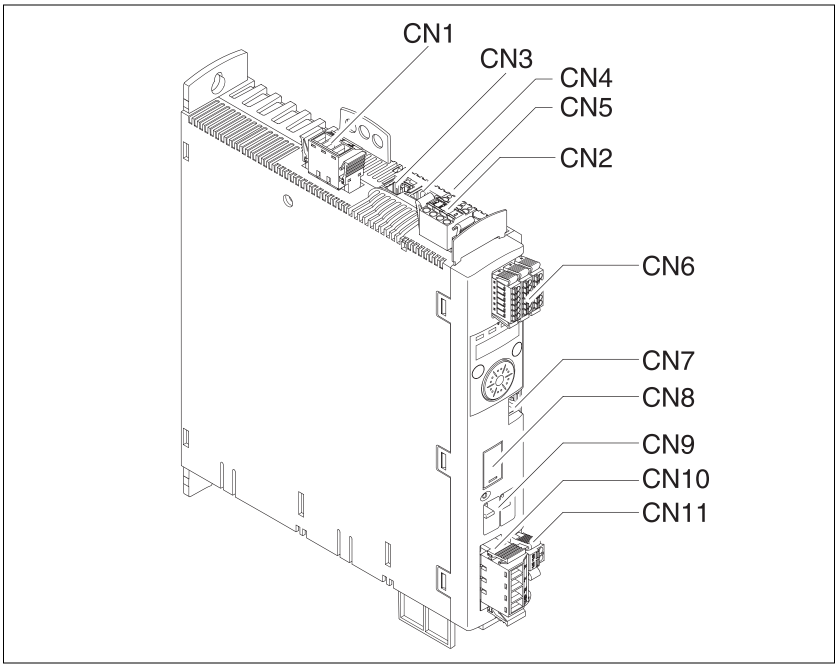


Figure 6.2 Overview of the signal connections

Connection	Assignment
CN1	Power stage supply
CN2	24 controller supply voltage and STO safety function
CN3	Motor encoder (encoder 1)
CN4	PTO (encoder simulation ESIM)
CN5	PTI (A/B signals, P/D-Signale, CW/CCW signals)
CN6	Analog inputs and digital inputs/outputs
CN7	Modbus (commissioning interface)
CN8	External braking resistor
CN9	DC bus connection for parallel operation
CN10	Motor phases
CN11	Holding brake

Table 6.2 Assignment of the signal connections

6.2.3 Connection grounding screw

⚠ DANGER

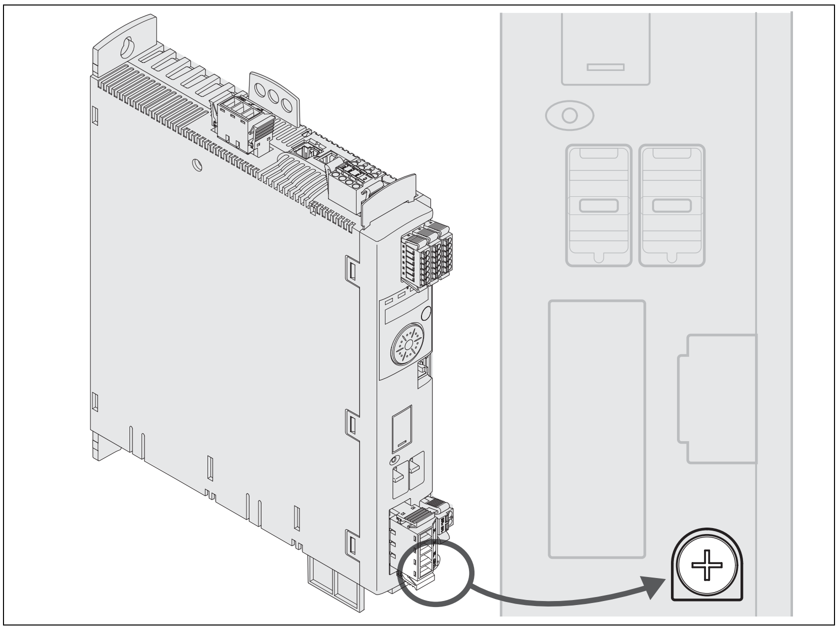
ELECTRIC SHOCK CAUSED BY INSUFFICIENT GROUNDING

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

- Use a protective ground conductor at with least 10 mm^2 (AWG 6) or two protective ground conductors with the cross section of the conductors supplying the power terminals. Verify compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.

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

The central grounding screw of the product is located at the bottom of the front side.



▶ Connect the ground connection of the device to the central ground point of the system.

LXM32•...		
Tightening torque for terminal screws	[Nm] ([lb.in])	5.5 (48.7)

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6.2.4 Connecting the motor phases (CN 10, motor)

⚠ DANGER

ELECTRIC SHOCK

High voltages at the motor connection may occur unexpectedly.

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

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

⚠ WARNING

UNEXPECTED MOVEMENT

Drive systems may perform unexpected movements because of incorrect connection or other errors.

- Operate the device with approved motors only. Even if motors are similar, different adjustment of the encoder system may be a source of hazards.
- Even if the connectors for power connection and encoder match mechanically, this does NOT imply that they may be used.

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

Route the cables from the motor and the encoder to the device (start at the motor). Due to the pre-assembled connectors, this direction is often faster and easier.

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Cable specifications See chapter 5.2 "Cables", page 62 for information on the cables.

Shield:	Required, both ends grounded
Twisted Pair:	-
PELV:	The wires for the holding brake must be PELV-compliant.
Cable composition:	3 wires for motor phases 2 wires for holding brake Cross section: The conductors must have a sufficiently large cross section so that the fuse at the mains connection can trip if required.
Maximum cable length:	Depends on the required limit values for conducted interference, see chapter 3.3.6 "Internal mains filter", page 48, and chapter 3.3.7 "External mains filters (accessories)", page 49.
Special features:	Contains wires for the holding brake

Note the following information:

- You may only connect the original motor cable (with two wires for the holding brake).
- The wires for the holding brake must also be connected to the device at connection CN11 in the case of motors without holding brakes. At the motor end, connect the wires to the appropriate pins for the holding brake; the cable can then be used for motors with or without holding brake. If you do not connect the wires at the motor end, you must isolate each wire individually (inductive voltages).
- Observe the polarity of the holding brake voltage.
- The voltage for the holding brake depends on the controller supply voltage (PELV). Observe the tolerance for the controller voltage and the specified voltage for the holding brake.

▶ Use pre-assembled cables (page 393) to reduce the risk of wiring errors.

Properties of connection terminals CN10

The terminals are approved for fine wire conductors and rigid conductors. Observe the maximum permissible connection cross section. Take into account the fact that wire ferrules increase the conductor cross section. Carefully insert the conductors for maximum current capacity and vibration resistance.

LXM32•U45••, LXM32•U60••, LXM32•U90••, LXM32•D12••, LXM32•D18••, LXM32•D30••		
Connection cross section	[mm^2]	0.75 ... 5.3 (AWG 18 ... AWG 10)
Tightening torque for terminal screws	[Nm] ([lb.in])	0.68 (6.0)
Stripping length	[mm]	6 ... 7

LXM32•D72N4		
Connection cross section	[mm^2]	0.75 ... 10 (AWG 18 ... AWG 8)
Tightening torque for terminal screws	[Nm] ([lb.in])	1.81 (16.0)
Stripping length	[mm]	8 ... 9

Assembling cables Note the dimensions specified when assembling cables.

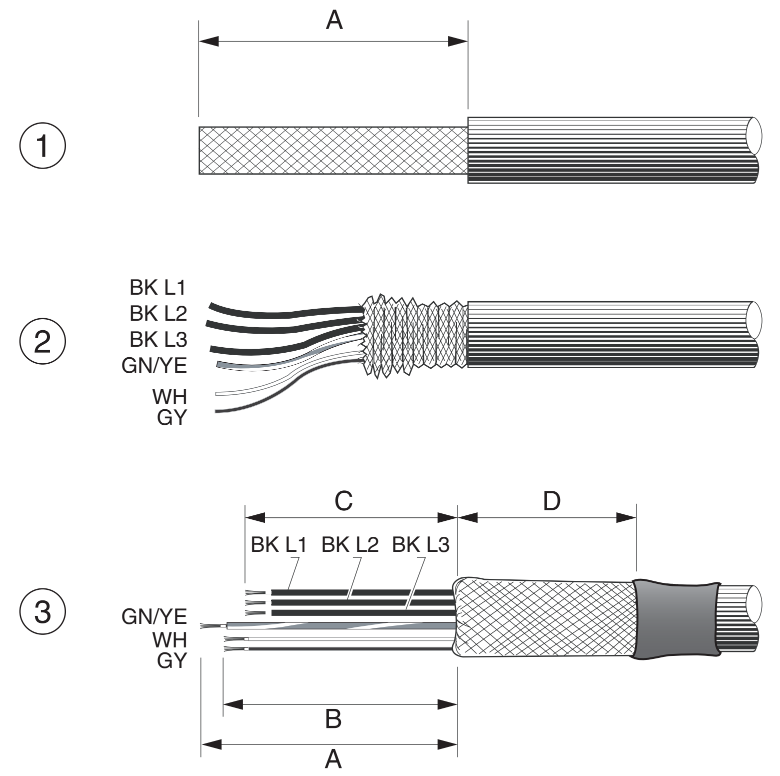

Figure 6.3 Steps (1-3) for assembling the motor cable

LXM32•...		
A	mm	140
B	mm	135
C	mm	130
D	mm	50

- ▶ (1) Strip the cable jacket; length A, see table.
- ▶ (2) Slide the shield braiding back over the cable jacket. The effective shield must have at least length D for connection to the shield clamp.
- ▶ (3) Secure the shield braiding with heat shrink tube. Note that a large surface area of the shield braiding must be connected to the EMC shield clamp.
  Shorten the wires for the holding brake to length B and the three wires for the motor phases to length C. The protective ground conductor has length A.
  Connect the the wires for the holding brake to the device even in the case of motors without holding brakes (inductive voltage). See also chapter 6.2.5 "Holding brake connection (CN11, Brake)", page 101.

Observe the maximum permissible connection cross section. Take into account the fact that wire ferrules increase the conductor cross section.

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Monitoring

The device monitor the motor phases for:

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

Short circuits between the motor phases and the DC bus, the braking resistor or the holding brake wires are not detected.

Wiring diagram motor

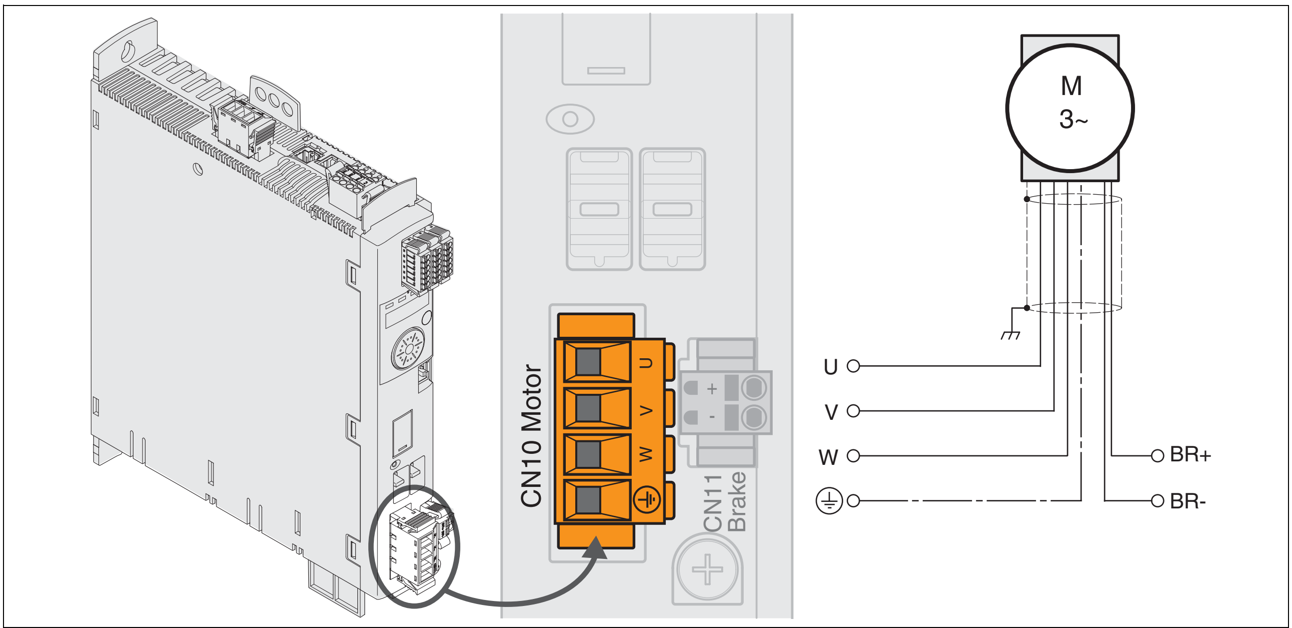

Figure 6.4 Wiring diagram motor with holding brake

Connection	Meaning	Color
U	Motor phase	Black L1 (BK)
V	Motor phase	Black L2 (BK)
W	Motor phase	Black L3 (BK)
PE	Protective ground conductor	Green/yellow (GN/YE)
BR+	Holding brake +	White (WH) or black 5 (BK)
BR-	Holding brake -	Gray (GR) or black 6 (BK)

Connecting the motor cable

- ▶ Note the EMC requirements for the motor cables, see page 58.
- ▶ Connect the motor phases and protective ground conductor to CN10. Verify that the connections U, V, W and PE (ground) match at the motor and the device.
- ▶ Note the tightening torque specified for the terminal screws.
- ▶ Connect the white wire or the black wire with the label 5 to connection BR+ of CN11.
  Connect the gray wire or the black wire with the label 6 to connection BR- of CN11 (see also page 101).
- ▶ Verify that the connector locks snap in properly at the housing.
- ▶ Connect the cable shield to the shield clamp (large surface area contact).

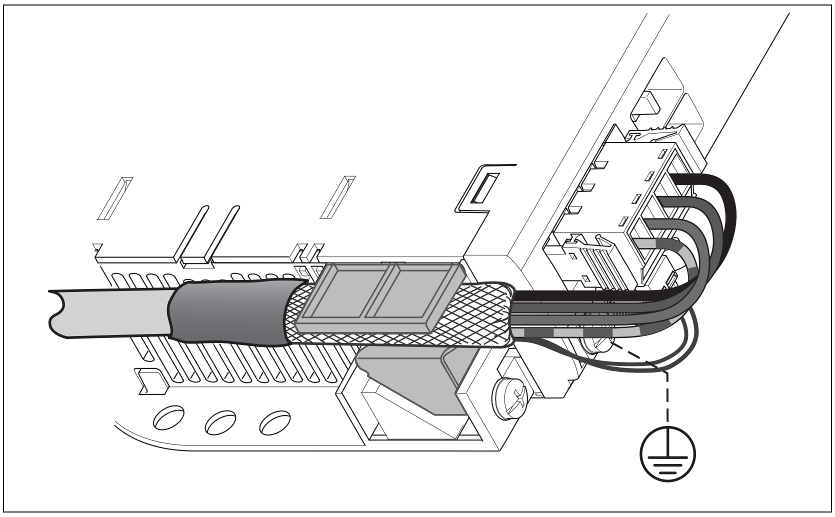

Figure 6.5 Shield clamp motor cable

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6.2.5 Holding brake connection (CN11, Brake)

⚠ DANGER

ELECTRIC SHOCK

High voltages at the motor connection may occur unexpectedly.

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

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

The optional holding brake of a motor is connected to connection CN11. The integrated holding brake controller releases the holding brake when the power stage is enabled. When the power stage is disabled, the holding brake is re-applied.

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

Note the following information:

- You may only connect the original motor cable (with two wires for the holding brake).
- The wires for the holding brake must be connected to the device via connection CN11 even in the case of motors without holding brakes (inductive voltage). The other end of the wires must be isolated or, as in the case of pre-assembled cables, connected to the appropriate pins of the connector at the motor end.
- Observe the polarity of the holding brake voltage.
- The voltage for the holding brake depends on the controller supply voltage (PELV). Observe the tolerance for the controller voltage and the specified voltage for the holding brake.

Properties of spring terminal CN11

LXM32•...		
Maximum terminal current	[A]	1.7
Connection cross section	[mm^2]	0.75 ... 2.5 (AWG 18 ... AWG 14
Stripping length	[mm]	12 ... 13

The terminals are approved for fine wire conductors and rigid conductors. Observe the maximum permissible connection cross section. Take into account the fact that wire ferrules increase the conductor cross section. Carefully insert the conductors for maximum current capacity and vibration resistance.

Wiring diagram of holding brake

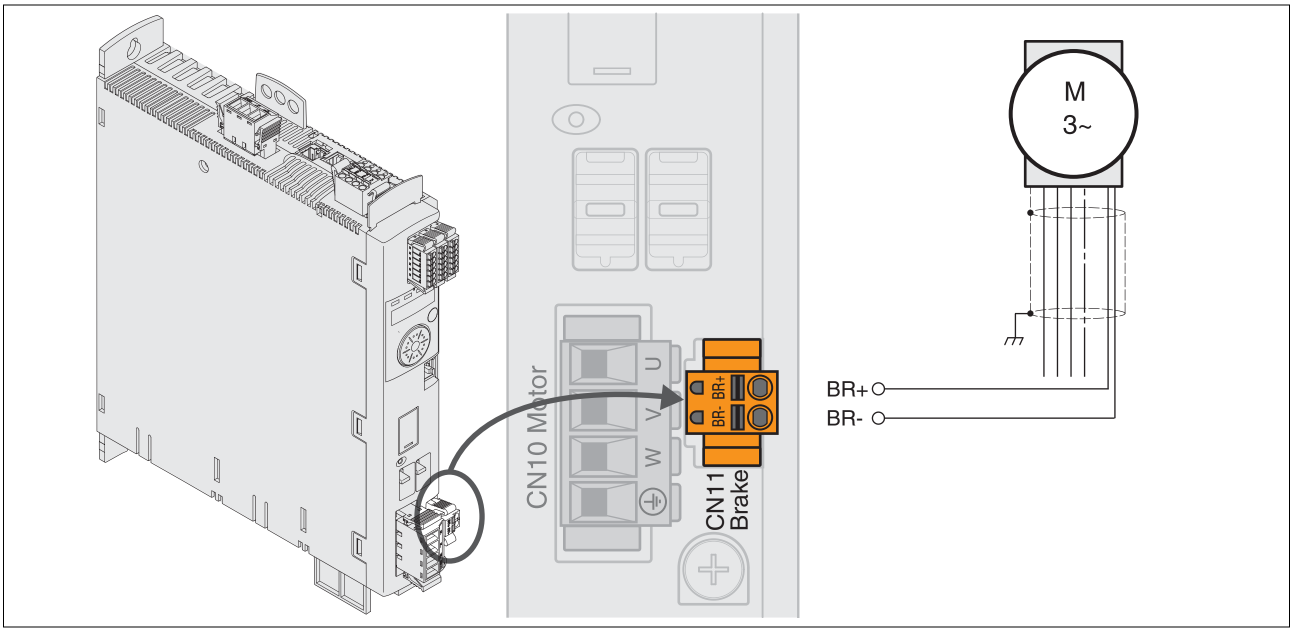

Figure 6.6 Wiring diagram motor with holding brake

Connection	Meaning	Color
U	Motor phase	Black L1 (BK)
V	Motor phase	Black L2 (BK)
W	Motor phase	Black L3 (BK)
PE	Protective ground conductor	Green/yellow (GN/YE)
BR+	Holding brake +	White (WH) or black 5 (BK)
BR-	Holding brake -	Gray (GR) or black 6 (BK)

Cable assembly, wiring and connection are described in chapter 6.2.4 "Connecting the motor phases (CN 10, motor)", page 95.

▶ Verify that the connector locks snap in properly at the housing.

6.2.6 Connecting the DC bus (CN9, DC bus)

⚠ WARNING

DESTRUCTION OF SYSTEM COMPONENTS AND LOSS OF CONTROL

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

- Note the requirements concerning the use of a parallel DC bus connection.

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

Requirements for use

The requirements and limit values for parallel connection of multiple LXM32 via the DC bus can be found on the Internet in the form of Application Note MNA01M001.

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6.2.7 Braking resistor connection (CN8, Braking Resistor)

⚠ WARNING

MOTOR WITHOUT BRAKING EFFECT

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

- Verify that the braking resistor has a sufficient rating.
- Check the parameter settings for the braking resistor.
- Check the I^2t value under the most critical condition by performing a test run. The device switches off at an I^2t value of 100%.
- When performing the calculation and the test run, take into account the fact that the DC bus capacitors can absorb less braking energy at higher mains voltages.

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

Further information on the subject	Page
Technical data braking resistor	44
Rating the braking resistor	70
Mounting the external braking resistor (accessory)	89
Setting the braking resistor parameters	168
Order data for external braking resistors (accessory)	389

6.2.7.1 Internal braking resistor

A braking resistor is integrated in the device to absorb braking energy. The device is shipped with the internal braking resistor active.

6.2.7.2 External braking resistor

An external braking resistor is required for applications in which the motor must be decelerated quickly and the internal braking resistor cannot absorb the excess braking energy.

Selection and rating of the external braking resistor are described in chapter 5.8 "Rating the braking resistor", page 70. For suitable braking resistors, see chapter 12 "Accessories and spare parts", page 392.

Cable specifications

See chapter 5.2 "Cables", page 62 for information on the cables.

Shield:	Required, both ends grounded
Twisted Pair:	-
PELV:	-
Cable composition:	Minimum conductor cross section: Same cross section as power stage supply voltage, see page 106. The conductors must have a sufficiently large cross section so that the fuse at the mains connection can trip if required.
Maximum cable length:	3 m
Special features:	Temperature resistance

The braking resistors recommended in chapter 12 "Accessories and spare parts" have a 3-wire, temperature-resistant cable with a length of 0.75 m to 3 m.

Properties of the connection terminals

LXM32•...		
Connection cross section	[mm^2]	0.75 ... 3.3 (AWG 18 ... AWG 12)
Tightening torque for terminal screws	[Nm]([lb.in])	0.51 (4.5)
Stripping length	[mm]	10 ... 11

The terminals are approved for fine wire conductors and rigid conductors. Observe the maximum permissible connection cross section. Take into account the fact that wire ferrules increase the conductor cross section.

Wire ferrules: If you use wire ferrules, use only wire ferrules with collars for these connection terminals.

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Wiring diagram

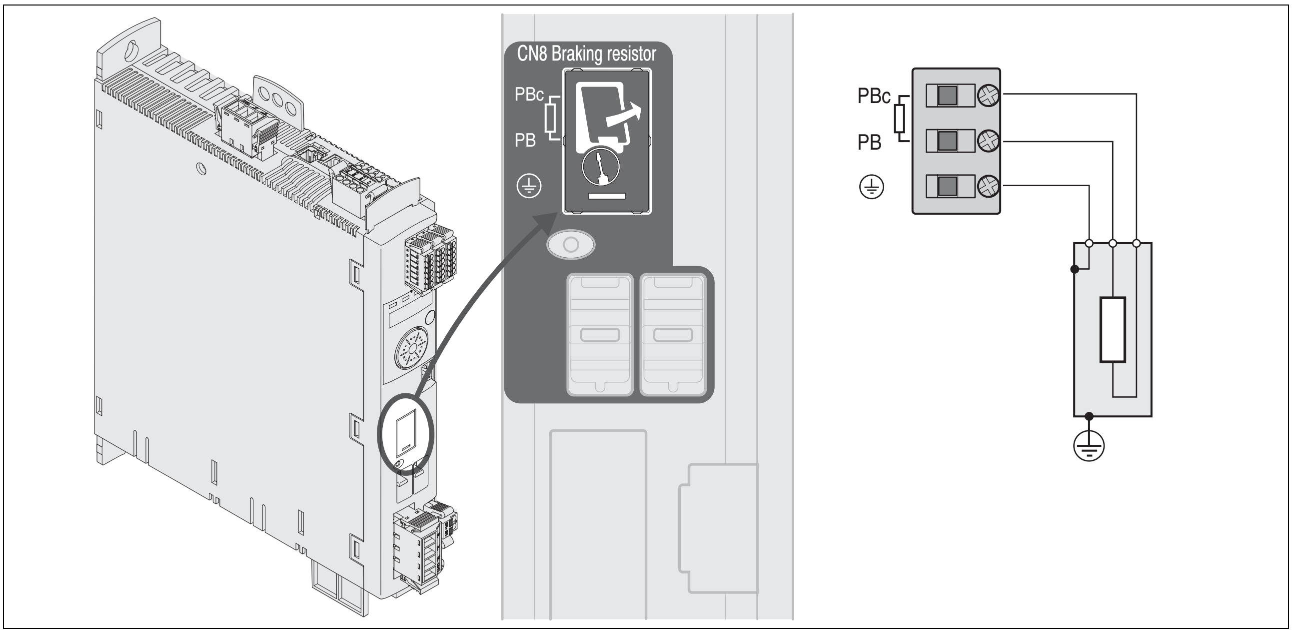

Figure 6.7 Wiring diagram external braking resistor

Connecting the external braking resistor

- Switch off all supply voltages. Observe the safety instructions concerning electrical installation.
- Verify that no voltages are present (safety instructions).
- Remove the cover from the connection.
- Ground the ground connection (PE) of the braking resistor.
- Connect the external braking resistor to the device, see Figure 6.7. Note the tightening torque specified for the terminal screws.
- Connect the cable shield to the shield connection at the bottom of the device (large surface area contact).

The parameter `RESint_ext` is used to switch between the internal and an external braking resistor. The parameter settings for the braking resistor can be found in chapter 7.6.10 "Setting the braking resistor parameters", page168. Verify that the selected external braking resistor is really connected. Test the function of the braking resistor under realistic conditions during commissioning, see chapter 7.6.10 "Setting the braking resistor parameters", page 150.

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6.2.8 Connection of power stage supply voltage (CN1)

⚠ DANGER

ELECTRIC SHOCK CAUSED BY INSUFFICIENT GROUNDING

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

- Use a protective ground conductor at with least 10 mm^2 (AWG 6) or two protective ground conductors with the cross section of the conductors supplying the power terminals. Verify compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.

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

⚠ WARNING

INSUFFICIENT PROTECTION AGAINST OVERCURRENTS

- Use the external fuses specified in "Technical data".
- Do not connect the product to a supply mains whose short-circuit current rating (SCCR) exceeds the permissible value specified in the chapter "Technical Data".

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

CAUTION

DESTRUCTION DUE TO INCORRECT MAINS VOLTAGE

Incorrect mains voltage may destroy the product.

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

Failure to follow these instructions can result in equipment damage.

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

Prior to connecting the device, check the approved mains types, see chapter 3.3.1 "Power stage", page 25.

Cable specifications

Verify the suitability of the cables, see page 62, and the EMC-compliant connection, see page 58.

Shield:	-
Twisted Pair:	-
PELV:	-
Cable composition:	The conductors must have a sufficiently large cross section so that the fuse at the mains connection can trip if required.
Maximum cable length:	-
Special features:	-

Properties of connection terminals CN1

LXM32•U45••, LXM32•U60••, LXM32•U90••, LXM32•D12••, LXM32•D18••, LXM32•D30••		
Connection cross section	[mm^2]	0.75 ... 5.3 (AWG 18 ... AWG 10)
Tightening torque for terminal screws	[Nm] ([lb.in])	0.68 (6.0)
Stripping length	[mm]	6 ... 7

LXM32•D72N4		
Connection cross section	[mm^2]	0.75 ... 10 (AWG 18 ... AWG 8)
Tightening torque for terminal screws	[Nm] ([lb.in])	1.81 (16.0)
Stripping length	[mm]	8 ... 9

The terminals are approved for fine wire conductors and rigid conductors. Observe the maximum permissible connection cross section. Take into account the fact that wire ferrules increase the conductor cross section. Carefully insert the conductors for maximum current capacity and vibration resistance.

Prerequisites for connecting the power stage supply voltage

Note the following information:

- Three-phase devices may only be connected and operated via three phases.
- Use upstream mains fuses. See chapter 3.3.1 "Power stage", page 25 for recommended ratings and fuse types.
- Observe the EMC requirements. If necessary, use surge arresters, mains filters and mains reactors, see page 67.
- If you use an external mains filter, the mains cable must be shielded and grounded at both ends if the length between the external mains filter and the device exceeds 200 mm.
- See page 21 for a UL-compliant design.
- Due to high leakage currents, use a protective ground conductor at with least 10 mm^2 (AWG 6) or two protective ground conductors with the cross section of the conductors supplying the power terminals. Verify compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.

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Accessories: Mains reactor and external mains filter

Note the information on the following accessories: mains reactor and external mains filter.

Further information on the subject	Page
Technical data mains reactor (accessory)	50
Engineering information mains reactor (accessory)	67
Mounting the mains reactor (accessory)	89
Order data mains reactor (accessory)	393

Further information on the subject	Page
Technical data external mains filters (accessory)	49
Engineering information external mains filters (accessory)	68
Mounting the external mains filter (accessory)	89
Order data external mains filters (accessory)	393

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Connecting a single-phase device

Figure 6.8 shows an overview for the connection of the power stage supply voltage for a single-phase device. The figure also shows the wiring of an external mains filter and a mains reactor which are available as accessories.

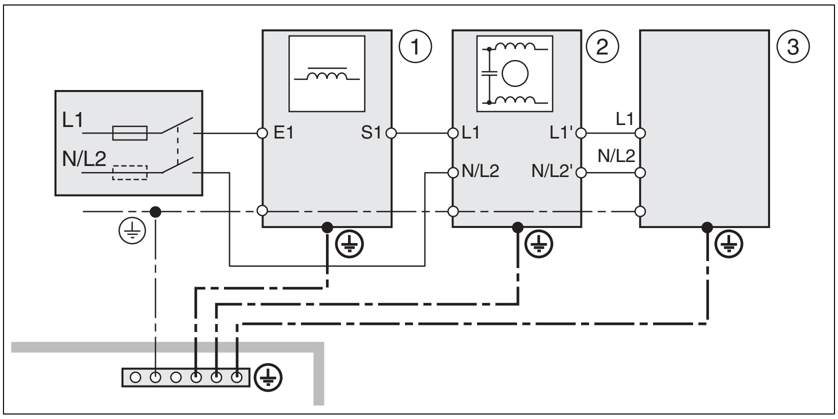

Figure 6.8 Overview power stage supply voltage for single-phase device

(1) Mains reactor (accessory)
(2) External mains filter (accessory)
(3) Drives

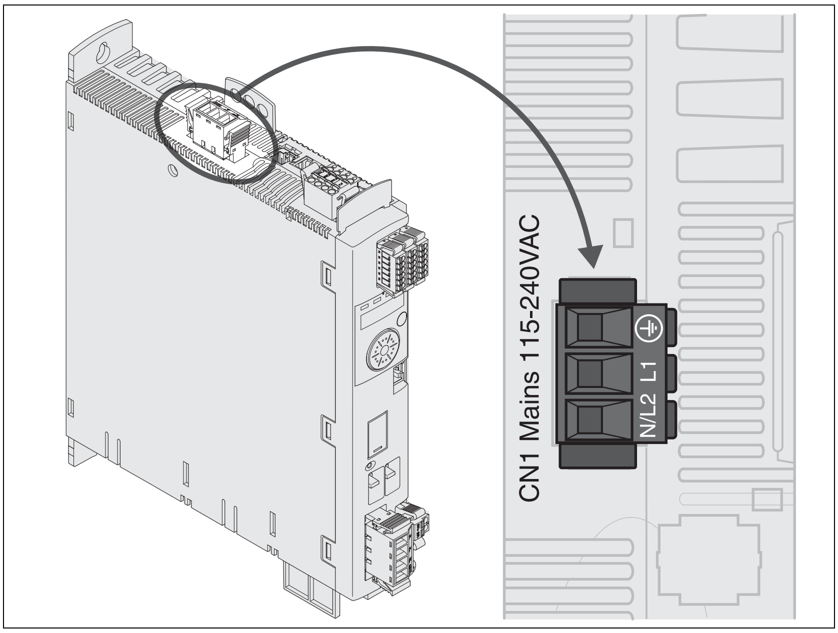

Figure 6.9 Wiring diagram power stage supply voltage for single-phase device.

- ▶ Verify the type of mains. See chapter 3.3.1 "Power stage", page 25 for the approved mains types.
- ▶ Connect the mains cable (Figure 6.9). Note the tightening torque specified for the terminal screws.
- ▶ Verify that the connector locks snap in properly at the housing.

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Connecting a three-phase device

Figure 6.10 shows an overview for the connection of the power stage supply voltage for a three-phase device. The figure also shows the wiring of an external mains filter and a mains reactor which are available as accessories.

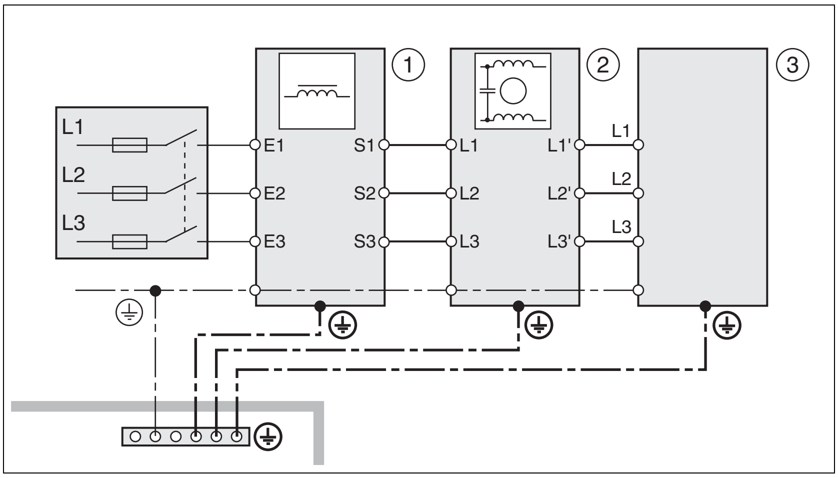

Figure 6.10 Wiring diagram, power stage supply voltage for three-phase device

(1) Mains reactor (accessory)
(2) External mains filter (accessory)
(3) Drives

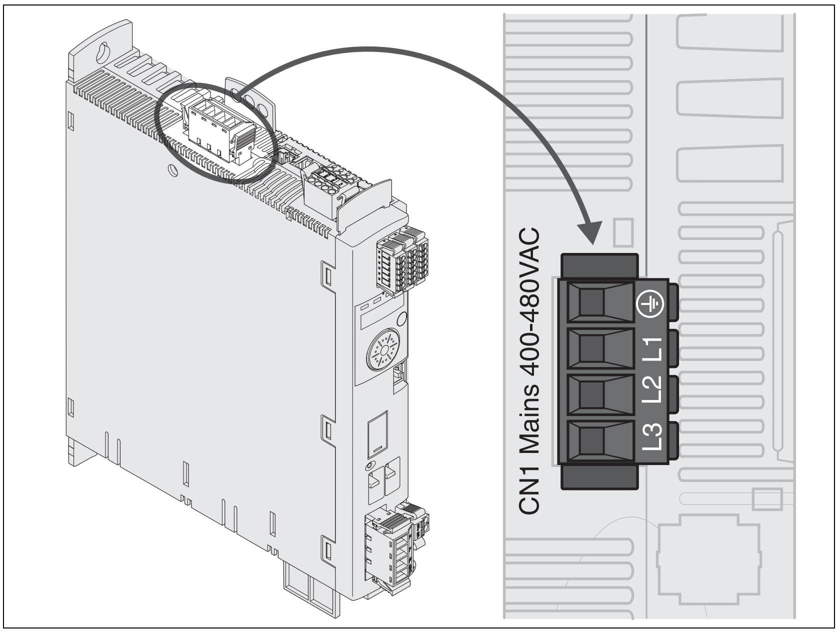

Figure 6.11 Wiring diagram power stage supply voltage for three-phase device

- ▶ Verify the type of mains. See chapter 3.3.1 "Power stage", page 25 for the approved mains types.
- ▶ Connect the mains cable (Figure 6.11). Note the tightening torque specified for the terminal screws.
- ▶ Verify that the connector locks snap in properly at the housing.

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6.2.9 Connecting the motor encoder (CN3)

Function and encoder type

The motor encoder is a Hiperface encoder integrated in the motor. It provides the device with information on the motor position (analog and digital).

Note the information on approved motors, see chapter 3.3 "Electrical Data".

Cable specifications

See chapter 5.2 "Cables", page 62 for information on the cables.

Shield:	Required, both ends grounded
Twisted Pair:	Required
PELV:	Required
Cable composition:	6*0.14 mm^2 + 2*0.34 mm^2 (6*AWG 24 + 2*AWG 20)
Maximum cable length:	100 m
Special features:	Fieldbus cables are not suitable for connecting encoders.

Wiring diagram

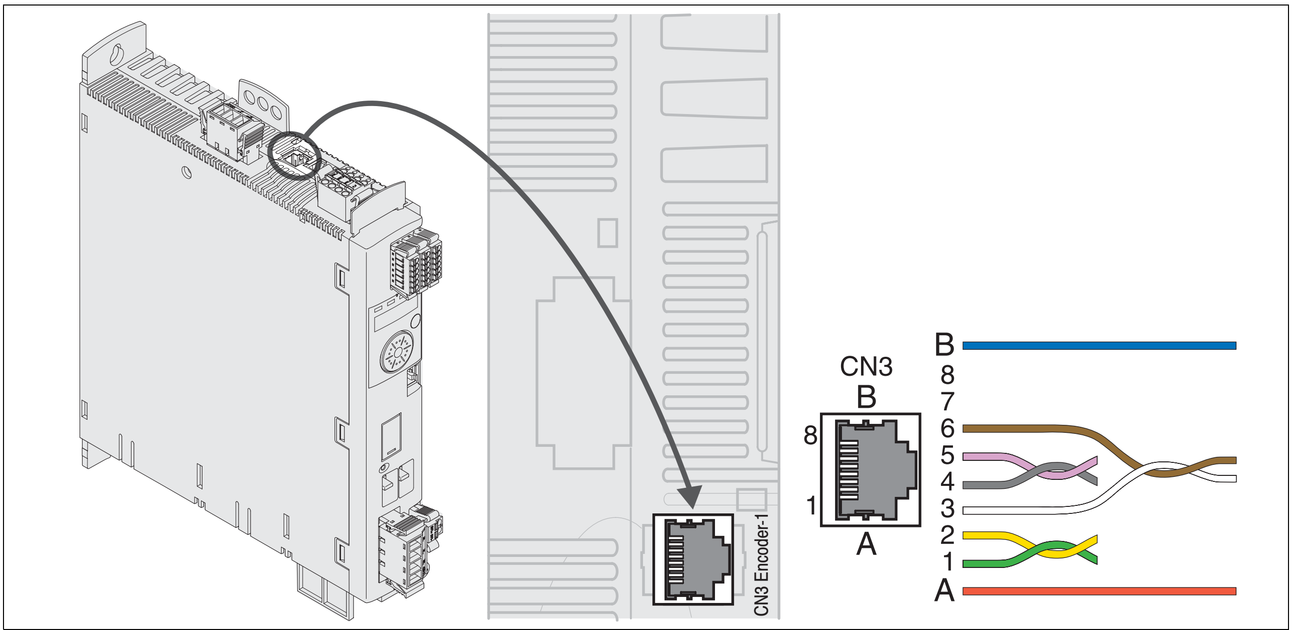

Figure 6.12 Wiring diagram motor encoder

Pin	Signal	Motor, pin	Pair	Meaning	I/O
1	COS+	9	2	Cosine signal	I
2	REFCOS	5	2	Reference for cosine signal	I
3	SIN+	8	3	Sine signal	I
6	REFSIN	4	3	Reference for sine signal	I
4	Data	6	1	Receive data, transmit data	I/O
5	$\overline{\text{Data}}$	7	1	Receive data and transmit data, inverted	I/O
7	reserved		4	Not assigned	
8	reserved		4	Not assigned	
A	ENC+10V_OUT	10	5	Encoder supply	O
B	ENC_0V	11	5	Reference potential for encoder supply	
	SHLD			Shield	

Connecting the motor encoder

- ▶ Verify that wiring, cables and connected interface meet the PELV requirements.
- ▶ Note the EMC requirements for encoder cables, page 58. Use equipotential bonding conductors for equipotential bonding.
- ▶ Connect the connector to CN3, Encoder -1.
- ▶ Verify that the connector locks snap in properly at the housing.

Route the cables from the motor and the encoder to the device (start at the motor). Due to the pre-assembled connectors, this direction is often faster and easier.

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6.2.10 Connection PTO (CN4, Pulse Train Out)

5 V signals are available at the PTO (Pulse Train Out, CN4) output. Depending on parameter `PTO_mode`, these signals are ESIM signals (encoder simulation) or logically fed through PTI input signals (P/D signals, A/B signals, CW/CCW signals). The PTO output signals can be used as PTI input signals for another device. The signal level corresponds to RS422, see chapter 3.3.3.1 "Output PTO (CN4)", page 37. The PTO output supplies 5 V signals, even if the PTI input signal is a 24 V signal.

Cable specifications

See chapter 5.2 "Cables", page 62 for information on the cables.

Shield:	Required, both ends grounded
Twisted Pair:	Required
PELV:	Required
Cable composition:	8*0.14 mm^2 (8*AWG 24)
Maximum cable length:	100 m
Special features:	-

- ▶ Use equipotential bonding conductors, see page 62.
- ▶ Use pre-assembled cables (page 391) to reduce the risk of wiring errors.

Wiring diagram

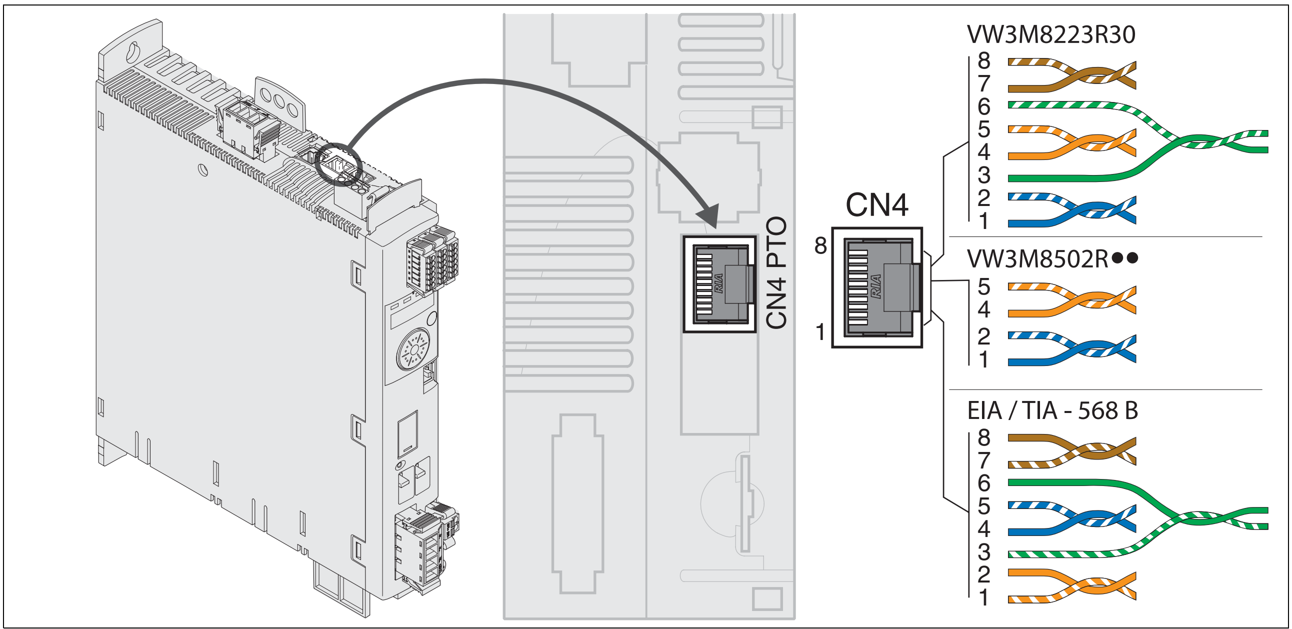

Figure 6.13 Wiring diagram Pulse Train Out (PTO)

PTO: ESIM signals

Pin	Signal	Pair	Meaning	I/O
1	ESIM_A	2	ESIM channel A	O (5 V)
2	$\overline{\text{ESIM\_A}}$	2	ESIM channel A, inverted	O (5 V)
4	ESIM_B	1	ESIM channel B	O (5 V)
5	$\overline{\text{ESIM\_B}}$	1	ESIM channel B, inverted	O (5 V)
3	ESIM_I	3	ESIM index pulse	O (5 V)
6	$\overline{\text{ESIM\_I}}$	3	ESIM index pulse, inverted	O (5 V)
7		4	Reference potential	
8		4	Reference potential	

PTO: logically fed through signals PTI signals

At the PTO output, the PTI input signals can be made available again to control a subsequent device (daisy chain). Depending on the input signal, the output signal can be of type P/D signal, A/B signal or CW/CCW signal. The PTO output supplies 5 V signals.

Pin	P/D signal [1)]	A/B signal [2)]	CW/CCW signal [3)]	Pair	Meaning	I/O
1	PULSE(5)	ENC_A(5)	CW(5)	2	See PTI connection, pin 1	O (5 V)
2	$\overline{\text{PULSE}}$	$\overline{\text{ENC\_A}}$	$\overline{\text{CW}}$	2	See PTI connection, pin 2	O (5 V)
4	DIR(5)	ENC_B(5)	CCW(5)	1	See PTI connection, pin 4	O (5 V)
5	$\overline{\text{DIR}}$	$\overline{\text{ENC\_B}}$	$\overline{\text{CCW}}$	1	See PTI connection, pin 5	O (5 V)

1) See page 113
2) See page 116
3) See page 116

Connecting PTO

▶ Connect the connector to CN4. If you do not use a pre-assembled cable, verify correct pin assignment.

▶ Verify that the connector locks snap in properly at the housing.

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6.2.11 Connection PTI (CN5, Pulse Train In)

P/D (pulse/direction), A/B signals or CW/CCW signals can be connected to the PTI connection (Pulse Train In, CN5).
It is possible to connect 5 V signals or 24 V signals, see chapter 3.3.3.2 "Input PTI (CN5)", page 38. Pin assignments and cables are different.

⚠ WARNING

UNEXPECTED MOVEMENT

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

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

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

Cable specifications PTI

See chapter 5.2 "Cables", page 62 for information on the cables.

Shield:	Required, both ends grounded
Twisted Pair:	Required
PELV:	Required
Minimum conductor cross section:	0.14 mm^2 (AWG 24)
Maximum cable length:	100 m with RS422 10 m with push-pull 1 m with open collector
Special features:	-

▶ Use equipotential bonding conductors, see page 62.

▶ Use pre-assembled cables (page 391) to reduce the risk of wiring errors.

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6.2.11.1 Connection assignment PTI 5 V

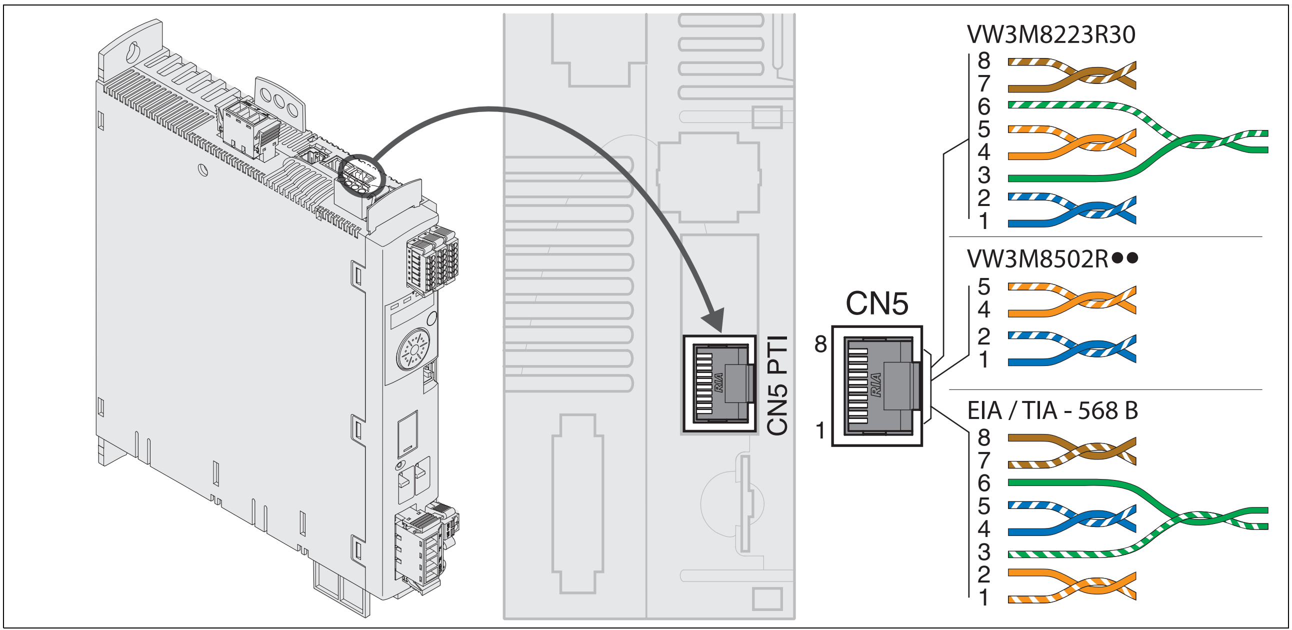

Figure 6.14 Wiring diagram Pulse Train In (PTI) 5 V

P/D signals 5 V

Pin	Signal	Pair	Meaning	I/O
1	PULSE(5)	2	Pulse 5V	I (5 V)
2	$\overline{\text{PULSE}}$	2	Pulse, inverted	I (5 V)
4	DIR(5)	1	Direction 5V	I (5 V)
5	$\overline{\text{DIR}}$	1	Direction, inverted	I (5 V)

A/B signals 5 V

Pin	Signal	Pair	Meaning	I/O
1	ENC_A(5)	2	Encoder channel A 5V	I (5 V)
2	$\overline{\text{ENC\_A}}$	2	Encoder channel A, inverted	I (5 V)
4	ENC_B(5)	1	Encoder channel B 5V	I (5 V)
5	$\overline{\text{ENC\_B}}$	1	Encoder channel B, inverted	I (5 V)

CW/CCW signals 5 V

Pin	Signal	Pair	Meaning	I/O
1	CW(5)	2	Pulse positive 5V	I (5 V)
2	$\overline{\text{CW}}$	2	Pulse positive, inverted	I (5 V)
4	CCW(5)	1	Pulse negative 5V	I (5 V)
5	$\overline{\text{CCW}}$	1	Pulse negative, inverted	I (5 V)

Connecting Pulse Train IN (PTI) 5 V

▶ Connect the connector to CN5. If you do not use a pre-assembled cable, verify correct pin assignment.

▶ Verify that the connector locks snap in properly at the housing.

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6.2.11.2 Connection assignment PTI 24 V

Note that the wire pairs for 24 V signals require assignments different from those for 5 V signals. Use a cable that complies with the cable specifications and assemble it as shown below.

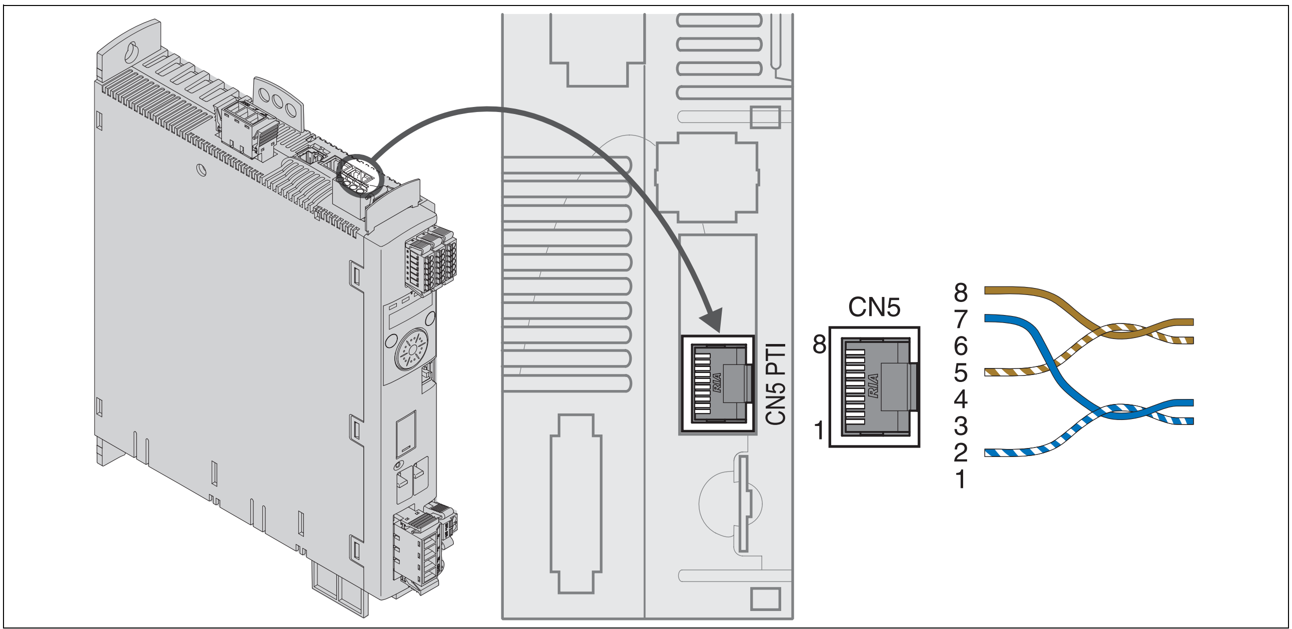

Figure 6.15 Wiring diagram Pulse Train In (PTI) 24 V

P/D signals 24 V

Pin	Signal	Pair	Meaning	I/O
7	PULSE(24)	A	Pulse 24V	I (24 V)
2	$\overline{\text{PULSE}}$	A	Pulse, inverted	I (24 V)
8	DIR(24)	B	Direction 24V	I (24 V)
5	$\overline{\text{DIR}}$	B	Direction, inverted	I (24 V)

A/B signals 24 V

Pin	Signal	Pair	Meaning	I/O
7	ENC_A(24)	A	Encoder channel A 24V	I (24 V)
2	$\overline{\text{ENC\_A}}$	A	Encoder channel A, inverted	I (24 V)
8	ENC_B(24)	B	Encoder channel B 24V	I (24 V)
5	$\overline{\text{ENC\_B}}$	B	Encoder channel B, inverted	I (24 V)

CW/CCW signals 24 V

Pin	Signal	Pair	Meaning	I/O
7	CW(24)	A	Pulse positive 24V	I (24 V)
2	$\overline{\text{CW}}$	A	Pulse positive, inverted	I (24 V)
8	CCW(24)	B	Pulse negative 24V	I (24 V)
5	$\overline{\text{CCW}}$	B	Pulse negative, inverted	I (24 V)

Connecting Pulse Train In (PTI) 24 V

▶ Connect the connector to CN5. Verify correct pin assignment and correct pairing.

▶ Verify that the connector locks snap in properly at the housing.

6.2.12 Connection the controller supply voltage and STO (CN2, DC Supply and STO)

⚠ DANGER

ELECTRIC SHOCK CAUSED BY INCORRECT POWER SUPPLY UNIT

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

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

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

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.

Safety function STO

⚠ WARNING

LOSS OF SAFETY FUNCTION

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

- Observe the requirements for using the safety function.

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

Information on the signals of the STO safety function can be found in chapter 5.9 "Safety function STO ("Safe Torque Off")". If the safety function is NOT required, the inputs $\overline{\text{STO\_A}}$ and $\overline{\text{STO\_B}}$ must be connected to +24VDC.

Cable specifications CN2

See chapter 5.2 "Cables", page 62 for information on the cables.

Shield:	- 1)
Twisted Pair:	-
PELV:	Required
Minimum conductor cross section:	0.75 mm^2 (AWG 18)
Maximum cable length:	100 m
Special features:	-

1) See 5.9.3 "Requirements for using the safety function"

Properties of spring terminal CN2

LXM32•...		
Maximum terminal current	[A]	16 1)
Connection cross section	[mm^2]	0.5 ... 2.5 (AWG 20 ... AWG 14)
Stripping length	[mm]	12 ... 13

1) Note the maximum permissible terminal current when connecting several devices.

The terminals are approved for fine wire conductors and rigid conductors. Observe the maximum permissible connection cross section. Take into account the fact that wire ferrules increase the conductor cross section. Carefully insert the conductors for maximum current capacity and vibration resistance.

Permissible terminal current of controller supply voltage

- Connection CN2, pins 3 and 7 as well as CN2, pins 4 and 8 (see Figure 6.16) can be used as 24V/0V connections for additional consumers.[1] Note the maximum permissible terminal current ("Properties of spring terminal CN2").
- The voltage at the holding brake output depends on the controller supply voltage. Note that the current of the holding brake also flows via this terminal.
- As long as the controller supply voltage is switched on, the position of the motor will remain the same, even if the power stage supply voltage is switched off.

1. In the connector, the following pins are connected: pin 1 to pin 5, pin 2 to pin 6, pin 3 to pin 7 and pin 4 to pin 8.

Wiring diagram

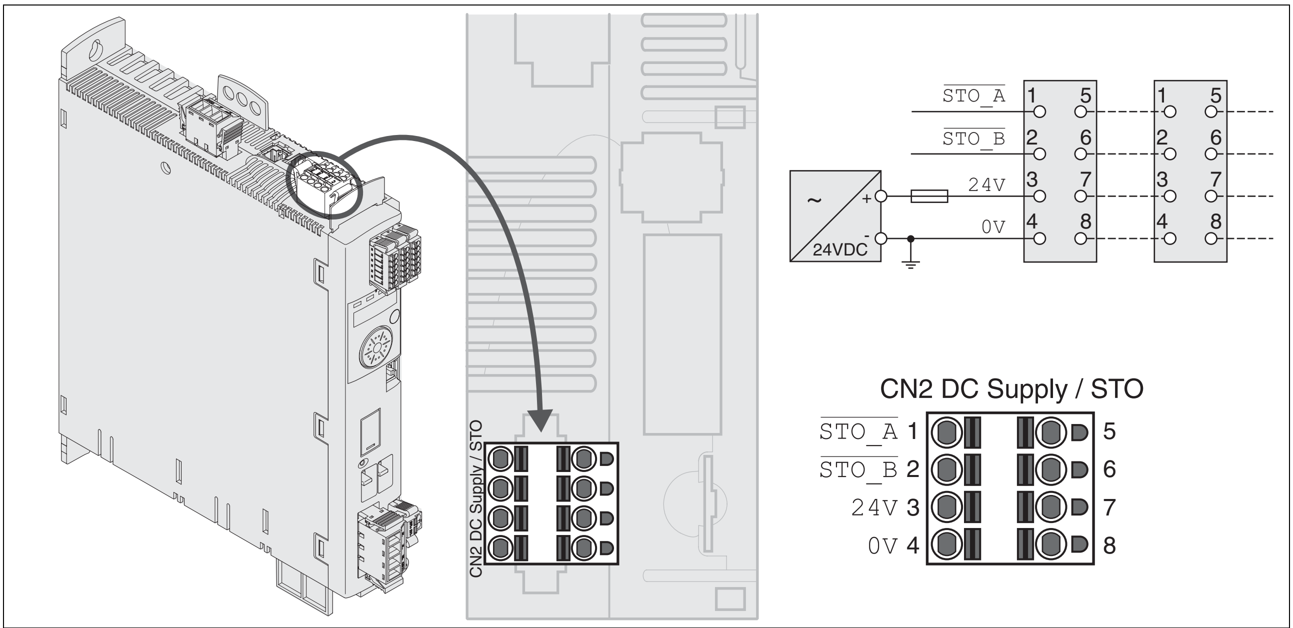

Figure 6.16 Wiring diagram controller supply voltage

Pin	Signal	Meaning
1, 5	STO_A	Safety function STO: Dual-channel connection, connection A
2, 6	STO_B	Safety function STO: Dual-channel connection, connection B
3, 7	+24VDC	24 V controller supply voltage
4, 8	0VDC	Reference potential for 24V controller supply voltage; Reference potential for STO

Connecting the safety function STO

- ▶ Verify that wiring, cables and connected interfaces meet the PELV requirements.
- ▶ Connect the safety function in accordance with the specifications in chapter 5.9 "Safety function STO ("Safe Torque Off")", page 77.

Connecting the controller supply voltage

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

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6.2.13 Connecting the analog inputs (CN6)

Cable specifications

See chapter 62 for information on the cables.

Shield:	Required, grounded at the device, other end insulated or grounded via capacitor (for example, 10nF)
PELV:	Required
Cable composition:	2* 2*0.25 mm^2, (2* 2*AWG 22)
Maximum cable length:	10 m
Special features:	

Properties of spring terminal CN6

LXM32•...		
Connection cross section	[mm^2]	0.2 ... 1.0 (AWG 24 ... AWG 16)
Stripping length	[mm]	10

Wiring diagram

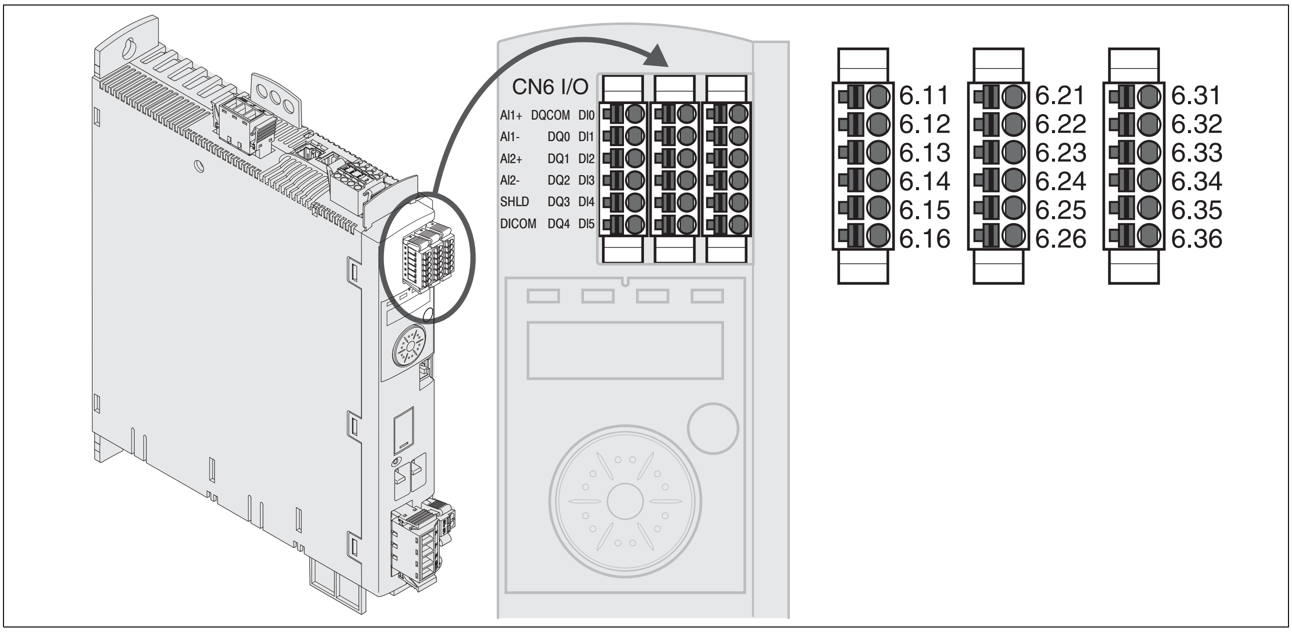

Figure 6.17 Wiring diagram analog inputs

Pin	Signal	1)	Meaning	I/O
6.11	`AI1+`		Analog input 1, ±10V, for example, for reference value current or reference value speed of rotation	I
6.12	`AI1-`		Reference potential to `AI1+`, pin 1	I
6.13	`AI2+`		Analog input 2, ±10V, for example for current limitation or limitation of speed of rotation	I
6.14	`AI2-`		Reference potential to `AI2+`, pin 3	I
6.15	`SHLD`		Shield connection	
6.16	`DI_COM`	**X**	Reference potential to `DI0` ... `DI5` at CN6.31 ... CN6.36	

1) Connector coding, X=coding

The connectors CN6.1, CN6.2 and CN6.3 are coded. Verify correct assignment when connecting them.

Reference values and limits

The ±10 V scaling of the analog reference values and analog limits can be specified for operation, see page 154.

Connecting the analog inputs

▶ Wire the analog inputs at CN6.

▶ Ground the shield to pin 6.15.

▶ Verify that the connector locks snap in properly at the housing.

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6.2.14 Connecting the digital inputs/outputs (CN6)

The device has configurable inputs and configurable outputs. The standard assignment and the configurable assignment depends on the selected operating mode. For more information, see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

Cable specifications

See chapter 5.2 "Cables" for information on the cables.

Shield:	-
Twisted Pair:	-
PELV:	Required
Cable composition:	0.25 mm^2, (AWG 22)
Maximum cable length:	30 m
Special features:	

Properties of spring terminal CN6

LXM32•...		
Connection cross section	[mm^2]	0.2 ... 1.0 (AWG 24 ... AWG 16)
Stripping length	[mm]	10

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Wiring diagram

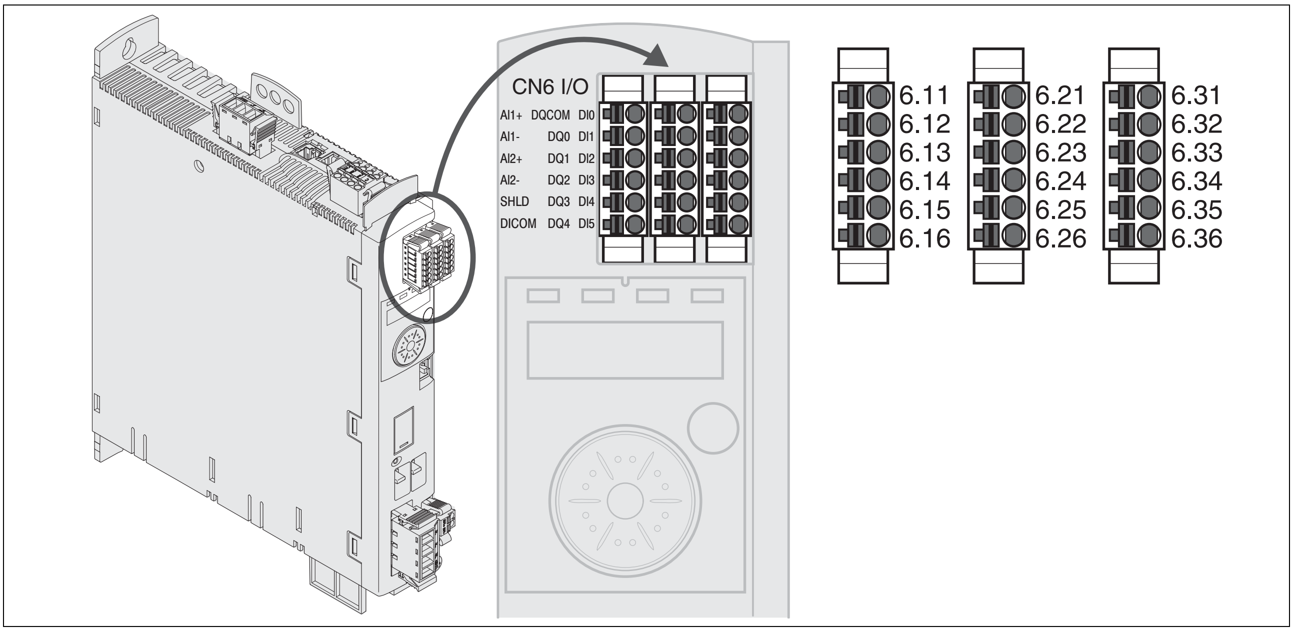

Figure 6.18 Wiring diagram, digital inputs/outputs

Pin	Signal	1)	Meaning	I/O
CN6.21	`DQ_COM`		Reference potential digital outputs	
CN6.22	`DQ0`		Digital output 0	O (24 V)
CN6.23	`DQ1`		Digital output 1	O (24 V)
CN6.24	`DQ2`		Digital output 2	O (24 V)
CN6.25	`DQ3`	**X**	Digital output 3	O (24 V)
CN6.26	`DQ4`		Digital output 4	O (24 V)

1) Connector coding, X=coding

Pin	Signal	1)	Meaning	I/O
CN6.31	`DI0`		Digital input 0	I (24 V)
CN6.32	`DI1`		Digital input 1	I (24 V)
CN6.33	`DI2`		Digital input 2	I (24 V)
CN6.34	`DI3`	**X**	Digital input 3	I (24 V)
CN6.35	`DI4`		Digital input 4	I (24 V)
CN6.36	`DI5`		Digital input 5	I (24 V)

1) Connector coding, X=coding

Pin	Signal		Meaning	I/O
	`DI_COM`		Reference potential digital inputs: CN6.16	

The connectors are coded. Verify correct assignment when connecting them.

The configuration and the standard assignment of the inputs and outputs are described in chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

Connecting the digital inputs/ outputs

▶ Wire the digital connections to CN6.

▶ Verify that the connector locks snap in properly at the housing.

6.2.15 Connection of PC with commissioning software CN7)

CAUTION

DAMAGE TO PC

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

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

Failure to follow these instructions can result in equipment damage.

Cable specifications

See chapter 5.2 "Cables", page 62 for information on the cables.

Shield:	Required, both ends grounded
Twisted Pair:	Required
PELV:	Required
Cable composition:	8*0.25 mm^2, (8*AWG 22)
Maximum cable length:	100 m
Special features:	-

Connecting a PC

A PC with commissioning software can be connected for commissioning. The PC is connected via a bidirectional USB/RS485 converter, see chapter Accessories, page 389.

Wiring diagram

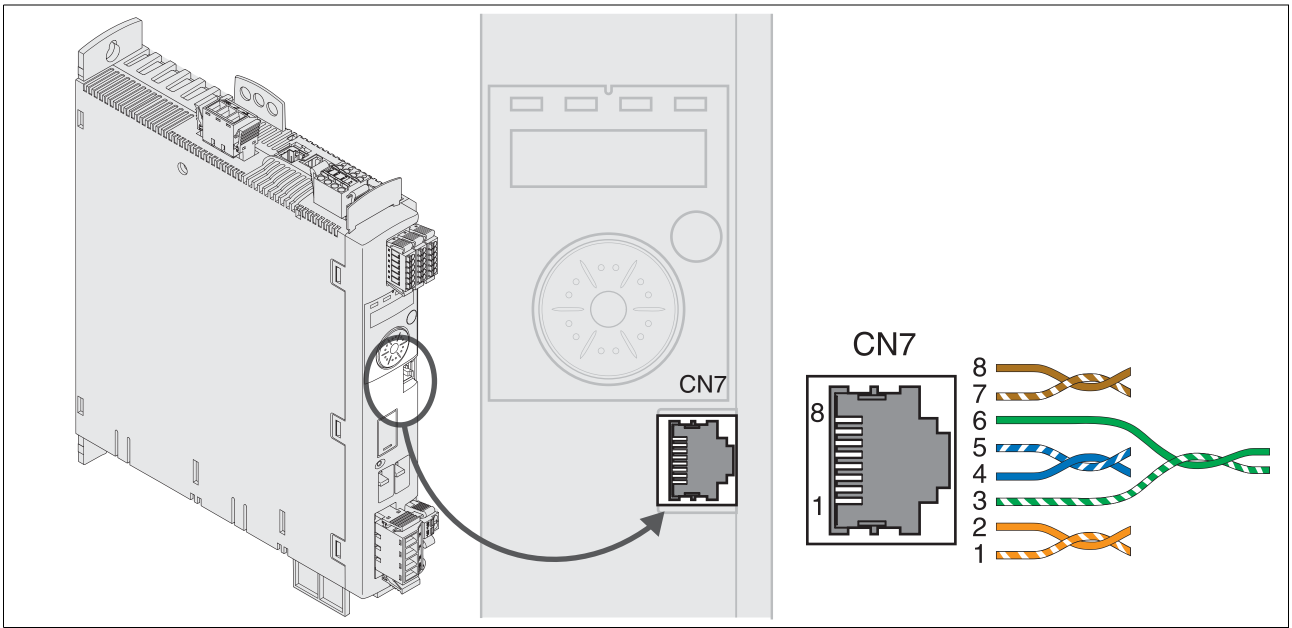

Figure 6.19 Wiring diagram PC with commissioning software

Pin	Signal	Meaning	I/O
1	reserved	Reserved	-
2	reserved	Reserved	-
3	reserved	Reserved	-
6	reserved	Reserved	-
4	`MOD_D1`	Bidirectional transmit/receive signal	RS485 level
5	`MOD_D0`	Bidirectional transmit/receive signal, inverted	RS485 level
7	`MOD+10V_OUT`	10 V power supply, max. 100 mA	O
8	`MOD_0V`	Reference potential to `MOD+10V_OUT`	

▶ Verify that the connector locks snap in properly at the housing.

6.3 Checking installation

Verify proper installation:

▶ Check the mechanical installation of the entire drive system:

- Does the installation meet the specified distance requirements?
- Did you tighten all fastening screws with the specified tightening torque?

▶ Check the electrical connections and the cabling:

- Did you connect all protective ground conductors?
- Do all fuses have the correct rating; are the fuses of the specified type?
- Did you connect both ends of all live cables or insulate them (no exposed cable ends)?
- Did you properly connect and install all cables and connectors?
- Are the mechanical locks of the connectors correct and effective?
- Did you properly connect the signal wires?
- Are the required shield connections EMC-compliant?
- Did you take all measures for EMC compliance?

▶ Verify that all covers and seals of the control cabinet are properly installed to meet the required degree of protection.

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7 Commissioning

7

This chapter describes how to commission the product.

7.1 Basic information

An alphabetically sorted overview of the 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 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

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 error 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.

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⚠ WARNING

MOTOR WITHOUT BRAKING EFFECT

If power outage, functions or errors cause the power stage to be switched off, the motor is no longer decelerated in a controlled way and may cause damage.

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

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

⚠ WARNING

UNEXPECTED MOVEMENT

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

- Run initial tests 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.

⚠ WARNING

HOT SURFACES

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

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

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

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7.2 Overview

7.2.1 Commissioning steps

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

To be done

6.3 "Checking installation"
7.6 "Commissioning procedure"
7.6.1 "Switching on the device for the first time"
7.6.2 "Operating state (state diagram)"
7.6.3 "Setting basic parameters and limit values"
7.6.4 "Analog inputs"
7.6.5 "Digital inputs / outputs"
7.6.6 "Testing the safety function STO"
7.6.7 "Holding brake"
7.6.8 "Checking the direction of movement"
7.6.9 "Setting parameters for encoder"
7.6.10 "Setting the braking resistor parameters"
7.6.11 "Autotuning the device"
7.6.12 "Enhanced settings for autotuning"

7.2.2 Commissioning tools

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

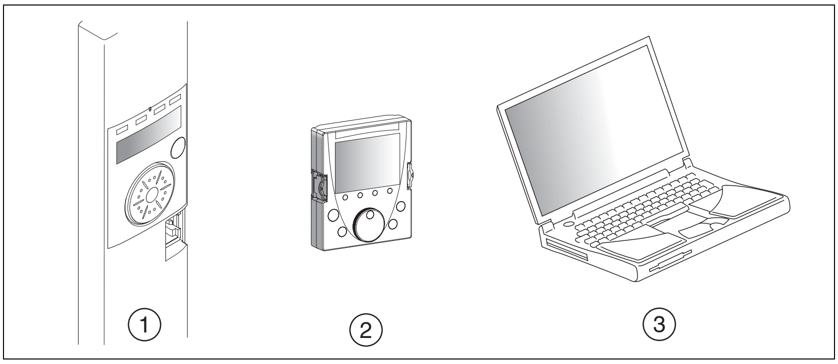

Figure 7.1 Commissioning tools

(1) Integrated HMI
(2) External graphic display terminal
(3) PC with commissioning software

Access to all parameters is only possible with the commissioning software.

Device settings can be duplicated. Stored device settings can be transferred to a device of the same type. Duplicating the device settings can be used if multiple devices are to have the same settings, for example, when devices are replaced.

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7.3 Integrated HMI

The device allows you to edit parameters, start the operating mode Jog or perform autotuning via the integrated Human-Machine Interface (HMI). Diagnostics information (such as parameter values or error numbers) can also be displayed.
The individual sections on commissioning and operation include information on whether a function can be carried out via the integrated HMI or whether the commissioning software must be used.

Overview

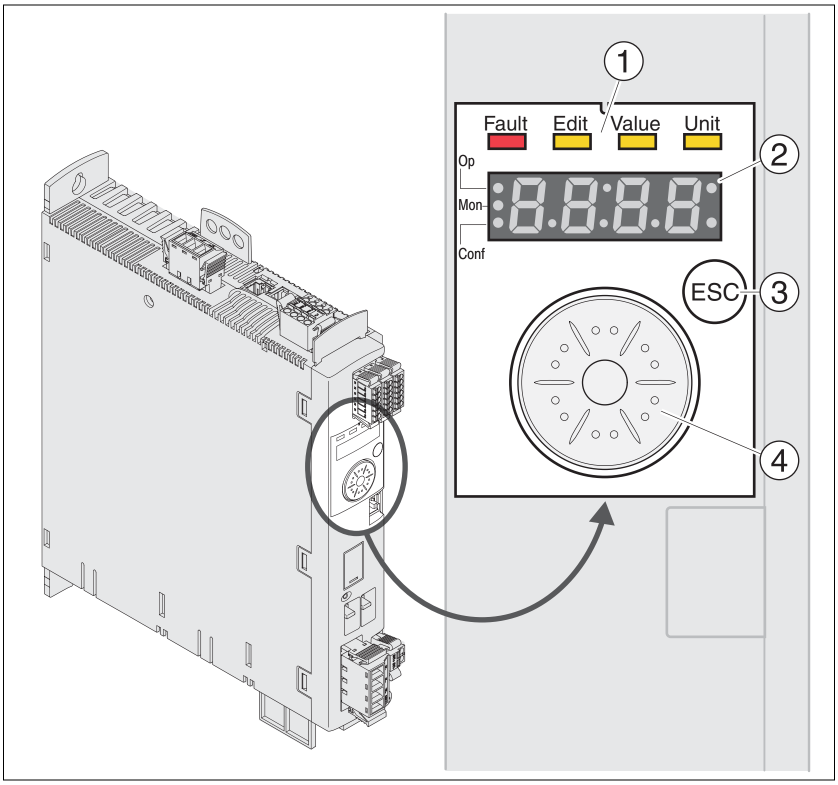

Figure 7.2 Controls at the integrated HMI

(1) Status LEDs
(2) 7-segment display
(3) ESC key
(4) Navigation button

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7.3.1 Indication and operation

Overview

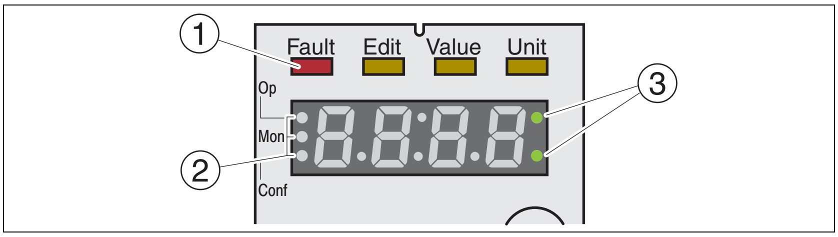
Status LEDs and a 4-digit 7-segment display indicate the device status, menu designation, parameter codes, status codes and error numbers. By turning the navigation button, you can select menu levels and parameters and increment or decrement values. To confirm a selection, press the navigation button.
The ESC (Escape) button allows you to exit parameters and menus. If values are displayed, the ESC button lets you return to the last saved value.

Character set on the HMI

The following table shows the assignment of the characters to the symbols displayed by the 4-digit 7-segment display.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
A	b	c C	d	E	F	G	h	,	J	H	L	Π	n	o	P	q	r
S	T	U	V	W	X	Y	Z	1	2	3	4	5	6	7	8	9	0
5	t	u	U	u	H	y	2	1	2	3	4	5	6	7	8	9	0
!	?	%	(	)	+	-	_	<	=	>	"	'	^	/	\	°	µ
!	?	%	[	]	+	-	_	c	=	ɔ	"	'	^	/	\	°	µ

Indication of the device status



(1) Four status LEDs are located above the 7-segment display:

Fault	Edit	Value	Unit	Meaning
Lights, red				Operating state Fault
	Lights yellow	Lights yellow		Parameter value can be edited
		Lights yellow		Value of the parameter
			Lights yellow	Unit of the selected parameter

(2) Three status LEDS for identification of the menu levels:

LED	Meaning
Op	Operation
Mon	Monitoring
Conf	Configuration

(3) Flashing dots indicate a warning, for example, if a limit value has been exceeded.

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Navigation button The navigation button can be turned and pressed. There are two types of pressing: short pressing (≤1 s) and long pressing (≥3 s).

Turn the navigation button to do the following:

- Go to the next or previous menu
- Go to the next or previous parameter
- Increment or decrement values

Briefly **press** the navigation button to do the following:

- Call the selected menu
- Call the selected parameter
- Save the current value to the EEPROM

Hold down the navigation button to do the following:

- Display a description of the selected parameter
- Display the unit of the selected parameter

Access channels The product can be addressed via different access channels. See chapter 8.1 "Access channels" for additional information.

7.3.2 Menu structure

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

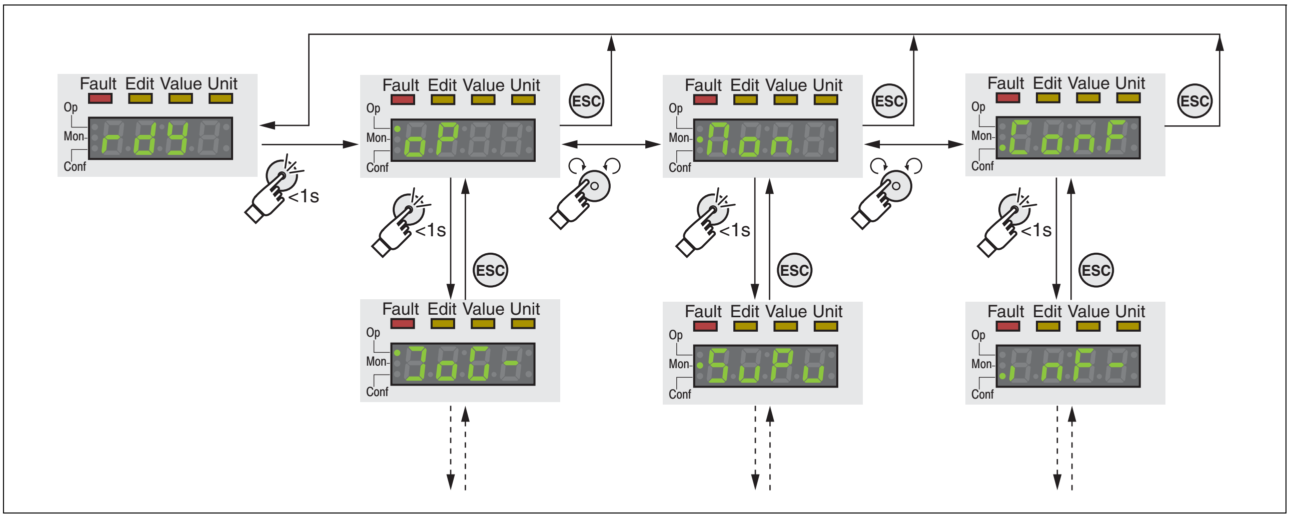

Figure 7.3 HMI menu structure

The level below the top level contains the parameters belonging to the respective menu items. To facilitate access, the parameter tables also specify the menu path, for example oP→JoG-.

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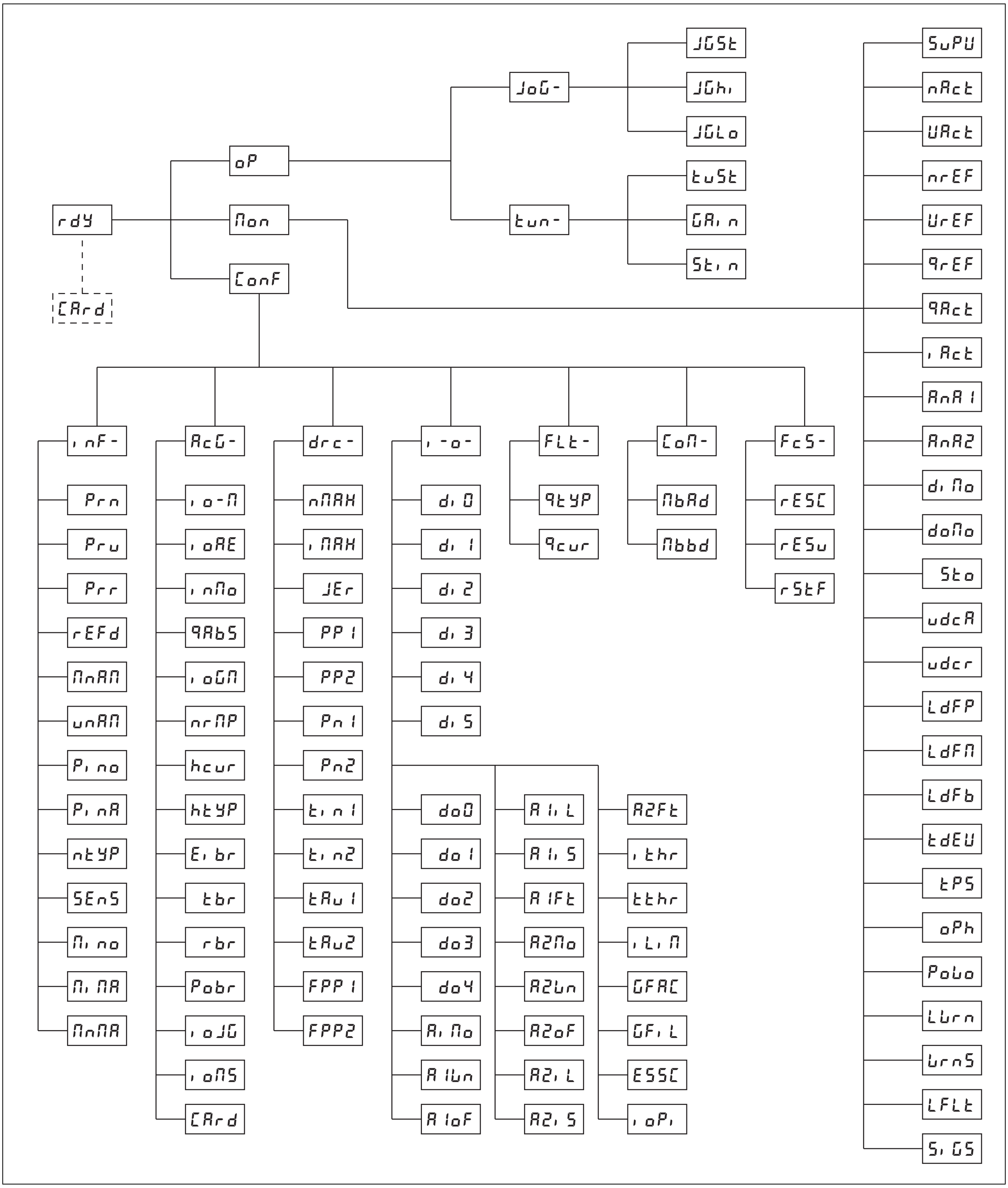

Figure 7.4 HMI menu structure LXM32C

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HMI menu oP	Description
oP	Operating mode (**Op**eration)
JoG-	Operating mode Jog
tun-	Autotuning

HMI menu JoG-	Description
JoG-	Operating mode Jog
JGSt	Start operating mode Jog
JGhi	Velocity for fast movement
JGLo	Velocity for slow movement

HMI menu tun-	Description
tun-	Autotuning
tuSt	Start autotuning
GAin	Global gain factor (affects parameter set 1)
Stin	Direction of movement for Autotuning

HMI menu Mon	Description
Mon	Monitoring (**Mon**itoring)
SuPv	HMI display when motor moves
nAct	Actual speed of rotation
VAct	Actual velocity
nrEF	Reference speed of rotation
VrEF	Reference velocity
qrEF	Reference motor current (q component, generating torque)
qAct	Actual motor current (q component, generating torque)
iAct	Total motor current
AnA1	Analog 1: Value of input voltage
AnA2	Analog 2: Value of input voltage
diMo	Status of digital inputs
doMo	Status of digital outputs
Sto	Status of the inputs for the safety function STO
udcA	Voltage at DC bus
udcr	Degree of utilization of DC bus voltage
LdFP	Current load of power stage
LdFM	Current load of motor
LdFb	Current load on braking resistor
tdEV	Current device temperature
tPS	Current power stage temperature
oPh	Operating hours counter
PoLo	Number of power on cycles
LWrn	Number of last warning (error class 0)
WrnS	Saved warnings, bit-coded

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HMI menu Mon	Description
LFLt	Error causing a stop (error classes 1 to 4)
SiGS	Saved status of monitoring signals

HMI menu ConF	Description
ConF	Configuration (**Conf**iguration)
inF-	Information/Identification (**INF**ormation / Identification)
AcG-	Axis configuration (**A**xis **C**onfi**g**uration)
drc-	Device configuration (**DR**ive **C**onfiguration)
i-o-	Configurable inputs/outputs (**I**n **O**ut)
FLt-	Error indication
CoM-	Communication (**COM**munication)
FcS-	Restore factory settings (default values) (**F**a**c**trory **S**ettings)

HMI menu inF-	Description
inF-	Information/Identification (**INF**ormation / Identification)
Prn	Firmware program number
Pru	Firmware version number
Prr	Firmware revision number
rEFd	Product Name
MnAM	Type
unAM	User application name
Pino	Nominal current of power stage
PiMA	Maximum current of power stage
MtYP	Motor type
SEnS	Encoder type of motor
Mino	Nominal current of motor
MiMA	Maximum current of motor
MnMA	Maximum permissible speed of rotation/velocity of motor

HMI menu AcG-	Description
AcG-	Axis configuration (**A**xis **C**onfi**g**uration)
io-M	Operating mode
ioAE	Enabling the power stage at PowerOn
inMo	Inversion of direction of movement
qAbS	Simulation of absolute position at power cycling
ioGM	Processing mode for operating mode Electronic Gear
nrMP	Maximum velocity of the motion profile for velocity
hcur	Current value for Halt
htYP	Halt option code
Eibr	Selection of internal or external braking resistor
tbr	Maximum permissible activation duration of external braking resistor
rbr	Resistance value of external braking resistor

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HMI menu AcG-	Description
Pobr	Nominal power of external braking resistor
ioJG	Selection of jog method
ioMS	Operating mode for signal input function Operating Mode Switch
CArd	Memory card management

HMI menu drC-	Description
drC-	Device configuration (**DR**ive **C**onfiguration)
nMAX	Velocity limitation
iMAX	Current limitation
JEr	Jerk limitation of the motion profile for velocity
PP1	Position controller P gain
PP2	Position controller P gain
Pn1	Velocity controller P gain
Pn2	Velocity controller P gain
tin1	Velocity controller integral action time
tin2	Velocity controller integral action time
tAu1	Filter time constant of reference velocity value filter
tAu2	Filter time constant of reference velocity value filter
FPP1	Velocity feed-forward control
FPP2	Velocity feed-forward control

HMI menu i-o-	Description
i-o-	Configurable inputs/outputs (**I**n **O**ut)
di0	Function Input DI0
di1	Function Input DI1
di2	Function Input DI2
di3	Function Input DI3
di4	Function Input DI4
di5	Function Input DI5
do0	Function Output DQ0
do1	Function Output DQ1
do2	Function Output DQ2
do3	Function Output DQ3
do4	Function Output DQ4
A1Mo	Analog 1: Type of usage
A1Wn	Analog 1: Zero voltage window
A1oF	Analog 1: Offset voltage
A1iL	Analog 1: Limitation of current at 10 V
A1iS	Analog 1: Target torque at 10 V in operating mode Profile Torque
a1ft	Analog 1: Filter time constant
A2Mo	Analog 2: Type of usage
A2Wn	Analog 2: Zero voltage window

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HMI menu i-o-	Description
A2oF	Analog 2: Offset voltage
A2iL	Analog 2: Limitation of current at 10 V
A2iS	Analog 2: Target torque at 10 V in operating mode Profile Torque
A2ft	Analog 2: Filter time constant
ithr	Monitoring of threshold value for current
tthr	Monitoring of time window
iLin	Current limitation via input
GFAc	Selection of special gear ratios
GFiL	Activation of jerk filter processing
ESSc	Resolution of encoder simulation
ioPi	Selection of signal type for PTI interface

HMI menu FLt-	Description
FLt-	Error indication
qtYP	Quick Stop option code
qcur	Current value for Quick Stop

HMI menu CoM-	Description
CoM-	Communication (**COM**munication)
MbAd	Modbus address
Mbbd	Modbus Baud rate

HMI menu FcS-	Description
FcS-	Restore factory settings (default values) (**Fac**trory **S**ettings)
rESc	Reset controller parameters
rESu	Reset user parameters
rStF	Restore factory settings (default values)

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7.3.3 Making settings

Displaying and setting parameters

The figure below shows an example of displaying a parameter (second level) and entering or selecting a parameter value (third level).

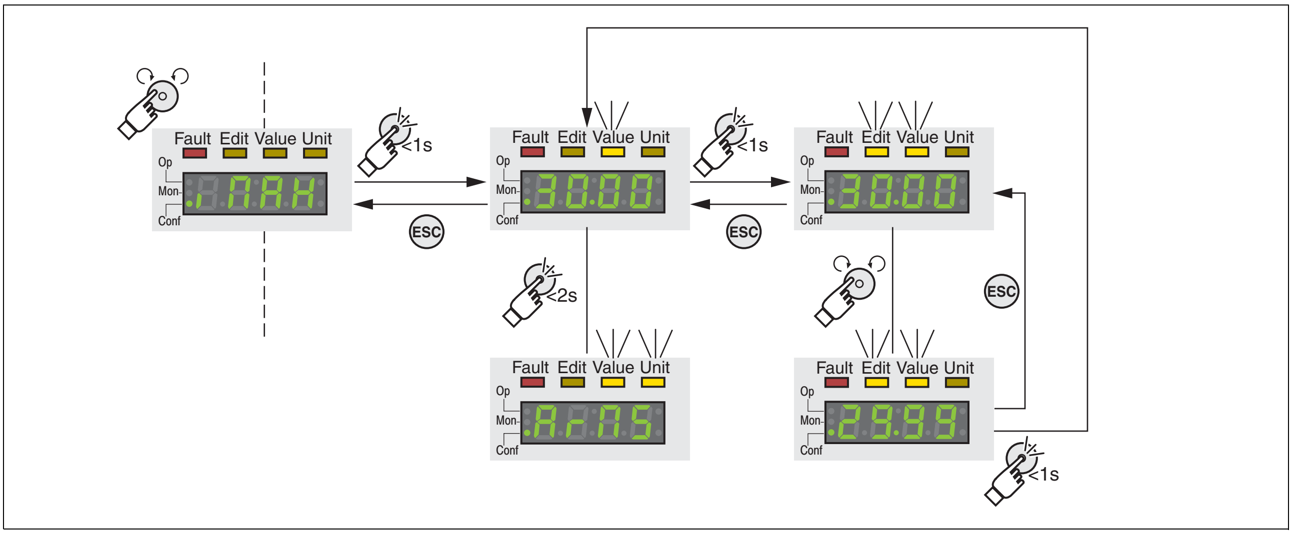

Figure 7.5 Integrated HMI, example of setting a parameter

- The parameter iMAX (iMax) is shown on the 7-segment display, see Figure 7.5.

▶ Press the navigation button for a longer period of time to display a parameter description.

◁ The parameter description is displayed in the form of horizontally scrolling text.

▶ Briefly press the navigation button to display the current value of the selected parameter.

◁ The Value status LED lights up and the current parameter value is displayed.

▶ Press the navigation button for a longer period of time to display the unit of the current parameter value.

◁ As long as the navigation button is held down, the status LEDs Value and Unit light. The unit of the current parameter value is displayed. Once you release the navigation button, the current parameter value is displayed again and the status LED Value lights.

▶ Briefly press the navigation button to activate the Edit mode which allows you to modify parameter values.

◁ The Edit and Value status LEDs light up and the current parameter value is displayed.

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▶ Turn the navigation button to change the value. The increments and the limit value for each parameter are pre-defined.

◁ The Edit and Value status LEDs light and the selected parameter value is displayed.

▶ Briefly press the navigation button to save the changed parameter value.

If you do not want to save the changed parameter value, press the ESC button to cancel. The display returns to the original value.

◁ The displayed parameter value flashes once; the changed parameter value is written to the EEPROM.

▶ Press ESC to return to the menu

Setting the 7-segment display

By default, the current operating state is displayed by the 4-digit 7-segment display, see page 193. You can set the following via the menu item drc- / SuPV:

- StAt displays the current operating state
- VAct displays the current velocity of the motor
- iAct displays the current motor current

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

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7.4 External graphic display terminal

The external graphic display terminal is only designed for commissioning drives.

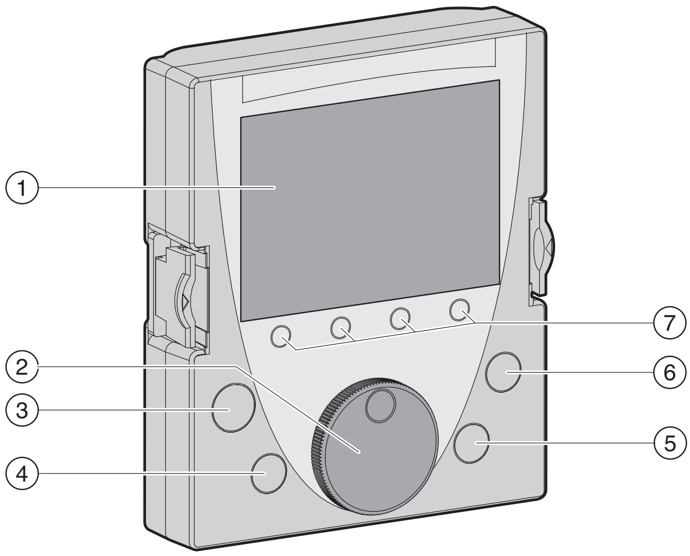

Figure 7.6 External graphic display terminal

(1) Display
(2) Navigation button
(3) STOP/RESET key
(4) RUN key
(5) FWD/REV key
(6) ESC key
(7) Function keys F1 ... F4

Depending on the firmware version of the external graphic display terminal, the information may be represented differently. Use the latest firmware version.

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.

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7.4.1 Display and controls

Display (1) The display is subdivided into 5 areas.

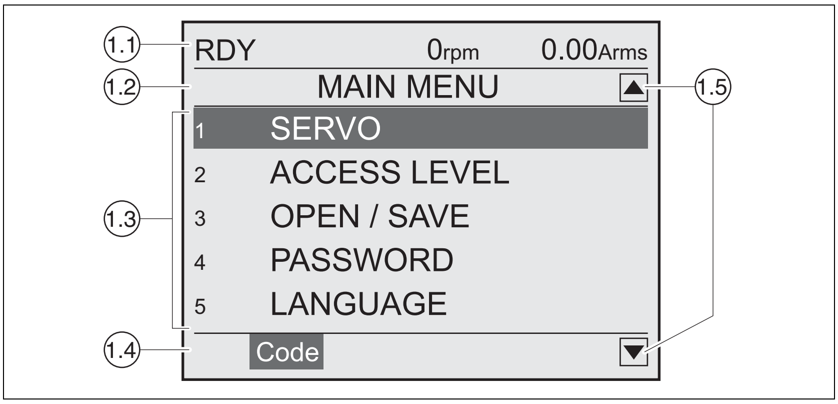

Figure 7.7 Display of the graphic display terminal (example shows English language)

(1.1) Status information of the drive
(1.2) Menu bar
(1.3) Data field
(1.4) Function bar
(1.5) Navigation

Status information of the drive (1.1) This line displays the current operating state, the actual velocity and the motor current. If an error occurs, the error number is displayed instead of the operating state.

Menu bar (1.2) The menu bar displays the name of the current menu.

Data field (1.3) The following information can be displayed and values entered in the data field:

- Submenus
- Operating mode
- Parameters and parameter values
- State of movement
- Error messages

Function bar (1.4) The function bar displays the name of the function that is triggered when you press the corresponding function key. Example: Pressing the F1 function key displays the "Code". If you press F1, the HMI name of the displayed parameter is shown.

Navigation (1.5) Arrows indicate that additional information is available that can be displayed by scrolling.

Navigation button (2) By turning the navigation button, you can select menu levels and parameters and increment or decrement values. To confirm a selection, press the navigation button.

Key STOP/RESET (3) The key STOP/RESET stops a movement by means of a Quick Stop.

Key RUN (4) The key RUN allows you to start a movement.

Key FWD/REV (5) The key FWD/REV allows you to reverse the direction of movement.

Key ESC (6) The ESC (Escape) button allows you to exit parameters and menus or cancel a movement. If values are displayed, the ESC key lets you return to the last saved value.

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Function keys F1 ... F4 (7) The assignment of the function keys F1 .... F4 depends on the context. The function bar displays the name of the function triggered when the corresponding function key is pressed.

7.4.2 Connecting the external graphic display terminal to LXM32

The external graphic display terminal is an accessory for the drive, see chapter 12.1 "Commissioning tools", page 389. The external graphic display terminal is connected to CN7 (commissioning interface). Only use the cable shipped with the external graphic display terminal to connect it. If the external graphic display terminal is connected to LXM32, the integrated HMI is deactivated. The integrated HMI shows di SP (Display).

7.4.3 Using the external graphic display terminal

The following 2 examples show you how to use the external graphic display terminal.

Example 'Setting the Language' In this example, you set the desired language for the external graphic display terminal. The drive must have been fully installed and the supply voltage must be on.

■ The external graphic display terminal has been connected to CN7 and the main menu is displayed.

▶ Rotate the navigation button until item 5 (LANGUAGE) is highlighted.

▶ Press the navigation button to confirm the selection.

◁ The menu bar shows the selected function ($_5$ LANGUAGE). The data field displays the selected value, in this case the selected language.

▶ Press the navigation button to change the value.

◁ The menu bar displays the selected function "Language". The supported languages are shown in the data field.

▶ Turn the navigation button to select the desired language.

◁ The currently active language is highlighted by a check.

▶ Press the navigation button to confirm the selected value.

◁ The menu bar displays the selected function "Language". The selected language is shown in the data field.

▶ Press ESC to return to the main menu.

◁ The main menu is displayed in the selected language.

Example 'Using Operating Mode Jog'

This example starts a movement in the operating mode Jog. The drive must have been fully installed. Commission the drive as per chapter 7.6 "Commissioning procedure". The following procedure corresponds to chapter .7.6.8 "Checking the direction of movement".

■ The external graphic display terminal has been connected to CN7 and the main menu is displayed. The desired language has been set.

▶ Rotate the navigation button until item 1 (SERVO) is highlighted.

▶ Press the navigation button to confirm the selection.

◁ The menu bar shows the selected function ($_1$ SERVO). The data field displays the submenu of the selected function ($_1$ SERVO).

▶ Rotate the navigation button until item 1.4 (OPERATION) is highlighted and press the navigation button to confirm the selection.

◁ The menu bar shows the selected function ($_{1.4}$ OPERATION). The data field displays the supported operating modes in a submenu.

▶ Rotate the navigation button until item 1.4.1 (JOG) is highlighted and press the navigation button to confirm the selection.

◁ The menu bar shows the selected function ($_{1.4.1}$ JOG). The data field displays "Op. mode Jog" and the parameters and parameter values for the operating mode

▶ Rotate the navigation button until the item "Op. mode Jog" is highlighted and press the navigation button to confirm the selection.

◁ The data field displays "JOG →" (Jog, slow movement in positive direction).

▶ Rotate the navigation button to change the (slow: →, ← fast: →→, ←←) and the direction of movement (positive direction of movement: →, →→, negative direction of movement: ←,←←). You can also use the FWD/REV key to change the direction of movement.

▶ Press the navigation button or the RUN key to enable the power stage.

▶ Press the navigation button or the RUN key to start a movement.

◁ The movement continues as long as you hold down the navigation button / the RUN key or until you press the STOP/RESET key. You can neither change the velocity nor the direction of movement during the movement.

▶ To stop the movement, press the STOP/RESET key or release the navigation button / the RUN key.

▶ Press the ESC key to disable the power stage.

◁ Power stage is disabled.

▶ Press ESC 3 times to return to the main menu.

◁ Each time you press ESC you go back by one menu level.

7.5 Commissioning software

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

- Tuning of the controller parameters via a graphical user interface
- Comprehensive set of diagnostics tools for optimization and maintenance
- Long-term recording for evaluation of the performance
- Testing the input and output signals
- Tracking signals on the screen
- Archiving of device settings and recordings with export function for further processing in other applications

See page 125 for details on connecting a PC to the device.

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

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7.6 Commissioning procedure

⚠ 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 error 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

UNINTENDED BEHAVIOR CAUSED BY ACCESS CONTROL

Improper use of access control may cause commands to be triggered or blocked.

- Verify that no unintended behavior is caused as a result of enabling or disabling exclusive access.
- Verify that impermissible access is blocked.
- Verify that required access is available.

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

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7.6.1 Switching on the device for the first time

Duplicating device settings

A memory card or the commissioning software allows you duplicate device settings. See chapter 7.9 "Duplicating existing device settings", page 188 for additional information.

Automatic reading of the motor data record

When the device is switched on and if an encoder is connected to CN3, the device automatically reads the electronic nameplate from the Hiperface encoder. The record is checked and written to the EEPROM.

The record contains technical information on the motor such as nominal torque and peak torque, nominal current, nominal velocity and number of pole pairs. The record cannot be changed by the user. Without this information, the device is not ready for operation.

Preparation

If the device is not to be commissioned exclusively via the HMI, a PC with the commissioning software must be connected.

Switching on the device

■ The power stage supply voltage is switched off.

▶ Switch on the controller supply voltage.

◁ The device goes through an initialization routine, all LEDs are tested, all segments of the 7-segment display and the status LEDs light up.

If a memory card is in the the slot of the device, the message CArd is displayed by the 7-segment display for a short period of time. This indicates that a memory card has been detected. If the message CArd is permanently displayed by the 7-segment display, there are differences between the content of the memory card and the parameter values stored in the device. See chapter 7.8 "Memory Card", page 185 for additional information.

After the initialization, the device is ready for operation. The device is in the operating mode Jog. See chapter 8.3 "Operating modes", page 198 for changing operating modes.

7.6.2 Operating state (state diagram)

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

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

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

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

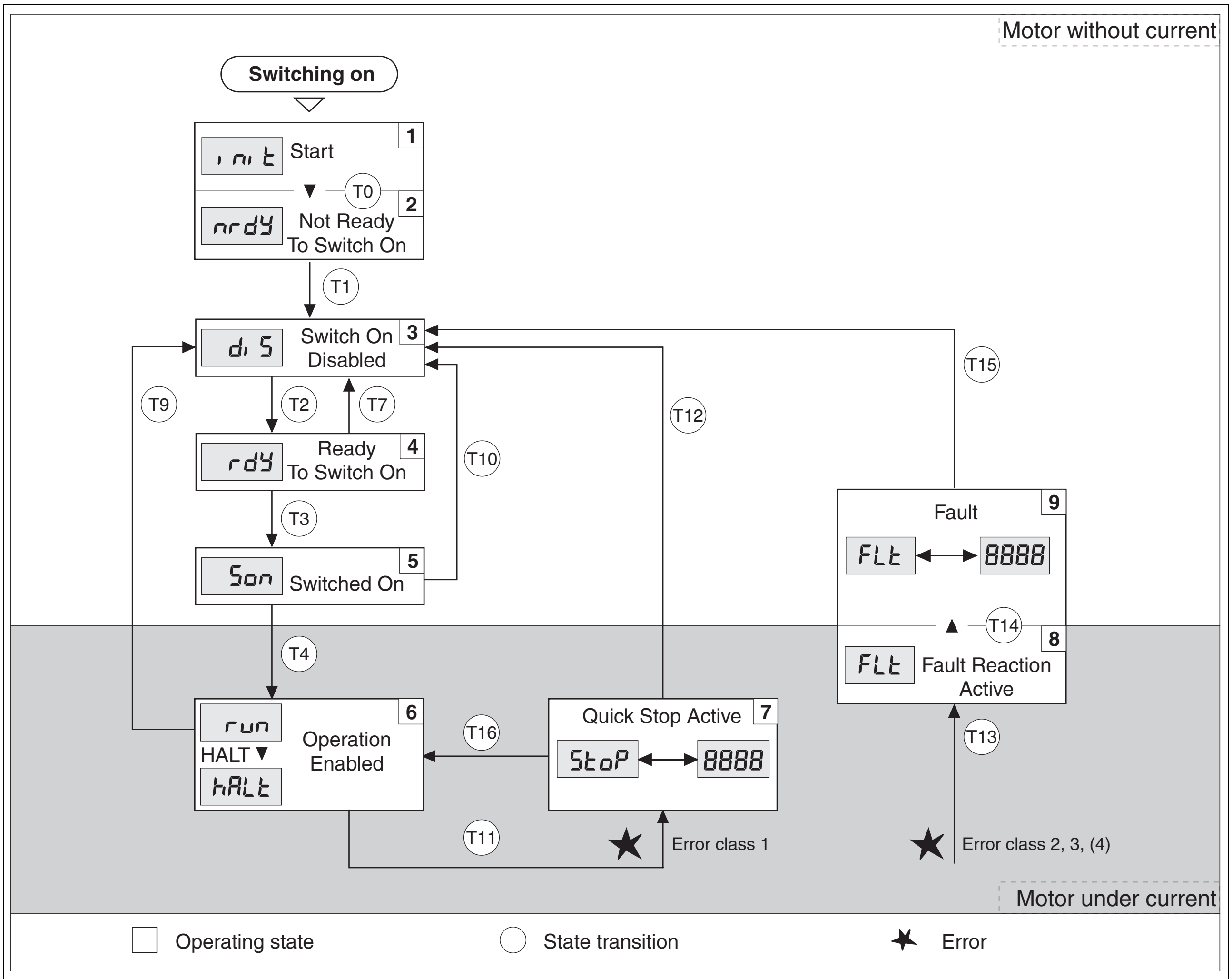

Figure 7.8 State diagram

Operating states and state transitions See page 193 for detailed information on operating states and state transitions.

7.6.3 Setting basic parameters and limit values

Prepare a list with the parameters required for the functions used.

Controller parameter sets

This device allows you to use two controller parameter sets. It is possible to switch form one set of controller parameters to the other during operation. The active controller parameter set is selected with the parameter `CTRL_SelParSet`.

The corresponding parameters are `CTRL1_xx` for the first controller parameter set and `CTRL2_xx` for the second controller parameter set. The following descriptions use the notation `CTRL1_xx` (`CTRL2_xx`) if there are no functional differences between the two controller parameter sets.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`CTRL_SelParSet`	Selection of controller parameter set (non-persistent) Coding see parameter: CTRL_PwrUpParSet Changed settings become active immediately.	- 0 1 2	UINT16 R/W - -	Modbus 4402
`_CTRL_ActParSet`	Active controller parameter set Value 1: Controller parameter set 1 is active Value 2: Controller parameter set 2 is active A controller parameter set is active after the time for the parameter switching (CTRL_ParChgTime) has elapsed.	- - - -	UINT16 R/- - -	Modbus 4398
`CTRL_ParChgTime`	Period of time for parameter switching In the case of parameter set switching, the values of the following parameters are changed gradually: - CTRL_KPn - CTRL_TNn - CTRL_KPp - CTRL_TAUnref - CTRL_TAUiref - CTRL_KFPp Such a parameter switching can be caused by - change of the active controller parameter set - change of the global gain - change of any of the parameters listed above - switching off the integral term of the velocity controller Changed settings become active immediately.	ms 0 0 2000	UINT16 R/W per. -	Modbus 4392

Setting limit values

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

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Current limitation

The maximum motor current can be set with the parameter `CTRL_I_max`.

The maximum current for the "Quick Stop" function can be limited with the parameter `LIM_I_maxQSTP` and for the "Halt" function with the parameter `LIM_I_maxHalt`.

▶ Use the parameter `CTRL_I_max` to set the maximum motor current.

▶ Use the parameter `LIM_I_maxQSTP` to set the maximum motor current for the "Quick Stop" function.

▶ Use the parameter `LIM_I_maxHalt` to set the maximum motor current for the "Halt" function.

The motor can be decelerated via a deceleration ramp or the maximum current for the functions "Quick Stop" and "Halt".

The device limits the maximum permissible current on the basis of the motor data and the device data. Even if the value entered for the maximum current in the parameter `CTRL_I_max` is too high, the value is limited.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`CTRL_I_max` ConF → drC- iMAX	Current limitation During operation, the actual current limit is one of the following values (whichever is lowest): - CTRL_I_max - M_I_max - PA_I_max - Current limitation via analog input - Current limitation via digital input Limitations caused by I2t monitoring are also taken into account. Default: PA_I_max at 8 kHz PWM frequency and 230/480 V mains voltage In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} 0.00 - 300.00	UINT16 R/W per. -	Modbus 4376

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
LIM_I_maxQSTP ConF → FLt- qcur	Current value for Quick Stop This value is only limited by the minimum/ maximum value range (no limitation of this value by motor/power stage). In the case of a Quick Stop, the actual current limit (_Imax_actual) is one of the following values (whichever is lowest): - LIM_I_maxQSTP - M_I_max - PA_I_max Further current reductions caused by I2t monitoring are also taken into account during a Quick Stop. Default: PA_I_max at 8 kHz PWM frequency and 230/480 V mains voltage In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} - - -	UINT16 R/W per. -	Modbus 4378
LIM_I_maxHalt ConF → ACG- hcur	Current value for Halt This value is only limited by the minimum/ maximum value range (no limitation of this value by motor/power stage). In the case of a Halt, the actual current limit (_Imax_actual) is one of the following values (whichever is lowest): - LIM_I_maxHalt - M_I_max - PA_I_max Further current reductions caused by I2t monitoring are also taken into account during a Halt. Default: PA_I_max at 8 kHz PWM frequency and 230/480 V mains voltage In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} - - -	UINT16 R/W per. -	Modbus 4380

Velocity limitation

The parameter `CTRL_v_max` can be used to limit the maximum velocity.

▶ Use the parameter `CTRL_v_max` to set the maximum velocity of the motor.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`CTRL_v_max` ConF → drC- nMAX	Velocity limitation During operation, the actual velocity limit is one of the following values (whichever is lowest): - CTRL_v_max - M_n_max - Velocity limitation via analog input - Velocity limitation via digital input Changed settings become active immediately.	usr_v 1 13200 2147483647	UINT32 R/W per. -	Modbus 4384

7.6.4 Analog inputs

The two analog inputs are referred to as AI1 and AI2. The following descriptions use the notation AI1 (AI2) if there are no functional differences between the two inputs.

Analog inputs

Analog input voltages between -10 V_{dc} and +10 V_{dc} can be read via the analog inputs. The current voltage value at AI1+ (AI2+) can be read with the parameter _AI1_act (_AI2_act).

■ Power stage supply voltage is switched off.
Controller supply voltage is switched on.

▶ Apply a voltage in the range from ±10V_{dc} to the analog input AI1 (AI2).

▶ Check the applied voltage with the parameter _AI1_act (_AI2_act).

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_AI1_act Mon AnA1	Analog 1: Value of input voltage	mV -10000 - 10000	INT16 R/- - -	Modbus 2306
_AI2_act Mon AnA2	Analog 2: Value of input voltage	mV -10000 - 10000	INT16 R/- - -	Modbus 2314

Offset and zero voltage window

The parameter AI1_offset (AI2_offset) can be used to define an offset and the parameter AI1_win (AI2_win) to define a zero voltage window for the input voltage at AI1 (AI2).

This corrected input voltage is the voltage value for the operating modes Profile Torque and Profile Velocity as well as the read value of the parameter AI1_act (AI1_act).

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
AI1_offset ConF → i-o- A1oF	Analog 1: Offset voltage The analog input AI1 is corrected/offset by the offset value. If you have defined a zero voltage window, this window is effective in the zero pass range of the corrected analog input AI1. Changed settings become active immediately.	mV -5000 0 5000	INT16 R/W per. -	Modbus 2326
AI2_offset ConF → i-o- A2oF	Analog 2: Offset voltage The analog input AI2 is corrected/offset by the offset value. If you have defined a zero voltage window, this window is effective in the zero pass range of the corrected analog input AI2. Changed settings become active immediately.	mV -5000 0 5000	INT16 R/W per. -	Modbus 2328

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`AI1_win` ConF → i-o- A1Wn	Analog 1: Zero voltage window Threshold value up to which an input voltage value is treated as 0 V. Example: Value 20, this means a range from -20 ... +20 mV is treated as 0 mV. Changed settings become active immediately.	mV 0 0 1000	UINT16 R/W per. -	Modbus 2322
`AI2_win` ConF → i-o- A2Wn	Analog 2: Zero voltage window Threshold value up to which an input voltage value is treated as 0 V. Example: Value 20, this means a range from -20 ... +20 mV is treated as 0 mV. Changed settings become active immediately.	mV 0 0 1000	UINT16 R/W per. -	Modbus 2324

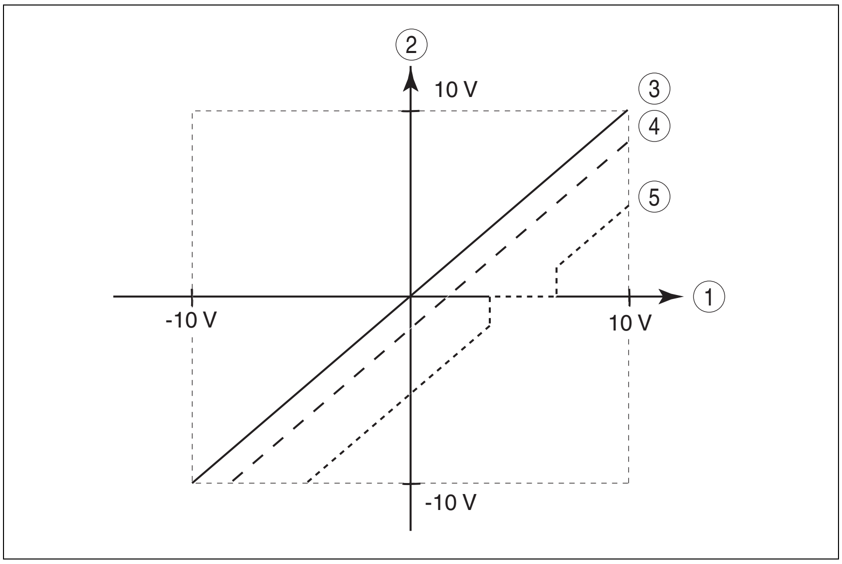

Figure 7.9 Offset and zero voltage window

(1) Input voltage at `AI1` (`AI2`)
(2) Voltage value for operating modes Profile Torque and Profile Velocity as well as read value of the parameter `AI1_act` (`AI2_act`)
(3) Input voltage without processing
(4) Input voltage with offset
(5) Input voltage with offset and zero voltage window

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7.6.5 Digital inputs / outputs

The device has configurable inputs and configurable outputs. The standard assignment and the configurable assignment depends on the selected operating mode. For more information, see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

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

Integrated HMI

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

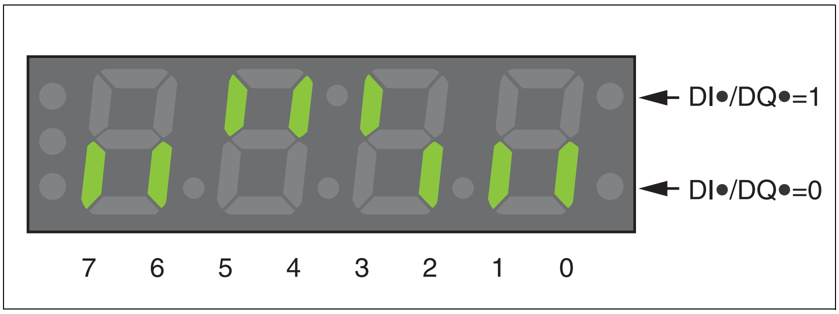

Figure 7.10 Integrated HMI, displaying the signal state of the digital inputs (DI•) and outputs (DQ•)

Inputs (parameter `_IO_DI_act`):

▶ Open the menu item -Mon / diMo.

◁ The digital inputs are displayed in a bit-coded way.

Bit	Signal	I/O
0	`DI0`	I
1	`DI1`	I
2	`DI2`	I
3	`DI3`	I
4	`DI4`	I
5	`DI5`	I
6	-	-
7	-	-

The parameter `_IO_DI_act` does not display the states of the inputs of the STO safety function. Use the parameter `_IO_STO_act` to visualize the states of the inputs of the STO safety function.

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Outputs (parameter `_IO_DQ_act`):

▶ Open the menu item `-Mon` / `doMo`.

◁ The digital outputs are displayed in a bit-coded way.

Bit	Signal	I/O
0	DQ0	O
1	DQ1	O
2	DQ2	O
3	DQ3	O
4	DQ4	O
5	DQ5	O
6	-	-
7	-	-

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7.6.6 Testing the safety function STO

Operation with STO

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

■ Power stage supply is switched off.
Controller supply voltage is switched off.

▶ Verify that the inputs $\overline{\text{STO\_A}}$ and $\overline{\text{STO\_B}}$ are isolated from each other. The two signals must not be electrically connected.

■ Power stage supply voltage is switched on.
Controller supply voltage is switched on.

▶ To avoid unintended restart after restoration of power, the parameter `IO_AutoEnable` must be set to "off". Verify that the parameter `IO_AutoEnable` is set to "off" (HMI: conF→ACG→ioAE).

▶ Start the operating mode Jog (without motor movement) (see page 200).

▶ Trigger the STO safety function. $\overline{\text{STO\_A}}$ and $\overline{\text{STO\_B}}$ must be switched off simultaneously.

◁ The power stage is disabled and error message 1300 is generated. (NOTE: Error message 1301 indicates a wiring error.)

▶ Check the behavior of the drive when errors are present.

▶ Document all tests of the safety function in your acceptance certificate.

Operation without STO

If you do not want to use the STO safety function:

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

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7.6.7 Holding brake

Holding brake

The holding brake in the motor has the task of holding the current motor position when the power stage is disabled, even if external forces act (for example, in the case of a vertical axis). The holding brake is not a safety function.

The signals of the holding brake meet the PELV requirements.

Adjustable parameters

The electronic nameplate of the motor contains the delay for releasing and the delay applying the holding brake. It is possible to parameterize an additional time delay for releasing the holding brake (`BRK_AddT_release`) and an additional time delay for applying (`BRK_AddT_apply`) the holding brake.

Time delay for releasing the holding brake

The time delay for releasing the holding brake stored in the electronic nameplate depends on the motor type.

The parameter `BRK_AddT_release` allows you to add an additional time delay. The power stage is enabled (Operation Enabled) after the entire delay time has passed.

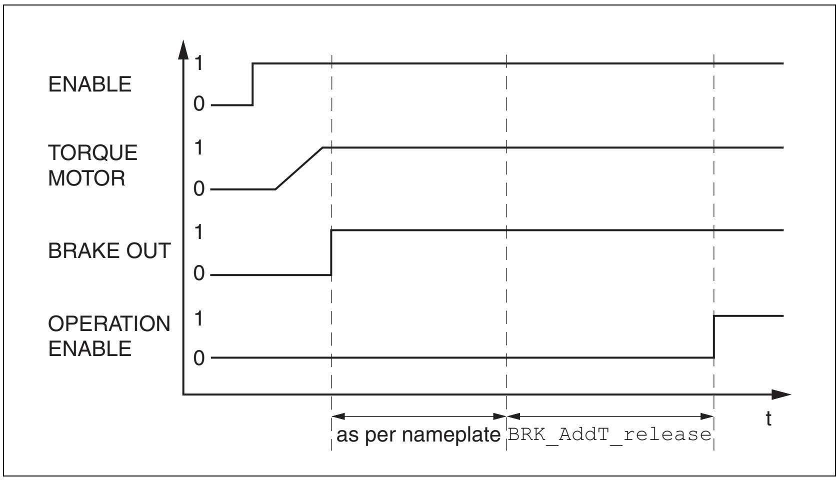

Figure 7.11 Releasing the holding brake

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`BRK_AddT_release`	Additional time delay for releasing the holding brake The overall time delay for releasing the holding brake is the time delay from the electronic nameplate of the motor and the additional time delay in this parameter. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	ms 0 0 400	INT16 R/W per. -	Modbus 1294

Time delay for applying the holding brake

When the power stage is disabled, the holding brake is applied. However, current continues to be applied to the motor for the period of time corresponding to the time delay for applying the holding brake.

The time delay for applying the holding brake stored in the electronic nameplate depends on the motor type.

The parameter `BRK_AddT_apply` allows you to add an additional time delay. Current continues to be applied to the motor until the entire delay time has passed.

NOTE: Triggering the STO safety function means that the time delay for motors with holding brake is not effective. The motor cannot generate holding torque to bridge the time to application of the holding brake. Check whether additional measures have to be taken; for example, this may cause the load of vertical axes to lower.

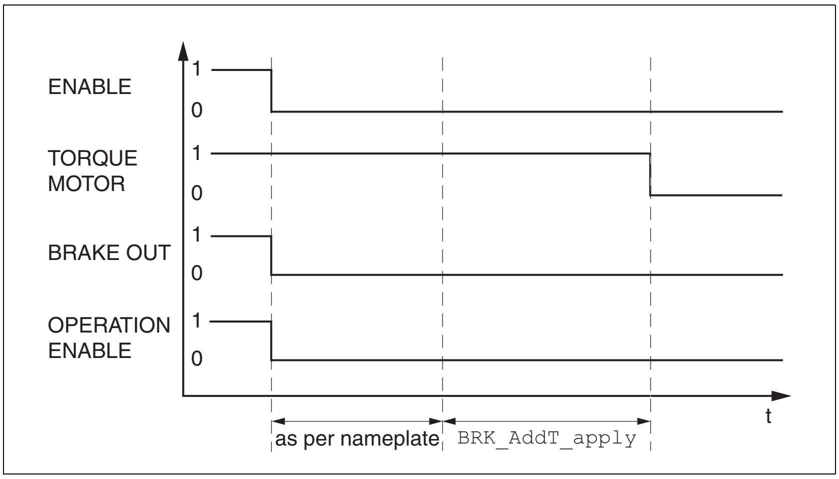

Figure 7.12 Applying the holding brake

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`BRK_AddT_apply`	Additional time delay for applying the holding brake The overall time delay for applying the holding brake is the time delay from the electronic nameplate of the motor and the additional time delay in this parameter. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	ms 0 0 1000	INT16 R/W per. -	Modbus 1296

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7.6.7.1 Checking the holding brake

> **⚠ WARNING**
>
> **UNEXPECTED MOVEMENT**
>
> Releasing the holding brake may cause an unexpected movement in the system, for example if vertical axes are used.
>
> - Take appropriate measures to avoid damage caused by the falling loads.
> - Only run the test if there are no persons or obstacles in the hazardous area.
>
> **Failure to follow these instructions can result in death, serious injury or equipment damage.**

Checking the holding brake

■ The device is in operating state "Ready to switch on" and the parameters for the holding brake must have been set.

▶ Start the operating mode Jog (HMI: oP→JoG→JGSt).

◁ The power stage is enabled and the holding brake released. The HMI displays JG-.

▶ Press the navigation button and hold it down.

◁ As long as the navigation button is held down, the motor moves.

▶ Press ESC.

◁ The holding brake is applied. The power stage is disabled.

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7.6.8 Checking the direction of movement

⚠ WARNING

UNEXPECTED MOVEMENT CAUSED BY INTERCHANGED MOTOR PHASES

Interchanging motor phases results in unexpected movements with fast acceleration.

- If required, use the parameter `POSdirOfRotat` for reversing the direction.
- Do not interchange the motor phases.

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

Direction of movement

Movements are made in positive or in negative directions.
In the case of a rotary motors, direction of movement is defined in accordance with IEC 61800-7-204: Positive direction is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft.

Checking the direction of movement

▶ Start the operating mode Jog. (HMI: oP→JoG→JGSt)

◁ The HMI displays JG-.

Movement in positive direction:

▶ Press the navigation button and hold it down.

◁ A movement is made in positive direction.

Movement in negative direction:

▶ Turn the navigation button until the HMI displays -JG.

▶ Press the navigation button and hold it down.

◁ A movement is made in negative direction.

Changing the direction of movement

If the expected direction of movement and the actual direction of movement are not identical, you can invert the direction of movement.

- Inversion of direction of movement is off:
  Movements are made in positive direction with positive target values.
- Inversion of direction of movement is on:
  Movements are made in positive direction with negative target values.

The parameter `InvertDirOfMove` allows you to invert the direction of movement.

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`InvertDirOfMove` ConF → ACG- inMo	Inversion of direction of movement **0 / Inversion Off /** oFF: Inversion of direction of movement is off **1 / Inversion On /** on: Inversion of direction of movement is on The limit switch which is reached with a movement in positive direction must be connected to the positive limit switch input and vice versa. Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- 0 0 1	UINT16 R/W per. -	Modbus 1560

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7.6.9 Setting parameters for encoder

Setting an absolute position

When starting up, the device reads the absolute position of the motor from the encoder. The current absolute position can be read with the parameter `_p_absENC`.

When the motor is at a standstill, the new absolute position of the motor can be set to the current mechanical motor position the with the parameter `ENC1_adjustment`. The value can be set with the power stage enabled or disabled. Setting the absolute position also shifts the position of the index pulse of the encoder and the index pulse of the encoder simulation.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`_p_absENC`	Absolute position with reference to the encoder range This value corresponds to the modulo position of the absolute encoder range. The value is no longer valid if the gear ratio of machine encoder and motor encoder is changed. A restart is required in such a case.	usr_p - - -	UINT32 R/- - -	Modbus 7710
`ENC1_adjustment`	Adjustment of absolute position of encoder 1 The value range depends on the encoder type. Singleturn encoder: 0 ... max_pos_usr/rev. - 1 Singleturn encoder (shifted with parameter ShiftEncWorkRang): -(max_pos_usr/rev)/2 ... (max_pos_usr/rev.)/2 -1 Multiturn encoder: 0 ... (4096 * max_pos_usr/rev.) -1 Multiturn encoder (shifted with parameter ShiftEncWorkRang): -2048 * max_pos_usr/rev ... (2048 * max_pos_usr/rev.) -1 max_pos_usr/rev.: Maximum user-defined position for one encoder turn. This value is 16384 with the default scaling. NOTE: * If processing is to be performed with inversion of the direction of movement, this must be set before the encoder position is adjusted. * After the write access, a wait time of at least 1 second is required before the drive is switched off. * Changing this value also changes the position of the virtual index pulse and the index pulse for the encoder simulation. Changed settings become active the next time the product is switched on.	usr_p - - -	INT32 R/W - -	Modbus 1324

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If you have replaced the device, you must check the absolute position of the motor. If there is a deviation or if you replace the motor, you must set the absolute position once again.

Singleturn encoder

In the case of a singleturn encoder, you can shift the position of the index pulse of the encoder by setting a new absolute position. If the position value is 0, the index pulse is defined at the current mechanical motor position.

This also changes the position of the index pulse of the encoder simulation.

Multiturn encoder

If a rotary motor with multiturn encoder performs a movement from 0 into negative direction, there is an underrun of the absolute position of the multiturn encoder. However, the actual position in the drive keeps counting forward and delivers a negative position value. After switching off and on, the actual position of the drive no longer corresponds to the negative position value, but to the absolute position of the encoder (a position of -10 revolutions prior to switching off becomes an absolute position of 4086 revolutions after switching on again).

The parameter `ShiftEncWorkRang` lets you specify whether the working range continues to comprise 0...4096 revolutions or whether the working range comprises -2048...+2048 revolutions.

`ShiftEncWorkRang` = 0: The working range is defined as 0 ... 4096 revolutions.
`ShiftEncWorkRang` = 1: The working range is defined as -2048 ... 2048 revolutions. With a typical application (positive and negative movements), the working range of the motor is in the continuous range of the encoder.

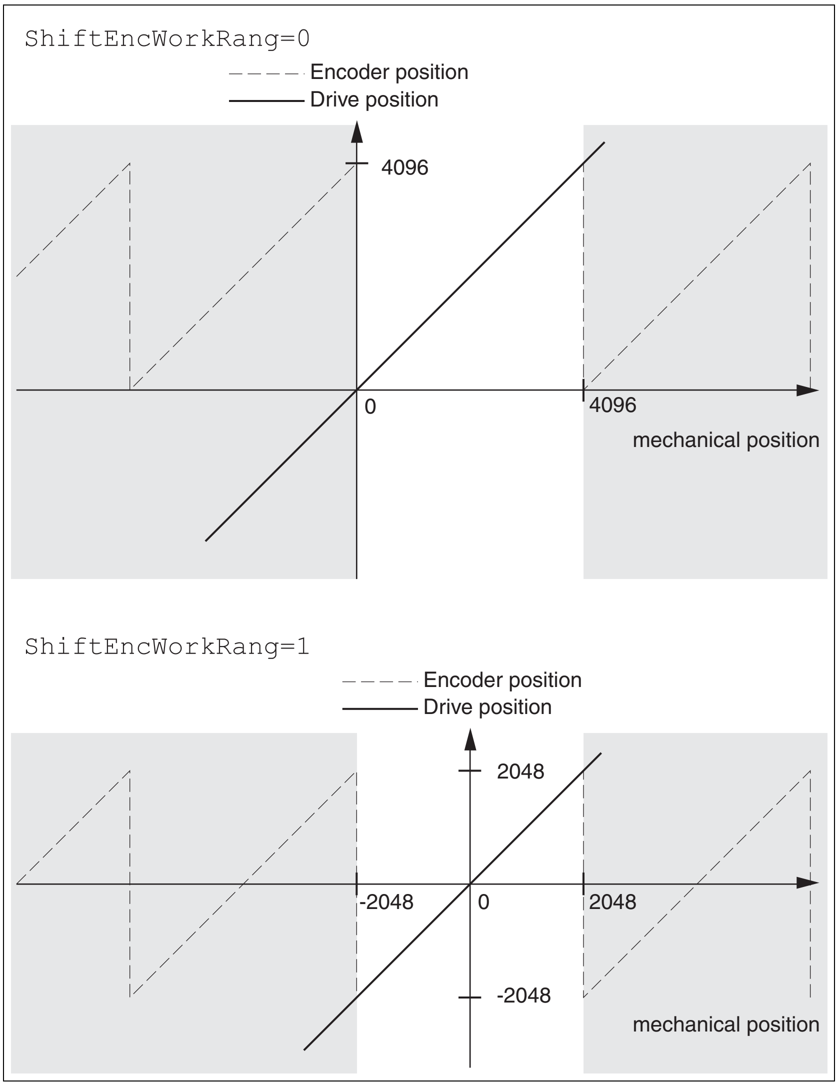

Figure 7.13 Position values of multiturn encoder

▶ Set the absolute position at the mechanical limit to a position value >0.

This achieves that the mechanical working range will be in the continuous range of the encoder.

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`ShiftEncWor-kRang`	Shifting of the encoder working range **0 / Off**: Shifting off **1 / On**: Shifting on Value 0: Position values are between 0 ... 4096 revolutions. Value 1: Position values are between -2048 ... 2048 revolutions. After activating the shifting function, the position range of a multiturn encoder is shifted for half of the range. Example for the position range of a multiturn encoder with 4096 revolutions. Changed settings become active the next time the product is switched on.	- 0 0 1	UINT16 R/W per. -	Modbus 1346

7.6.10 Setting the braking resistor parameters

⚠ WARNING

MOTOR WITHOUT BRAKING EFFECT

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

- Verify that the braking resistor has a sufficient rating.
- Check the parameter settings for the braking resistor.
- Check the I^2t value under the most critical condition by performing a test run. The device switches off at an I^2t value of 100%.
- When performing the calculation and the test run, take into account the fact that the DC bus capacitors can absorb less braking energy at higher mains voltages.

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

⚠ WARNING

HOT SURFACES

The braking resistor may heat up to over 250°C (480°F) during operation.

- Avoid contact with the hot braking resistor.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity of the braking resistor.
- Provide for good heat dissipation.
- Check the temperature of the braking resistor under the most critical condition by performing a test run.

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

Further information on braking resistors	Page
Technical data braking resistor	44
Rating the braking resistor	103
Mounting the external braking resistor	89
Electrical installation of the braking resistor	103
Order data for external braking resistors	389

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- Check the parameter `RESint_ext`. If you have connected an external braking resistor, you must set the parameter to "external".
- If you have connected an external braking resistor, (value of the parameter `RESint_ext` is set to "external"), you must assign the appropriate values to the parameters `RESext_P`, `RESext_R` and `RESext_ton`. Verify that the selected external braking resistor is really connected.
- Test the function of the braking resistor under realistic, worst case conditions.

If the regenerated power becomes greater than the power that can be absorbed by the braking resistor, an error message is generated and the power stage is disabled.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`RESint_ext` ConF → ACG- Eibr	Selection of internal or external braking resistor **0 / Internal Braking Resistor / int**: Internal braking resistor **1 / External Braking Resistor / Eht**: External braking resistor Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 0 1	UINT16 R/W per. -	Modbus 1298
`RESext_P` ConF → ACG- Pobr	Nominal power of external braking resistor Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	W 1 10 32767	UINT16 R/W per. -	Modbus 1316
`RESext_R` ConF → ACG- rbr	Resistance value of external braking resistor The minimum value depends on the power stage. In increments of 0.01 Ω. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	Ω - 100.00 327.67	UINT16 R/W per. -	Modbus 1318
`RESext_ton` ConF → ACG- tbr	Maximum permissible switch-on time of external braking resistor Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	ms 1 1 30000	UINT16 R/W per. -	Modbus 1314

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7.6.11 Autotuning the device

There are three ways of tuning the drive control loops:

- Easy Tuning: Automatic - autotuning without user intervention. For most applications, autotuning yields good, highly dynamic results.
- Comfort Tuning: Semi-automatic - autotuning with user intervention. Parameters for direction and parameters for damping can be set by the user.
- Manual: The user can set and tune the control loop parameters manually. Expert mode.

Autotuning

Autotuning determines the friction torque as a constantly acting load torque and considers it in the calculation of the moment of inertia of the entire system.

External factors such as a load at the motor are considered. Autotuning optimizes the settings of the control loop parameters; see chapter 7.7 "Controller optimization with step response".

Autotuning also supports typical vertical axes.

⚠ WARNING

UNEXPECTED MOVEMENT

Autotuning moves the motor in order to tune the control loops. Incorrect parameters may cause unexpected movements or the loss of monitoring functions.

- Check the parameters `AT_dir` and `AT_dis_usr` (`AT_dis`). The distance required for the deceleration ramp must also be taken into account.
- Verify that the parameter `LIM_I_maxQSTP` for Quick Stop is correctly set.
- If possible, use the limit switches.
- Verify that a functioning button for emergency stop is within reach.
- Verify that the system is free and ready for the movement before starting the function.

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

During autotuning, the motor is activated and small movements are made. Noise development and mechanical oscillations of the system are normal.

If you want to perform Easy Tuning, no additional parameters need to be set. If you want to perform Comfort Tuning, set the parameters `AT_dir`, `AT_dis_usr` (`AT_dis`) and `AT_mechanics` to meet the requirements of your system.

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The parameter `AT_Start` is used to selected between Easy Tuning and Comfort Tuning. When the value is written, autotuning also starts.

▶ Start autotuning via the commissioning software.

It is also possible to start autotuning via the HMI.
HMI: oP→tun→tuSt

▶ Save the new settings to the EEPROM via the commissioning software.

The product features 2 controller parameter sets that can be parameterized separately. The values for the controller parameters determined during autotuning are stored in controller parameter set 1.

If you have started autotuning via the HMI, press the navigation button to save the new values to the EEPROM.

If autotuning cancels with an error message, the default values are used. Change the mechanical position and restart autotuning. If you want to verify the plausibility of the calculated values, you can have them displayed; see chapter 7.6.12 "Enhanced settings for autotuning", page 173.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`AT_dir` oP → tun- StiM	Direction of movement for Autotuning **1 / Positive Negative Home / Pnh**: Positive direction first, then negative direction with return to initial position **2 / Negative Positive Home / nPh**: Negative direction first, then positive direction with return to initial position **3 / Positive Home / P-h**: Positive direction only with return to initial position **4 / Positive / P--**: Positive direction only without return to initial position **5 / Negative Home / n-h**: Negative direction only with return to initial position **6 / Negative / n--**: Negative direction only without return to initial position Changed settings become active the next time the motor moves.	- 1 1 6	UINT16 R/W - -	Modbus 12040
`AT_dis_usr`	Movement range for Autotuning Range within which the control parameters are automatically optimized. The range is entered with reference to the current position. NOTE: In the case of "Movement in one direction only" (Parameter AT_dir), the specified range is used for each optimization step. The actual movement typically corresponds to 20 times the value, but it is not limited. The minimum value, the factory setting and the maximum value depend on the scaling factor. Available as of firmware version V01.05 Changed settings become active the next time the motor moves.	usr_p 1 32768 2147483647	INT32 R/W - -	Modbus 12068

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`AT_dis`	Movement range for Autotuning Range within which the control parameters are automatically optimized. The range is entered with reference to the current position. NOTE: In the case of "Movement in one direction only" (Parameter AT_dir), the specified range is used for each optimization step. The actual movement typically corresponds to 20 times the value, but it is not limited. The parameter AT_dis_usr allows you to enter the value in user-defined units. In increments of 0.1 revolution. Changed settings become active the next time the motor moves.	revolution 1.0 2.0 999.9	UINT32 R/W - -	Modbus 12038
`AT_mechanical`	Type of coupling of the system **1 / Direct Coupling**: Direct coupling **2 / Belt Axis**: Belt axis **3 / Spindle Axis**: Spindle axis Changed settings become active the next time the motor moves.	- 1 2 3	UINT16 R/W - -	Modbus 12060
`AT_start`	Autotuning start Value 0: Terminate Value 1: Activate EasyTuning Value 2: Activate ComfortTuning Changed settings become active immediately.	- 0 - 2	UINT16 R/W - -	Modbus 12034

7.6.12 Enhanced settings for autotuning

The following parameters allow you to monitor and influence autotuning.

The parameters AT_state and AT_progress allow you to monitor the progress (in percent) and the status of autotuning.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_AT_state	Autotuning status Bit assignments: Bits 0 ... 10: Last processing step Bit 13: auto_tune_process Bit 14: auto_tune_end Bit 15: auto_tune_err	- - - -	UINT16 R/- - -	Modbus 12036
_AT_progress	Progress of Autotuning	% 0 0 100	UINT16 R/- - -	Modbus 12054

If, in a test run, you want to check the effects of harder or softer settings of the controller parameters on your system, you can write the parameter CTRL_GlobGain to modify the settings determined during autotuning. The parameter _AT_J allows you to read the moment of inertia of the entire system calculated during autotuning.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL_GlobGain oP → tun- GAin	Global gain factor (affects parameter set 1) The global gain factor affects the following parameters of controller parameter set 1: - CTRL_KPn - CTRL_TNn - CTRL_KPp - CTRL_TAUnref The global gain factor is set to 100% - if the controller parameters are set to default - at the end of the Autotuning process - if the controller parameter set 2 is copied to set 1 via the parameter CTRL_ParSetCopy In increments of 0.1 %. Changed settings become active immediately.	% 5.0 100.0 1000.0	UINT16 R/W per. -	Modbus 4394
_AT_M_friction	Friction torque of the system Is determined during Autotuning. In increments of 0.01 A_{rms}.	A_{rms} - - -	UINT16 R/- - -	Modbus 12046
_AT_M_load	Constant load torque Is determined during Autotuning. In increments of 0.01 A_{rms}.	A_{rms} - - -	INT16 R/- - -	Modbus 12048

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_AT_J	Moment of inertia of the complete system Is automatically calculated during Autotuning. In increments of 0.1 kg cm^2.	kg cm^2 0.1 0.1 6553.5	UINT16 R/- per. -	Modbus 12056

The parameter AT_wait lets you set a waiting time between the individual autotuning steps. Setting a waiting time is only useful in the case of a low-rigidity coupling, in particular so if the next autotuning step (changing the hardness) is already performed while the system is still settling.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
AT_wait	Waiting time between Autotuning steps Changed settings become active the next time the motor moves.	ms 300 500 10000	UINT16 R/W - -	Modbus 12050

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7.7 Controller optimization with step response

7.7.1 Controller structure

The controller structure corresponds to the classical cascaded closed loop with current controller, velocity controller and position controller. In addition, the reference value of the velocity controller can be smoothed via a filter.

The controllers are tuned one after the other from the "inside" to the "outside" in the following sequence: current control, velocity control, position control. The superimposed control loop remains off.

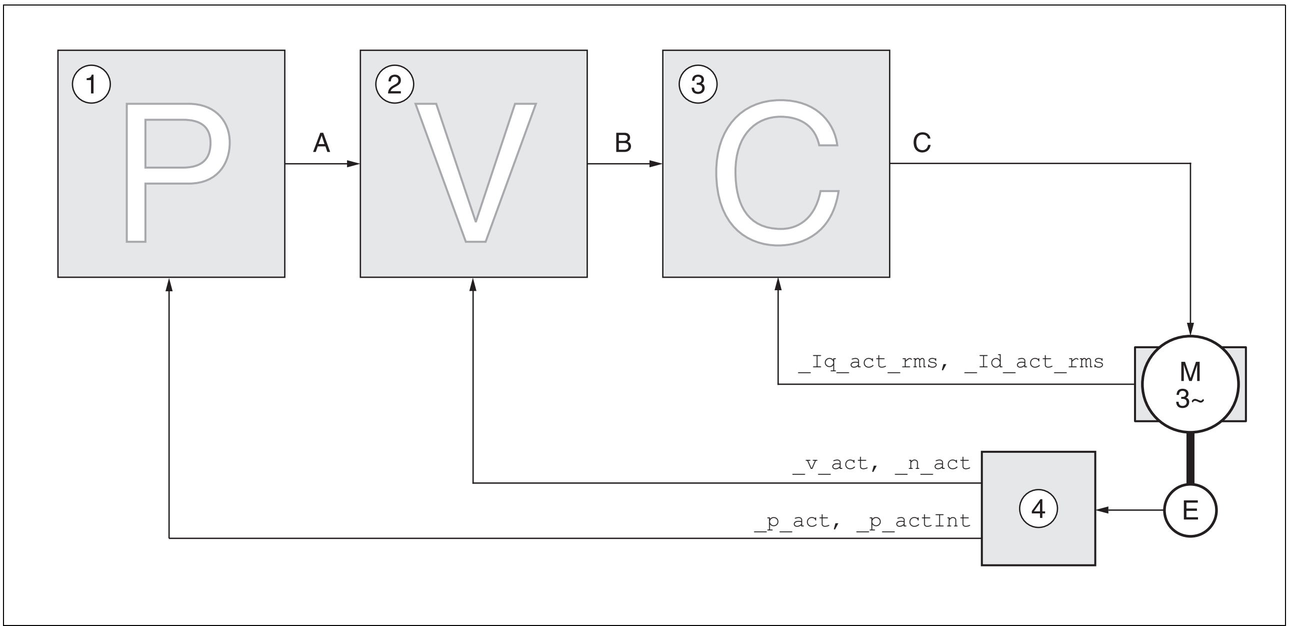

Figure 7.14 Controller structure

(1) Position controller
(2) Velocity controller
(3) Current controller
(4) Encoder evaluation

See chapter 8.5.4 "Setting the controller parameters" for a detailed description of the controller structure.

Current controller The current controller determines the torque of the motor. The current controller is automatically optimally tuned with the stored motor data.

Velocity controller The velocity controller controls the motor velocity by varying the motor current depending on the load situation. The velocity controller has a decisive influence on the dynamic response of the drive. The dynamics of the velocity controller depend on:

- Moment of inertia of the drive and the controlled system
- Power of the motor
- Stiffness and elasticity of the elements in the flow of forces
- Backlash of the drive elements
- Friction

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Position controller

The position controller reduces the difference between the reference position and the actual position of the motor (position deviation) to a minimum. When the motor is at a standstill, the position deviation is close to zero in the case of a well-tuned position controller.

An optimized velocity control loop is a prerequisite for good amplification of the position controller.

7.7.2 Optimization

The drive optimization function matches the device to the application conditions. The following options are available:

- Selecting control loops. Superimposed control loops are automatically deactivated.
- Defining reference value signals: signal type, amplitude, frequency and starting point
- Testing control performance with the signal generator.
- Recording the control performance on screen and evaluating it with the commissioning software.

Setting reference value signals

▶ Start controller optimization with the commissioning software.

▶ Set the following values for the reference value signal:

- Signal type: Step "positive"
- Amplitude: 100 1/min
- Cycle duration: 100 ms
- Number of repetitions: 1

▶ Start recording

Only the signal types "Step" and "Square" allow you to determine the entire dynamic behavior of a control loop. The manual shows signal paths for the signal type "Step".

Entering controller values

The optimization steps described on the following pages require you to enter control loop parameters and test their effect by triggering a step function.

A step function is triggered as soon as you start recording in the commissioning software.

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

Controller parameter sets

This device allows you to use two controller parameter sets. It is possible to switch form one set of controller parameters to the other during operation. The active controller parameter set is selected with the parameter `CTRL_SelParSet`.

The corresponding parameters are `CTRL1_xx` for the first controller parameter set and `CTRL2_xx` for the second controller parameter set. The following descriptions use the notation `CTRL1_xx` (`CTRL2_xx`) if there are no functional differences between the two controller parameter sets.

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7.7.3 Optimizing the velocity controller

Optimum settings of complex mechanical control systems require hands-on experience with controller tuning . This includes the ability to calculate control loop parameters and to apply identification procedures.

Less complex mechanical systems can often be successfully optimized by means of experimental adjustment using the aperiodic limit method. The following parameters are used for this:

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL1_KPn ConF → drC- Pn1	Velocity controller P gain The default value is calculated on the basis of the motor parameters. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.0001 A/min^{-1}. Changed settings become active immediately.	A/min^{-1} 0.0001 - 1.2700	UINT16 R/W per. -	Modbus 4610
CTRL2_KPn ConF → drC- Pn2	Velocity controller P gain The default value is calculated on the basis of the motor parameters. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.0001 A/min^{-1}. Changed settings become active immediately.	A/min^{-1} 0.0001 - 1.2700	UINT16 R/W per. -	Modbus 4866
CTRL1_TNn ConF → drC- tin1	Velocity controller integral action time The default value is calculated on the basis of CTRL_TAUiref. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 - 327.67	UINT16 R/W per. -	Modbus 4612
CTRL2_TNn ConF → drC- tin2	Velocity controller integral action time The default value is calculated on the basis of CTRL_TAUiref. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 - 327.67	UINT16 R/W per. -	Modbus 4868

Check and optimize the calculated values in a second step, as described on page 182.

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Determining the mechanical system of the system

To assess and optimize the transient response behavior of your system, group its mechanical system into one of the following two categories.

- System with rigid mechanical system
- System with a less rigid mechanical system

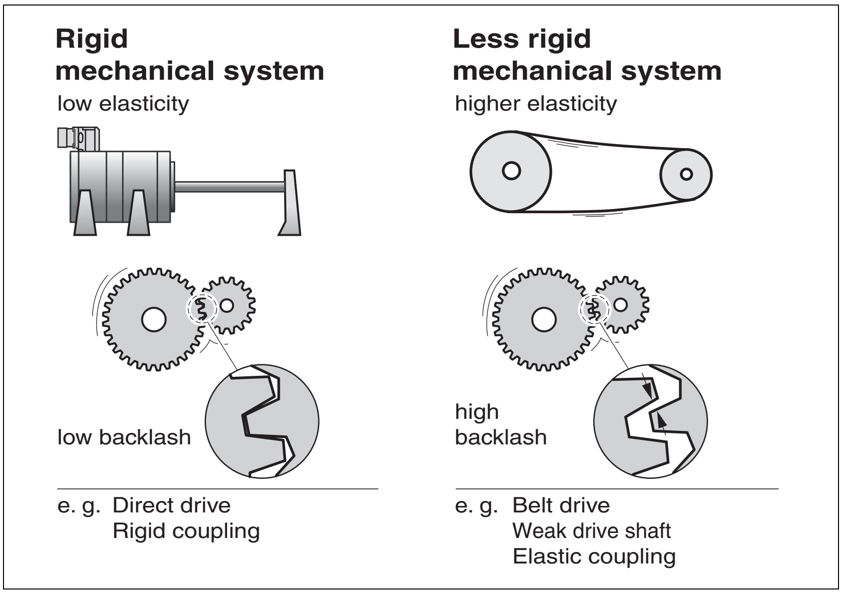

Figure 7.15 Rigid and less rigid mechanical systems

▶ Couple the motor and the mechanical system

▶ If you use limit switches: verify the function of the limit switches after installation of the motor.

Switching of the reference value filter of the velocity controller

The reference value filter of the velocity controller allows you to improve the transient response at optimized velocity control. The reference value filter must be switched off for the first setup of the velocity controller.

▶ Deactivate the reference value filter of the velocity controller. Set the parameter `CTRL1_TAUnref` (`CTRL2_TAUnref`) to the lower limit value "0".

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`CTRL1_TAUnref` ConF → drC- tAu1	Filter time constant of the reference velocity value filter This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 9.00 327.67	UINT16 R/W per. -	Modbus 4616

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL2_TAUnref ConF → drC- tAu2	Filter time constant of the reference velocity value filter This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 9.00 327.67	UINT16 R/W per. -	Modbus 4872

NOTE: The procedure for optimization of the settings is only a suggestion. It is the responsibility of the user to decide whether the method is suitable for the actual application.

Determining controller parameter values for rigid mechanical systems

In the case of a rigid mechanical system, adjusting the control performance on the basis of the table is possible if:

- the moment of inertia of the load and of the motor are known and
- the moment of inertia of the load and of the motor are constant

The P gain CTRL_KPn and the integral action time CTRL_TNn depend on:

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

▶ Determine the controller parameter values using Table 7.1:

	$J_L = J_M$		$J_L = 5 * J_M$		$J_L = 10 * J_M$	
J_L[kgcm^2]	KPn	TNn	KPn	TNn	KPn	TNn
1	0.0125	8	0.008	12	0.007	16
2	0.0250	8	0.015	12	0.014	16
5	0.0625	8	0.038	12	0.034	16
10	0.125	8	0.075	12	0.069	16
20	0.25	8	0.15	12	0.138	16

Table 7.1 Determining controller values

Determining controller parameter values for rigid mechanical systems

For optimization purposes, determine the P gain of the velocity controller at which the controller adjusts velocity _v_act as quickly as possible without overshooting.

▶ Set the integral action time CTRL1_TNn (CTRL2_TNn) to infinite (= 327.67 ms).

If a load torque acts on the motor when the motor is at a standstill, the integral action time must not exceed a value that causes uncontrolled change of the motor position.

If the motor is subject to loads when it is at a standstill, setting the integral action time to "infinite" may cause position deviations. Reduce the integral action time if the deviation is unacceptable in your application. However, reducing the integral action time can adversely affect optimization results.

⚠ WARNING

UNEXPECTED MOVEMENT

The step function moves the motor at constant velocity until the specified time has expired.

- Verify that the selected values for velocity and time do not exceed the available distance.
- If possible, use limit switches.
- Verify that a functioning button for emergency stop is within reach.
- Verify that the system is free and ready for the movement before starting the function.

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

▶ Initiate a step function.

▶ After the first test, check the maximum amplitude for the reference value for the current `_Iq_ref`.

Set the amplitude of the reference value just high enough so the reference value for the current `_Iq_ref` remains below the maximum value `CTRL_I_max`. On the other hand, the value selected should not be too low, otherwise friction effects of the mechanical system will determine the performance of the control loop.

▶ Trigger another step function if you had to modify `_v_ref` and check the amplitude of `_Iq_ref`.

▶ Increase or decrease the P gain in small increments until `_v_act` is obtained as fast as possible. The following diagram shows the required transient response on the left. Overshooting - as shown on the right - is reduced by reducing `CTRL1_KPn` (`CTRL2_KPn`).

Differences between `_v_ref` and `_v_act` result from setting `CTRL1_TNn` (`CTRL2_TNn`) to "Infinite".

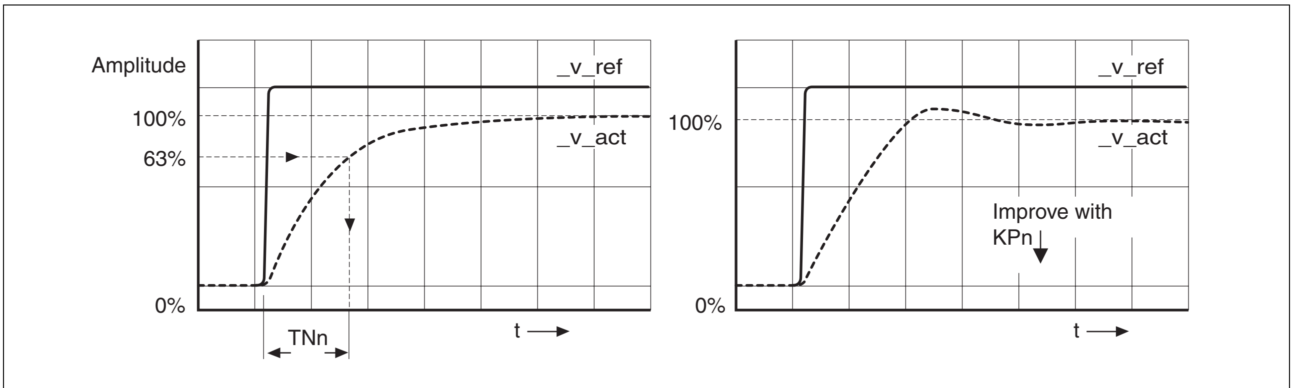

Figure 7.16 Determining "TNn" for the aperiodic limit

In the case of drive systems in which oscillations occur before the aperiodic limit is reached, the P gain "KPn" must be reduced until oscillations can no longer be detected. This occurs frequently in the case of linear axes with a toothed belt drive.

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Graphic determination of the 63% value

Graphically determine the point at which the actual velocity `_v_act` reaches 63% of the final value. The integral action time `CTRL1_TNn` (`CTRL2_TNn`) then results as a value on the time axis. The commissioning software supports you with the evaluation:

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`CTRL1_TAUiref`	Filter time constant of the reference current value filter This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 0.50 4.00	UINT16 R/W per. -	Modbus 4618
`CTRL2_TAUiref`	Filter time constant of the reference current value filter This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 0.50 4.00	UINT16 R/W per. -	Modbus 4874

7.7.4 Checking and optimizing default settings

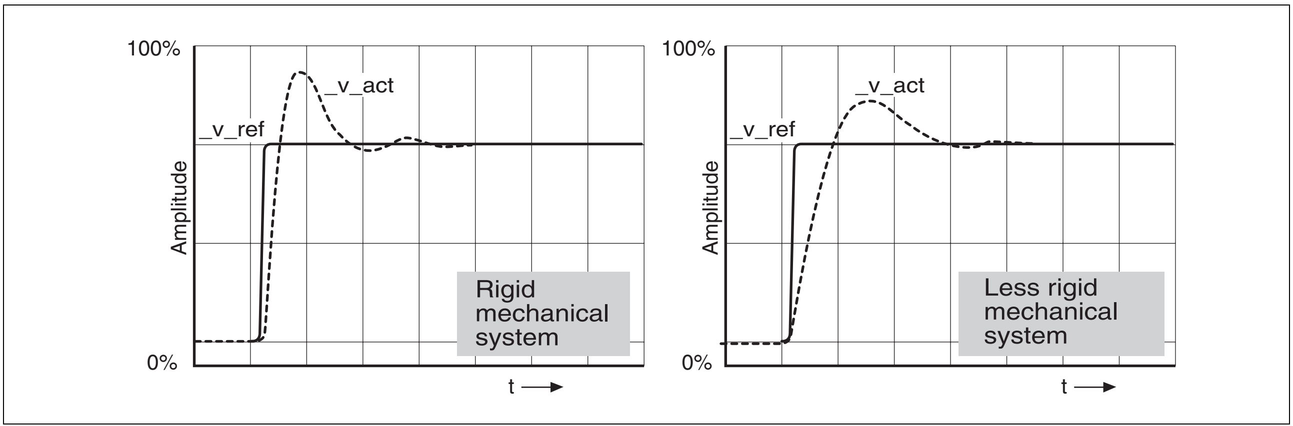

Figure 7.17 Step responses with good control performance

The controller is properly set when the step response is approximately identical to the signal shown. Good control performance is characterized by

- Fast transient response
- Overshooting up to a maximum of 40%, 20% is recommended.

If the control performance does not correspond to the curve shown, change `CTRL_KPn` in increments of about 10% and then trigger another step function:

- If the control is too slow: Use a higher `CTRL1_KPn` (`CTRL2_KPn`) value.
- If the control tends to oscillate: Use a lower `CTRL1_KPn` (`CTRL2_KPn`) value.

Oscillation ringing is characterized by continuous acceleration and deceleration of the motor.

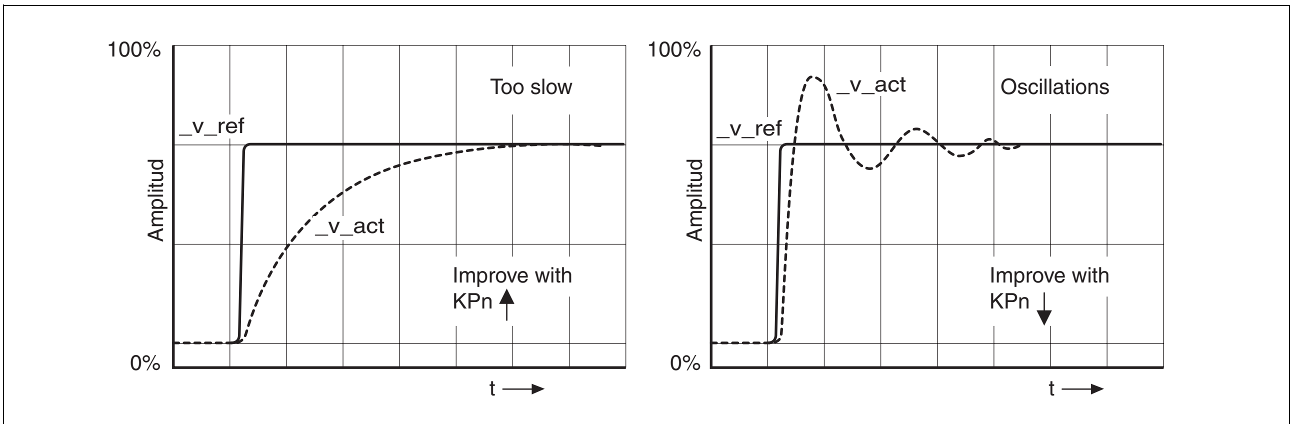

Figure 7.18 Optimizing insufficient velocity controller settings

If the controller performance remains unsatisfactory in spite of optimization, contact your local sales representative.

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7.7.5 Optimizing the position controller

Optimization requires good control dynamics in the subordinate velocity control circuit.

When tuning the position controller, you must optimize the P gain CTRL1_KPp (CTRL2_KPp) in two limits:

- CTRL1_KPp (CTRL2_KPp) too high: Overshooting of the mechanical system, instability of the closed-loop control
- CTRL1_KPp (CTRL2_KPp) too low: High position deviation

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL1_KPp ConF → drC- PP1	Position controller P gain The default value is calculated. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.1 1/s. Changed settings become active immediately.	1/s 2.0 - 900.0	UINT16 R/W per. -	Modbus 4614
CTRL2_KPp ConF → drC- PP2	Position controller P gain The default value is calculated. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.1 1/s. Changed settings become active immediately.	1/s 2.0 - 900.0	UINT16 R/W per. -	Modbus 4870

⚠ WARNING

UNEXPECTED MOVEMENT

The step function moves the motor at constant velocity until the specified time has expired.

- Verify that the selected values for velocity and time do not exceed the available distance.
- If possible, use limit switches.
- Verify that a functioning button for emergency stop is within reach.
- Verify that the system is free and ready for the movement before starting the function.

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

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Setting the reference value signal

▶ Select Position Controller as the reference value in the commissioning software.

▶ Set the reference signal:

- Signal type: "Step"
- For rotary motors: Set the amplitude to approx. 1/10 motor revolution.

The amplitude is entered in user-defined units. With the default scaling, the resolution is 16384 usr per motor revolution.

Selecting the recording signals

▶ Select the values in the box General Recording Parameters:

- Reference position of position controller `_p_refusr` (`_p_ref`)
- Actual position of position controller `_p_actusr` (`_p_act`)
- Actual velocity `_v_act`
- Current motor current `_Iq_ref`

Controller values for the position controller can be changed in the same parameter group that you already used for the velocity controller.

Optimizing the position controller value

▶ Trigger a step function with the default controller values.

▶ After the first test, check the values achieved for `_n_act` and `_Iq_ref` for current and velocity control. The values must not reach the current and velocity limitation range.

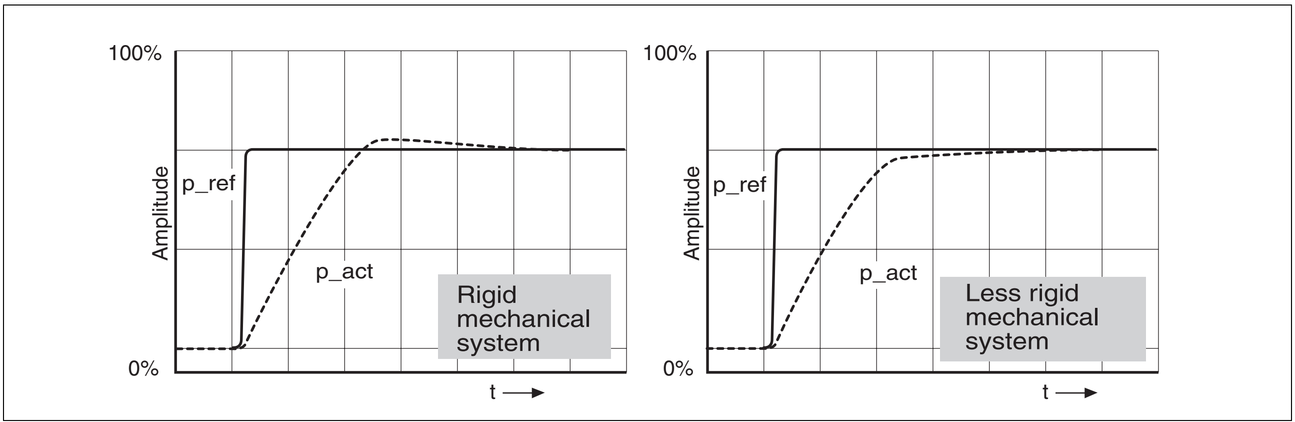

Figure 7.19 Step responses of a position controller with good control performance

The setting of the p gain `CTRL1_KPp` (`CTRL2_KPp`) is optimal if the reference value is reached rapidly and with little or no overshooting.

If the control performance does not correspond to the curve shown, change the P gain `CTRL1_KPp` (`CTRL2_KPp`) in increments of approximately 10% and trigger another step function.

- If the control tends to oscillate: Use a lower KPp value.
- If the actual value is too slow reaching the reference value: Use a higher KPp value.

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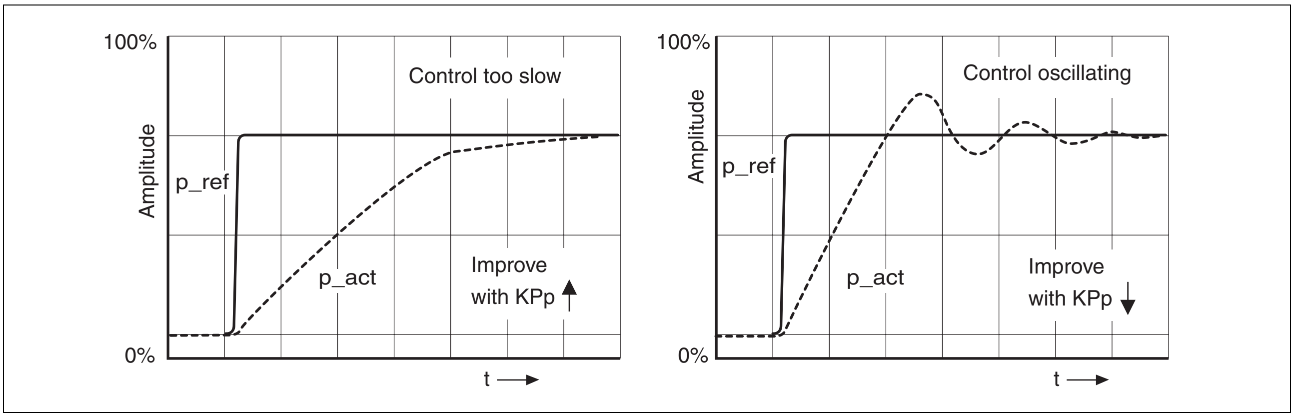

Figure 7.20 Optimizing inadequate position controller settings

7.8 Memory Card

The devices features a slot for a memory card. The parameters stored on the memory card can be transferred to other devices. If a device is replaced, a new device of the same type can be operated with identical parameters.

NOTE: The contents of the memory card is only compared to the parameters stored in the device when the device is switched on.

If the parameters on the memory card and in the device are identical, the 7-segment display briefly shows CArd during start-up.

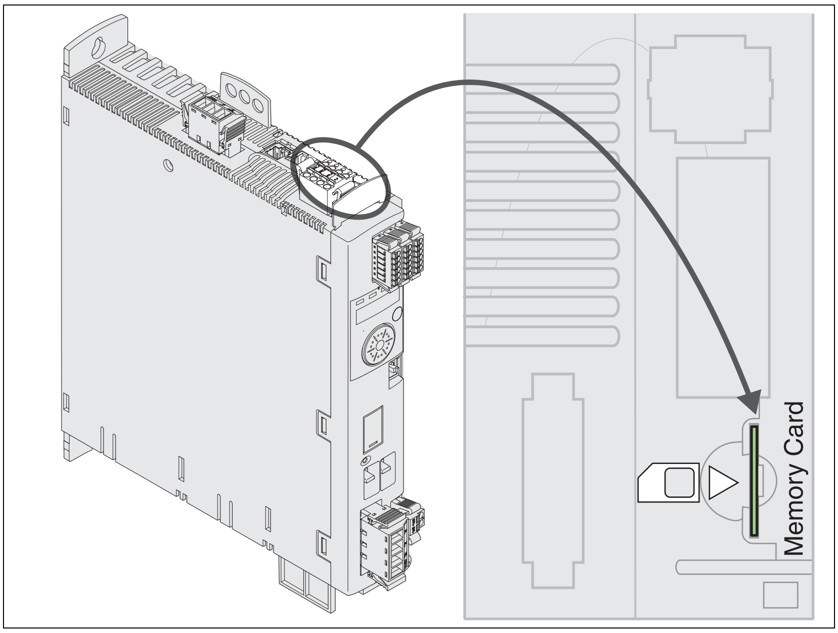

Figure 7.21 Slot for memory card

Note the following:

- Use only genuine accessory memory cards.
- Do not touch the gold contacts.
- The insert/remove cycles of the memory card are limited.
- The memory card can remain in the device.

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Inserting a memory card

- The controller supply voltage is switched off.
- ▶ Insert the memory card into the device with the gold contacts face down; the slanted corner must be face to the mounting plate.
- ▶ Switch on the controller supply voltage.

Observe the 7-segment display during the initialization of the device:

CArd is displayed	
CArd is displayed for a short period of time during initialization of the device.	Memory card detected, no user intervention required. The parameter values stored in the device and the contents of the memory card are identical.
CArd is displayed permanently.	Memory card detected, user intervention required. See chapter 7.8.1 "Data exchange with the memory card", page 187. The parameter values stored in the device and the contents of the memory card are different or the memory card has been removed.
CArd is not displayed.	No memory card detected. Switch off the controller supply voltage. Verify that the memory card has been properly inserted (contacts, slanted corner).

7.8.1 Data exchange with the memory card

If there are differences between the parameters on the memory card and the parameters stored in the device, the device stops after initialization and displays CArd.

Copying data or ignoring the memory card (CArd, iGnr, ctod, dtoc)

■ The 7-segment display shows CArd.

▶ Press the navigation button.

◁ The 7-segment display shows the last setting, for example iGnr.

▶ Briefly press the navigation button to activate the Edit mode.

◁ The 7-segment display continues to display the last setting, the Edit LED lights.

▶ Select one of the following using the navigation button[1]:

- iGnr ignores the memory card.
- ctod transfers the data from the memory card to the device.
- dtoc transfers the data from the device to the memory card.

◁ The device switches to operating state **4** Ready To Switch On.

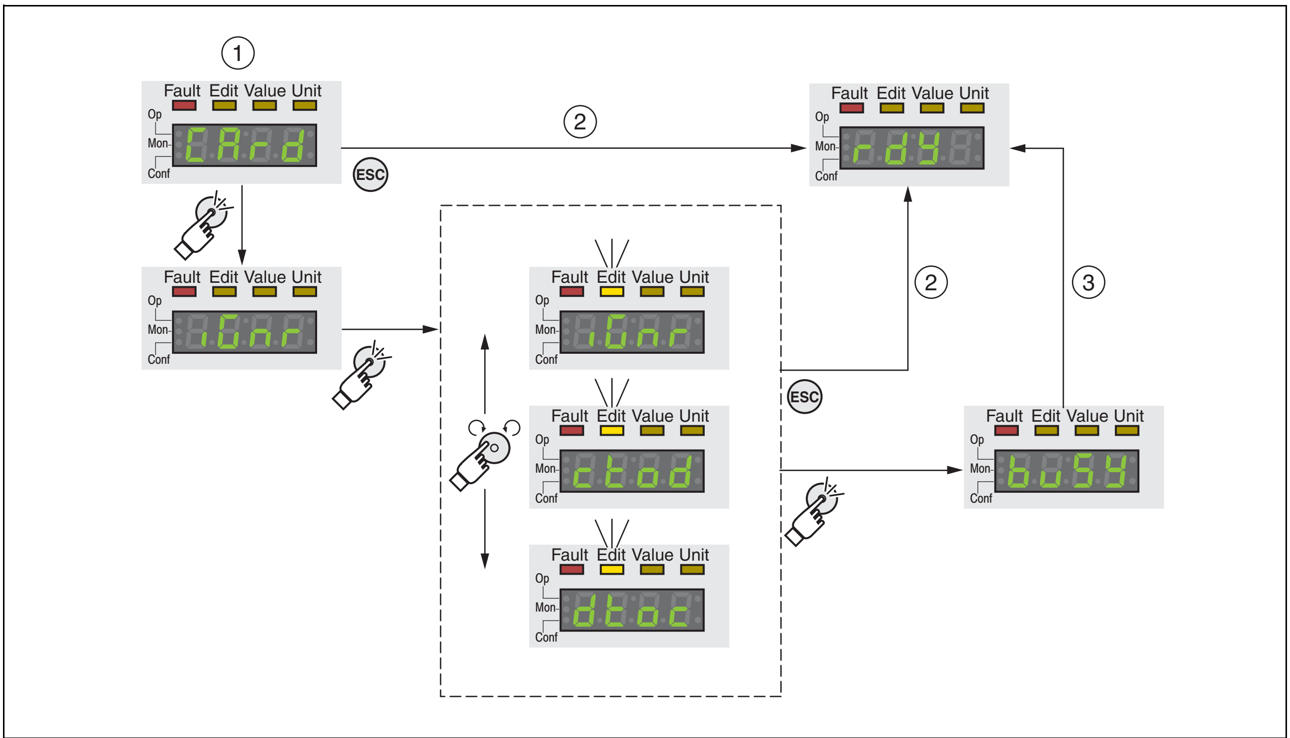

Figure 7.22 Memory card via integrated HMI

(1) Data on the memory card and in the device are different: The device displays cArd and waits for user intervention.

(2) Transition to operating state **4** Ready To Switch On (memory card is ignored).

(3) Transfer of data (ctod = card to device, dtoc = device to card) and transition to operating state **4** Ready To Switch On.

1. Options may be limited

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Memory card has been removed (CArdMiSS)

If you removed the memory card, the device displays CArd after initialization. If you confirm this, the display shows MiSS. After you have confirmed this warning, the product switches to the operating state **4** Ready To Switch On..

Write protection for memory card (CArd, EnPr, diPr, Prot)

It is possible to write-protect the memory card for LXM 32 (Prot). For example, you may want to write-protect memory cards used for regular duplication of device data.

To write-protect the memory card, select ConF - ACG-CArd on the HMI.

Selection	Meaning
EnPr	Write protection on (Prot)
diPr	Write protection off

Memory cards can also be write-protected via the commissioning software.

7.9 Duplicating existing device settings

Application and advantage

- Multiple devices are to have the same settings, for example, when devices are replaced.

Prerequisites

Device type, motor type and device firmware must be identical.
Tools for duplication:

- Memory card
- Commissioning software (for Windows)

The controller supply voltage must be switched on at the device.

Duplication using a memory card

Device settings can be stored on a memory card (accessories). The stored device settings can be copied to a device of the same type. Note that the fieldbus address and the settings for the monitoring functions are copied along with this information. See chapter 7.8 "Memory Card", page 185 for additional information.

Duplication using the commissioning software

The commissioning software installed on a PC can save the settings of a device in the form of a configuration file. The stored device settings can be copied to a device of the same type. Note that the fieldbus address and the settings for the monitoring functions are copied along with this information. See the manual for the commissioning software or the online help for additional information.

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8 Operation

8

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

⚠ 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 error 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.

Access channels

8.1 "Access channels"

Operating states

8.2 "Operating states"
8.2.1 "State diagram"
8.2.2 "State transitions"
8.2.3 "Indication of the operating state"
8.2.4 "Changing the operating state"

Operating modes

8.3 "Operating modes"
8.3.1 "Starting the operating mode"
8.3.2 "Changing the operating mode"
8.3.3 "Operating mode Jog"
8.3.4 "Operating mode Electronic Gear"
8.3.5 "Operating mode Profile Torque"
8.3.6 "Operating mode Profile Velocity"

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Movement range

Extended settings

Functions for target value processing

Functions for monitoring movements

Functions for monitoring internal device signals

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8.1 Access channels

⚠ WARNING

UNINTENDED BEHAVIOR CAUSED BY ACCESS CONTROL

Improper use of access control may cause commands to be triggered or blocked.

- Verify that no unintended behavior is caused as a result of enabling or disabling exclusive access.
- Verify that impermissible access is blocked.
- Verify that required access is available.

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

The product can be addressed via different access channels. Access channels are:

- Integrated HMI
- Commissioning software
- Digital and analog Input signals

If several access channels are active at the same time, this may lead to unintended behavior. Access control can be used to limit access to a particular access channel.

The product offers 2 different possibilities of access control.

- Non-exclusive access
- Exclusive access via an access channel

When the product is switched on, there is no exclusive access via an access channel.

Only one access channel can have exclusive access to the product. An exclusive access can be provided via different access channels:

- Via the integrated HMI:

  The operating mode Jog or Autotuning can be started via the HMI.

- Via the commissioning software:

  The commissioning software receives exclusive access via the switch "Exclusive access" in position "On".

When the product is switched on, the reference values are effective at the analog inputs (CN6.1) and PTI interface (Pulse Train In, CN5). If exclusive access has been assigned to an access channel, signals at the analog inputs and the PTI interface are ignored.

The signal input functions "Halt", "Fault Reset", "Enable", "Positive Limit Switch (LIMP)", "Negative Limit Switch (LIMN)" and "Reference Switch (REF)" as well as the signals of the safety function STO ($\overline{\text{STO\_A}}$ and $\overline{\text{STO\_B}}$) are effective during exclusive access.

Access to the product via the HMI (writing parameters) can be revoked by means of the parameter `HMIlocked`.

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
AccessLock	Locking other access channels Value 0: Allow control via other access channels Value 1: Lock control via other access channels Example: The access channel is used by the fieldbus. In this case, control via the commissioning software or the HMI is not possible. The access channel can only be locked after the current operating mode has terminated. Changed settings become active immediately.	- 0 0 1	UINT16 R/W - -	Modbus 284
HMIlocked	Lock HMI **0 / Not Locked / nLoc**: HMI not locked **1 / Locked / Loc**: HMI locked The following functions can no longer be started when the HMI is locked: - Parameter change - Jog - Autotuning - Fault Reset Changed settings become active immediately.	- 0 0 1	UINT16 R/W per. -	Modbus 14850

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8.2 Operating states

8.2.1 State diagram

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

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

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

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

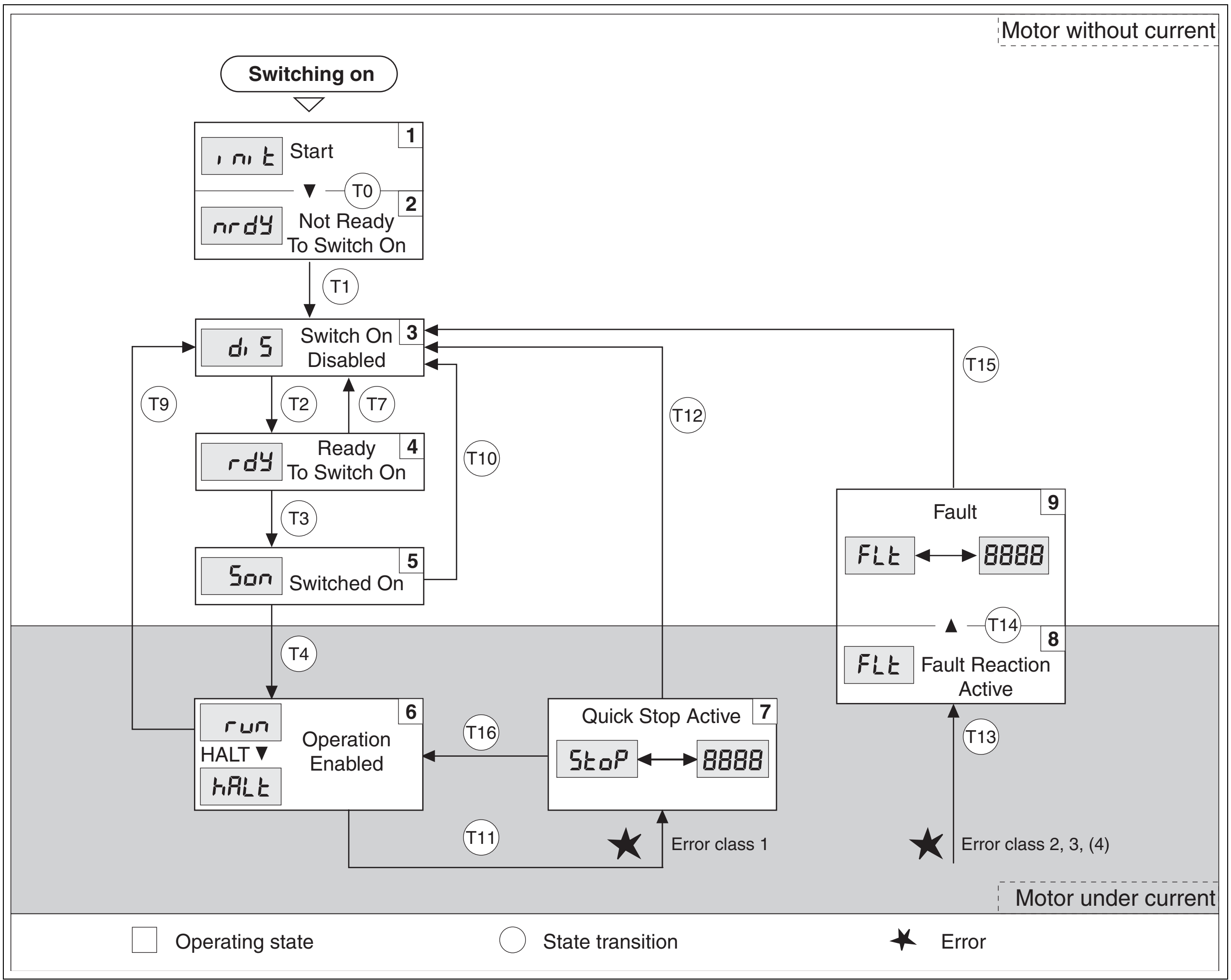

Figure 8.1 State diagram

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Operating states

Operating state	Description
1 Start	Controller supply voltage switched on Electronics are initialized
2 Not Ready To Switch On	The power stage is not ready to switch on
3 Switch On Disabled	Impossible to enable the power stage
4 Ready To Switch On	The power stage is ready to switch on.
5 Switched On	Power stage is switched on
6 Operation Enabled	Power stage is enabled Selected operating mode is active
7 Quick Stop Active	"Quick Stop" is being executed
8 Fault Reaction Active	Error response is active
9 Fault	Error response terminated Power stage is disabled

Error class

The product triggers an error response if an error occurs. Depending upon the severity of the error, the device responds in accordance with one of the following error classes:

Error class	Response	Meaning
0	Warning	A monitoring function has detected a problem. No interruption of the movement.
1	"Quick Stop"	Motor stops with "Quick Stop", the power stage remains enabled.
2	"Quick Stop" with switch-off	Motor stops with "Quick Stop", the power stage is disabled after standstill has been achieved.
3	Fatal error	The power stage is immediately disabled without stopping the motor first.
4	Uncontrolled operation	The power stage is immediately disabled without stopping the motor first. The error can only be reset by switching off the product.

Error response

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

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

An error can be triggered by a temperature sensor, for example. The product cancels the running movement and performs an error response, for example stopping with "Quick Stop" or disabling the power stage. Subsequently, the operating state changes to **9** Fault.

To exit the **9** Fault operating state, the cause of the error must be remedied and a Fault Reset must be executed.

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Resetting an error message

A "Fault Reset" resets an error message.

The signal input function "Fault Reset" is the factory setting for `DI1`.

*In the event of a "Quick Stop" triggered by an error of class 1 (operating state **7** Quick Stop Active), a "Fault Reset" causes a direct transition to operating state **6** Operation Enabled.*

8.2.2 State transitions

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

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

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

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8.2.3 Indication of the operating state

Information on the operating state is available via the HMI and the signal outputs

The table below provides an overview.

Operating state	**HMI**	**"No fault"** 1)	**"Active"** 2)
1 Start	init	0	0
2 Not Ready To Switch On	nrdY	0	0
3 Switch On Disabled	diS	0	0
4 Ready To Switch On	rdY	1	0
5 Switched On	Son	1	0
6 Operation Enabled	run	1	1
7 Quick Stop Active	Stop	0	0
8 Fault Reaction Active	FLt	0	0
9 Fault	FLt	0	0

1) The signal output function is factory setting for `DQ0`
2) The signal output function is the factory setting for `DQ1`

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8.2.4 Changing the operating state

8.2.4.1 HMI

An error message can be reset via the HMI.

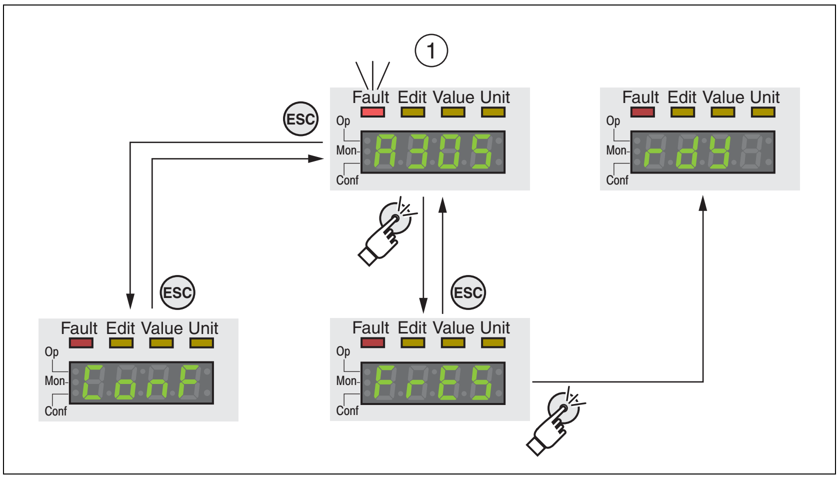

Figure 8.2 Reseting an error message

In the case of an error of error class 1, resetting the error message causes a transition from operating state **7** Quick Stop Active back to operating state **6** Operation Enabled.

In the case of an error of error classes 2 or 3, resetting the error message causes a transition from operating state **9** Fault back to operating state **3** Switch On Disable.

8.2.4.2 Signal inputs

It is possible to switch between operating states via the signal inputs.

Signal input function "Enable"

The power stage is enabled by means of the signal input function "Enable".

"Enable"	State transition
Rising edge	Enable power stage T3
Falling edge	Disable power stage T9 and T12

The signal input function "Enable" is the factory setting for `DI0`.

Signal input function "Fault Reset"

The signal input function"Fault Reset" is used to reset an error message.

"Fault Reset"	State transition
Rising edge	Resetting an error message T15 and T16

The signal input function "Fault Reset" is the factory setting for `DI1`.

8.3 Operating modes

8.3.1 Starting the operating mode

The parameter `IOdefaultMode` is used to set the desired operating mode.

The selected operating mode is starting by enabling the power stage.

▶ Set the operating mode with the parameter `IOdefaultMode`.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IOdefaultMode` ConF → ACG- io-M	Operating mode **0 / None / nonE**: None **1 / Profile Torque / torq**: Profile Torque **2 / Profile Velocity / VELP**: Profile Velocity **3 / Electronic Gear / GEAr**: Electronic Gear **5 / Jog / JoG**: Jog Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- 0 5 5	UINT16 R/W per. -	Modbus 1286

8.3.2 Changing the operating mode

The operating mode can be changed after the current operating mode has been terminated.

In addition, it is also possible to change the operating mode during a running movement; however, this is only possible in certain operating modes.

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Changing the operating mode during a movement

You can switch between the following operating modes during a running movement.

- Jog
- Electronic Gear
- Profile Torque
- Profile Velocity

The operating mode can be changed while the motor is at a standstill or while the motor is not at a standstill, depending on the new operating mode.

Operating mode to be changed to	Motor standstill
Jog	With motor standstill
Electronic Gear (position synchronization)	With motor standstill
Electronic Gear (velocity synchronization)	Without motor standstill
Profile Torque	Without motor standstill
Profile Velocity	Without motor standstill

The motor is decelerated to a standstill via the ramp set in the parameter `LIM_HaltReaction`, see chapter 8.6.1 "Stop movement with Halt".

Changing the operating mode via signal input

The product features the signal input function "Operating Mode Switch".

It allows you to switch via a signal input from the operating mode set in the `IOdefaultMode` to the operating mode set in the parameter `IO_ModeSwitch`.

To switch between two operating modes, you must parameterize the signal input function "Operating Mode Switch", see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IO_ModeSwitch` ConF → ACG- ioMS	Operating mode for signal input function Operating Mode Switch **0 / None / nonE**: None **1 / Profile Torque / torq**: Profile Torque **2 / Profile Velocity / VELP**: Profile Velocity **3 / Electronic Gear / GEAr**: Electronic Gear Changed settings become active immediately.	- 0 0 3	UINT16 R/W per. -	Modbus 1630

8.3.3 Operating mode Jog

Description

In the operating mode Jog, a movement is made from the actual motor position in the desired direction.

A movement can be made using one of 2 methods:

- Continuous movement
- Step movement

In addition, the product features 2 parameterizable velocities.

Continuous movement

As long as the signal for the direction ("Jog Positive" or "Jog Negative") is available, a movement is made in the desired direction.

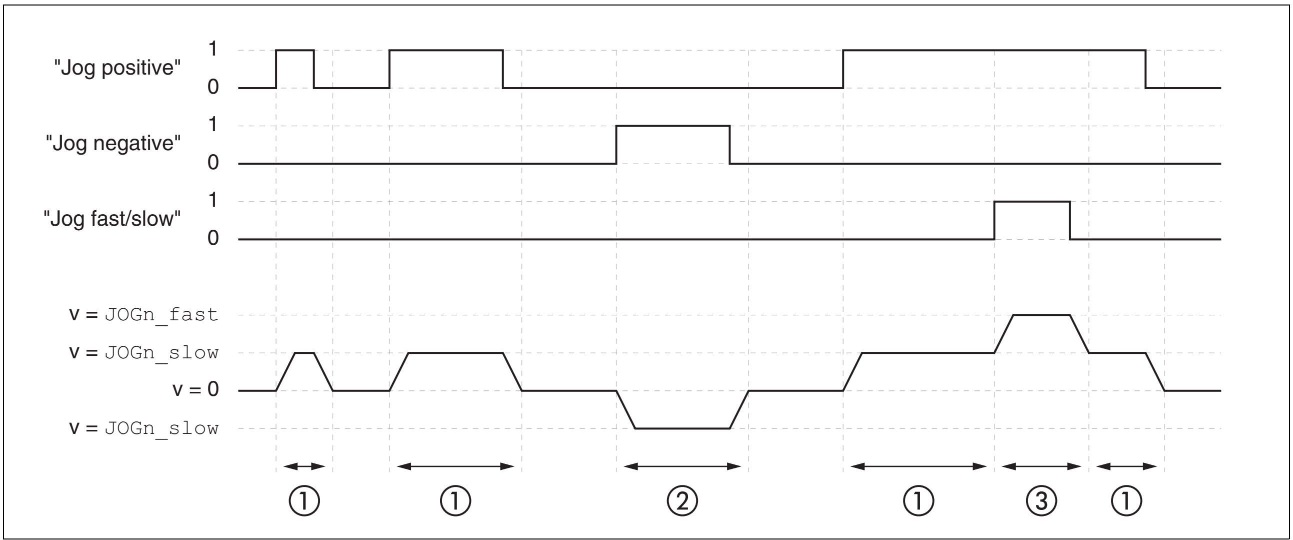

Figure 8.3 Continuous movement

(1) Slow movement in positive direction
(2) Slow movement in negative direction
(3) Fast movement in positive direction

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Step movement

If the signal for the direction ("Jog Positive" or "Jog Negative") is available, a movement with a parameterizable number of user-defined units is made in the desired direction. After this movement, the motor stops for a defined time. Then a continuous movement is made in the desired direction.

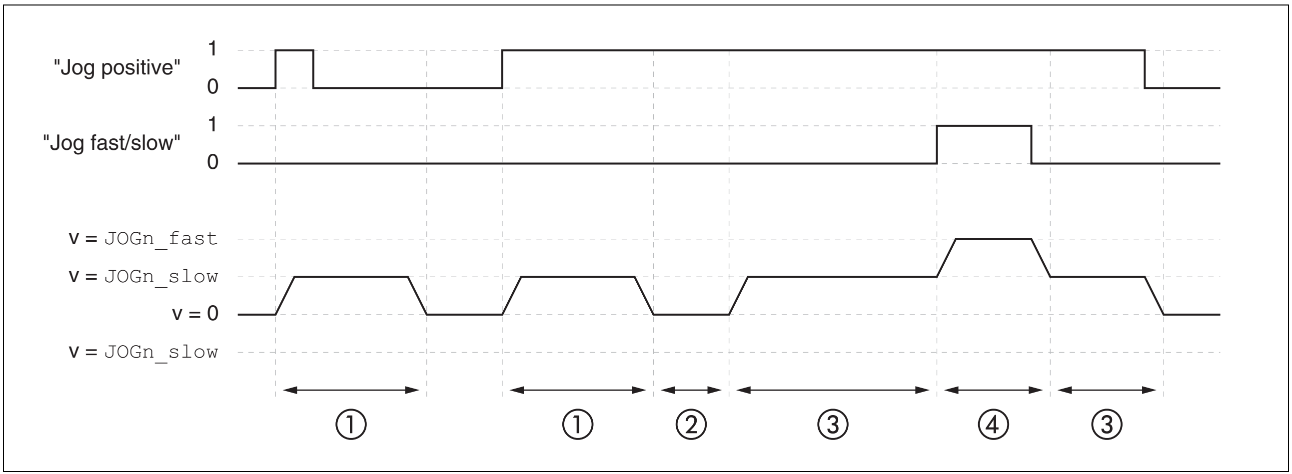

Figure 8.4 Step movement

(1) Slow movement in positive direction with a parameterizable number of user-defined units `JOGstep`
(2) Waiting time `JOGtime`
(3) Slow continuous movement in positive direction
(4) Fast continuous movement in positive direction

Starting the operating mode

The operating mode must first have been selected, see chapter 8.3.1 "Starting the operating mode". After the power stage is enabled, the operating mode is started automatically.

The power stage is enabled via the signal inputs, see chapter 8.2 "Operating states". The table below provides an overview of the factory settings of the signal inputs:

Signal input	**Signal input function**
`DI0`	"Enable" Enable and disable the power stage
`DI1`	"Fault Reset" Resetting an error message
`DI2`	"Positive Limit Switch (LIMP)" See chapter 8.7.1 "Limit switches"
`DI3`	"Negative Limit Switch (LIMN)" See chapter 8.7.1 "Limit switches"
`DI4`	"Jog Negative" Operating mode Jog: Movement in negative direction
`DI5`	"Jog Positive" Operating mode Jog: Movement in positive direction

The factory settings of the signal inputs depend on the selected operating mode; it can be adapted, see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

Integrated HMI

It is also possible to start the operating mode via the HMI. Calling →oP→JoG-→JGSt enables the power stage and starts the operating mode.

The method Continuous Movement is controlled via the HMI.

Turn the navigation button to select one of 4 types of movement:

- JG- : slow movement in positive direction
- JG= : fast movement in positive direction
- -JG : slow movement in negative direction
- =JG : fast movement in negative direction

Press the navigation button to start the movement.

Terminating the operating mode

The operating mode is automatically terminated by disabling the power stage.

Status messages

Information on the operating state and the current movement is available via signal outputs.

The table below provides an overview of the signal outputs:

Signal output	Signal output function
DQ0	"No Fault" Signals the operating states **4** Ready To Switch On, **5** Switched On and **6** Operation Enabled
DQ1	"Active" Signals the operating state **6** Operation Enabled
DQ2	"In Position Deviation Window" See chapter 8.7.4 "Position deviation window"
DQ3	"Motor Standstill" See chapter 8.7.3 "Motor standstill"
DQ4	"Selected Error" See chapter 8.2.3 "Indication of the operating state"

The factory settings of the signal outputs depend on the selected operating mode; it can be adapted, see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

8.3.3.1 Parameterization

Overview The illustration below provides an overview of the adjustable parameters.

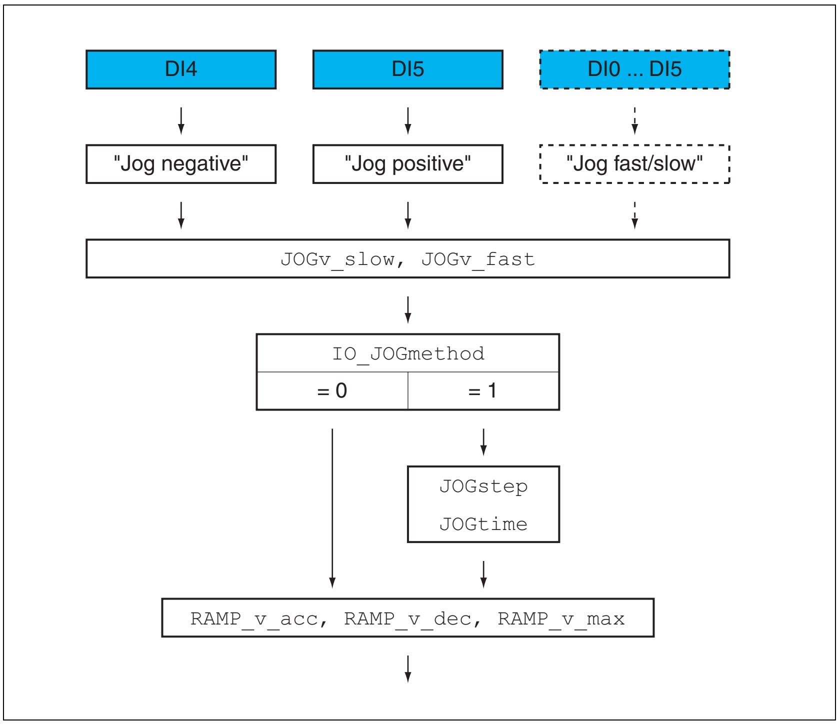

Figure 8.5 Overview of adjustable parameters

Velocities 2 parameterizable velocities are available.

▶ Set the desired values with the parameters `JOGv_slow` and `JOGv_fast`.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`JOGv_slow` oP → JoG- JGLo	Velocity for slow movement The adjustable value is internally limited to the current parameter setting in RAMP_v_max. Changed settings become active immediately.	usr_v 1 60 2147483647	UINT32 R/W per. -	Modbus 10504
`JOGv_fast` oP → JoG- JGhi	Velocity for fast movement The adjustable value is internally limited to the current parameter setting in RAMP_v_max. Changed settings become active immediately.	usr_v 1 180 2147483647	UINT32 R/W per. -	Modbus 10506

Switching between velocities The product features the signal input function "Jog Fast/Slow". It allows you to switch between the two velocities via a signal input.

To switch between the two velocities, you must parameterize the signal input function "Jog Fast/Slow", see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

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Selection of the method

The parameter `IO_JOGmethod` lets you set the method.

▶ Set the desired method with the parameter `IO_JOGmethod`.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IO_JOGmethod` ConF → ACG- ioJG	Selection of jog method **0 / Continuous Movement / coNo**: Jog with continuous movement **1 / Step Movement / StNo**: Jog with step movement Changed settings become active the next time the motor moves.	- 0 0 1	UINT16 R/W per. -	Modbus 1328

Setting the step movement

The parameters `JOGstep` and `JOGtime` are used to set the parameterizable number of user-defined units and the time for which the motor is stopped.

▶ Set the desired values with the parameters `JOGstep` and `JOGtime`.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`JOGstep`	Distance for step movement Changed settings become active the next time the motor moves.	usr_p 1 20 2147483647	INT32 R/W per. -	Modbus 10510
`JOGtime`	Wait time for step movement Changed settings become active the next time the motor moves.	ms 1 500 32767	UINT16 R/W per. -	Modbus 10512

Changing the motion profile for the velocity

It is possible to change the parameterization of the motion profile for the velocity, see chapter 8.5.3 "Setting the motion profile for the velocity".

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8.3.3.2 Additional settings

The following functions can be used for target value processing:

- Chapter 8.6.1 "Stop movement with Halt"
- Chapter 8.6.2 "Stopping a movement with Quick Stop"
- Chapter 8.6.4 "Limitation of the velocity via signal inputs"
- Chapter 8.6.5 "Limitation of the current via signal inputs"
- Chapter 8.6.6 "Jerk limitation"

The following functions can be used for monitoring the movement:

- Chapter 8.7.1 "Limit switches"
- Chapter 8.7.2 "Load-dependent position deviation (following error)"
- Chapter 8.7.3 "Motor standstill"
- Chapter 8.7.4 "Position deviation window"
- Chapter 8.7.5 "Velocity deviation window"
- Chapter 8.7.6 "Velocity threshold value"
- Chapter 8.7.7 "Current threshold value"

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8.3.4 Operating mode Electronic Gear

Description

In the operating mode Electronic Gear, movements are carried out according to externally supplied reference value signals. A new position value is calculated on the basis of these reference value signals plus an adjustable gear ratio. The reference value signals can be A/B signals, P/D signals or CW/CCW signals.

A movement can be made using one of 3 methods:

- Position synchronization without compensation movement

  In the case of position synchronization without compensation movement, the movement is made synchronously (position synchronicity) with the supplied reference value signals. Reference value signals supplied during an interruption caused by Halt or by an error of error class 1 are not considered.

- Position synchronization with compensation movement

  In the case of position synchronization with compensation movement, the movement is made synchronously (position synchronicity) with the supplied reference value signals. Reference value signals supplied during an interruption caused by Halt or by an error of error class 1 are considered and compensated for.

- Velocity synchronization

  In the case of velocity synchronization, the movement is made synchronously (velocity synchronicity) with the supplied reference value signals.

Internal units

The position value for the movement depends on the internal units.

The internal units are 131072 increments per revolution.

Starting the operating mode

The operating mode must first have been selected, see chapter 8.3.1 "Starting the operating mode". After the power stage is enabled, the operating mode is started automatically.

The power stage is enabled via the signal inputs, see chapter 8.2 "Operating states". The table below provides an overview of the factory settings of the signal inputs:

Signal input	Signal input function
`DI0`	"Enable" Enable and disable the power stage
`DI1`	"Fault Reset" Resetting an error message
`DI2`	"Positive Limit Switch (LIMP)" See chapter 8.7.1 "Limit switches"
`DI3`	"Negative Limit Switch (LIMN)" See chapter 8.7.1 "Limit switches"
`DI4`	"Gear Ratio Switch" Switch between 2 parameterizable gear ratios
`DI5`	"Halt" See chapter 8.6.1 "Stop movement with Halt"

The factory settings of the signal inputs depend on the selected operating mode; it can be adapted, see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

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Terminating the operating mode The operating mode is automatically terminated by disabling the power stage.

Status messages Information on the operating state and the current movement is available via signal outputs.

The table below provides an overview of the signal outputs:

Signal output	Signal output function
`DQ0`	"No Fault" Signals the operating states **4** Ready To Switch On, **5** Switched On and **6** Operation Enabled
`DQ1`	"Active" Signals the operating state **6** Operation Enabled
`DQ2`	"In Position Deviation Window" See chapter 8.7.4 "Position deviation window"
`DQ3`	"Motor Standstill" See chapter 8.7.3 "Motor standstill"
`DQ4`	"Selected Error" See chapter 8.2.3 "Indication of the operating state"

The factory settings of the signal outputs depend on the selected operating mode; it can be adapted, see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

8.3.4.1 Parameterization

Overview The illustration below provides an overview of the adjustable parameters.

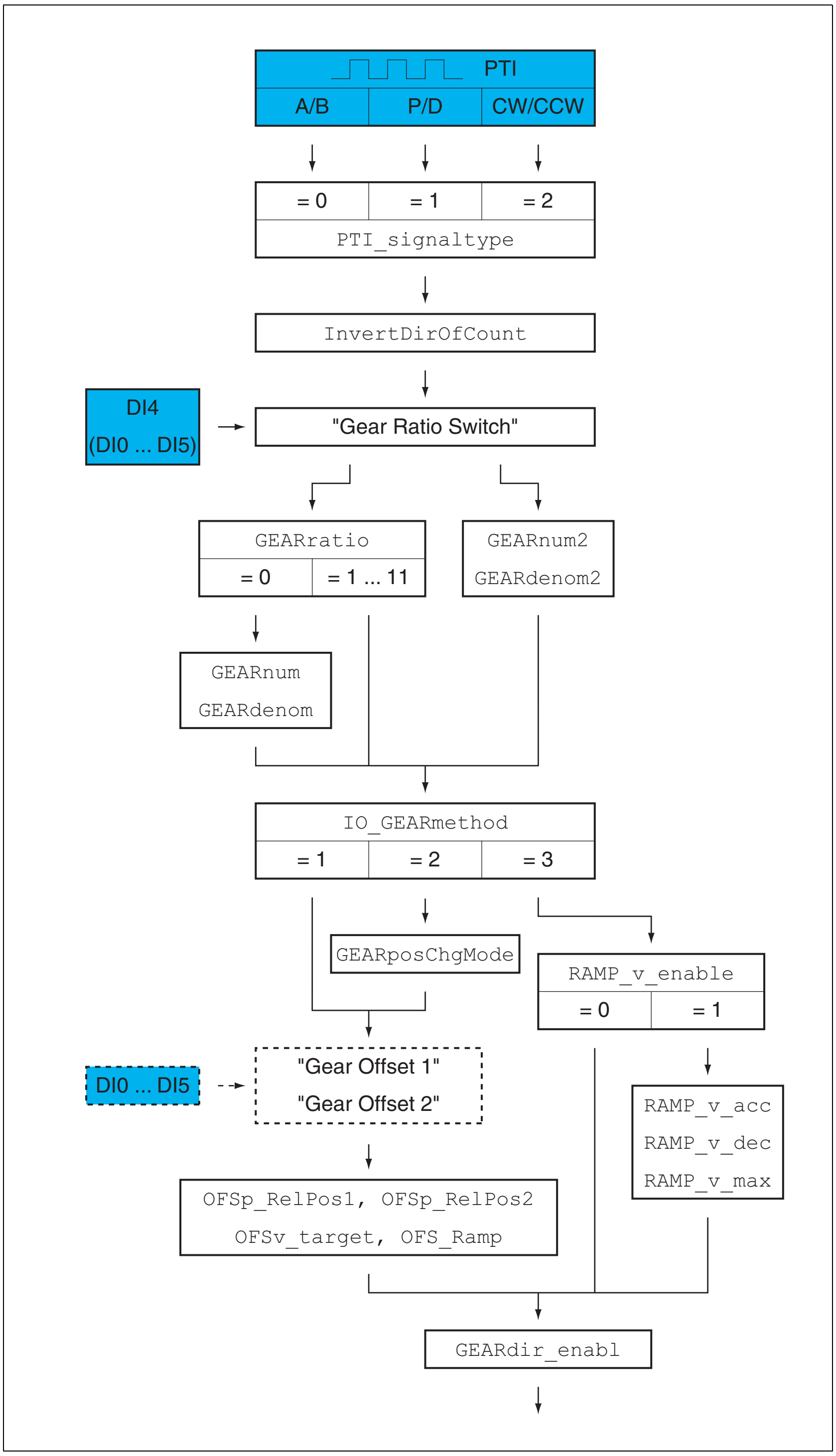

Figure 8.6 Overview of adjustable parameters

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Type of reference signals

A/B signals, P/D signals or CW/CCW signals can be connected to the PTI connection (Pulse Train In, CN5).

▶ Set the type of reference value signal with the `PTI_signal_type` parameter.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`PTI_signal_type` ConF → i-o- ioPi	Selection of signal type for PTI interface **0 / A/B Signals / Ab**: Signals ENC_A and ENC_B (quadruple evaluation) **1 / P/D Signals / Pd**: Signals PULSE and DIR **2 / CW/CCW Signals / cwcc**: Signals CW and CCW Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- 0 0 2	UINT16 R/W per. -	Modbus 1284

Inverting the reference value signals

The direction of counting of the reference value signals at the PTI interface can be inverted by means of the parameter `InvertDirOfCount`.

▶ Activate or deactivate inversion of the direction of counting by means of the parameter `InvertDirOfCount`.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`InvertDirOf-Count`	Inversion of direction of counting at PTI interface **0 / Inversion Off**: Inversion of direction of counting is off **1 / Inversion On**: Inversion of direction of counting is on Changed settings become active immediately.	- 0 0 1	UINT16 R/W per. -	Modbus 2062

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

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

The signal input function "Gear Ratio Switch" allows you to switch between 2 parameterizable gear ratios during operation.

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

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

▶ Set the desired gear ratio with the parameters `GEARratio`, `GEARnum`, `GEARdenom`, `GEARnum2` and `GEARdenom2`.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`GEARratio` ConF → i-o- GFAC	Selection of special gear ratios **0 / Gear Factor / FAct**: Usage of gear ratio adjusted with GEARnum/GEARdenom **1 / 200 / 200**: 200 **2 / 400 / 400**: 400 **3 / 500 / 500**: 500 **4 / 1000 / 1000**: 1000 **5 / 2000 / 2000**: 2000 **6 / 4000 / 4000**: 4000 **7 / 5000 / 5000**: 5000 **8 / 10000 / 10.00**: 10000 **9 / 4096 / 4096**: 4096 **10 / 8192 / 8192**: 8192 **11 / 16384 / 16.38**: 16384 A change of the reference value by the specified value causes one motor revolution. Changed settings become active immediately.	- 0 0 11	UINT16 R/W per. -	Modbus 9740
`GEARnum`	Numerator of gear ratio GEARnum --------------------- = Gear ratio GEARdenom The new gear ratio is applied when the numerator value is supplied. Changed settings become active immediately.	- -2147483648 1 2147483647	INT32 R/W per. -	Modbus 9736
`GEARdenom`	Denominator of gear ratio See description GEARnum	- 1 1 2147483647	INT32 R/W per. -	Modbus 9734

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`GEARnum2`	Numerator of gear ratio number 2 GEARnum2 --------------------- = Gear ratio GEARdenom2 The new gear ratio is applied when the numerator value is supplied. Changed settings become active immediately.	- -2147483648 1 2147483647	INT32 R/W per. -	Modbus 9754
`GEARdenom2`	Denominator of gear ratio number 2 See description GEARnum	- 1 1 2147483647	INT32 R/W per. -	Modbus 9752

Selection of the method

The methods specifies the way the movement is to be performed.

▶ Set the desired method with the parameter `IO_GEARmethod`.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IO_GEARmethod` ConF → ACG- ioGM	Processing mode for operating mode Electronic Gear **1 / Position Synchronization Immediate / PoiM**: Position synchronization without compensation movement **2 / Position Synchronization Compensated / Poco**: Position synchronization with compensation movement **3 / Velocity Synchronization / VELo**: Velocity synchronization Changed settings become active the next time the motor moves.	- 1 1 3	UINT16 R/W per. -	Modbus 1326

Position change with power stage disabled

If the method "Synchronization With Compensation Movement" is selected, the parameter `GEARposChgMode` determines the way changes to the motor position and to the reference value signals are handled with disabled power stage.

Position changes can be ignored or taken into account during a transition to operating state **6** Operation Enabled.

- Off: Position changes with disabled power stage are ignored.
- On: Position changes with disabled power stage are taken into account.

  Position changes between starting the operating mode and the subsequent enabling of the power stage are not taken into account.

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

Offset movement

The offset movement allows you to perform a movement with a parameterizable number of increments.

Offset movements are only available for the methods "Position Synchronization Without Compensation Movement" and "Position Synchronization With Compensation Movement".

2 parameterizable offset positions are available. The parameters `OFSp_RelPos1` and `OFSp_RelPos2` are used to set the offset positions.

An offset movement is started via a signal input.

To start offset movements via the signal input, you must first parameterize the signal input functions "Gear Offset 1" and "Gear Offset 2", see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

The velocity and the acceleration for the offset movement are set via the parameters `OFSv_target` and `OFS_Ramp`.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
OFSp_RelPos1	Relative offset position 1 for offset movement Changed settings become active immediately.	Inc -2147483648 0 2147483647	INT32 R/W per. -	Modbus 10000
OFSp_RelPos2	Relative offset position 2 for offset movement Changed settings become active immediately.	Inc -2147483648 0 2147483647	INT32 R/W per. -	Modbus 10004
OFSv_target	Target velocity for offset movement The maximum possible value is 5000 if the user-defined scaling factor of the velocity scaling is 1. This applies to all user-defined scaling factors. Example: If the user-defined scaling factor of the velocity scaling is 2 (ScaleVELnum = 2, ScaleVELdenom = 1), the maximum possible value is 2500. Changed settings become active immediately.	usr_v 1 60 2147483647	UINT32 R/W per. -	Modbus 9992

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`OFS_Ramp`	Acceleration and deceleration for offset movement Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	usr_a 1 600 2147483647	UINT32 R/W per. -	Modbus 9996

Changing the motion profile for the velocity

If the method "Velocity Synchronization" is selected, the motion profile for the velocity can be changed.

It is possible to change the parameterization of the motion profile for the velocity, see chapter 8.5.3 "Setting the motion profile for the velocity".

Release of direction

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

▶ Set the desired directions of movement with the parameter `GEARdir_enabl`.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`GEARdir_enabl`	Enabled movement direction of gear processing **1 / Positive**: Positive direction **2 / Negative**: Negative direction **3 / Both**: Both directions This allows you to activate a return movement lock function. Changed settings become active immediately.	- 1 3 3	UINT16 R/W per. -	Modbus 9738

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8.3.4.2 Additional settings

The following functions can be used for target value processing:

- Chapter 8.6.1 "Stop movement with Halt"
- Chapter 8.6.2 "Stopping a movement with Quick Stop"
- Chapter 8.6.4 "Limitation of the velocity via signal inputs"
- Chapter 8.6.5 "Limitation of the current via signal inputs"
- Chapter 8.6.6 "Jerk limitation"

  This function is only available for the methods "Position Synchronization Without Compensation Movement" and "Position Synchronization With Compensation Movement".

- Chapter 8.6.7 "Zero Clamp"

  This function is only available with the method "Velocity Synchronization".

The following functions can be used for monitoring the movement:

- Chapter 8.7.1 "Limit switches"
- Chapter 8.7.2 "Load-dependent position deviation (following error)"

  This function is only available for the methods "Position Synchronization Without Compensation Movement" and "Position Synchronization With Compensation Movement".

- Chapter 8.7.3 "Motor standstill"
- Chapter 8.7.4 "Position deviation window"

  This function is only available for the methods "Position Synchronization Without Compensation Movement" and "Position Synchronization With Compensation Movement".

- Chapter 8.7.5 "Velocity deviation window"

  This function is only available with the method "Velocity Synchronization".

- Chapter 8.7.6 "Velocity threshold value"
- Chapter 8.7.7 "Current threshold value"

8.3.5 Operating mode Profile Torque

⚠ WARNING
EXCESSIVELY HIGH VELOCITY DUE TO INCORRECT LIMIT VALUE Without a proper limit value, the motor can reach a very high velocity in this operating mode. • Check the parameterized velocity limitation. **Failure to follow these instructions can result in death, serious injury or equipment damage.**

Description

In the operating mode Profile Torque, a movement is made with a desired target torque.

Starting the operating mode

The operating mode must first have been selected, see chapter 8.3.1 "Starting the operating mode". After the power stage is enabled, the operating mode is started automatically.

The power stage is enabled via the signal inputs, see chapter 8.2 "Operating states". The table below provides an overview of the factory settings of the signal inputs:

Signal input	Signal input function
DI0	"Enable" Enable and disable the power stage
DI1	"Fault Reset" Resetting an error message
DI2	"Operating Mode Switch" See chapter 8.3.2 "Changing the operating mode"
DI3	"Velocity Limitation" See chapter 8.6.4 "Limitation of the velocity via signal inputs"
DI4	"Current Limitation" See chapter 8.6.5 "Limitation of the current via signal inputs"
DI5	"Halt" See chapter 8.6.1 "Stop movement with Halt"

The factory settings of the signal inputs depend on the selected operating mode; it can be adapted, see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

Terminating the operating mode

The operating mode is automatically terminated by disabling the power stage.

Status messages

Information on the operating state and the current movement is available via signal outputs.

The table below provides an overview of the signal outputs:

Signal output	Signal output function
`DQ0`	"No Fault" Signals the operating states **4** Ready To Switch On, **5** Switched On and **6** Operation Enabled
`DQ1`	"Active" Signals the operating state **6** Operation Enabled
`DQ2`	"Current Threshold Reached" See chapter 8.7.7 "Current threshold value"
`DQ3`	"Motor Standstill" See chapter 8.7.3 "Motor standstill"
`DQ4`	"Selected Error" See chapter 8.2.3 "Indication of the operating state"

The factory settings of the signal outputs depend on the selected operating mode; it can be adapted, see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

8.3.5.1 Parameterization

Overview

The illustration below provides an overview of the adjustable parameters.

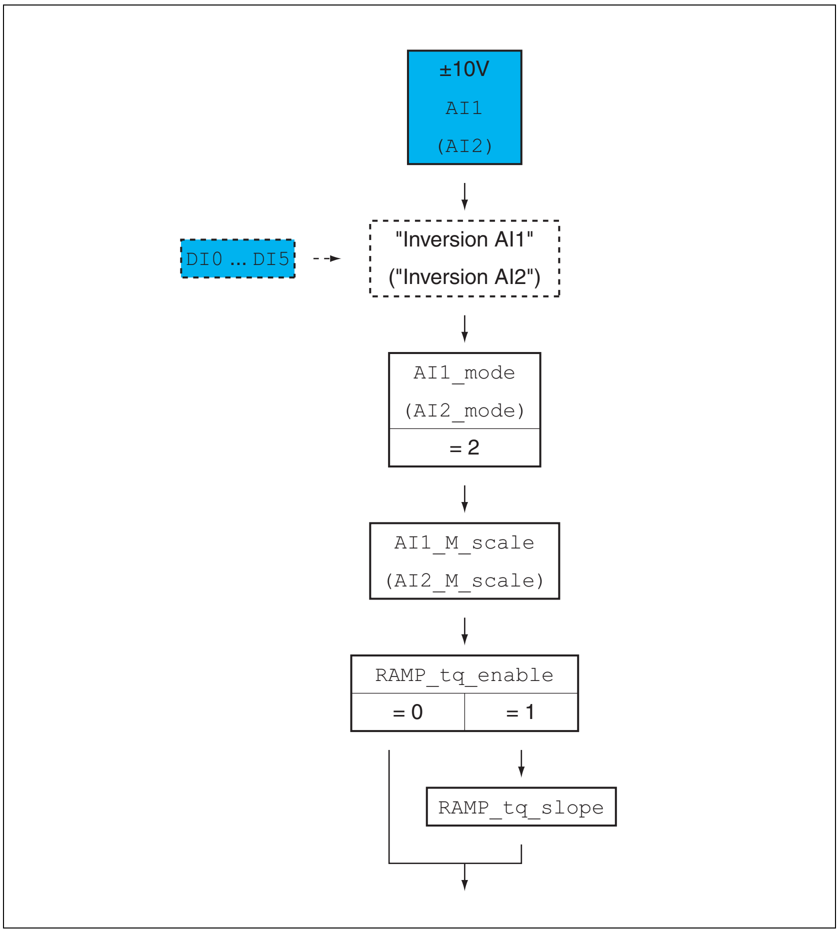

Figure 8.7 Overview of adjustable parameters

Offset and zero voltage window

It is possible to change the development of the target value with reference to the ±10V input value:

- Parameterization of an offset
- Parameterization of a zero voltage window

See chapter 7.6.4 "Analog inputs" for settings for the analog inputs.

Setting the type of usage

The parameters `AI1_mode` and `AI2_mode` let you select the type of usage of the analog signal inputs.

▶ If you do not want to use the analog signal input, set the parameter `AI1` to `AI1_mode` the value "Target Torque".

If you do not want to use the analog signal input, set the parameter `AI2` to `AI2_mode` the value "Target Torque".

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
AI1_mode ConF → i-o- A1Mo	Analog 1: Type of usage **0 / None / nonE**: No function **1 / Target Velocity / SPdS**: Target velocity for the velocity controller **2 / Target Torque / trqS**: Target torque for the current controller **3 / Velocity Limitation / LSPd**: Limitation of the velocity for the velocity controller **4 / Torque Limitation / Ltrq**: Limitation of the torque for the current controller Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 1 4	UINT16 R/W per. -	Modbus 2332
AI2_mode ConF → i-o- A2Mo	Analog 2: Type of usage **0 / None / nonE**: No function **1 / Target Velocity / SPdS**: Target velocity for the velocity controller **2 / Target Torque / trqS**: Target torque for the current controller **3 / Velocity Limitation / LSPd**: Limitation of the velocity for the velocity controller **4 / Torque Limitation / Ltrq**: Limitation of the torque for the current controller Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 0 4	UINT16 R/W per. -	Modbus 2342

Setting the target torque

The parameters AI1_M_scale and AI2_M_scale let you set the target torque for a voltage value of +10V.

▶ If you want to use the analog signal input AI1, use the parameter AI1_M_scale to set the desired target torque for a voltage value of +10V.

If you want to use the analog signal input AI2, use the parameter AI2_M_scale to set the desired target torque for a voltage value of +10V.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
AI1_M_scale ConF → i-o- A1iS	Analog 1: Target torque at 10 V in operating mode Profile Torque 100.0 % correspond to the continuous stall torque _M_M_0. By using a negative sign, you can invert the evaluation of the analog signal. In increments of 0.1 %. Changed settings become active immediately.	% -3000.0 100.0 3000.0	INT16 R/W per. -	Modbus 2340

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`AI2_M_scale` ConF → i-o- A2iS	Analog 2: Target torque at 10 V in operating mode Profile Torque 100.0 % correspond to the continuous stall torque _M_M_0. By using a negative sign, you can invert the evaluation of the analog signal. In increments of 0.1 %. Changed settings become active immediately.	% -3000.0 100.0 3000.0	INT16 R/W per. -	Modbus 2350

Changing the motion profile for the torque

It is possible to change the parameterization of the motion profile for the torque.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`RAMP_tq_enable`	Activation of the motion profile for torque **0 / Profile Off**: Profile off **1 / Profile On**: Profile on The motion profile for torque can be activated or deactivated for the operating mode Profile Torque. In all other operating modes, the motion profile for torque is inactive. Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 0 1	UINT16 R/W per. -	Modbus 1624
`RAMP_tq_slope`	Slope setting of the motion profile for torque 100.0 % correspond to the continuous stall torque _M_M_0. In increments of 0.1 %/s. Changed settings become active immediately.	%/s 0.1 10000.0 3000000.0	UINT32 R/W per. -	Modbus 1620

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8.3.5.2 Additional settings

The following functions can be used for target value processing:

- Chapter 8.6.1 "Stop movement with Halt"
- Chapter 8.6.2 "Stopping a movement with Quick Stop"
- Chapter 8.6.3 "Inverting the analog signal inputs"
- Chapter 8.6.4 "Limitation of the velocity via signal inputs"
- Chapter 8.6.5 "Limitation of the current via signal inputs"

The following functions can be used for monitoring the movement:

- Chapter 8.7.1 "Limit switches"
- Chapter 8.7.3 "Motor standstill"
- Chapter 8.7.6 "Velocity threshold value"
- Chapter 8.7.7 "Current threshold value"

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8.3.6 Operating mode Profile Velocity

Description

In the operating mode Profile Velocity, a movement is made with a desired target velocity.

Starting the operating mode

The operating mode must first have been selected, see chapter 8.3.1 "Starting the operating mode". After the power stage is enabled, the operating mode is started automatically.

The power stage is enabled via the signal inputs, see chapter 8.2 "Operating states". The table below provides an overview of the factory settings of the signal inputs:

Signal input	Signal input function
DI0	"Enable" Enable and disable the power stage
DI1	"Fault Reset" Resetting an error message
DI2	"Operating Mode Switch" See chapter 8.3.2 "Changing the operating mode"
DI3	"Velocity Limitation" See chapter 8.6.4 "Limitation of the velocity via signal inputs"
DI4	"Zero Clamp" See chapter 8.6.7 "Zero Clamp"
DI5	"Halt" See chapter 8.6.1 "Stop movement with Halt"

The factory settings of the signal inputs depend on the selected operating mode; it can be adapted, see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

Terminating the operating mode

The operating mode is automatically terminated by disabling the power stage.

Status messages

Information on the operating state and the current movement is available via signal outputs.

The table below provides an overview of the signal outputs:

Signal output	Signal output function
DQ0	"No Fault" Signals the operating states **4** Ready To Switch On, **5** Switched On and **6** Operation Enabled
DQ1	"Active" Signals the operating state **6** Operation Enabled
DQ2	"In Velocity Deviation Window" See chapter 8.7.5 "Velocity deviation window"
DQ3	"Motor Standstill" See chapter 8.7.3 "Motor standstill"
DQ4	"Selected Error" See chapter 8.2.3 "Indication of the operating state"

The factory settings of the signal outputs depend on the selected operating mode; it can be adapted, see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

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8.3.6.1 Parameterization

Overview The illustration below provides an overview of the adjustable parameters.

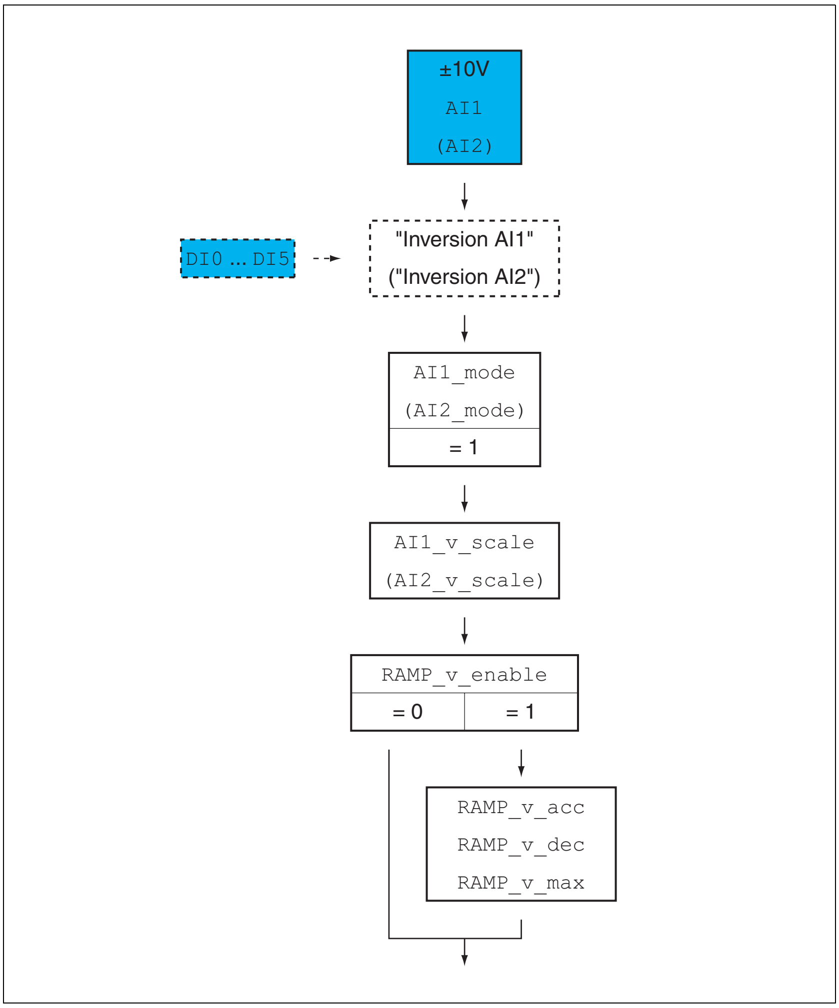

Figure 8.8 Overview of adjustable parameters

Offset and zero voltage window It is possible to change the development of the target value with reference to the ±10V input value:

- Parameterization of an offset
- Parameterization of a zero voltage window

See chapter 7.6.4 "Analog inputs" for settings for the analog inputs.

Setting the type of usage The parameters `AI1_mode` and `AI2_mode` let you select the type of usage of the analog signal inputs.

▶ If you do not want to use the analog signal input, set the parameter `AI1` to `AI1_mode` the value "Target Velocity".

If you do not want to use the analog signal input, set the parameter `AI2` to `AI2_mode` the value "Target Velocity".

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
AI1_mode ConF → i-o- A1Mo	Analog 1: Type of usage **0 / None / nonE**: No function **1 / Target Velocity / SPdS**: Target velocity for the velocity controller **2 / Target Torque / trqS**: Target torque for the current controller **3 / Velocity Limitation / LSPd**: Limitation of the velocity for the velocity controller **4 / Torque Limitation / Ltrq**: Limitation of the torque for the current controller Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 1 4	UINT16 R/W per. -	Modbus 2332
AI2_mode ConF → i-o- A2Mo	Analog 2: Type of usage **0 / None / nonE**: No function **1 / Target Velocity / SPdS**: Target velocity for the velocity controller **2 / Target Torque / trqS**: Target torque for the current controller **3 / Velocity Limitation / LSPd**: Limitation of the velocity for the velocity controller **4 / Torque Limitation / Ltrq**: Limitation of the torque for the current controller Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 0 4	UINT16 R/W per. -	Modbus 2342

Setting the target velocity

The parameters AI1_v_scale and AI2_v_scale are used to set the target velocity for a voltage value of +10.

▶ If you want to use the analog signal input AI1, use the parameter AI1_v_scale to set the desired target velocity for a voltage value of +10V.

If you want to use the analog signal input AI2, use the parameter AI2_v_scale to set the desired target velocity for a voltage value of +10V.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
AI1_v_scale	Analog 1: Target velocity at 10 V in operating mode Profile Velocity The maximum velocity is limited to the setting in CTRL_v_max. By using a negative sign, you can invert the evaluation of the analog signal. Changed settings become active immediately.	usr_v -2147483648 6000 2147483647	INT32 R/W per. -	Modbus 2338

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`AI2_v_scale`	Analog 2: Target velocity at 10 V in operating mode Profile Velocity The maximum velocity is limited to the setting in CTRL_v_max. By using a negative sign, you can invert the evaluation of the analog signal. Changed settings become active immediately.	usr_v -2147483648 6000 2147483647	INT32 R/W per. -	Modbus 2348

Changing the motion profile for the velocity

It is possible to change the parameterization of the motion profile for the velocity, see chapter 8.5.3 "Setting the motion profile for the velocity".

8.3.6.2 Additional settings

The following functions can be used for target value processing:

- Chapter 8.6.1 "Stop movement with Halt"
- Chapter 8.6.2 "Stopping a movement with Quick Stop"
- Chapter 8.7.3 "Motor standstill"
- Chapter 8.6.3 "Inverting the analog signal inputs"
- Chapter 8.6.4 "Limitation of the velocity via signal inputs"
- Chapter 8.6.5 "Limitation of the current via signal inputs"
- Chapter 8.6.7 "Zero Clamp"

The following functions can be used for monitoring the movement:

- Chapter 8.7.1 "Limit switches"
- Chapter 8.7.5 "Velocity deviation window"
- Chapter 8.7.6 "Velocity threshold value"
- Chapter 8.7.7 "Current threshold value"

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8.4 Movement range

The movement range is the maximum possible range within which a movement can be made to any position.

The actual position of the motor is the position in the movement range.

The figure below shows the movement range in user-defined units with the factory scaling.

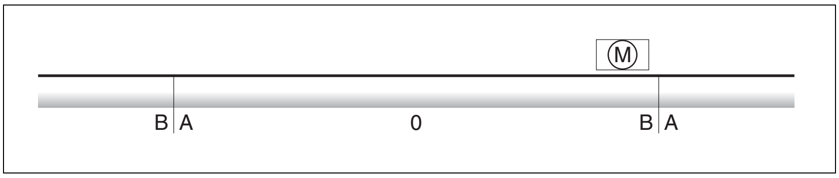

Figure 8.9 Movement range

(A) -268435456 user-defined units (usr_p)
(B) 268435455 user-defined units (usr_p)

Availability The movement range is only relevant in the operating mode Jog.

8.4.1 Scaling

⚠ WARNING

UNEXPECTED MOVEMENT CAUSED BY CHANGED SCALING

Changing the scaling changes the effect of the values in user-defined units. The same user-defined units cause different movements when the scaling is changed.

- Note that scaling affects all relationships between the user-defined units and the movements.
- Check the parameters with user-defined units.

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

Scaling converts user-defined units into internal units of the device, and vice versa.

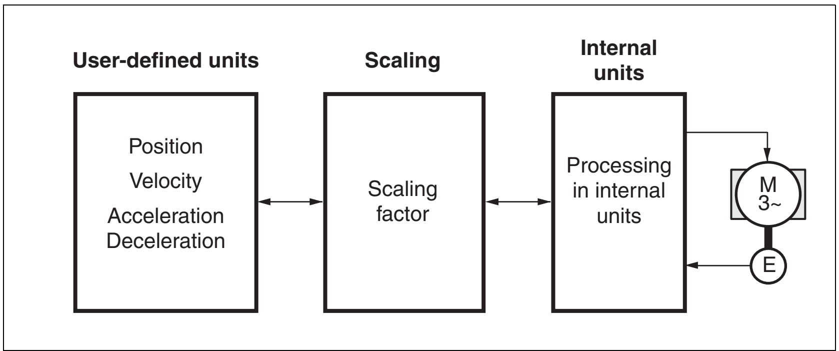

Figure 8.10 Scaling

User-defined units User-defined units are values for positions, velocities, acceleration and deceleration; they have the following units:

- usr_p for positions
- usr_v for velocities
- usr_a for acceleration and deceleration

Scaling factor The scaling factor is the relationship between the motor movement and the required user-defined units. When specifying the scaling factor, note that numerator and denominator can only be integer values.

Commissioning software As of firmware version , you can adjust the scaling via the commissioning software. The parameters with user-defined units are automatically checked and adjusted.

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8.4.1.1 Configuration of position scaling

Position scaling is the relationship between the number of motor revolutions and the required user-defined units [usr_p].

Scaling factor Position scaling is specified by means of scaling factor:

In the case of a rotary motor, the scaling factor is calculated as shown below:

$$\frac{\text{Number of revolutions of the motor}}{\text{Number of user-defined units [usr\_p]}}$$

Figure 8.11 Scaling factor of position scaling

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

Factory setting The following factory settings are used:

- 1 motor revolution corresponds to 16384 user-defined units

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`ScalePOSnum`	Position scaling: Numerator Specification of the scaling factor: Motor revolutions -- User-defined units [usr_p] A new scaling is activated when the numerator value is supplied. Setting can only be changed if power stage is disabled. Changed settings become active immediately.	revolution 1 1 2147483647	INT32 R/W per. -	Modbus 1552
`ScalePOSdenom`	Position scaling: Denominator Refer to numerator (ScalePOSnum) for a description. A new scaling is activated when the numerator value is supplied. Setting can only be changed if power stage is disabled.	usr_p 1 16384 2147483647	INT32 R/W per. -	Modbus 1550

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8.4.1.2 Configuration of velocity scaling

Velocity scaling is the relationship between the number of motor revolutions per minute and the required user-defined units [usr_v].

Scaling factor Velocity scaling is specified by means of scaling factor:

In the case of a rotary motor, the scaling factor is calculated as shown below:

$$\frac{\text{Number of revolutions of the motor per minute}}{\text{Number of user-defined units [usr\_v]}}$$

Figure 8.12 Scaling factor of velocity scaling

Factory setting The following factory settings are used:

- 1 motor revolution per minute corresponds to 1 user-defined unit

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`ScaleVELnum`	Velocity scaling: Numerator Specification of the scaling factor: Speed of rotation of motor [min^{-1}] -- User-defined units [usr_v] A new scaling is activated when the numerator value is supplied. Setting can only be changed if power stage is disabled. Changed settings become active immediately.	min^{-1} 1 1 2147483647	INT32 R/W per. -	Modbus 1604
`ScaleVELdenom`	Velocity scaling: Denominator Refer to numerator (ScaleVELnum) for a description. A new scaling is activated when the numerator value is supplied. Setting can only be changed if power stage is disabled.	usr_v 1 1 2147483647	INT32 R/W per. -	Modbus 1602

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8.4.1.3 Configuration of ramp scaling

Ramp scaling is the relationship between the change in velocity and the required user-defined units [usr_a].

Scaling factor Ramp scaling is specified by means of scaling factor:

$$\frac{\text{Velocity change per second}}{\text{Number of user-defined units [usr\_a]}}$$

Figure 8.13 Scaling factor of ramp scaling

Factory setting The following factory settings are used:

- A change of 1 motor revolution per minute per second corresponds to 1 user-defined unit.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`ScaleRAMPnum`	Ramp scaling: Numerator Setting can only be changed if power stage is disabled. Changed settings become active immediately.	min^{-1}/s 1 1 2147483647	INT32 R/W per. -	Modbus 1634
`ScaleRAMPdenom`	Ramp scaling: Denominator Refer to numerator (ScaleRAMPnum) for a description. A new scaling is activated when the numerator value is supplied. Setting can only be changed if power stage is disabled.	usr_a 1 1 2147483647	INT32 R/W per. -	Modbus 1632

8.5 Extended settings

8.5.1 Setting the PTO interface

The PTO interface allows you to make reference value signals from the device externally available.

The PTO interface can be used in one of 2 ways.

- Encoder simulation
- PTI signal

The parameter `PTO_mode` lets you set the way the PTO interface is used.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`PTO_mode`	Type of usage of PTO interface **0 / Off**: PTO interface disabled **1 / Esim pAct Enc 1**: Encoder simulation based on actual position of encoder 1 **2 / Esim pRef**: Encoder simulation based on reference position values (_p_ref) **3 / PTI Signal**: Directly the signal from PTI interface Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 1 3	UINT16 R/W per. -	Modbus 1342

Encoder simulation

The following types of encoder simulation are possible:

- Encoder simulation based on actual position of encoder 1
- Encoder simulation based on the reference position values (_p_ref)

The resolution for the encoder simulation is set with the parameter `ESIM_scale`.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`ESIM_scale` ConF → i-o- ESSC	Resolution of encoder simulation Resolution defines the number of increments per revolution (AB signal with quadruple evaluation). The index pulse is created once per revolution at an interval where signal A and signal B are high. Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	EncInc 8 4096 65535	UINT16 R/W per. -	Modbus 1322

PTI signal

If the PTI signal is selected by means of parameter `PTO_mode`, the signal from the PTI interface is directly made available at the PTO interface.

8.5.2 Setting the digital signal inputs and signal outputs

⚠ WARNING

UNINTENDED BEHAVIOR OF INPUTS AND OUTPUTS

The functions of the inputs and outputs depend on the selected operating mode and the settings of the corresponding parameters.

- Verify that the wiring is appropriate for the settings.
- 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.

Different signal functions can be assigned to the digital signal inputs and digital signal outputs.

Depending on the selected operating mode, different functions are assigned to the digital signal inputs and digital signal outputs.

Current state The parameters `_IO_DI_act` and `_IO_DQ_act` can be used to read the status of the digital signal inputs and the digital signal outputs.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`_IO_DI_act` Mon diMo	Status of digital inputs Bit assignments: Bit 0: DI0 Bit 1: DI1 Bit 2: DI2 Bit 3: DI3 Bit 4: DI4 Bit 5: DI5	- - - -	UINT16 R/- - -	Modbus 2078
`_IO_DQ_act` Mon doMo	Status of digital outputs Bit assignments: Bit 0: DQ0 Bit 1: DQ1 Bit 2: DQ2 Bit 3: DQ3 Bit 4: DQ4	- - - -	UINT16 R/- - -	Modbus 2080

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Factory settings The table below shows the factory settings of the digital signal inputs depending on the selected operating mode:

Signal	Jog	Electronic Gear	Profile Torque	Profile Velocity
`DI0`	Enable	Enable	Enable	Enable
`DI1`	Fault Reset	Fault Reset	Fault Reset	Fault Reset
`DI2`	Positive Limit Switch (LIMP)	Positive Limit Switch (LIMP)	Operating Mode Switch	Operating Mode Switch
`DI3`	Negative Limit Switch (LIMN)	Negative Limit Switch (LIMN)	Velocity Limitation	Velocity Limitation
`DI4`	Jog negative	Gear Ratio Switch	Current Limitation	Zero Clamp
`DI5`	Jog positive	Halt	Halt	Halt

The table below shows the factory settings of the digital signal outputs depending on the selected operating mode:

Signal	Jog	Electronic Gear	Profile Torque	Profile Velocity
`DQ0`	No Fault	No Fault	No Fault	No Fault
`DQ1`	Active	Active	Active	Active
`DQ2`	In Position Deviation Window	In Position Deviation Window	Current Threshold Reached	In Velocity Deviation Window
`DQ3`	Motor Standstill	Motor Standstill	Motor Standstill	Motor Standstill
`DQ4`	Selected Error Output	Selected Error Output	Selected Error Output	Selected Error Output

When the operating mode is changed and after the product is switched off and on, the factory settings are assigned to the digital signal inputs and digital signal outputs.

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8.5.2.1 Configuration of signal inputs

The table below provides an overview of the possible signal input functions depending on the selected operating mode:

Signal input function	Jog	Electronic Gear	Profile Torque	Profile Velocity	Description in chapter
Freely Available	•	•	•	•	No function
Fault Reset	•	•	•	•	8.2 "Operating states"
Enable	•	•	•	•	8.2 "Operating states"
Halt	•	•	•	•	8.6.1 "Stop movement with Halt"
Current Limitation	•	•	•	•	8.6.5 "Limitation of the current via signal inputs"
Zero Clamp		•		•	8.6.7 "Zero Clamp"
Velocity Limitation	•	•	•	•	8.6.4 "Limitation of the velocity via signal inputs"
Jog Positive	•				8.3.3 "Operating mode Jog"
Jog Negative	•				8.3.3 "Operating mode Jog"
Jog Fast/Slow	•				8.3.3 "Operating mode Jog"
Gear Ratio Switch		•			8.3.4 "Operating mode Electronic Gear"
Gear Offset 1		•			8.3.4 "Operating mode Electronic Gear"
Gear Offset 2		•			8.3.4 "Operating mode Electronic Gear"
Positive Limit Switch (LIMP)	•	•	•	•	8.7.1 "Limit switches"
Negative Limit Switch (LIMN)	•	•	•	•	8.7.1 "Limit switches"
Switch Controller Parameter Set	•	•	•	•	8.5.4.5 "Parameterizable controller parameter"
Inversion AI1			•	•	8.6.3 "Inverting the analog signal inputs"
Inversion AI2			•	•	8.6.3 "Inverting the analog signal inputs"
Operating Mode Switch	•	•	•	•	8.3.2 "Changing the operating mode"
Velocity Controller Integral Off	•	•	•	•	8.5.4.9 "Deactivating the integral term"

The following parameters can be used to parameterize the digital signal inputs:

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IOfunct_DI0` ConF → i-o- di0	Function Input DI0 **1 / Freely Available / nonE**: Available as required **2 / Fault Reset / FrES**: Fault reset after error **3 / Enable / EnAb**: Enables the power stage **4 / Halt / hALt**: Halt **6 / Current Limitation / iLiM**: Limits the current to parameter value **7 / Zero Clamp / CLMP**: Zero clamping **8 / Velocity Limitation / VLiM**: Limits the velocity to parameter value **9 / Jog Positive / JoGP**: Jog: Moves in positive direction **10 / Jog Negative / JoGn**: Jog: Moves in negative direction **11 / Jog Fast/Slow / JoGF**: Jog: Switches between slow and fast movement **12 / Gear Ratio Switch / GrAt**: Electronic Gear: Switches between two gear ratios **19 / Gear Offset 1 / GoF1**: Electronic Gear: Adds first gear offset **20 / Gear Offset 2 / GoF2**: Electronic Gear: Adds second gear offset **21 / Reference Switch (REF) / rEF**: Reference switch **22 / Positive Limit Switch (LIMP) / LiMP**: Positive limit switch **23 / Negative Limit Switch (LIMN) / LiMn**: Negative limit switch **24 / Switch Controller Parameter Set / CPAr**: Switches controller parameter set **25 / Inversion AI1 / A1iV**: Inverts analog input AI1 **26 / Inversion AI2 / A2iV**: Inverts analog input AI2 **27 / Operating Mode Switch / MSWt**: Switches operating mode **28 / Velocity Controller Integral Off / tnoF**: Switches off velocity controller integral term Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1794

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IOfunct_DI1` ConF → i-o- di1	Function Input DI1 **1 / Freely Available / nonE**: Available as required **2 / Fault Reset / FrES**: Fault reset after error **3 / Enable / EnAb**: Enables the power stage **4 / Halt / hALt**: Halt **6 / Current Limitation / iLiM**: Limits the current to parameter value **7 / Zero Clamp / CLMP**: Zero clamping **8 / Velocity Limitation / VLiM**: Limits the velocity to parameter value **9 / Jog Positive / JoGP**: Jog: Moves in positive direction **10 / Jog Negative / JoGn**: Jog: Moves in negative direction **11 / Jog Fast/Slow / JoGF**: Jog: Switches between slow and fast movement **12 / Gear Ratio Switch / GrAt**: Electronic Gear: Switches between two gear ratios **19 / Gear Offset 1 / GoF1**: Electronic Gear: Adds first gear offset **20 / Gear Offset 2 / GoF2**: Electronic Gear: Adds second gear offset **21 / Reference Switch (REF) / rEF**: Reference switch **22 / Positive Limit Switch (LIMP) / LiMP**: Positive limit switch **23 / Negative Limit Switch (LIMN) / LiMn**: Negative limit switch **24 / Switch Controller Parameter Set / CPAr**: Switches controller parameter set **25 / Inversion AI1 / A1iV**: Inverts analog input AI1 **26 / Inversion AI2 / A2iV**: Inverts analog input AI2 **27 / Operating Mode Switch / MSWt**: Switches operating mode **28 / Velocity Controller Integral Off / tnoF**: Switches off velocity controller integral term Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1796

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IOfunct_DI2` ConF → i-o- di2	Function Input DI2 **1 / Freely Available / nonE**: Available as required **2 / Fault Reset / FrES**: Fault reset after error **3 / Enable / EnAb**: Enables the power stage **4 / Halt / hALt**: Halt **6 / Current Limitation / iLiM**: Limits the current to parameter value **7 / Zero Clamp / CLMP**: Zero clamping **8 / Velocity Limitation / VLiM**: Limits the velocity to parameter value **9 / Jog Positive / JoGP**: Jog: Moves in positive direction **10 / Jog Negative / JoGn**: Jog: Moves in negative direction **11 / Jog Fast/Slow / JoGF**: Jog: Switches between slow and fast movement **12 / Gear Ratio Switch / GrAt**: Electronic Gear: Switches between two gear ratios **19 / Gear Offset 1 / GoF1**: Electronic Gear: Adds first gear offset **20 / Gear Offset 2 / GoF2**: Electronic Gear: Adds second gear offset **21 / Reference Switch (REF) / rEF**: Reference switch **22 / Positive Limit Switch (LIMP) / LiMP**: Positive limit switch **23 / Negative Limit Switch (LIMN) / LiMn**: Negative limit switch **24 / Switch Controller Parameter Set / CPAr**: Switches controller parameter set **25 / Inversion AI1 / A1iV**: Inverts analog input AI1 **26 / Inversion AI2 / A2iV**: Inverts analog input AI2 **27 / Operating Mode Switch / MSWt**: Switches operating mode **28 / Velocity Controller Integral Off / tnoF**: Switches off velocity controller integral term Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1798

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOfunct_DI3 ConF → i-o- di3	Function Input DI3 **1 / Freely Available / nonE**: Available as required **2 / Fault Reset / FrES**: Fault reset after error **3 / Enable / EnAb**: Enables the power stage **4 / Halt / hALt**: Halt **6 / Current Limitation / iLiM**: Limits the current to parameter value **7 / Zero Clamp / CLMP**: Zero clamping **8 / Velocity Limitation / VLiM**: Limits the velocity to parameter value **9 / Jog Positive / JoGP**: Jog: Moves in positive direction **10 / Jog Negative / JoGn**: Jog: Moves in negative direction **11 / Jog Fast/Slow / JoGF**: Jog: Switches between slow and fast movement **12 / Gear Ratio Switch / GrAt**: Electronic Gear: Switches between two gear ratios **19 / Gear Offset 1 / GoF1**: Electronic Gear: Adds first gear offset **20 / Gear Offset 2 / GoF2**: Electronic Gear: Adds second gear offset **21 / Reference Switch (REF) / rEF**: Reference switch **22 / Positive Limit Switch (LIMP) / LiMP**: Positive limit switch **23 / Negative Limit Switch (LIMN) / LiMn**: Negative limit switch **24 / Switch Controller Parameter Set / CPAr**: Switches controller parameter set **25 / Inversion AI1 / A1iU**: Inverts analog input AI1 **26 / Inversion AI2 / A2iU**: Inverts analog input AI2 **27 / Operating Mode Switch / MSWt**: Switches operating mode **28 / Velocity Controller Integral Off / tnoF**: Switches off velocity controller integral term Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1800

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IOfunct_DI4` ConF → i-o- di4	Function Input DI4 **1 / Freely Available / nonE**: Available as required **2 / Fault Reset / FrES**: Fault reset after error **3 / Enable / EnAb**: Enables the power stage **4 / Halt / hALt**: Halt **6 / Current Limitation / iLiM**: Limits the current to parameter value **7 / Zero Clamp / CLMP**: Zero clamping **8 / Velocity Limitation / VLiM**: Limits the velocity to parameter value **9 / Jog Positive / JoGP**: Jog: Moves in positive direction **10 / Jog Negative / JoGn**: Jog: Moves in negative direction **11 / Jog Fast/Slow / JoGF**: Jog: Switches between slow and fast movement **12 / Gear Ratio Switch / GrAt**: Electronic Gear: Switches between two gear ratios **19 / Gear Offset 1 / GoF1**: Electronic Gear: Adds first gear offset **20 / Gear Offset 2 / GoF2**: Electronic Gear: Adds second gear offset **21 / Reference Switch (REF) / rEF**: Reference switch **22 / Positive Limit Switch (LIMP) / LiMP**: Positive limit switch **23 / Negative Limit Switch (LIMN) / LiMn**: Negative limit switch **24 / Switch Controller Parameter Set / CPAr**: Switches controller parameter set **25 / Inversion AI1 / A1iV**: Inverts analog input AI1 **26 / Inversion AI2 / A2iV**: Inverts analog input AI2 **27 / Operating Mode Switch / MSWt**: Switches operating mode **28 / Velocity Controller Integral Off / tnoF**: Switches off velocity controller integral term Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1802

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOfunct_DI5 ConF → i-o- di5	Function Input DI5 **1 / Freely Available / nonE**: Available as required **2 / Fault Reset / FrES**: Fault reset after error **3 / Enable / EnAb**: Enables the power stage **4 / Halt / hALt**: Halt **6 / Current Limitation / iLiM**: Limits the current to parameter value **7 / Zero Clamp / CLMP**: Zero clamping **8 / Velocity Limitation / VLiM**: Limits the velocity to parameter value **9 / Jog Positive / JoGP**: Jog: Moves in positive direction **10 / Jog Negative / JoGn**: Jog: Moves in negative direction **11 / Jog Fast/Slow / JoGF**: Jog: Switches between slow and fast movement **12 / Gear Ratio Switch / GrAt**: Electronic Gear: Switches between two gear ratios **19 / Gear Offset 1 / GoF1**: Electronic Gear: Adds first gear offset **20 / Gear Offset 2 / GoF2**: Electronic Gear: Adds second gear offset **21 / Reference Switch (REF) / rEF**: Reference switch **22 / Positive Limit Switch (LIMP) / LiMP**: Positive limit switch **23 / Negative Limit Switch (LIMN) / LiMn**: Negative limit switch **24 / Switch Controller Parameter Set / CPAr**: Switches controller parameter set **25 / Inversion AI1 / A1iV**: Inverts analog input AI1 **26 / Inversion AI2 / A2iV**: Inverts analog input AI2 **27 / Operating Mode Switch / MSWt**: Switches operating mode **28 / Velocity Controller Integral Off / tnoF**: Switches off velocity controller integral term Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1804

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8.5.2.2 Configuration of the signal outputs

The table below provides an overview of the possible signal output functions depending on the selected operating mode:

Signal output function	Jog	Electronic Gear	Profile Torque	Profile Velocity	Description in chapter
Freely Available	•	•	•	•	
No Fault	•	•	•	•	8.2.3 "Indication of the operating state"
Active	•	•	•	•	8.2.3 "Indication of the operating state"
In Position Deviation Window	•	•			8.7.4 "Position deviation window"
In Velocity Deviation Window	•	•		•	8.7.5 "Velocity deviation window"
Velocity Threshold Reached	•	•	•	•	8.7.6 "Velocity threshold value"
Current Threshold Reached	•	•	•	•	8.7.7 "Current threshold value"
Halt Acknowledge	•	•	•	•	8.6.1 "Stop movement with Halt"
Motor Standstill	•	•	•	•	8.7.3 "Motor standstill"
Selected Error	•	•	•	•	8.2.3 "Indication of the operating state"
Selected Warning	•	•	•	•	8.2.3 "Indication of the operating state"

The following parameters can be used to parameterize the digital signal outputs:

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IOfunct_DQ0` ConF → i-o- do0	Function Output DQ0 **1 / Freely Available / nonE**: Available as required **2 / No Fault / nFLt**: Signals operating states Ready To Switch On, Switched On and Operation Enable **3 / Active / Acti** : Signals operating state Operation Enable **5 / In Position Deviation Window / in-P**: Position deviation is within window **6 / In Velocity Deviation Window / in-V**: Velocity deviation is within window **7 / Velocity Below Threshold / Vthr**: Motor velocity below threshold **8 / Current Below Threshold / ithr**: Motor current below threshold **9 / Halt Acknowledge / hALt**: Halt acknowledgement **13 / Motor Standstill / MStd**: Motor at a standstill **14 / Selected Error / SErr**: One of the selected errors is active **16 / Selected Warning / SWrn**: One of the selected warnings is active Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1810

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IOfunct_DQ1` ConF → i-o- do1	Function Output DQ1 **1 / Freely Available / nonE**: Available as required **2 / No Fault / nFLt**: Signals operating states Ready To Switch On, Switched On and Operation Enable **3 / Active / Acti** : Signals operating state Operation Enable **5 / In Position Deviation Window / in-P**: Position deviation is within window **6 / In Velocity Deviation Window / in-V**: Velocity deviation is within window **7 / Velocity Below Threshold / Vthr**: Motor velocity below threshold **8 / Current Below Threshold / ithr**: Motor current below threshold **9 / Halt Acknowledge / hALt**: Halt acknowledgement **13 / Motor Standstill / MStd**: Motor at a standstill **14 / Selected Error / SErr**: One of the selected errors is active **16 / Selected Warning / SWrn**: One of the selected warnings is active Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1812
`IOfunct_DQ2` ConF → i-o- do2	Function Output DQ2 **1 / Freely Available / nonE**: Available as required **2 / No Fault / nFLt**: Signals operating states Ready To Switch On, Switched On and Operation Enable **3 / Active / Acti** : Signals operating state Operation Enable **5 / In Position Deviation Window / in-P**: Position deviation is within window **6 / In Velocity Deviation Window / in-V**: Velocity deviation is within window **7 / Velocity Below Threshold / Vthr**: Motor velocity below threshold **8 / Current Below Threshold / ithr**: Motor current below threshold **9 / Halt Acknowledge / hALt**: Halt acknowledgement **13 / Motor Standstill / MStd**: Motor at a standstill **14 / Selected Error / SErr**: One of the selected errors is active **16 / Selected Warning / SWrn**: One of the selected warnings is active Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1814

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IOfunct_DQ3` ConF → i-o- do3	Function Output DQ3 **1 / Freely Available / nonE**: Available as required **2 / No Fault / nFLt**: Signals operating states Ready To Switch On, Switched On and Operation Enable **3 / Active / Acti** : Signals operating state Operation Enable **5 / In Position Deviation Window / in-P**: Position deviation is within window **6 / In Velocity Deviation Window / in-V**: Velocity deviation is within window **7 / Velocity Below Threshold / Vthr**: Motor velocity below threshold **8 / Current Below Threshold / ithr**: Motor current below threshold **9 / Halt Acknowledge / hALt**: Halt acknowledgement **13 / Motor Standstill / MStd**: Motor at a standstill **14 / Selected Error / SErr**: One of the selected errors is active **16 / Selected Warning / SWrn**: One of the selected warnings is active Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1816
`IOfunct_DQ4` ConF → i-o- do4	Function Output DQ4 **1 / Freely Available / nonE**: Available as required **2 / No Fault / nFLt**: Signals operating states Ready To Switch On, Switched On and Operation Enable **3 / Active / Acti** : Signals operating state Operation Enable **5 / In Position Deviation Window / in-P**: Position deviation is within window **6 / In Velocity Deviation Window / in-V**: Velocity deviation is within window **7 / Velocity Below Threshold / Vthr**: Motor velocity below threshold **8 / Current Below Threshold / ithr**: Motor current below threshold **9 / Halt Acknowledge / hALt**: Halt acknowledgement **13 / Motor Standstill / MStd**: Motor at a standstill **14 / Selected Error / SErr**: One of the selected errors is active **16 / Selected Warning / SWrn**: One of the selected warnings is active Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1818

8.5.3 Setting the motion profile for the velocity

Target position and target velocity are input values specified by the user. A motion profile for the velocity is calculated on the basis of these input values.

The motion profile for the velocity consists of an acceleration, a deceleration and a maximum velocity.

A linear ramp for both directions of movement is available.

Availability The availability of the motion profile for the velocity depends on the operating mode.

In the following operating modes, the motion profile for the velocity is permanently active:

- Jog

In the following operating modes, the motion profile for the velocity can be activated and deactivated:

- Electronic Gear (velocity synchronization)
- Profile Velocity

In the following operating modes, the motion profile for the velocity is unavailable:

- Electronic Gear (position synchronization)
- Profile Torque

Ramp slope The ramp slope determines the velocity changes of the motor per time unit. The ramp slope can be set for acceleration and deceleration.

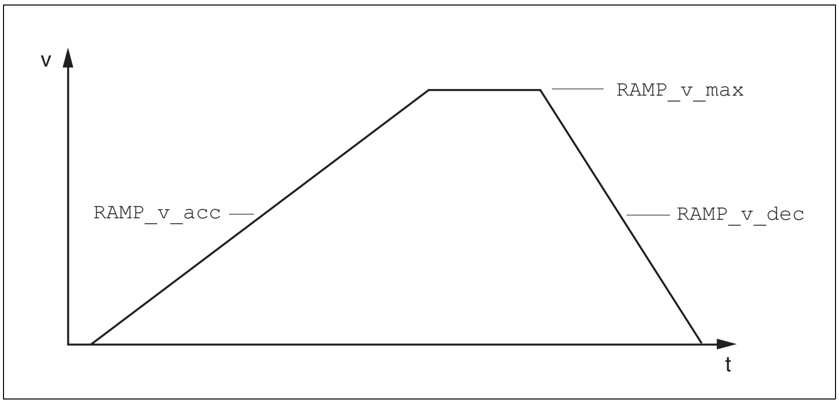

Figure 8.14 Ramp slope

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMP_v_enable	Activation of the motion profile for velocity **0 / Profile Off**: Profile off **1 / Profile On**: Profile on The motion profile for velocity can be activated or deactivated for the operating modes Profile Velocity and Electronic Gear (velocity synchronization). Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 0 1	UINT16 R/W per. -	Modbus 1622
RAMP_v_max ConF → ACG- nrMP	Maximum velocity of the motion profile for velocity If a greater reference speed is set in one of these operating modes, it is automatically limited to RAMP_v_max. This way, commissioning at limited speed is easier to perform. Setting can only be changed if power stage is disabled. Changed settings become active the next time the motor moves.	usr_v 1 13200 2147483647	UINT32 R/W per. -	Modbus 1554
RAMP_v_acc	Acceleration of the motion profile for velocity Writing the value 0 has no effect on the parameter. Changed settings become active the next time the motor moves.	usr_a 1 600 2147483647	UINT32 R/W per. -	Modbus 1556
RAMP_v_dec	Deceleration of the motion profile for velocity The minimum value depends on the operating mode: Operating modes with minimum value 1: Electronic Gear (velocity synchronization) Profile Velocity Operating modes with minimum value 120: Jog Writing the value 0 has no effect on the parameter. Changed settings become active the next time the motor moves.	usr_a 1 600 2147483647	UINT32 R/W per. -	Modbus 1558

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8.5.4 Setting the controller parameters

8.5.4.1 Overview of the controller structure

The illustration below shows an overview of the controller structure.

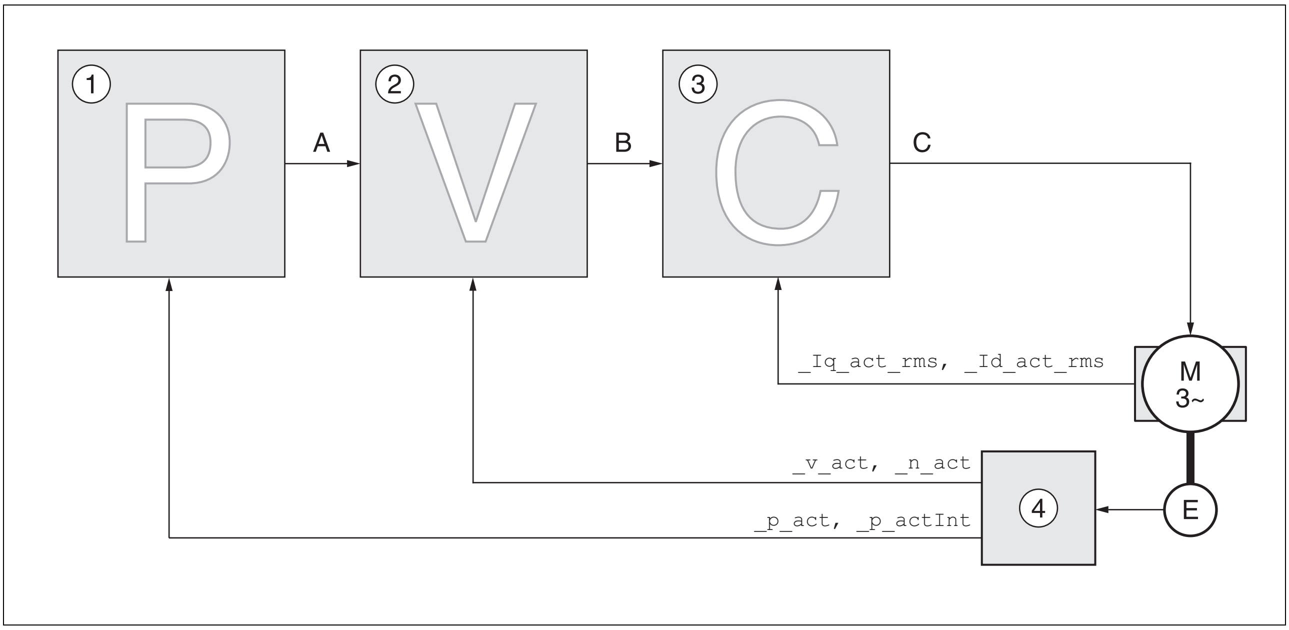

Figure 8.15 Controller structure, overview

(1) Position controller
(2) Velocity controller
(3) Current controller
(4) Encoder evaluation

Position controller The position controller reduces the difference between the reference position and the actual position of the motor (position deviation) to a minimum. When the motor is at a standstill, the position deviation is close to zero in the case of a well-tuned position controller.

An optimized velocity control loop is a prerequisite for good amplification of the position controller.

Velocity controller The velocity controller controls the motor velocity by varying the motor current depending on the load situation. The velocity controller has a decisive influence on the dynamic response of the drive. The dynamics of the velocity controller depend on:

- Moment of inertia of the drive and the controlled system
- Power of the motor
- Stiffness and elasticity of the elements in the flow of forces
- Backlash of the drive elements
- Friction

Current controller The current controller determines the torque of the motor. The current controller is automatically optimally tuned with the stored motor data.

8.5.4.2 Overview of position controller

The illustration below shows an overview of the position controller.

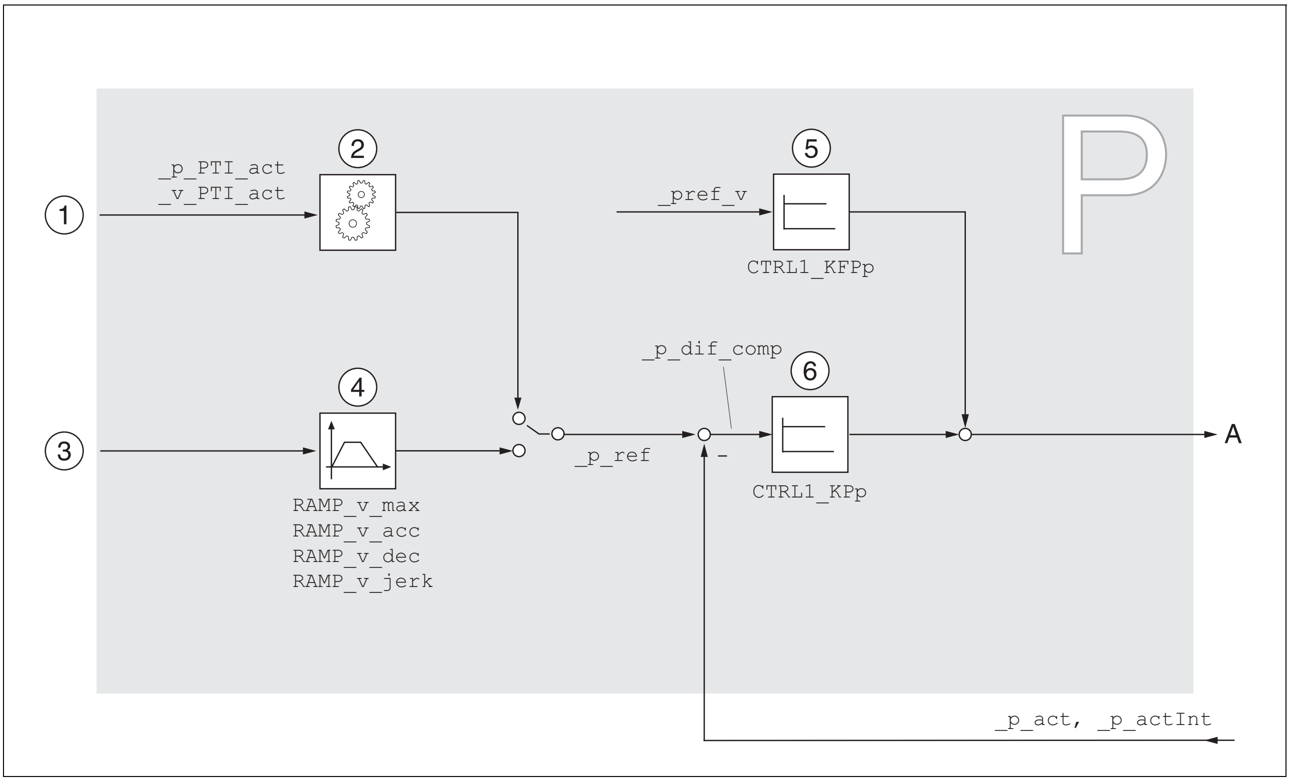

Figure 8.16 Position controller

(1)	Reference value signals for the operating mode Electronic Gear with the methods "Position Synchronization Without Compensation Movement" and "Position Synchronization With Compensation Movement"
(2)	Evaluation of the reference value signal for the operating mode Electronic Gear
(3)	Target values for the operating mode Jog
(4)	Motion profile for the velocity
(5)	Velocity feed-forward control
(6)	Position controller

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8.5.4.3 Overview of velocity controller

The illustration below shows an overview of the velocity controller.

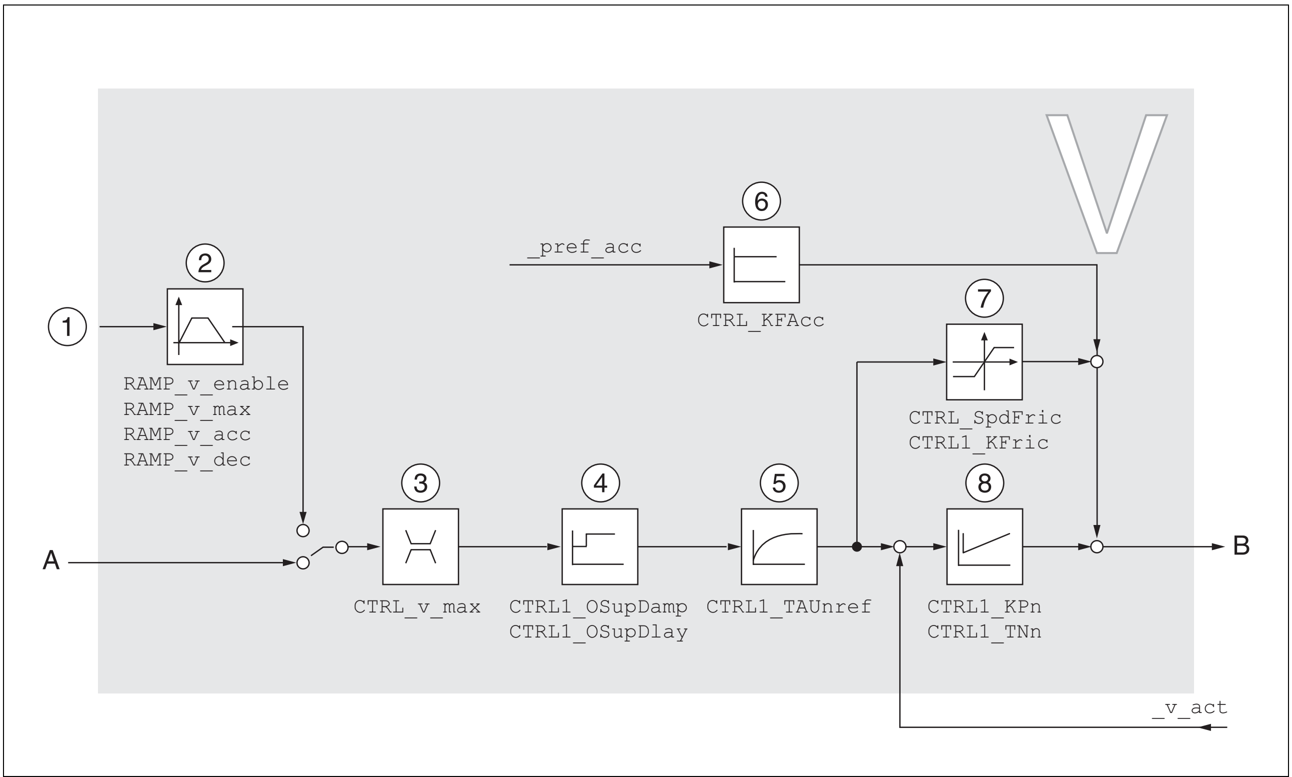

Figure 8.17 Velocity controller

- (1) Reference value signals for the operating mode Electronic Gear with the method "Velocity Synchronization" and target values for the operating mode Profile Velocity
- (2) Motion profile for the velocity
- (3) Velocity limitation
- (4) Overshoot suppression filter (parameter accessible in Expert mode)
- (5) Filter time constant of reference velocity value filter
- (6) Acceleration feed forward control (parameter accessible in Expert mode)
- (7) Friction compensation (parameter accessible in Expert mode)
- (8) Velocity controller

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8.5.4.4 Overview of current controller

The illustration below shows an overview of the current controller.

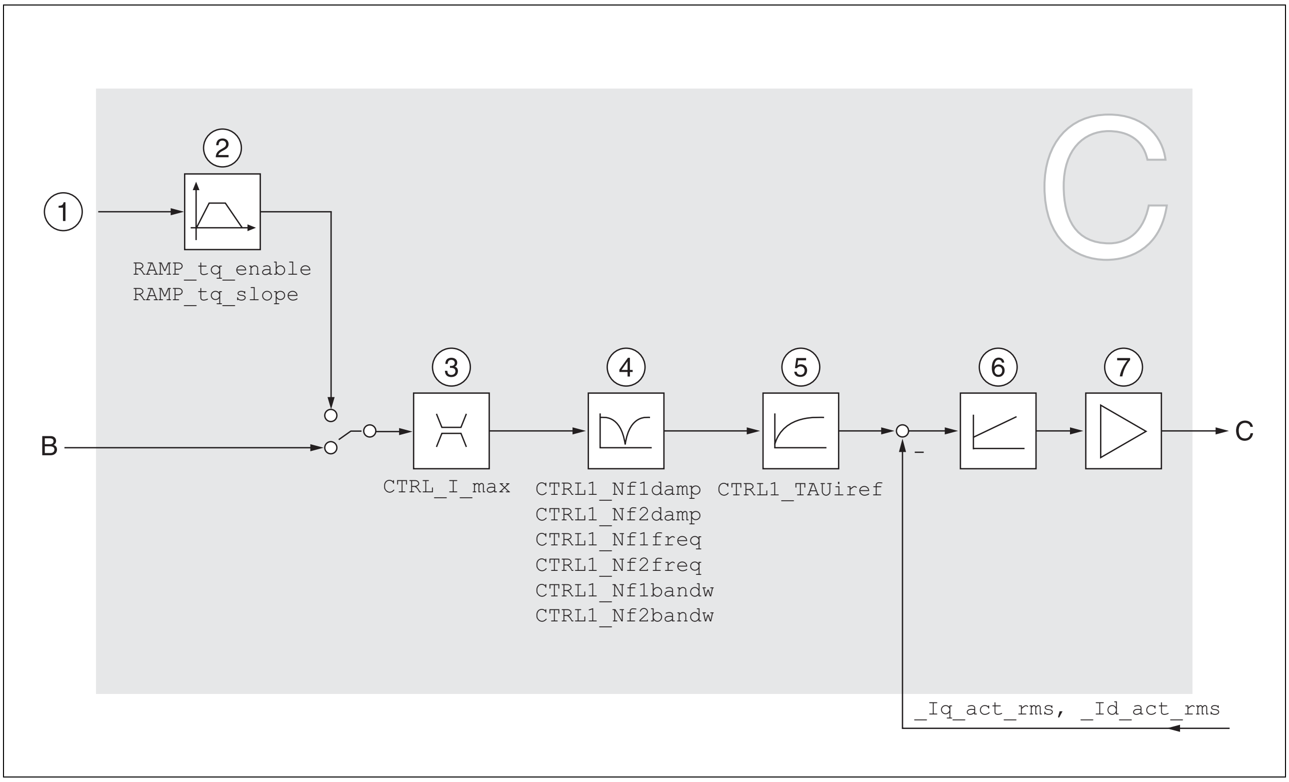

Figure 8.18 Current controller

(1) Target values for the operating mode Profile Torque
(2) Motion profile for the torque
(3) Current limitation
(4) Notch filter (parameter accessible in Expert mode)
(5) Filter time constant of the reference current value filter
(6) Current controller
(7) Power stage

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8.5.4.5 Parameterizable controller parameter

The product features 2 controller parameter sets that can be parameterized separately. The values for the controller parameters determined during autotuning are stored in controller parameter set 1.

Controller parameter set

A controller parameter set consists of freely accessible parameters and parameters which are only accessible in Expert mode.

Controller parameter set 1	Controller parameter set 2
Freely accessible parameters:	Freely accessible parameters:
CTRL1_KPn CTRL1_TNn CTRL1_KPp CTRL1_TAUiref CTRL1_TAUnref CTRL1_KFPp	CTRL2_KPn CTRL2_TNn CTRL2_KPp CTRL2_TAUiref CTRL2_TAUnref CTRL2_KFPp
Parameters only accessible in expert mode:	Parameters only accessible in expert mode:
CTRL1_Nf1damp CTRL1_Nf1freq CTRL1_Nf1bandw CTRL1_Nf2damp CTRL1_Nf2freq CTRL1_Nf2bandw CTRL1_Osupdamp CTRL1_Osupdelay CTRL1_Kfric	CTRL2_Nf1damp CTRL2_Nf1freq CTRL2_Nf1bandw CTRL2_Nf2damp CTRL2_Nf2freq CTRL2_Nf2bandw CTRL2_Osupdamp CTRL2_Osupdelay CTRL2_Kfric

See chapters 8.5.4.10 "Controller parameter set 1" and 8.5.4.11 "Controller parameter set 2".

Parameterization

- Selecting a controller parameter set

  Select a controller parameter set after switching on.

  See chapter 8.5.4.6 "Selecting a controller parameter set".

- Automatically switching between control parameter sets

  It is possible to switch between the two controller parameter sets.

  See chapter 8.5.4.7 "Automatically switching between control parameter sets".

- Copying a controller parameter set

  The values of controller parameter set 1 can be copied to controller parameter set 2.

  See chapter 8.5.4.8 "Copying a controller parameter set".

- Deactivating the integral term

  The integral term and, by implication, the integral action time, can be switched off via a digital signal input.

  See chapter 8.5.4.9 "Deactivating the integral term".

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8.5.4.6 Selecting a controller parameter set

The currently active controller parameter set is indicated via the parameter _CTRL_ActParSet.

The parameter CTRL_PwrUpParSet allows you to set the controller parameter set to be activated after switching on. Alternatively, you can set whether or not the product is to switch automatically between the two controller parameter sets.

The parameter CTRL_SelParSet allows you to switch between the two controller parameter sets during operation.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
_CTRL_ActParSet	Active controller parameter set Value 1: Controller parameter set 1 is active Value 2: Controller parameter set 2 is active A controller parameter set is active after the time for the parameter switching (CTRL_ParChgTime) has elapsed.	- - - -	UINT16 R/- - -	Modbus 4398
CTRL_PwrUpParSet	Selection of controller parameter set at power up **0 / Switching Condition**: The switching condition is used for parameter set switching **1 / Parameter Set 1**: Parameter set 1 is used **2 / Parameter Set 2**: Parameter set 2 is used The selected value is also written to CTRL_ParSetSel (non-persistent). Changed settings become active immediately.	- 0 1 2	UINT16 R/W per. -	Modbus 4400
CTRL_SelParSet	Selection of controller parameter set (non-persistent) Coding see parameter: CTRL_PwrUpParSet Changed settings become active immediately.	- 0 1 2	UINT16 R/W - -	Modbus 4402

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8.5.4.7 Automatically switching between control parameter sets

It is possible to automatically switch between the two controller parameter sets.

The following criteria can be set for switching between the controller parameter sets:

- Digital signal input
- Position deviation window
- Target velocity below parameterizable value
- Actual velocity below parameterizable value

Settings The illustration below shows an overview of switching between the controller parameter sets.

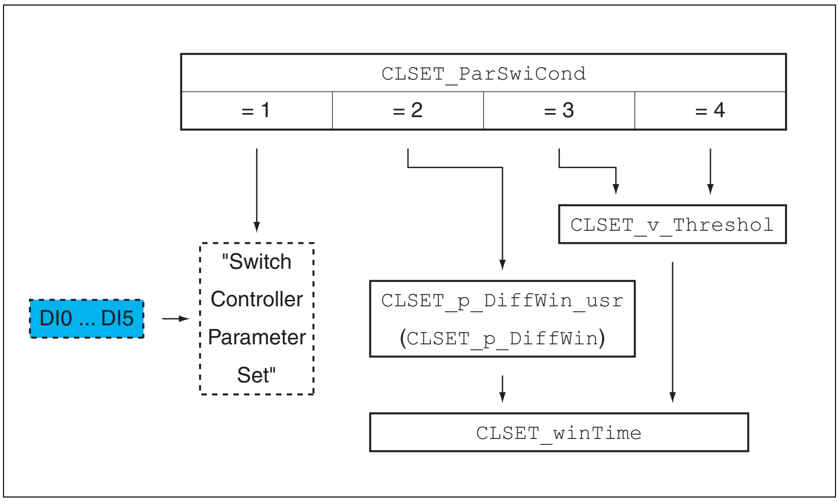

Figure 8.19 Parameters for switching the controller parameter sets

Time chart The freely accessible parameters are changed linearly. This linear change of the values of controller parameter set 1 to the values of controller parameter set 2 takes place during the parameterizable time `CTRL_ParChgTime`.

The parameters only accessible in Expert mode are directly changed to the values of the other controller parameter set after the parameterizable time `CTRL_ParChgTime` has passed.

The figure below shows the time chart for switching the controller parameters.

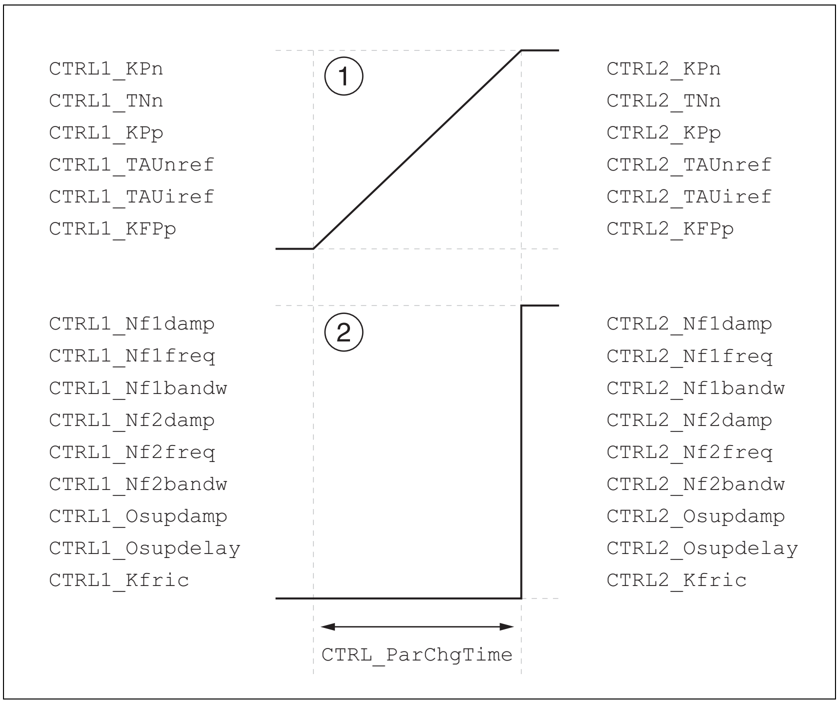

Figure 8.20 Time chart for switching the controller parameter sets

(1) Freely accessible parameters are changed linearly over time
(2) Parameters which are only accessible in Expert mode are switched over directly

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`CLSET_ParSwiCond`	Condition for parameter set switching **0 / None Or Digital Input**: None or digital input function selected **1 / Inside Position Deviation**: Inside position deviation (value definition in parameter CLSET_p_DiffWin) **2 / Below Reference Velocity**: Below reference velocity (value definition in parameter CLSET_v_Threshol) **3 / Below Actual Velocity**: Below actual velocity (value definition in parameter CLSET_v_Threshol) In the case of parameter set switching, the values of the following parameters are changed gradually: - CTRL_KPn - CTRL_TNn - CTRL_KPp - CTRL_TAUnref - CTRL_TAUiref - CTRL_KFPp The following parameters are changed immediately after the time for parameter set switching (CTRL_ParChgTime): - CTRL_Nf1damp - CTRL_Nf1freq - CTRL_Nf1bandw - CTRL_Nf2damp - CTRL_Nf2freq - CTRL_Nf2bandw - CTRL_Osupdamp - CTRL_Osupdelay - CTRL_Kfric Changed settings become active immediately.	- 0 0 3	UINT16 R/W per. -	Modbus 4404
`CLSET_p_DiffWin_usr`	Position deviation for parameter set switching If the position deviation of the position controller is less than the value of this parameter, the controller parameter set 2 is used. Otherwise, controller parameter set 1 is used. The minimum value, the factory setting and the maximum value depend on the scaling factor Changed settings become active immediately.	usr_p 0 164 2147483647	INT32 R/W per. -	Modbus 4426

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CLSET_p_DiffWin	Position deviation for parameter set switching If the position deviation of the position controller is less than the value of this parameter, the controller parameter set 2 is used. Otherwise, controller parameter set 1 is used. The parameter CLSET_p_DiffWin_usr allows you to enter the value in user-defined units. In increments of 0.0001 revolution. Changed settings become active immediately.	revolution 0.0000 0.0100 2.0000	UINT16 R/W per. -	Modbus 4408
CLSET_v_Threshol	Velocity threshold for parameter set switching If the reference velocity or the actual velocity are less than the value of this parameter, the controller parameter set 2 is used. Otherwise, controller parameter set 1 is used. Changed settings become active immediately.	usr_v 0 50 2147483647	UINT32 R/W per. -	Modbus 4410
CLSET_winTime	Time window for parameter set switching Value 0: Window monitoring deactivated. Value >0: Window time for the parameters CLSET_v_Threshol and CLSET_p_DiffWin. Changed settings become active immediately.	ms 0 0 1000	UINT16 R/W per. -	Modbus 4406
CTRL_ParChgTime	Period of time for parameter switching In the case of parameter set switching, the values of the following parameters are changed gradually: - CTRL_KPn - CTRL_TNn - CTRL_KPp - CTRL_TAUnref - CTRL_TAUiref - CTRL_KFPp Such a parameter switching can be caused by - change of the active controller parameter set - change of the global gain - change of any of the parameters listed above - switching off the integral term of the velocity controller Changed settings become active immediately.	ms 0 0 2000	UINT16 R/W per. -	Modbus 4392

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8.5.4.8 Copying a controller parameter set

The parameter CTRL_ParSetCopy allows you to copy the values of controller parameter set 1 to controller parameter set 2 or the values of controller parameter set 2 to controller parameter set 1.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`CTRL_ParSetCopy`	Controller parameter set copying Value 1: Copy controller parameter set 1 to set 2 Value 2: Copy controller parameter set 2 to set 1 If parameter set 2 copied to parameter set 1, the parameter CTRL_GlobGain is set to 100%. Changed settings become active immediately.	- 0.0 - 0.2	UINT16 R/W - -	Modbus 4396

8.5.4.9 Deactivating the integral term

The integral term of the velocity controller can be deactivated via the signal input function "Velocity Controller Integral Off". If the integral term is deactivated, the integral action time of the velocity controller (CTRL1_TNn and CTRL2_TNn) is implicitly and gradually reduced to zero. The time it takes to reduce the value to zero depends on the parameter CTRL_ParChgTime. In the case of vertical axes, the integral term is needed to reduce position deviations during standstill.

8.5.4.10 Controller parameter set 1

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL1_KPn ConF → drC- Pn1	Velocity controller P gain The default value is calculated on the basis of the motor parameters. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.0001 A/min^{-1}. Changed settings become active immediately.	A/min^{-1} 0.0001 - 1.2700	UINT16 R/W per. -	Modbus 4610
CTRL1_TNn ConF → drC- tin1	Velocity controller integral action time The default value is calculated on the basis of CTRL_TAUiref. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 - 327.67	UINT16 R/W per. -	Modbus 4612
CTRL1_KPp ConF → drC- PP1	Position controller P gain The default value is calculated. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.1 1/s. Changed settings become active immediately.	1/s 2.0 - 900.0	UINT16 R/W per. -	Modbus 4614
CTRL1_TAUiref	Filter time constant of the reference current value filter This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 0.50 4.00	UINT16 R/W per. -	Modbus 4618
CTRL1_TAUnref ConF → drC- tAu1	Filter time constant of the reference velocity value filter This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 9.00 327.67	UINT16 R/W per. -	Modbus 4616
CTRL1_KFPp ConF → drC- FPP1	Velocity feed-forward This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.1 %. Changed settings become active immediately.	% 0.0 0.0 200.0	UINT16 R/W per. -	Modbus 4620

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`CTRL1_Nf1damp`	Notch filter 1: Damping In increments of 0.1 %. Changed settings become active immediately.	% 55.0 90.0 99.0	UINT16 R/W per. expert	Modbus 4624
`CTRL1_Nf1freq`	Notch filter 1: Frequency The filter is switched off at a value of 15000. In increments of 0.1 Hz. Changed settings become active immediately.	Hz 50.0 1500.0 1500.0	UINT16 R/W per. expert	Modbus 4626
`CTRL1_Nf1bandw`	Notch filter 1: Bandwidth Definition of bandwidth: 1 - Fb/F0 In increments of 0.1 %. Changed settings become active immediately.	% 1.0 70.0 90.0	UINT16 R/W per. expert	Modbus 4628
`CTRL1_Nf2damp`	Notch filter 2: Damping In increments of 0.1 %. Changed settings become active immediately.	% 55.0 90.0 99.0	UINT16 R/W per. expert	Modbus 4630
`CTRL1_Nf2freq`	Notch filter 2: Frequency The filter is switched off at a value of 15000. In increments of 0.1 Hz. Changed settings become active immediately.	Hz 50.0 1500.0 1500.0	UINT16 R/W per. expert	Modbus 4632
`CTRL1_Nf2bandw`	Notch filter 2: Bandwidth Definition of bandwidth: 1 - Fb/F0 In increments of 0.1 %. Changed settings become active immediately.	% 1.0 70.0 90.0	UINT16 R/W per. expert	Modbus 4634
`CTRL1_Osupdamp`	Overshoot suppression filter: Damping The filter is switched off at a value of 0. In increments of 0.1 %. Changed settings become active immediately.	% 0.0 0.0 50.0	UINT16 R/W per. expert	Modbus 4636
`CTRL1_Osupdelay`	Overshoot suppression filter: Time delay The filter is switched off at a value of 0. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 0.00 75.00	UINT16 R/W per. expert	Modbus 4638
`CTRL1_Kfric`	Friction compensation: Gain In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} 0.00 0.00 10.00	UINT16 R/W per. expert	Modbus 4640

8.5.4.11 Controller parameter set 2

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL2_KFPp ConF → drC- FPP2	Velocity feed-forward This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.1 %. Changed settings become active immediately.	% 0.0 0.0 200.0	UINT16 R/W per. -	Modbus 4876
CTRL2_Kfric	Friction compensation: Gain In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} 0.00 0.00 10.00	UINT16 R/W per. expert	Modbus 4896
CTRL2_KPn ConF → drC- Pn2	Velocity controller P gain The default value is calculated on the basis of the motor parameters. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.0001 A/min^{-1}. Changed settings become active immediately.	A/min^{-1} 0.0001 - 1.2700	UINT16 R/W per. -	Modbus 4866
CTRL2_KPp ConF → drC- PP2	Position controller P gain The default value is calculated. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.1 1/s. Changed settings become active immediately.	1/s 2.0 - 900.0	UINT16 R/W per. -	Modbus 4870
CTRL2_Nf1bandw	Notch filter 1: Bandwidth Definition of bandwidth: 1 - Fb/F0 In increments of 0.1 %. Changed settings become active immediately.	% 1.0 70.0 90.0	UINT16 R/W per. expert	Modbus 4884
CTRL2_Nf1damp	Notch filter 1: Damping In increments of 0.1 %. Changed settings become active immediately.	% 55.0 90.0 99.0	UINT16 R/W per. expert	Modbus 4880
CTRL2_Nf1freq	Notch filter 1: Frequency The filter is switched off at a value of 15000. In increments of 0.1 Hz. Changed settings become active immediately.	Hz 50.0 1500.0 1500.0	UINT16 R/W per. expert	Modbus 4882

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL2_Nf2bandw	Notch filter 2: Bandwidth Definition of bandwidth: 1 - Fb/F0 In increments of 0.1 %. Changed settings become active immediately.	% 1.0 70.0 90.0	UINT16 R/W per. expert	Modbus 4890
CTRL2_Nf2damp	Notch filter 2: Damping In increments of 0.1 %. Changed settings become active immediately.	% 55.0 90.0 99.0	UINT16 R/W per. expert	Modbus 4886
CTRL2_Nf2freq	Notch filter 2: Frequency The filter is switched off at a value of 15000. In increments of 0.1 Hz. Changed settings become active immediately.	Hz 50.0 1500.0 1500.0	UINT16 R/W per. expert	Modbus 4888
CTRL2_Osupdamp	Overshoot suppression filter: Damping The filter is switched off at a value of 0. In increments of 0.1 %. Changed settings become active immediately.	% 0.0 0.0 50.0	UINT16 R/W per. expert	Modbus 4892
CTRL2_Osupdelay	Overshoot suppression filter: Time delay The filter is switched off at a value of 0. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 0.00 75.00	UINT16 R/W per. expert	Modbus 4894
CTRL2_TAUiref	Filter time constant of the reference current value filter This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 0.50 4.00	UINT16 R/W per. -	Modbus 4874
CTRL2_TAUnref ConF → drC- tAu2	Filter time constant of the reference velocity value filter This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 9.00 327.67	UINT16 R/W per. -	Modbus 4872

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL2_TNn ConF → drC- tin2	Velocity controller integral action time The default value is calculated on the basis of CTRL_TAUiref. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 - 327.67	UINT16 R/W per. -	Modbus 4868

8.5.5 Settings of parameter _DCOMstatus

The meaning of bit 11 of the parameter _DCOMstatus can be set.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_DCOMstatus	DriveCom status word Bits 0 ... 3: Status bits Bit 4: Voltage enabled Bits 5 ... 6: Status bits Bit 7: Warning Bit 8: HALT request active Bit 9: Remote Bit 10: Target reached Bit 11: Internal limit Bit 12: Operating mode-specific Bit 13: x_err Bit 14: x_end Bit 15: ref_ok The meaning of bit 11 can be set via the parameter DS402intLim.	- - - -	UINT16 R/- - -	Modbus 6916

The meaning of bit 11 can be set via the parameter DS402intLim.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
DS402intLim	DS402 status word: Setting for bit 11 (internal limit) **0 / None**: Not used (reserved) **1 / Current Below Threshold**: Current threshold value **2 / Velocity Below Threshold**: Velocity threshold value **3 / In Position Deviation Window**: Position deviation window **4 / In Velocity Deviation Window**: Velocity deviation window **9 / Hardware Limit Switch**: Hardware limit switch **10 / RMAC active or finished**: Relative movement after capture is active or finished **11 / Standstill Window**: Standstill window Setting for: - bit 11 of the parameter _DCOMstatus and - bit 10 of the parameters _motionStat and _actionStatus Changed settings become active immediately.	- 0 0 11	UINT16 R/W per. -	Modbus 6972

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8.6 Functions for target value processing

8.6.1 Stop movement with Halt

With a Halt, the current movement is interrupted; it can be resumed.

A Halt can be triggered via a digital signal input.

In order to interrupt a movement via a signal input, you must parameterize the signal input function "Halt", see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

The movement can be interrupted with 2 different deceleration types.

- Deceleration via deceleration ramp
- Deceleration via torque ramp

Setting the type of deceleration

The parameter `LIM_HaltReaction` lets you set the type of deceleration.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`LIM_HaltReaction` ConF → ACG- htYP	Halt option code **1 / Deceleration Ramp / dEcE**: Deceleration ramp **3 / Torque Ramp / torq**: Torque ramp Type of deceleration for Halt. Setting of deceleration ramp with parameter RAMP_v_dec. Setting of torque ramp with parameter LIM_I_maxHalt. If a deceleration ramp is already active, the parameter cannot be written. Changed settings become active immediately.	- 1 1 3	INT16 R/W per. -	Modbus 1582

Setting the deceleration ramp

The deceleration ramp is set with the parameter `Ramp_v_dec` via the motion profile for the velocity, see chapter 8.5.3 "Setting the motion profile for the velocity". The parameter `Ramp_v_dec` is available in all operating modes.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IO_ModeSwitch` ConF → ACG- ioMS	Operating mode for signal input function Operating Mode Switch **0 / None / nonE**: None **1 / Profile Torque / torq**: Profile Torque **2 / Profile Velocity / VELP**: Profile Velocity **3 / Electronic Gear / GEAr**: Electronic Gear Changed settings become active immediately.	- 0 0 3	UINT16 R/W per. -	Modbus 1630

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`RAMP_v_dec`	Deceleration of the motion profile for velocity The minimum value depends on the operating mode: Operating modes with minimum value 1: Electronic Gear (velocity synchronization) Profile Velocity Operating modes with minimum value 120: Jog Writing the value 0 has no effect on the parameter. Changed settings become active the next time the motor moves.	usr_a 1 600 2147483647	UINT32 R/W per. -	Modbus 1558

Setting the torque ramp The parameter `LIM_I_maxHalt` lets you set the torque ramp.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`LIM_I_maxHalt` ConF → ACG- hcur	Current value for Halt This value is only limited by the minimum/maximum value range (no limitation of this value by motor/power stage). In the case of a Halt, the actual current limit (_Imax_actual) is one of the following values (whichever is lowest): - LIM_I_maxHalt - M_I_max - PA_I_max Further current reductions caused by I2t monitoring are also taken into account during a Halt. Default: PA_I_max at 8 kHz PWM frequency and 230/480 V mains voltage In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} - - -	UINT16 R/W per. -	Modbus 4380

8.6.2 Stopping a movement with Quick Stop

With a Quick Stop, the current movement is stopped.

A Quick Stop can be triggered by an error of error classes 1 or 2.

The movement can be stopped with 2 different deceleration types.

- Deceleration via deceleration ramp
- Deceleration via torque ramp

In addition, you can set the operating state to switch to after the deceleration.

- Transition to operating state **9** Fault
- Transition to operating state **7** Quick Stop Active

Setting the type of deceleration The parameter `LIM_QStopReact` lets you set the type of deceleration.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`LIM_QStopReact` ConF → FLt- qtYP	Quick Stop option code **6 / Deceleration ramp (Quick Stop) / dEc**: Use deceleration ramp and remain in operating state 7 Quick Stop **7 / Torque ramp (Quick Stop) / tor**: Use torque ramp and remain in operating state 7 Quick Stop Type of deceleration for Quick Stop. Setting of deceleration ramp with parameter RAMPquickstop. Setting of torque ramp with parameter LIM_I_maxQSTP. If a deceleration ramp is already active, the parameter cannot be written. Changed settings become active immediately.	- 6 6 7	INT16 R/W per. -	Modbus 1584

Setting the deceleration ramp The parameter `RAMPquickstop` lets you set the deceleration ramp.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`RAMPquickstop`	Deceleration ramp for Quick Stop Deceleration ramp for a software stop or an error with error class 1 or 2. Changed settings become active the next time the motor moves.	usr_a 1 6000 2147483647	UINT32 R/W per. -	Modbus 1572

Setting the torque ramp The parameter `LIM_I_maxQSTP` lets you set the torque ramp.

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
LIM_I_maxQSTP ConF → FLt- qcur	Current value for Quick Stop This value is only limited by the minimum/maximum value range (no limitation of this value by motor/power stage). In the case of a Quick Stop, the actual current limit (_Imax_actual) is one of the following values (whichever is lowest): - LIM_I_maxQSTP - M_I_max - PA_I_max Further current reductions caused by I2t monitoring are also taken into account during a Quick Stop. Default: PA_I_max at 8 kHz PWM frequency and 230/480 V mains voltage In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} - - -	UINT16 R/W per. -	Modbus 4378

8.6.3 Inverting the analog signal inputs

The evaluation of the analog signal inputs can be inverted via the digital signal inputs.

- The signal input function "Inversion AI1" inverts the signal evaluation of the analog signal input AI1.
- The signal input function "Inversion AI2" inverts the signal evaluation of the analog signal input AI2.

In order to invert the signal evaluation of the analog signal inputs, you must parameterize the signal input functions "Inversion AI1" or "Inversion AI2", see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

Availability The signal input functions are available in the following operating modes:

- Profile Torque
- Profile Velocity

8.6.4 Limitation of the velocity via signal inputs

Limitation analog signal input

The velocity can be limited via an analog signal input.

The parameters `AI1_mode` and `AI2_mode` let you select the type of usage of the analog signal inputs.

▶ If you do not want to use the analog signal input, set the parameter `AI1` to `AI1_mode` the value "Velocity Limitation".

If you do not want to use the analog signal input, set the parameter `AI2` to `AI2_mode` the value "Velocity Limitation".

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`AI1_mode` ConF → i-o- A1Mo	Analog 1: Type of usage **0 / None / nonE**: No function **1 / Target Velocity / SPdS**: Target velocity for the velocity controller **2 / Target Torque / trqS**: Target torque for the current controller **3 / Velocity Limitation / LSPd**: Limitation of the velocity for the velocity controller **4 / Torque Limitation / Ltrq**: Limitation of the torque for the current controller Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 1 4	UINT16 R/W per. -	Modbus 2332
`AI2_mode` ConF → i-o- A2Mo	Analog 2: Type of usage **0 / None / nonE**: No function **1 / Target Velocity / SPdS**: Target velocity for the velocity controller **2 / Target Torque / trqS**: Target torque for the current controller **3 / Velocity Limitation / LSPd**: Limitation of the velocity for the velocity controller **4 / Torque Limitation / Ltrq**: Limitation of the torque for the current controller Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 0 4	UINT16 R/W per. -	Modbus 2342

The parameters `AI1_v_max` and `AI2_v_max` are used to set the value of the limitation for a voltage value of +10V.

▶ If you want to use the analog signal input `AI1`, use the parameter `AI1_v_max` to set the value of the limitation for a voltage value of +10V.

If you want to use the analog signal input `AI2`, use the parameter `AI2_v_max` to set the value of the limitation for a voltage value of +10V.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`AI1_v_max`	Analog 1: Limitation of velocity at 10 V The maximum velocity is limited to the setting in CTRL_v_max. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	usr_v 1 3000 2147483647	UINT32 R/W per. -	Modbus 2336
`AI2_v_max`	Analog 2: Limitation of velocity at 10 V The maximum velocity is limited to the setting in CTRL_v_max. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	usr_v 1 3000 2147483647	UINT32 R/W per. -	Modbus 2346

Limitation via digital signal input

The velocity can be limited to a specific value via a digital signal input.

The parameter `IO_v_limit` lets you set the velocity limitation.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IO_v_limit`	Velocity limitation via input A velocity limitation can be activated via a digital input. NOTE: In operating mode Profile Torque, the minimum velocity is internally limited to 100 min^{-1}. Changed settings become active immediately.	usr_v 1 10 2147483647	UINT32 R/W per. -	Modbus 1596

In order to limit the velocity via a digital signal input, you must parameterize the signal input function "Velocity Limitation", see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

8.6.5 Limitation of the current via signal inputs

Limitation analog signal input

The current can be limited via an analog signal input.

The parameters `AI1_mode` and `AI2_mode` let you select the type of usage of the analog signal inputs.

▶ If you do not want to use the analog signal input, set the parameter `AI1` to `AI1_mode` the value "Current Limitation".

If you do not want to use the analog signal input, set the parameter `AI2` to `AI2_mode` the value "Current Limitation".

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
AI1_mode ConF → i-o- A1Mo	Analog 1: Type of usage **0 / None / nonE**: No function **1 / Target Velocity / SPdS**: Target velocity for the velocity controller **2 / Target Torque / trqS**: Target torque for the current controller **3 / Velocity Limitation / LSPd**: Limitation of the velocity for the velocity controller **4 / Torque Limitation / Ltrq**: Limitation of the torque for the current controller Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 1 4	UINT16 R/W per. -	Modbus 2332
AI2_mode ConF → i-o- A2Mo	Analog 2: Type of usage **0 / None / nonE**: No function **1 / Target Velocity / SPdS**: Target velocity for the velocity controller **2 / Target Torque / trqS**: Target torque for the current controller **3 / Velocity Limitation / LSPd**: Limitation of the velocity for the velocity controller **4 / Torque Limitation / Ltrq**: Limitation of the torque for the current controller Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 0 4	UINT16 R/W per. -	Modbus 2342

The parameters `AI1_I_max` and `AI2_I_max` are used to set the value of the limitation for a voltage value of +10V.

▶ If you want to use the analog signal input `AI1`, use the parameter `AI1_I_max` to set the value of the limitation for a voltage value of +10V.

If you want to use the analog signal input `AI2`, use the parameter `AI2_I_max` to set the value of the limitation for a voltage value of +10V.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`AI1_I_max` ConF → i-o- A1iL	Analog 1: Limitation of current at 10 V In increments of 0.01 A_{rms}. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	A_{rms} 0.00 3.00 300.00	UINT16 R/W per. -	Modbus 2334
`AI2_I_max` ConF → i-o- A2iL	Analog 2: Limitation of current at 10 V In increments of 0.01 A_{rms}. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	A_{rms} 0.00 3.00 300.00	UINT16 R/W per. -	Modbus 2344

Limitation via digital signal input

The current can be limited to a specific value via a digital signal input.

The parameter `IO_I_limit` lets you set the current limitation.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IO_I_limit` ConF → i-o- iLiM	Current limitation via input A current limit can be activated via a digital input. In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} 0.00 0.20 300.00	UINT16 R/W per. -	Modbus 1614

In order to limit the current via a digital signal input, you must parameterize the signal input function "Current Limitation", see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

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8.6.6 Jerk limitation

Jerk limitation smoothes sudden acceleration changes to allow for smooth transitions with almost no jerking.

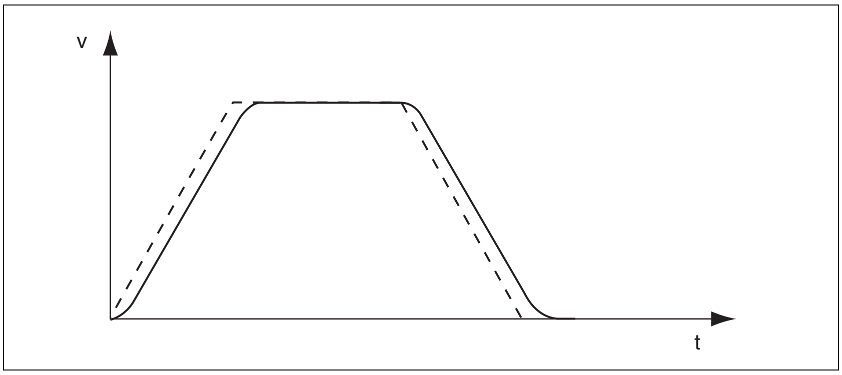

Figure 8.21 Jerk limitation

Availability Jerk limitation is available in the following operating modes.

- Jog
- Electronic Gear (position synchronization)
  (firmware version ≥V01.02 and parameter `GEARjerklim`)

Jerk limitation is activated and set via the parameter `RAMP_v_jerk`.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`RAMP_v_jerk` ConF → drC- JEr	Jerk limitation of the motion profile for velocity **0 / Off /** oFF: Off **1 / 1 /** 1: 1 ms **2 / 2 /** 2: 2 ms **4 / 4 /** 4: 4 ms **8 / 8 /** 8: 8 ms **16 / 16 /** 16: 16 ms **32 / 32 /** 32: 32 ms **64 / 64 /** 64: 64 ms **128 / 128 /** 128: 128 ms Adjustments can only be made if the operating mode is inactive (x_end=1). Changed settings become active the next time the motor moves.	ms 0 0 128	UINT16 R/W per. -	Modbus 1562

Operating mode Electronic Gear Jerk limitation is activated for the operating mode Electronic Gear by means of the parameter `GEARjerklim`.

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
GEARjerklim ConF → i -o- GFiL	Activation of jerk filter processing **0 / Off / oFF**: Jerk filter deactivated. **1 / PosSyncOn / P_on**: Jerk filter active in processing modes with position synchronization. The jerk filter processing time must be activated via parameter RAMP_v_jerk. Setting can only be changed if power stage is disabled. Changed settings become active immediately. Available as of software version V01.02.05.	- 0 0 1	UINT16 R/W per. -	Modbus 9742

8.6.7 Zero Clamp

The motor can be stopped via a digital signal input. The velocity of the motor must be below a parameterizable velocity value.

Availability The signal input function "Zero Clamp" is available in the following operating mode:

- Electronic Gear (velocity synchronization)
- Profile Velocity

Target velocities in the operating mode Profile Velocity and reference velocities in the operating mode Electronic Gear (Velocity Synchronization) that are below the parameterizable velocity value are interpreted as "Zero".

The signal input function "Zero Clamp" has a hysteresis of 20 %.

The parameter `MON_v_zeroclamp` lets you set the velocity value.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
MON_v_zeroclamp	Velocity limit for Zero Clamp A Zero Clamp operation is only possible if the reference velocity is below the Zero Clamp velocity limit. Changed settings become active immediately.	usr_v 0 10 2147483647	UINT32 R/W per. -	Modbus 1616

In order to stop the motor via a digital signal input, you must parameterize the signal input function "Zero Clamp", see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

8.7 Functions for monitoring movements

8.7.1 Limit switches

⚠ WARNING

LOSS OF CONTROL

The use of limit switches can provide some protection against hazards (for example, collision with mechanical stop caused by incorrect reference values).

- If possible, use the limit switches.
- Verify correct connection of the limit switches.
- Verify the correct installation of the limit switches. The limit switches must be mounted in a position far enough away from the mechanical stop to allow for an adequate stopping distance.
- You must release the limit switches before you can use them.
- Verify the correct function of the limit switches.

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

Limit switches

Movements can be monitored using limit switches. A positive limit switch and a negative limit switch can be used for monitoring.

If the positive or negative limit switch are tripped, the movement stops. An error message is generated and the operating state switches to **7** Quick Stop Active.

The error message can be reset by means of a "Fault Reset". The operating state switches back to **6** Operation Enabled.

The movement can continue, however, only in the opposite direction. For example, if the positive limit switch was triggered, further movement is only possible in negative direction. In the case of further movement in positive direction, a new error message is generated and the operating state switches back to **7** Quick Stop Active.

The parameters `IOsigLIMP` and `IOsigLIMN` are used to set the the type of limit switch.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`IOsigLIMP`	Signal evaluation for positive limit switch **0 / Inactive**: Inactive **1 / Normally closed**: Normally closed NC **2 / Normally open**: Normally open NO Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 1 2	UINT16 R/W per. -	Modbus 1568

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IOsigLIMN`	Signal evaluation for negative limit switch **0 / Inactive**: Inactive **1 / Normally closed**: Normally closed NC **2 / Normally open**: Normally open NO Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 1 2	UINT16 R/W per. -	Modbus 1566

The signal input functions "Positive Limit Switch" and "Negative Limit Switch" must be parameterized, see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

If possible, use normally closed contacts so that a wire break can be signaled as an error.

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8.7.2 Load-dependent position deviation (following error)

The load-dependent position deviation is the difference between the reference position and the actual position caused by the load.

Parameters are available to read the load-dependent position deviation during operation and the maximum position deviation reached so far.

The maximum permissible load-dependent position deviation can be parameterized. In addition, you can set the error class for a following error.

Availability Monitoring of the load-dependent position deviation is available in the following operating modes:

- Jog
- Electronic Gear (position synchronization)
- Profile Position
- Homing

Reading the position deviation The following parameters let you read the current load-dependent position deviation in user-defined units or revolutions.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`_p_dif_load_usr`	Current load-dependent position deviation between reference and actual position The load-dependent position deviation is the difference between the reference position and the actual position caused by the load. This value is used for following error monitoring. Available as of firmware version V01.05	usr_p -2147483648 - 2147483647	INT32 R/- - -	Modbus 7724
`_p_dif_load`	Current load-dependent position deviation between reference and actual position The load-dependent position deviation is the difference between the reference position and the actual position caused by the load. This value is used for following error monitoring. The parameter _p_dif_load_usr allows you to enter the value in user-defined units. In increments of 0.0001 revolution.	revolution -214748.3648 - 214748.3647	INT32 R/- - -	Modbus 7736

The following parameters let you read the maximum value of the load-dependent position deviation reached so far in user-defined units or revolutions.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`_p_dif_load_peak_usr`	Maximum value of the load-dependent position deviation This parameter contains the maximum load-dependent position deviation reached so far. A write access resets this value. Available as of firmware version V01.05 Changed settings become active immediately.	usr_p 0 - 2147483647	INT32 R/W - -	Modbus 7722
`_p_dif_load_peak`	Maximum value of the load-dependent position deviation This parameter contains the maximum load-dependent position deviation reached so far. A write access resets this value. The parameter _p_dif_load_peak_usr allows you to enter the value in user-defined units.. In increments of 0.0001 revolution. Changed settings become active immediately.	revolution 0.0000 - 429496.7295	UINT32 R/W - -	Modbus 7734

Setting the position deviation The following parameter lets you set the warning threshold for the maximum load-dependent position deviation.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`MON_p_dif_warn`	Maximum load-dependent position deviation (warning) 100.0 % correspond to the maximum position deviation (following error) as specified by means of parameter MON_p_dif_load. Changed settings become active immediately.	% 0 75 100	UINT16 R/W per. -	Modbus 1618

The following parameters let you set the following error threshold in user-defined units or revolutions for the maximum load-dependent position deviation.

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`MON_p_dif_load_usr`	Maximum load-dependent position deviation (following error) The load-dependent position deviation is the difference between the reference position and the actual position caused by the load. The minimum value, the factory setting and the maximum value depend on the scaling factor. Available as of firmware version V01.05 Changed settings become active immediately.	usr_p 1 16384 2147483647	INT32 R/W per. -	Modbus 1660
`MON_p_dif_load`	Maximum load-dependent position deviation (following error) The load-dependent position deviation is the difference between the reference position and the actual position caused by the load. The parameter MON_p_dif_load_usr allows you to enter the value in user-defined units. In increments of 0.0001 revolution. Changed settings become active immediately.	revolution 0.0001 1.0000 200.0000	UINT32 R/W per. -	Modbus 1606

Setting the error class The following parameter lets you set the error response to an excessively high load-dependent position deviation (following error).

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`ErrorResp_p_dif`	Error response to following error **1 / Error Class 1**: Error class 1 **2 / Error Class 2**: Error class 2 **3 / Error Class 3**: Error class 3 Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 1 3 3	UINT16 R/W per. -	Modbus 1302

8.7.3 Motor standstill

It is possible to monitor whether the motor is at a standstill.

At a velocity of <10 min^{-1}, the motor is at a standstill.

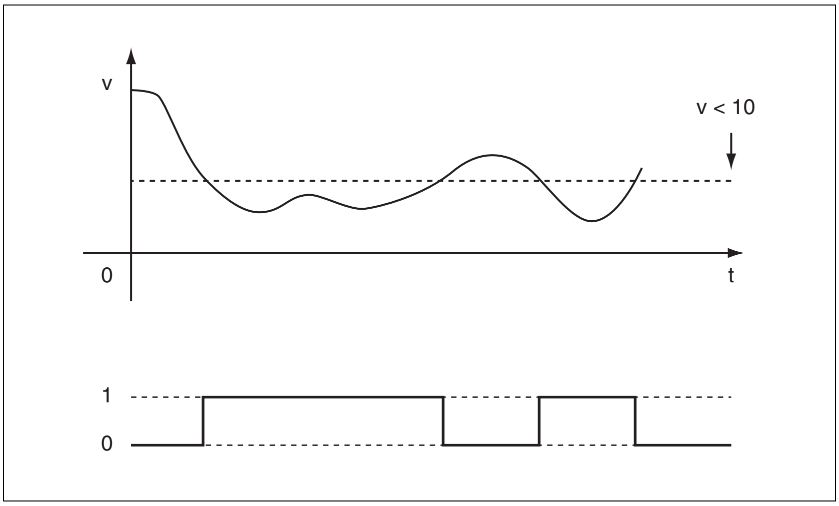

Figure 8.22 Motor standstill

The status is available via a signal output. In order to read the status, you must parameterize the signal output function "Motor Standstill", see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

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8.7.4 Position deviation window

The position deviation window allows you to monitor whether the motor is within a parameterizable position deviation.

The position deviation is the difference between reference position and actual position.

The position deviation window comprises position deviation and monitoring time.

Availability The position deviation window is available in the following operating modes.

- Jog
- Electronic Gear (position synchronization)

Monitoring

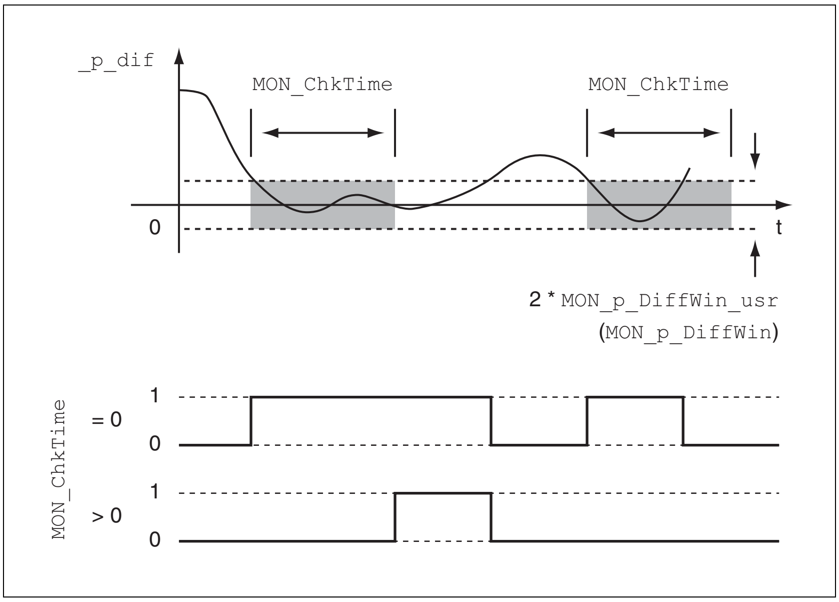

Figure 8.23 Position deviation window

The parameters `MON_p_DiffWin_usr` (`MON_p_DiffWin`) and `MON_ChkTime` specify the size of the window.

Status indication The status is available via a signal output. In order to read the status, you must parameterize the signal output function "In Position Deviation Window", see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

The parameter `MON_ChkTime` acts on the parameters `MON_p_DiffWin_usr` (`MON_p_DiffWin`), `MON_v_DiffWin`, `MON_v_Threshold` and `MON_I_Threshold`.

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
MON_p_DiffWin_usr	Monitoring of position deviation The system checks whether the drive is within the defined deviation during the period set with MON_ChkTime. The status can be output via a parameterizable output. The minimum value, the factory setting and the maximum value depend on the scaling factor. Available as of firmware version V01.05 Changed settings become active immediately.	usr_p 0 16 2147483647	INT32 R/W per. -	Modbus 1662
MON_p_DiffWin	Monitoring of position deviation The system checks whether the drive is within the defined deviation during the period set with MON_ChkTime. The status can be output via a parameterizable output. The parameter MON_p_DiffWin_usr allows you to enter the value in user-defined units. In increments of 0.0001 revolution. Changed settings become active immediately.	revolution 0.0000 0.0010 0.9999	UINT16 R/W per. -	Modbus 1586
MON_ChkTime ConF → i-o- tthr	Monitoring of time window Adjustment of a time for monitoring of position deviation, speed deviation, speed value and current value. If the monitored value is in the permissible range during the adjusted time, the monitoring function delivers a positive result. The status can be output via a parameterizable output. Changed settings become active immediately.	ms 0 0 9999	UINT16 R/W per. -	Modbus 1594

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8.7.5 Velocity deviation window

The velocity deviation window allows you to monitor whether the motor is within a parameterizable velocity deviation.

The velocity deviation is the difference between the reference velocity and the actual velocity.

The velocity deviation window comprises velocity deviation and monitoring time.

Availability The velocity deviation window is available in the following operating modes.

- Jog
- Electronic Gear (velocity synchronization)
- Profile Velocity

Monitoring

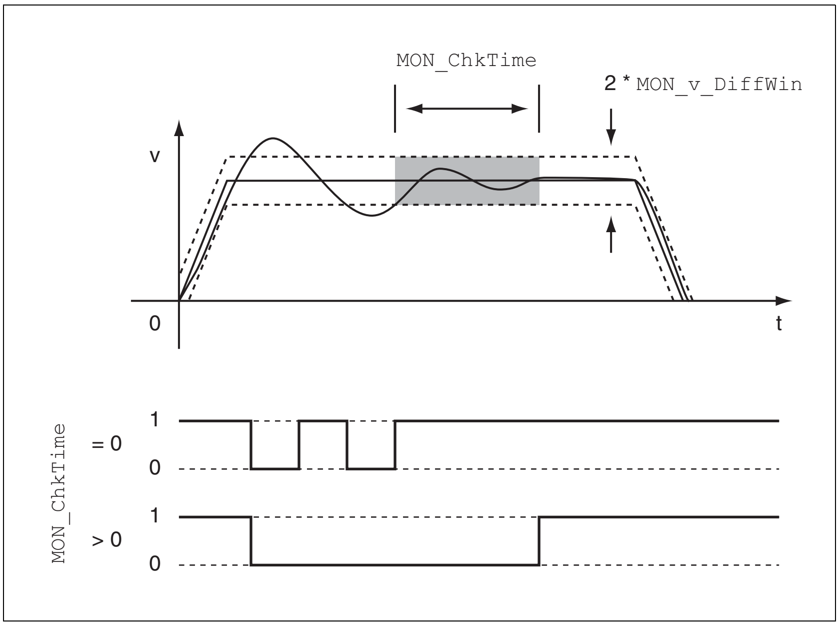

Figure 8.24 Velocity deviation window

The parameters MON_v_DiffWin and MON_ChkTime specify the size of the window.

Status indication The status is available via a signal output. In order to read the status, you must parameterize the signal output function "In Velocity Deviation Window", see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

The parameter MON_ChkTime acts on the parameters MON_p_DiffWin_usr (MON_p_DiffWin), MON_v_DiffWin, MON_v_Threshold and MON_I_Threshold.

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
MON_v_DiffWin	Monitoring of velocity deviation The system checks whether the drive is within the defined deviation during the period set with MON_ChkTime. The status can be output via a parameterizable output. Changed settings become active immediately.	usr_v 1 10 2147483647	UINT32 R/W per. -	Modbus 1588
MON_ChkTime ConF → i-o- tthr	Monitoring of time window Adjustment of a time for monitoring of position deviation, speed deviation, speed value and current value. If the monitored value is in the permissible range during the adjusted time, the monitoring function delivers a positive result. The status can be output via a parameterizable output. Changed settings become active immediately.	ms 0 0 9999	UINT16 R/W per. -	Modbus 1594

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8.7.6 Velocity threshold value

The velocity threshold value allows you to monitor whether the current velocity is below a parameterizable velocity value.

The velocity threshold value comprises the velocity and the monitoring time.

Monitoring

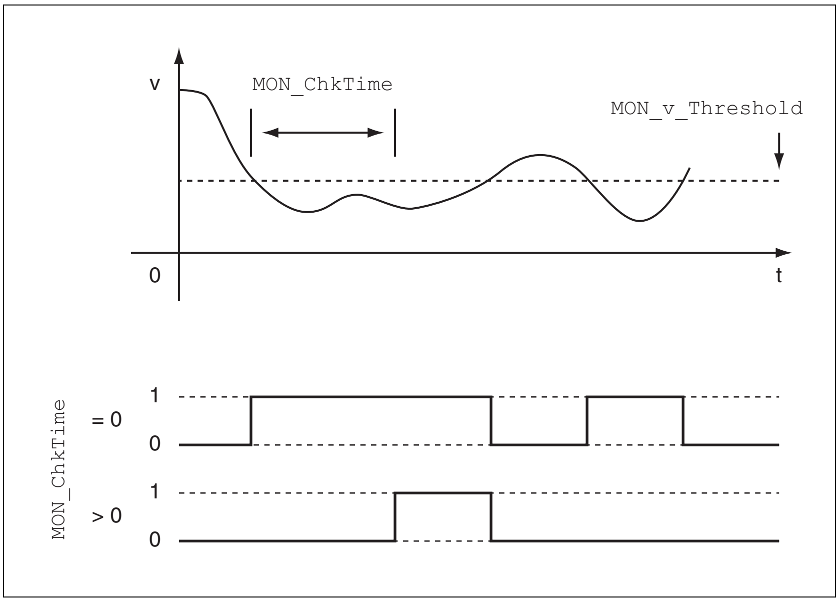

Figure 8.25 Velocity threshold value

The parameters `MON_v_Threshold` and `MON_ChkTime` specify the size of the window.

Status indication The status is available via a signal output. In order to read the status, you must parameterize the signal output function "Velocity Below Threshold", see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

The parameter `MON_ChkTime` acts on the parameters `MON_p_DiffWin_usr` (`MON_p_DiffWin`), `MON_v_DiffWin`, `MON_v_Threshold` and `MON_I_Threshold`.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`MON_v_Threshold`	Monitoring of velocity threshold The system checks whether the drive is below the defined value during the period set with MON_ChkTime. The status can be output via a parameterizable output. Changed settings become active immediately.	usr_v 1 10 2147483647	UINT32 R/W per. -	Modbus 1590

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`MON_ChkTime` ConF → i-o- tthr	Monitoring of time window Adjustment of a time for monitoring of position deviation, speed deviation, speed value and current value. If the monitored value is in the permissible range during the adjusted time, the monitoring function delivers a positive result. The status can be output via a parameterizable output. Changed settings become active immediately.	ms 0 0 9999	UINT16 R/W per. -	Modbus 1594

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8.7.7 Current threshold value

The current threshold value allows you to monitor whether the current motor current is below a parameterizable current value.

The current threshold value comprises the current value and the monitoring time.

Monitoring

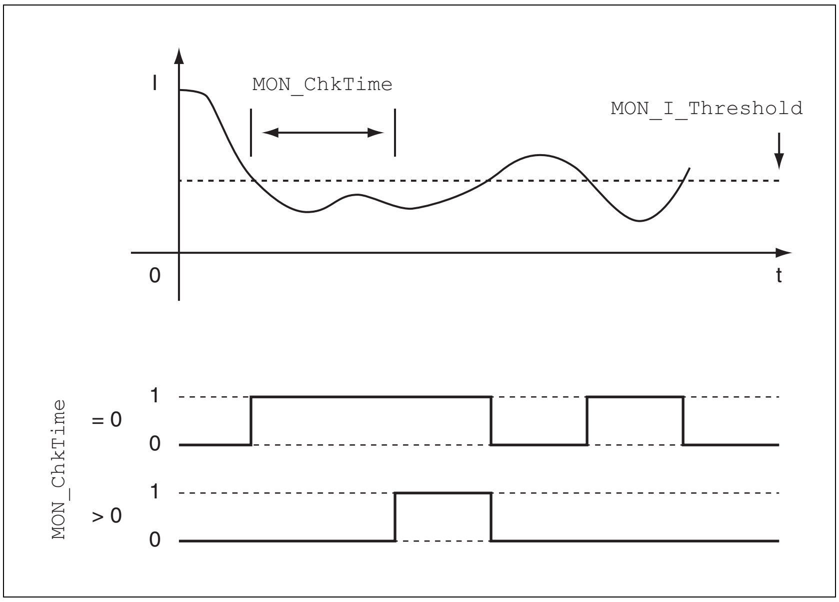

Figure 8.26 Current threshold value

The parameters `MON_I_Threshold` and `MON_ChkTime` specify the size of the window.

Status indication

The status is available via a signal output. In order to read the status, you must parameterize the signal output function "Current Below Threshold", see chapter 8.5.2 "Setting the digital signal inputs and signal outputs".

The parameter `MON_ChkTime` acts on the parameters `MON_p_DiffWin_usr` (`MON_p_DiffWin`), `MON_v_DiffWin`, `MON_v_Threshold` and `MON_I_Threshold`.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`MON_I_Threshold` ConF → i-o- ithr	Monitoring of current threshold The system checks whether the drive is below the defined value during the period set with MON_ChkTime. The status can be output via a parameterizable output. The parameter _Iq_act_rms is used as comparison value. In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} 0.00 0.20 300.00	UINT16 R/W per. -	Modbus 1592

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
MON_ChkTime ConF → i-o- tthr	Monitoring of time window Adjustment of a time for monitoring of position deviation, speed deviation, speed value and current value. If the monitored value is in the permissible range during the adjusted time, the monitoring function delivers a positive result. The status can be output via a parameterizable output. Changed settings become active immediately.	ms 0 0 9999	UINT16 R/W per. -	Modbus 1594

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8.8 Functions for monitoring internal device signals

8.8.1 Temperature monitoring

The power stage temperature the motor temperature are monitored internally.

Power stage temperature

The parameters _PS_T_current and _PS_T_max can be used to read the current temperature and the maximum temperature of the power stage.

The parameter _PS_T_warn contains as threshold value for a warning.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_PS_T_current MOn tPS	Current power stage temperature	°C - - -	INT16 R/- - -	Modbus 7200
_PS_T_warn	Temperature warning threshold of power stage	°C - - -	INT16 R/- per. -	Modbus 4108
_PS_T_max	Maximum power stage temperature	°C - - -	INT16 R/- per. -	Modbus 4110

Motor temperature

The parameters _M_T_current and _M_T_max can be used to read the current temperature and the maximum temperature of the motor.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_M_T_current	Current motor temperature No meaningful indication possible for switching temperature sensors (see parameter M_TempType for temperature sensor type)	°C - - -	INT16 R/- - -	Modbus 7202
_M_T_max	Maximum temperature of motor	°C - - -	INT16 R/- - -	Modbus 3360

8.8.2 Monitoring load and overload (I2T monitoring)

The load is the thermal load on the power stage, the motor and the braking resistor.

Load and overload on the individual components are monitored internally; the values can be read by means of parameters.

Overload starts at a load value of 100 %.

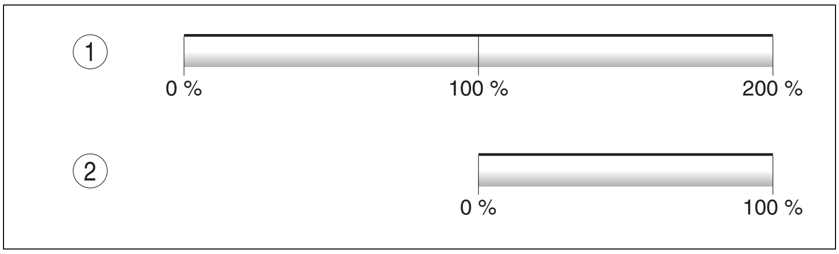

Figure 8.27 Load and overload

(1) Load
(2) Overload

Load monitoring The current load can be read using the following parameters:

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`_PS_load` MOn LdFP	Current load of power stage	% - - -	INT16 R/- - -	Modbus 7214
`_M_load` MOn LdFM	Current load of motor	% - - -	INT16 R/- - -	Modbus 7220
`_RES_load` MOn LdFb	Current load of braking resistor Monitoring of internal and external braking resistor depending on parameter RESint_ext.	% - - -	INT16 R/- - -	Modbus 7208

Overload monitoring If the overload persists for an excessive period of time (100 % overload), the current is limited internally.

The current overload and the peak value can be read using the following parameters:

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`_PS_maxoverload`	Maximum value of overload of power stage Maximum overload of power stage during the last 10 seconds.	% - - -	INT16 R/- - -	Modbus 7216
`_M_overload`	Current overload of motor (I2t)	% - - -	INT16 R/- - -	Modbus 7218

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`_M_maxoverload`	Maximum value of overload of motor Maximum overload of motor during the last 10 seconds.	% - - -	INT16 R/- - -	Modbus 7222
`_RES_overload`	Current overload of braking resistor (I2t) Monitoring of internal and external braking resistor depending on parameter RESint_ext.	% - - -	INT16 R/- - -	Modbus 7206
`_RES_maxoverload`	Maximum value of overload of braking resistor Maximum overload of braking resistor during the last 10 seconds.	% - - -	INT16 R/- - -	Modbus 7210

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8.8.3 Commutation monitoring

⚠ WARNING

UNEXPECTED MOVEMENT

The risk of unexpected movements increases if monitoring functions are deactivated.

- Use the monitoring functions.

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

The device checks the plausibility of motor acceleration and effective motor torque in order to recognize uncontrolled movements and to suppress them if required. The monitoring function is referred to as commutation monitoring.

If the motor accelerates for a period of more than 5 to 10 ms even though the drive control decelerates the motor with the maximum current set, commutation monitoring signals an uncontrolled motor movement.

The parameter `MON_commutat` lets you deactivate commutation monitoring.

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`MON_commutat`	Commutation monitoring **0 / Off**: Commutation monitoring off **1 / On**: Commutation monitoring on Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 1 1	UINT16 R/W per. -	Modbus 1290

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8.8.4 Monitoring of mains phases

CAUTION
DESTRUCTION CAUSED BY MISSING MAINS PHASE If a mains phase for a three-phase product misses and the monitoring function is deactivated, this can cause overload and destruction of the product. • Use the monitoring functions. • Do not operate the product if a mains phase misses. **Failure to follow these instructions can result in equipment damage.**

The mains phases are monitored internally.

The parameter `ErrorResp_Flt_AC` lets you set the error response to a missing mains phase for three-phase devices.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`ErrorResp_Flt_AC`	Error response to missing mains phase **1 / Error Class 1**: Error class 1 **2 / Error Class 2**: Error class 2 **3 / Error Class 3**: Error class 3 Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 1 2 3	UINT16 R/W per. -	Modbus 1300

If the product is supplied via the DC bus, mains phase monitoring must be set to the mains voltage used.

The type of main phase monitoring is set by means of the parameter `MON_MainsVolt`.

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`MON_MainsVolt`	Detection and monitoring of mains phases **0 / Automatic Mains Detection**: Automatic detection and monitoring of mains voltage **1 / DC-Bus Only (Mains 1~230 V / 3~480 V)**: DC bus supply only, corresponding to mains voltage 230 V (single-phase) or 480 V (three phases) **2 / DC-Bus Only (Mains 1~115 V / 3~208 V)**: DC bus supply only, corresponding to mains voltage 115 V (single-phase) or 208 V (three phases) **3 / Mains 1~230 V / 3~480 V**: Mains voltage 230 V (single-phase) or 480 V (three phases) **4 / Mains 1~115 V / 3~208 V**: Mains voltage 115 V (single-phase) or 208 V (three phases) Value 0: As soon as a mains voltage detected, the device automatically checks whether the mains voltage is 115 V or 230 V in the case of single-phase devices or 208 V or 400/480 V in the case of three-phase devices. Values 1 ... 2: If the device is supplied only via the DC bus, the parameter has to be set to the voltage value corresponding to the mains voltage of the supplying device. There is no mains voltage monitoring. Values 3 ... 4: If the mains voltage is not detected properly during start-up, the mains voltage to be used can be selected manually. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 0 4	UINT16 R/W per. expert	Modbus 1310

0198441113761, V1.05, 12.2010

8.8.5 Ground fault monitoring

CAUTION
DESTRUCTION CAUSED BY GROUND FAULTS
If the monitoring function is deactivated, the product may be destroyed by a ground fault. • Use the monitoring functions. • Avoid ground faults by wiring the product properly.
Failure to follow these instructions can result in equipment damage.

When the power stage is enabled, the device monitors the motor phases for ground faults.

A ground fault of one or more motor phases is detected. A ground fault of the DC bus or the braking resistor is not detected.

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
`MON_GroundFault`	Ground fault monitoring **0 / Off**: Ground fault monitoring off **1 / On**: Ground fault monitoring on In exceptional cases, deactivation may be necessary, for example: - Long motor cables Deactivate ground fault monitoring if it responds in an unwanted way. Changed settings become active the next time the product is switched on.	- 0 1 1	UINT16 R/W per. expert	Modbus 1312

9 Examples

9

9.1 General information

The examples show some typical applications of the product. The examples are intended to provide an overview; they are not exhaustive wiring plans.

Using the safety functions integrated in this product requires careful planning. See chapter 5.9 "Safety function STO ("Safe Torque Off")", page 77 for additional information.

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9.2 Example of operating mode Electronic Gear

Reference values are provided in the form of A/B signals.

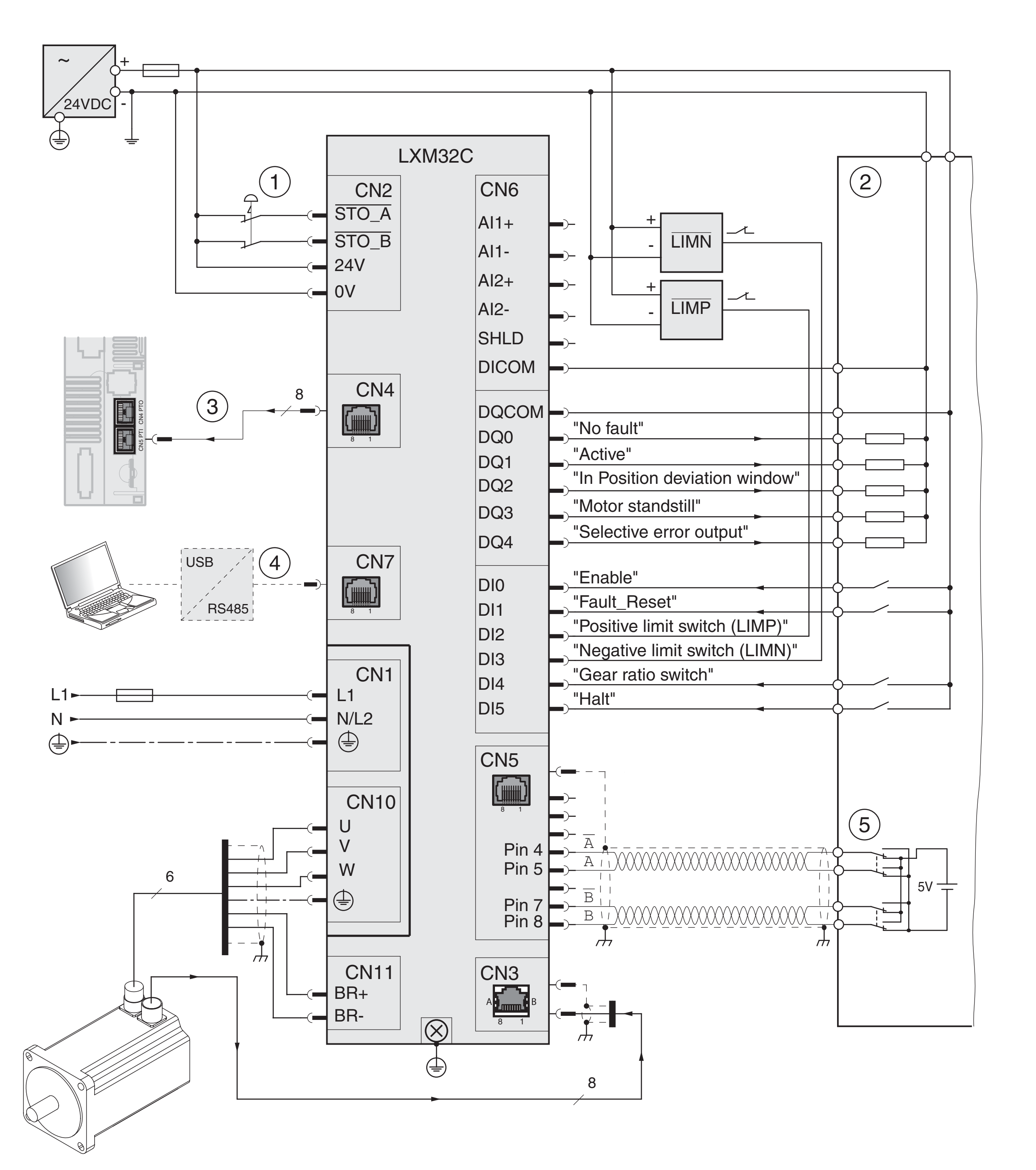

Figure 9.1 Wiring example

(1) EMERGENCY STOP
(2) PLC
(3) See chapter 9 "Examples"
(4) Commissioning accessories
(5) Signal source for A/B signals

0198441113761, V1.05, 12.2010

9.3 Example of operating mode Profile Velocity

Reference values are provided via a ±10V analog signal.

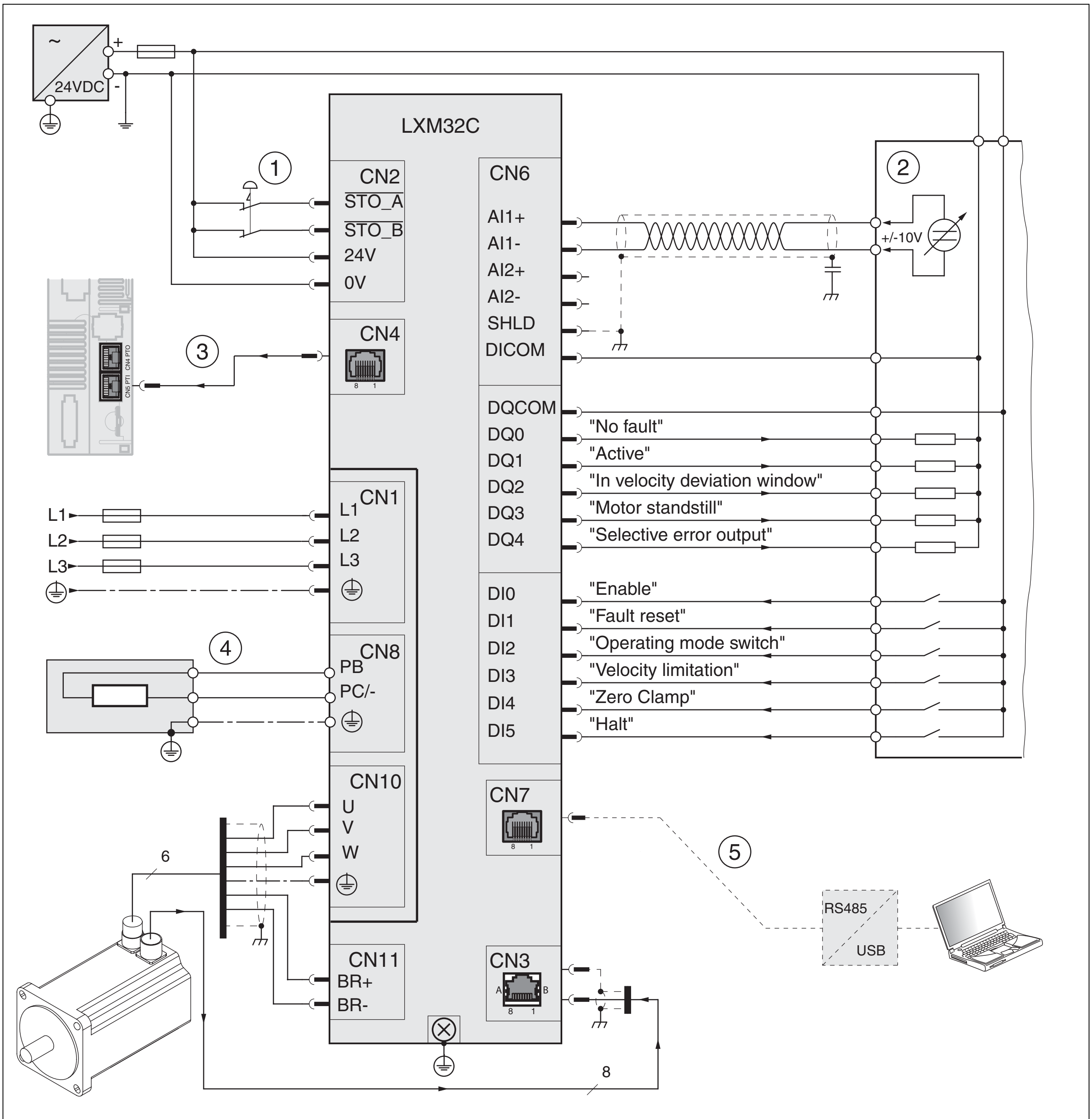

Figure 9.2 Wiring example

(1) EMERGENCY STOP
(2) PLC
(3) See chapter ESIM for using ESIM
(4) External braking resistor
(5) Commissioning accessories

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10 Diagnostics and troubleshooting

10

This chapter describes the various types of diagnostics and provides troubleshooting assistance.

10.1 Status request/status indication

Information on the product status is provided by:

- Integrated HMI
- Commissioning software

The error memory also contains a history of the last 10 errors.

Meaning of a warning message

A warning alerts to a problem that was detected by a monitoring function. The cause of a warning must be remedied.
A warning belongs to error class 0 and does not cause a transition of the operating state.

Meaning of an error message

An error is a deviation from the required value or state. Errors are subdivided into different error classes.

Error class

The product triggers an error response if an error occurs. Depending upon the severity of the error, the device responds in accordance with one of the following error classes:

Error class	Response	Meaning
0	Warning	A monitoring function has detected a problem. No interruption of the movement.
1	"Quick Stop"	Motor stops with "Quick Stop", the power stage remains enabled.
2	"Quick Stop" with switch-off	Motor stops with "Quick Stop", the power stage is disabled after standstill has been achieved.
3	Fatal error	The power stage is immediately disabled without stopping the motor first.
4	Uncontrolled operation	The power stage is immediately disabled without stopping the motor first. The error can only be reset by switching off the product.

10.1.1 Diagnostics via the integrated HMI

The following illustration shows the status LEDs and the 7-segment display of the integrated HMI

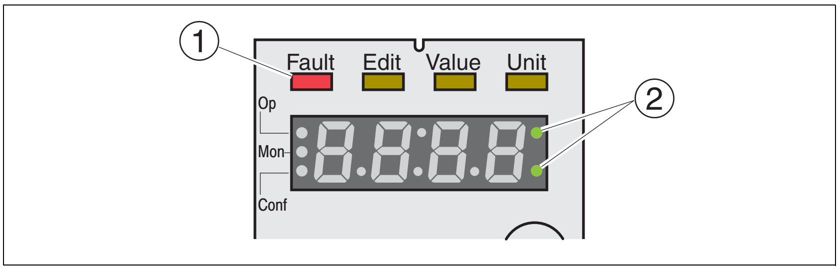

Figure 10.1 Status indication via the integrated HMI

Status LED "Fault" If the drive is in the operating state Fault, the "Fault" (1) status LED lights.

7-segment display The 7-segment display provides the user with information.

Warning messages If there are warnings (error class 0), the two dots to the right of the 7-segment display (2) flash. Warnings are not directly displayed on the 7-segment display in the form of an error number, bust must be explicitly queried by the user. See chapter 10.3.1 "Reading and acknowledging warnings", page 301 for additional information.

Error numbers Error numbers of errors belonging to error classes 1 to 4 on the one hand and the current operating state on the other hand are displayed alternately by the 7-segment display. See chapter 10.3.2 "Reading and acknowledging errors", page 302 for information on acknowledging errors via the integrated HMI.
The meanings of the error numbers can be found in chapter 10.4.1 "Table of warnings and errors by range", page 304.

Messages on the integrated HMI The table below provides an overview of the messages that can be displayed on the integrated HMI.

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Message	Description
CArd	Data on the memory card differs from data in the product. See chapter 7.8.1 "Data exchange with the memory card", page 187 for information on how to proceed.
dIS	The product is in the operating state **3** Switch On Disabled. There is no DC bus voltage or the inputs $\overline{\text{STO\_A}}$ and $\overline{\text{STO\_B}}$ have no current.
dISP	An external HMI is connected. The integrated HMI has no function.
FLt	The display alternately shows FLt (FLT) and a 4-digit error number. See chapter 10.4.1 "Table of warnings and errors by range", page 304 for the meaning of the error number.
hALt	The motor is stopped, the power stage is enabled.
Mot	A new motor was detected. See chapter 10.3.3 "Acknowledging a motor change", page 303 for replacing a motor.
nrdY	The product is not ready to switch on (operating state: **2** Not Ready To Switch On).
Prot	Parts of the integrated HMI were locked with the parameter `HMIlocked`.
rdY	The power stage is ready to switch on.
run	The product operates with the operating mode set.
StoP	The display alternately shows StoP (STOP) and a 4-digit error number. See chapter 10.4.1 "Table of warnings and errors by range" for the meaning of the error number.
uLou	Controller supply voltage during initialization not high enough.
8888	Undervoltage controller supply voltage.

Table 10.1 Table of the messages at the HMI

In addition to the messages as listed in Table 10.1, the integrated HMI displays information on the following:

- Error numbers (see chapter 10.4.1 "Table of warnings and errors by range", page 304)
- Menu labels (see chapter 7.3.2 "Menu structure", page 134)
- Parameter names (see chapter 11 "Parameters", page 321)
- Parameter values (for example, maximum current iMAX (IMAX))

10.1.2 Diagnostics via the commissioning software

See the information provided with the commissioning software for details on how to display the device state via the commissioning software.

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10.2 Error memory

General The error memory is an error history of the last 10 errors; it is not cleared even if the product is switched off. The error memory allows you to read and evaluate past events.

The following information on the events is stored:

- Error class
- Error number
- Motor current
- Number of switch-on cycles
- Additional error information (for example, parameter numbers)
- Product temperature
- Power stage temperature
- Time the error occurred (with reference to operating hours counter)
- DC bus voltage
- Velocity
- Number of Enable cycles after switch-on
- Time from Enable until occurrence of the error

The stored information relates to the situation at the point in time the error occurred.

10.2.1 Reading the error memory via the commissioning software

See the information provided with the commissioning software for details on how to read the error memory using the commissioning software.

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10.3 Special menus at the integrated HMI

The following functions depend on the situation. They are only available in specific contexts.

10.3.1 Reading and acknowledging warnings

Procedure for reading and acknowledging warnings via the integrated HMI:

■ A warning is active. The two dots to the right of the 7-segment display flash.

▶ Remedy the cause of the warning.

▶ Press the navigation button and hold it down.

◁ The 7-segment display shows the error number of the warning.

▶ Release the navigation button.

◁ The 7-segment display shows FrES.

▶ Press the navigation button to acknowledge the warning.

◁ The 7-segment display returns to the initial state.

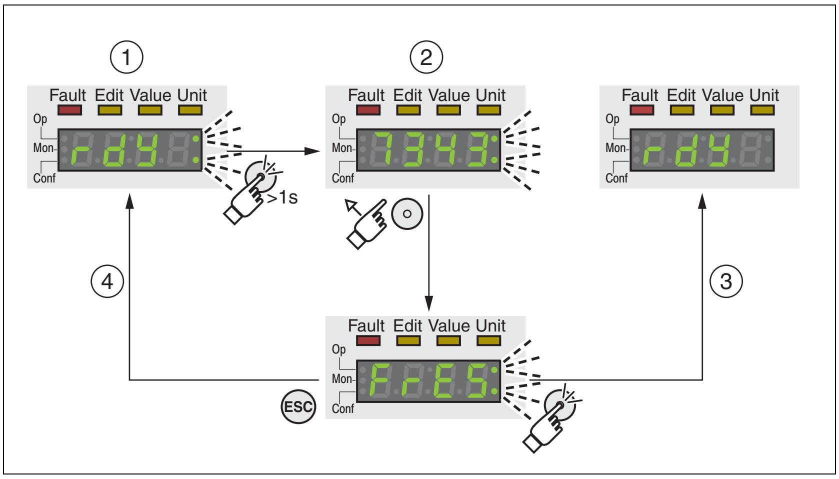

Figure 10.2 Acknowledging warnings via the integrated HMI

(1) HMI displays a warning
(2) Error number is displayed
(3) Resetting the warning
(4) Canceling, the warning remains in the memory

See chapter 10.4.1 "Table of warnings and errors by range", page 304, for detailed information on the warnings.

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10.3.2 Reading and acknowledging errors

Procedure for reading and acknowledging errors via the integrated HMI:

■ The LED "Fault" is on. The 7-segment display alternately shows FLt and an error number. An error of error classes 2 to 4 has occurred.

▶ Remedy the cause of the error.

▶ Press the navigation button.

◁ The 7-segment display shows FrES.

▶ Press the navigation button to acknowledge the error.

◁ The product switches to operating state **4** Ready To Switch On.

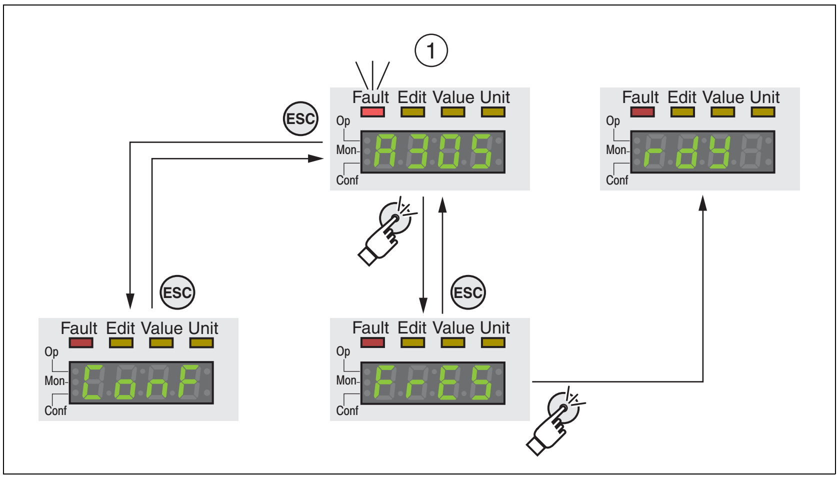

Figure 10.3 Acknowledging errors via the integrated HMI

(1) HMI displays an error with error number

The meanings of the error numbers can be determined using the table in chapter 10.4.1 "Table of warnings and errors by range", page 304.

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10.3.3 Acknowledging a motor change

Procedure for acknowledging a motor change via the integrated HMI:

■ The 7-segment display shows Mot.

▶ Press the navigation button.

◁ The 7-segment display shows SAVE.

▶ Press the navigation button to save the new motor parameters to the EEPROM.

◁ The product switches to operating state **4** Ready To Switch On.

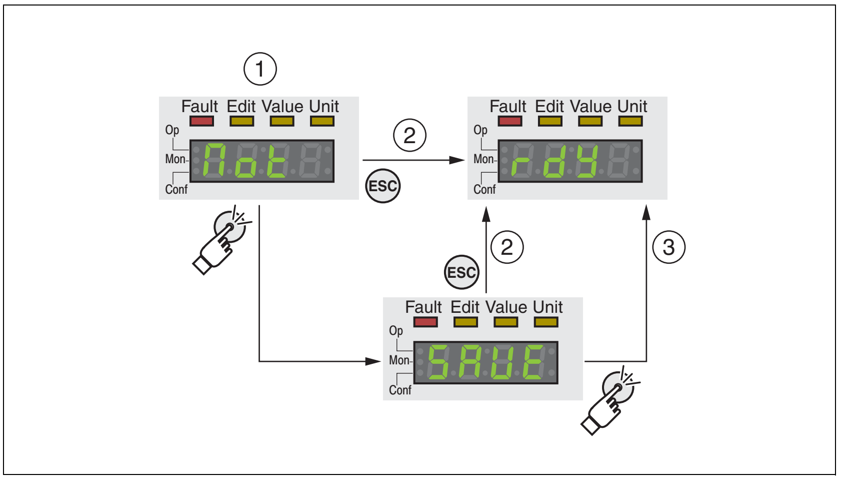

Figure 10.4 Acknowledging a motor change via the integrated HMI

(1) HMI displays that a replacement of a motor has been detected.
(2) Canceling the saving process
(3) Saving the new motor data and switching to operating state **4** Ready To Switch On.

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10.4 Troubleshooting

10.4.1 Table of warnings and errors by range

The table below summarizes the error numbers classified by range.

Error number	**Range**
E 1xxx	General
E 2xxx	Overcurrent
E 3xxx	Voltage
E 4xxx	Temperature
E 5xxx	Hardware
E 6xxx	Software
E 7xxx	Interface, wiring
E Axxx	Motor movement
E Bxxx	Communication

Error number not listed

If the error number is not listed in the table below, the firmware version may be newer than the version of the manual or there may be a system error.

▶ Verify that you use the correct manual ("About this manual")

▶ Verify that the wiring is EMC-compliant (5.1 "Electromagnetic compatibility, EMC")

▶ Contact technical support (13.1 "Service address")

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List of error numbers The table below provides an overview of the error numbers.

Error number	Error class	Description	Cause	Correctives
E 1100	-	Parameter out of permissible range	The value entered was outside of the permissible value range for this parameter.	The entered value must be within the permissible value range.
E 1101	-	Parameter does not exist	Error signaled by parameter management: Parameter (index) does not exist.	Select a different parameter (index).
E 1102	-	Parameter does not exist	Error signaled by parameter management: Parameter (subindex) does not exist.	Select a different parameter (subindex).
E 1103	-	Parameter write not permissible (READ only)	Write access to read only parameter.	Write only to parameters that are not read-only.
E 1104	-	Write access denied (no access authorization)	Parameter only accessible at expert level.	The write access level expert is required.
E 1106	-	Command not allowed while power stage is active	Command not allowed while the power stage is enabled (operating state Operation Enabled or Quick Stop Active).	Disable the power stage and repeat the command.
E 1107	-	Access via other interface blocked	Access occupied by another channel (for example: Commissioning software is active and fieldbus access was tried at the same time).	Check the channel that blocks the access.
E 110B	3	Configuration error (additional info=Modbus register address) Parameter `_SigLatched` Bit 30	Error detected during parameter check (for example, reference velocity value for operating mode Profile Position is greater than maximum allowed velocity of drive).	Value in additional error information shows the Modbus register address of the parameter where the initialization error was detected.
E 110D	1	Basic configuration of drive required after factory setting	The "First Setup" (FSU) was not run at all or not completed.	Perform a First Setup.
E 110E	-	Parameter changed that requires a restart of the drive	Only displayed by the commissioning software. A parameter modification requires the drive to be switched off and on.	Restart the drive to activate the parameter functionality. See the chapter Parameters for the parameter that requires a restart of the drive.
E 1110	-	Unknown file ID for upload or download	The specific type of device does not support this kind of file.	Verify that you have the correct device type or the correct configuration file.
E 1112	-	Locking of configuration denied	An external tool has tried to lock the configuration of the drive for upload or download. This may not work because another tool had already locked the configuration of the drive or the drive is in an operating state that does not allow locking.	
E 1114	4	Configuration download aborted Parameter `_SigLatched` Bit 5	During a configuration download, a communication error or an error in the external tool occurred. The configuration was only partially transferred to the drive and might be inconsistent now.	Switch the drive off/on and retry to download the configuration or reset the drive parameters to their factory settings.

Error number	Error class	Description	Cause	Correctives
E 1118	-	Configuration data incompatible with device	The configuration data contains data from a different device.	Check device type including type of power stage.
E 111B	4	Configuration download error (additional info=Modbus register address)	During a configuration download, one or more configuration values have not been accepted by the drive.	Check whether the configuration file is valid and matches the type and version of the drive. The value in the additional error info shows the Modbus register address of the parameter where the initialization error was detected.
E 111C	1	Not possible to initialize recalculation for scaling	A parameter could not be initialized.	The address of the parameter that caused the error can be read via the parameter _PAR_ScalingError.
E 111D	3	Original state of a parameter after error during recalculation of parameters with user-defined units cannot be restored.	The drive contained an invalid configuration before the recalculation was started. An error occurred during the recalculation.	Switch the drive off and on again. This may help you to identify the affected parameter(s). Change the parameters as required. Verify that the parameter configuration is valid before starting the recalculation procedure.
E 111F	1	Recalculation not possible.	Invalid scaling factor.	Check whether you really want the selected scaling factor. Try a different scaling factor. Before triggering scaling, reset the parameters with user-defined units.
E 1120	1	Recalculation for scaling not possible	A parameter could not be recalculated.	The address of the parameter that caused the error can be read via the parameter _PAR_ScalingError.
E 1121	-	Incorrect sequence of steps for scaling (fieldbus)	The recalculation has been started prior to the initialization.	The recalculation must be started after the initialization.
E 1122	-	Recalculation for scaling not possible	Recalculation for scaling is already running.	Wait for the running recalculation for scaling to finish.
E 1123	-	Parameter cannot be changed	Recalculation for scaling is running.	Wait for the running recalculation for scaling to finish.
E 1124	1	Timeout during recalculation for scaling	The time between the initialization of the recalculation and the start of the recalculation has been exceeded (30 seconds).	Recalculation must be started within 30 seconds after initialization.
E 1125	1	Scaling not possible	The scaling factors for position, velocity or acceleration/deceleration are beyond internal calculation limits.	Retry with different scaling factors.
E 1300	3	Safety function STO activated (STO_A, STO_B) Parameter `_SigLatched` Bit 10	The safety function STO was activated in the operating state Operation Enabled.	Check the wiring of the inputs of the STO safety function and reset the error.
E 1301	4	STO_A and STO_B different level Parameter `_SigLatched` Bit 11	The levels of the inputs STO_A and STO_B were different for more than 1 second.	The drive has to be switched off and the reason fixed (for example, check whether EMERGENCY STOP is active) before it is switched on.

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Error number	Error class	Description	Cause	Correctives
E 1302	0	Safety function STO activated (STO_A, STO_B) Parameter `_WarnLatched` Bit 10	STO safety function was activated while the power stage was disabled.	The warning is automatically reset once the STO safety function is deactivated.
E 1310	2	Reference signal frequency too high Parameter `_SigLatched` Bit 28	The frequency of the pulse signal (A/B, Pulse/Direction, CW/CCW) is higher than the allowed value.	Adapt the output pulse frequency of the controller to fit the input specification of the drive. Also adapt the gear ratio in the operating mode Electronic Gear to the application requirements (position accuracy and velocity).
E 1311	-	The selected signal input function or signal output function cannot be configured	The selected signal input function or signal output function cannot be used in the selected operating mode.	Select another function or change the operating mode.
E 1312	-	Limit switch or reference switch signal not defined for signal input function	Reference movements require limit switches. These limit switches are not assigned to inputs.	Assign the signal input functions Positive Limit Switch, Negative Limit Switch and Reference Switch.
E 1313	-	Configured debounce time not possible for this signal input function	The signal input function does not support the selected debounce time.	Set the debounce time to a valid value.
E 1314	4	At least two inputs have the same signal input function.	At least two inputs are configured with the same signal input function.	Reconfigure the inputs.
E 1315	0	Frequency of reference value signal is too high (warning). Parameter `_WarnLatched` Bit 28	The frequency of the pulse signal (A/B, Pulse/Direction, CW/CCW) exceeds the specified working range. Received pulses may be lost.	Adapt the output pulse frequency of the controller to fit the input specification of the drive. Also adapt the gear ratio in the operating mode Electronic Gear to the application requirements (position accuracy and velocity).
E 1316	1	Position capture via signal input currently not possible Parameter `_SigLatched` Bit 28	Position capture is already being used.	
E 1317	0	Interference at PTI input Parameter `_WarnLatched` Bit 28	Interfering pulses or impermissible edge transitions (A and B signal simultaneously) have been detected.	Check cable specifications, shielding and EMC.
E 160C	1	Autotuning: Moment of inertia outside permissible range	The load inertia is too high.	Verify that the system can easily be moved. Check the load. Use a differently rated drive.
E 160F	1	Autotuning: Power stage cannot be enabled	Autotuning was not started in the operating state Ready To Switch On.	Start Autotuning when the drive is in the operating state Ready To Switch On.
E 1610	1	Autotuning: Processing stopped	Autotuning process stopped by user command or by drive error (see additional error message in error memory, for example, DC bus undervoltage, limit switches triggered)	Fix the cause of the stop and restart Autotuning.

Error number	Error class	Description	Cause	Correctives
E 1611	1	System error: Autotuning internal write access	HALT is active and an Autotuning parameter is written. Occurs when Autotuning is started.	
E 1613	1	Autotuning: Maximum permissible movement range exceeded Parameter `_SigLatched` Bit 2	The motor exceeded the adjusted movement range during Autotuning.	Increase the movement range value or disable range monitoring by setting AT_DIS = 0.
E 1614	-	Autotuning: Already active	Autotuning has been started twice simultaneously or an Autotuning parameter is modified during Autotuning (parameter AT_dis and AT_dir).	Wait for Autotuning to finish before restarting Autotuning.
E 1615	-	Autotuning: This parameter cannot be changed while Autotuning is active	Parameter AT_gain or AT_J are written during Autotuning.	Wait for Autotuning to finish before changing the parameter.
E 1617	1	Autotuning: Friction torque or load torque too great	The current limit has been reached (parameter CTRL_I_max).	Verify that the system can easily be moved. Check the load. Use a differently rated drive.
E 1618	1	Autotuning: Optimization aborted	The internal Autotuning sequence has not been finished (following error?).	Note the additional information provided in the error memory.
E 1619	-	Autotuning: The velocity jump height in parameter AT_n_ref is too small	Parameter AT_n_ref < 2 * AT_n_tolerance. Checked only once at the first velocity jump.	Modify the parameter AT_n_ref or AT_n_tolerance to meet the desired condition.
E 1620	1	Autotuning: Load torque too high	Product rating is not suitable for the machine load. Detected machine inertia is too high compared to the inertia of the motor.	Reduce load, check rating.
E 1622	-	Autotuning: Not possible to perform Autotuning	Autotuning can only be performed if no operating mode is active.	Terminate the active operating mode or disable the power stage.
E 1623	1	Autotuning: HALT request has stopped the autotuning process	Autotuning can only be performed if no operating mode is active.	Terminate the active operating mode or disable the power stage.
E 1A01	3	Motor has been changed Parameter `_SigLatched` Bit 16	Detected motor type is different from previously detected motor.	Confirm the motor change.
E 1B04	2	Resolution of the encoder simulation too high Parameter `_SigLatched` Bit 30	Parameter CTRL_v_max too small or resolution of the encoder simulation too high.	Reduce the resolution of the encoder simulation or the maximum velocity in parameter CTRL_v_max.
E 1B0C	3	Actual motor velocity too high.		
E 2300	3	Power stage overcurrent Parameter `_SigLatched` Bit 27	Motor short circuit and disabling of the power stage. Motor phases are inverted.	Check the motor power connection.

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Error number	Error class	Description	Cause	Correctives
E 2301	3	Braking resistor overcurrent Parameter `_SigLatched` Bit 27	Braking resistor short circuit.	If you use the internal braking resistor, please contact Technical Support. If you use an external braking resistor, check the wiring and the rating of the braking resistor.
E 3100	par.	Mains power supply: Missing mains phase(s) or wrong mains voltage Parameter `_SigLatched` Bit 15	Missing phase(s) for more than 50ms. Mains voltage is too low. Mains frequency is out of range. Mains voltage and parameter setting of MON_MainsVolt do not match (for example, mains voltage is 230V and MON_MainsVolt is set to 115V).	Verify that the values of the mains power supply network comply with the technical data. Check the settings of the parameter for reduced mains voltage.
E 3200	3	DC bus overvoltage Parameter `_SigLatched` Bit 14	Excessive regeneration during braking.	Check deceleration ramp, check rating of drive and braking resistor.
E 3201	3	DC bus undervoltage (shutdown threshold) Parameter `_SigLatched` Bit 13	Power supply loss, poor power supply.	Check mains supply.
E 3202	2	DC bus undervoltage (Quick Stop threshold) Parameter `_SigLatched` Bit 13	Power supply loss, poor power supply.	Check mains supply.
E 3206	0	DC bus undervoltage (warning) Parameter `_WarnLatched` Bit 13	Power supply loss, poor/incorrect power supply.	Check mains supply.
E 3300	0	Maximum motor voltage is too low for the power stage used	The maximum motor voltage M_U_max is too low. The power stage supply voltage and the maximum motor voltage do not match.	Use a motor with a higher maximum voltage M_U_max. If this warning is ignored, the motor may be damaged.
E 4100	3	Power stage overtemperature Parameter `_SigLatched` Bit 18	Transistors overtemperature: Ambient temperature is too high, fan is inoperative, dust.	Check the fan, improve the heat dissipation in the cabinet.
E 4101	0	Warning power stage overtemperature Parameter `_WarnLatched` Bit 18	Transistors overtemperature: Ambient temperature is too high, fan is inoperative, dust.	Check the fan, improve the heat dissipation in the cabinet.
E 4102	0	Power stage overload (I2t) Parameter `_WarnLatched` Bit 30	The current has exceeded the nominal value for an extended period of time.	Check rating, reduce cycle time.
E 4200	3	Device overtemperature Parameter `_SigLatched` Bit 18	Board overtemperature: Ambient temperature is too high.	Check fan, improve the heat dissipation in the cabinet.

Error number	Error class	Description	Cause	Correctives
E 4300	2	Motor overtemperature Parameter _SigLatched Bit 17	Ambient temperature is too high. Duty cycle is too high. Motor not properly mounted (thermal isolation). Motor overload (power losses too high).	Check motor installation: The heat must be dissipated via the mounting surface. Reduce ambient temperature. Provide ventilation.
E 4301	0	Warning motor overtemperature Parameter _WarnLatched Bit 17	Resistance of thermal sensor is too high; overload, ambient temp (see I2t).	Check motor installation: The heat must be dissipated via the mounting surface.
E 4302	0	Motor overload (I2t) Parameter _WarnLatched Bit 31	The current has exceeded the nominal value for an extended period of time.	Verify that the system can easily be moved. Check the load. Use a differently sized motor, if necessary.
E 4402	0	Warning: Braking resistor overload (I2t > 75%) Parameter _WarnLatched Bit 29	The braking resistor has been switched on for such a long period of time that 75% of its overload capability have been exceeded.	The regeneration energy is too high. Possible causes: The external loads are too high, the motor velocity is too high, the deceleration is too fast.
E 4403	par.	Braking resistor overload (I2t > 100%)	The braking resistor is switched on for an excessively long period of time.	The regeneration energy is too high. Possible causes: The external loads are too high, the motor velocity is too high, the deceleration is too fast.
E 5101	0	Modbus power supply missing		
E 5102	4	Motor encoder supply voltage Parameter _SigLatched Bit 16	Encoder power supply is not within permissible range of 8V to 12V; there may be a hardware problem.	Replace the device. Contact Technical Support.
E 5200	4	Error at connection to motor encoder Parameter _SigLatched Bit 16	Incorrect encoder cable or cable not connected, EMC.	Check the cable connection and the shield.
E 5201	4	Errors in motor encoder communication Parameter _SigLatched Bit 16	Encoder error message: Communication error detected by the encoder itself.	Check the cable connection and the shield.
E 5202	4	Motor encoder is not supported Parameter _SigLatched Bit 16	Incompatible encoder type is connected.	Use genuine accessories.
E 5204	3	Connection to motor encoder lost Parameter _SigLatched Bit 16	Encoder cable problems (communication has been interrupted).	Check the cable connection.
E 5206	0	Communication error in encoder Parameter _WarnLatched Bit 16	Communication disturbed, EMC.	Check the connection, check the shielding on the EMC plate.
E 5207	1	Function is not supported	The current hardware revision does not support the function.	

Error number	Error class	Description	Cause	Correctives
E 5302	4	The motor requires a PWM frequency (16kHz) which the power stage does not support.	The connected motor only works with a PWM frequency of 16 kHz (motor nameplate entry). However, the power stage does not support this PWM frequency.	Use a motor that works with a PWM frequency of 8 kHz.
E 544C	4	System error: EEPROM is write-protected Parameter `_SigLatched` Bit 29		
E 5451	0	System error: No memory card available Parameter `_WarnLatched` Bit 20		
E 5452	2	System error: Data on memory card and device do not match Parameter `_SigLatched` Bit 20	Different type of device. Different type of power stage. Data on memory card does not match firmware version of device.	
E 5453	2	System error: Incompatible data on the memory card Parameter `_SigLatched` Bit 20		
E 5455	2	System error: Memory card not formatted Parameter `_SigLatched` Bit 20		Update memory card via HMI command "dtoc" (drive-to-card).
E 5456	1	System error: Memory card is write-protected Parameter `_SigLatched` Bit 20	The memory card has been write-protected.	Remove memory card or disable write protection via HMI.
E 5506	1	Error during write access to safety module via fieldbus (additional info = detailed error number)		
E 5600	3	Motor connection phase error Parameter `_SigLatched` Bit 26	Missing motor phase.	Check connection of motor phases.
E 5603	3	Commutation error Parameter `_SigLatched` Bit 26	Wiring error of motor cable. Encoder signals are lost or subject to interference. The load torque is greater than the motor torque. The encoder EEPROM contains incorrect data (encoder phase offset is incorrect). Motor is not adjusted.	Check motor phases, check encoder wiring. Check and improve EMC situation, check grounding and shielding. Resize the motor so it can withstand the load torque. Check the motor data. Contact Technical Support.
E 610D	-	Error in selection parameter	Wrong parameter value selected.	Check the value to be written.
E 610E	4	System error: 24 VDC below undervoltage threshold for shutdown		

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Error number	Error class	Description	Cause	Correctives
E 7100	4	System error: Invalid power stage data Parameter `_SigLatched` Bit 30	Power stage data stored in device is corrupt (wrong CRC), error in internal memory data.	Contact technical support or replace the device.
E 7111	-	Parameter cannot be changed because the external braking resistor is active.	An attempt is made to change one of the parameters RESext_ton, RESext_P or RESext_R even though the external braking resistor is active.	Verify that the external braking resistor is not active if one of the parameters RESext_ton, RESext_P or RESext_R has to be changed.
E 7112	2	No external braking resistor connected	External braking resistor activated (Parameter RESint_ext), but no external resistor is detected.	Check wiring of the external braking resistor. Verify correct resistance.
E 7120	4	Invalid motor data Parameter `_SigLatched` Bit 16	Motor data is corrupt (wrong CRC).	Contact technical support or replace the motor.
E 7121	2	System error: Errors in motor encoder communication Parameter `_SigLatched` Bit 16	EMC, detailed information is included in the error memory that contains the error code of the encoder.	Contact technical support.
E 7122	4	Invalid motor data Parameter `_SigLatched` Bit 30	Motor data stored in motor encoder is corrupt, error in internal memory data.	Contact technical support or replace the motor.
E 7124	4	System error: Motor encoder inoperative Parameter `_SigLatched` Bit 16	Encoder signals internal error.	Contact technical support or replace the motor.
E 712D	4	Electronic motor nameplate not found Parameter `_SigLatched` Bit 16	Motor data is corrupt (wrong CRC). Motor without electronic motor nameplate (for example, SER motor)	Contact technical support or replace the motor.
E 7134	4	Incomplete motor configuration Parameter `_SigLatched` Bit 16		
E 7137	4	Error during the internal conversion of the motor configuration Parameter `_SigLatched` Bit 16		
E 7138	4	Parameter of the motor configuration out of permissible range Parameter `_SigLatched` Bit 16		
E 7139	0	Encoder offset: Data segment in encoder is corrupt.		

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Error number	Error class	Description	Cause	Correctives
E 713A	3	Adjustment value of the encoder of the third party motor has not yet been determined. Parameter _SigLatched Bit 16		
E 7321	3	Timeout reading the absolute position from the encoder Parameter _SigLatched Bit 16	Communication channel (Hiperface) to encoder is subject to interference or motor encoder is inoperative.	Check wiring and shielding of encoder cable or replace motor.
E 7328	4	Motor encoder: Position evaluation error Parameter _SigLatched Bit 16	Position evaluation problem detected by encoder.	Contact technical support or replace the motor.
E 7329	0	Motor encoder: Warning Parameter _WarnLatched Bit 16	EMC, encoder signals internal warning.	Contact technical support or replace the motor.
E 7340	3	Reading of absolute position aborted, number of unsuccessful consecutive attempts too great Parameter _SigLatched Bit 16	Communication channel (Hiperface) to encoder is subject to interference. Encoder (in motor) is inoperative.	Check wiring and shielding of encoder cable, replace motor.
E 7341	0	Encoder temperature warning level reached Parameter _WarnLatched Bit 16	The maximum permissible duty cycle is exceeded. The motor was not mounted properly, for example, it is thermally isolated. The motor is blocked or damaged so that more current is used than under normal conditions. The ambient temperature is too high.	Reduce the duty cycle, for example, reduce acceleration. Supply additional cooling, for example, use a fan. Mount the motor in such a way as to increase thermal conductivity. Use a differently rated drive or motor. Replace the motor if it is damaged.
E 7342	2	Encoder temperature limit reached Parameter _SigLatched Bit 16	The maximum permissible duty cycle is exceeded. The motor was not mounted properly, for example, it is thermally isolated. The motor is blocked or damaged so that more current is used than under normal conditions. The ambient temperature is too high.	Reduce the duty cycle, for example, reduce acceleration. Supply additional cooling, for example, use a fan. Mount the motor in such a way as to increase thermal conductivity. Use a differently rated drive or motor. Replace the motor if it is damaged.
E 7343	0	Warning: Absolute position is different from incremental position Parameter _WarnLatched Bit 16	- Encoder is subject to EMC interference. - Motor encoder is inoperative.	Check wiring and shielding of encoder cable, replace motor.
E 7344	3	Absolute position is different from incremental position Parameter _SigLatched Bit 16	- Encoder is subject to EMC interference. - Motor encoder is inoperative.	Check wiring and shielding of encoder cable, replace motor.

Error number	Error class	Description	Cause	Correctives
E 734C	3	Error with quasi absolute position Parameter _SigLatched Bit 16	The motor shaft may have been moved while the drive was shut down. A quasi absolute position has been detected that is not within the permissible motor shaft deviation range.	If the quasi absolute function is active, only shut down the drive if the motor is at a standstill and do not move the motor shaft when the drive is off.
E 734D	0	Index pulse is not available for the encoder Parameter _WarnLatched Bit 16		
E 7500	0	RS485/Modbus: Overrun error Parameter _WarnLatched Bit 5	EMC; cabling problem.	Check cables.
E 7501	0	RS485/Modbus: Framing error Parameter _WarnLatched Bit 5	EMC; cabling problem.	Check cables.
E 7502	0	RS485/Modbus: Parity error Parameter _WarnLatched Bit 5	EMC; cabling problem.	Check cables.
E 7503	0	RS485/Modbus: Receive error Parameter _WarnLatched Bit 5	EMC; cabling problem.	Check cables.
E 7623	0	Absolute encoder signal is not available Parameter _WarnLatched Bit 22	There is no encoder available at the input specified via the parameter ENC_abs_source.	Check wiring, check encoder. Change the value of the parameter ENC_abs_source.
E 7625	0	Not possible to set the absolute position for encoder 1. Parameter _WarnLatched Bit 22	There is no encoder connected to the input for encoder 1.	Connect an encoder to the input for encoder 1 before trying to set the absolute position directly via ENC1_abs_pos.
E 8291	0	CANopen: TxPdo could not be processed Parameter _WarnLatched Bit 21		
E 8292	0	CANopen: TxPdo could not be processed Parameter _WarnLatched Bit 21		
E 8293	0	CANopen: TxPdo could not be processed Parameter _WarnLatched Bit 21		
E A060	2	Calculated velocity too high for operating mode Electronic Gear Parameter _SigLatched Bit 4	Gear ratio or reference velocity value too high	Reduce the gear ratio or reference velocity.
E A061	2	Position change in reference value for operating mode Electronic Gear too high Parameter _SigLatched Bit 4	Position reference change is too high. Error at signal input for reference value.	Reduce the resolution of the master. Check signal input for reference signal.

Error number	Error class	Description	Cause	Correctives
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 operating state Quick Stop Active	Error with error class 1 occurred. Drive stopped with Quick Stop command.	
E A302	1	Stop by positive limit switch Parameter `_SigLatched` Bit 1	The positive limit switch was activated because movement range was exceeded, misoperation of limit switch or signal disturbance.	Check application. Check limit switch function and connection.
E A303	1	Stop by negative limit switch Parameter `_SigLatched` Bit 1	The negative limit switch was activated because movement range was exceeded, misoperation of limit switch or signal disturbance.	Check application. Check limit switch function and connection.
E A305	-	Power stage cannot be enabled in the current operating state	Fieldbus: An attempt was made to enable the power stage in the operating state Not Ready To Switch On.	Refer to the state diagram.
E A306	1	Stop by user-initiated software stop Parameter `_SigLatched` Bit 3	Drive is in operating state Quick Stop Active due to a software stop request. The activation of a new operating mode is not possible, the error code is sent as the response to the activation command.	Clear break condition with command Fault Reset.
E A307	-	Interruption by internal software stop	In the operating mode Homing and Jog, the movement is internally interrupted by 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.	Clear break condition with command Fault Reset.
E A308	-	Drive is in operating state Fault or Fault Reaction Active	Error with error class 2 or higher occurred.	Check error code (HMI or commissioning software), remove error condition and clear error with command Fault Reset.
E A309	-	Drive not in operating state Operation Enabled	A command was sent that requires the drive to be in the operating state Operation Enabled was sent (for example, a command to change the operating mode).	Set drive to operating state Operation Enabled and repeat the command.
E A310	-	Power stage not enabled	Command cannot be used because the power stage is not enabled (operating state Operation Enabled or Quick Stop Active).	Set drive to an operating state in which the power stage is enabled, refer to the state diagram.
E A313	-	Position overtraveled, reference point is therefore no longer defined (ref_ok=0)	The movement range limits were exceeded which resulted in a loss of the reference point. An absolute movement cannot be made before a new reference point is defined.	Define a new reference point by means of the operating mode Homing.

Error number	Error class	Description	Cause	Correctives
E A314	-	No reference point	Command needs a defined reference point (ref_ok=1).	Define a new reference point by means of the operating mode Homing.
E A315	-	Homing active	Command cannot be used while the operating mode Homing is active.	Wait until reference movement is finished.
E A317	-	Motor is not at a standstill	Command sent which is not allowed when the motor is not at a standstill. For example: - Change of software limit switches - Change of handling of monitoring signals - Setting of reference point - Teach in of data set	Wait until the motor has come to a standstill (x_end = 1).
E A318	-	Operating mode active (x_end=0)	Activation of a new operating mode is not possible while the current operating mode is still active.	Wait until the command in the operating mode has finished (x_end=1) or terminate current operating mode with HALT command.
E A319	1	Manual tuning/Autotuning: Movement out of permissible range Parameter `_SigLatched` Bit 2	The movement exceeds the parameterized maximum permissible movement range.	Check permissible movement range value and time interval.
E A31A	-	Manual tuning/Autotuning: Amplitude/offset too high	Amplitude plus offset for tuning exceed internal velocity or current limitation.	Choose lower amplitude and offset values.
E A31B	-	HALT requested	Command not allowed while a HALT is requested.	Clear HALT request and repeat command.
E A31C	-	Invalid position setting with software limit switch	Value for negative (positive) software limit switch is greater (less) than value for positive (negative) software limit switch.	Set correct position values.
E A31D	-	Velocity range exceeded (parameter CTRL_v_max, M_n_max)	The velocity was set to a value greater than the maximum permissible velocity in parameter CTRL_v_max or M_n_max, whichever is lower.	If the value of parameter M_n_max is greater than the value of parameter CTRL_v_max, increase the value of parameter CTRL_v_max or reduce the velocity value.
E A31E	1	Stop by positive software limit switch Parameter `_SigLatched` Bit 2	Not possible to execute command because positive software limit switch was overtraveled.	Return to the permissible range.
E A31F	1	Stop by negative software limit switch Parameter `_SigLatched` Bit 2	Not possible to execute command because negative software limit switch was overtraveled.	Return to the permissible range.
E A320	par.	Following error Parameter `_SigLatched` Bit 8	External load or acceleration are too high.	Reduce external load or acceleration. Use a differently rated drive, if necessary. Error response can be adjusted via parameter ErrorResp_p_dif.

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Error number	Error class	Description	Cause	Correctives
E A324	1	Error during homing (additional info = detailed error number) Parameter `_SigLatched` Bit 4	Homing movement was stopped by an error, the detailed reason is indicated by the additional info in the error buffer.	Possible sub error codes: E A325, E A326, E A327, E A328 or E A329.
E A325	1	Limit switch to be approached not enabled Parameter `_SigLatched` Bit 4	Homing to positive limit switch or negative limit switch is disabled.	Enable limit switch via 'IOsigLimP' or 'IOsigLimN'.
E A326	1	Reference switch not found between positive limit switch and negative limit switch Parameter `_SigLatched` Bit 4	Reference switch inoperative or not correctly connected.	Check the function and wiring of the reference switch.
E A329	1	More than one signal positive limit switch/negative limit switch/reference switch signal active Parameter `_SigLatched` Bit 4	Reference switch or limit switch not connected correctly or supply voltage for switches too low.	Check the wiring and 24VDC supply voltage.
E A32A	1	Positive limit switch triggered with negative direction of movement Parameter `_SigLatched` Bit 4	Start reference movement with negative direction (for example reference movement to negative limit switch) and activate the positive limit switch (switch in opposite direction of movement).	Check correct connection and function of limit switch. Activate a jog movement with negative movement (target limit switch must be connected to the negative limit switch).
E A32B	1	Negative limit switch triggered with positive direction of movement Parameter `_SigLatched` Bit 4	Start reference movement with positive direction (for example reference movement to positive limit switch) and activate the negative limit switch (switch in opposite direction of movement).	Check correct connection and function of limit switch. Activate a jog movement with positive movement (target limit switch must be connected to the positive limit switch).
E A32C	1	Reference switch error (switch signal briefly enabled or switch overtraveled) Parameter `_SigLatched` Bit 4	Switch signal disturbance. Motor subjected to vibration or shock when stopped after activation of the switch signal.	Check supply voltage, cabling and function of switch. Check motor reaction after stopping and optimize controller settings.
E A32D	1	Positive limit switch error (switch signal briefly enabled or switch overtraveled) Parameter `_SigLatched` Bit 4	Switch signal disturbance. Motor subjected to vibration or shock when stopped after activation of the switch signal.	Check supply voltage, cabling and function of switch. Check motor reaction after stopping and optimize controller settings.
E A32E	1	Negative limit switch error (switch signal briefly enabled or switch overtraveled) Parameter `_SigLatched` Bit 4	Switch signal disturbance. Motor subjected to vibration or shock when stopped after activation of the switch signal.	Check supply voltage, cabling and function of switch. Check motor reaction after stopping and optimize controller settings.
E A330	0	Reference movement to index pulse cannot be reproduced. Index pulse is too close to the switch Parameter `_WarnLatched` Bit 4	The position difference between the index pulse and the switching point is insufficient.	Increase the distance between the index pulse and the switching point. If possible, the distance between the index pulse and the switching point should be a half motor revolution.
E A332	1	Jog error (additional info = detailed error number) Parameter `_SigLatched` Bit 4	Jog movement was stopped by error.	For additional info, check the detailed error number in the error buffer.

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Error number	Error class	Description	Cause	Correctives
E A334	2	Timeout Standstill Window monitoring	Position deviation after movement greater than standstill window. This may have been caused by an external load.	Check load. Check settings for standstill window (parameter MON_p_win, MON_p_winTime and MON_p_winTout). Optimize controller settings.
E A337	0	Operating mode cannot be continued Parameter `_WarnLatched` Bit 4	Continuation of interrupted movement in operating mode Profile Position is not possible because another operating mode had been active in the meantime. In the operating mode Motion Sequence, continuation is not possible if a motion blend was interrupted.	Restart the operating mode.
E A33A	0	Reference point is not defined (ref_ok=0) Parameter `_WarnLatched` Bit 4	No reference point defined by means of operating mode Homing. Reference position lost because the movement range has been left. Motor does not have an absolute encoder.	Use operating mode Homing to define a reference point. Use a motor with an absolute encoder.
E A33D	0	Motion blend is already active Parameter `_WarnLatched` Bit 4	Change of motion blend during the current motion blend (end position of motion blend not yet reached)	Wait for the motion blend to complete before setting the next position.
E A33E	0	No movement activated Parameter `_WarnLatched` Bit 4	Activation of a motion blend without movement.	Start a movement before the motion blend is activated.
E A33F	0	Position of motion blend movement not in the range of the active movement Parameter `_WarnLatched` Bit 4	The position of the motion blend is outside of the current movement range.	Check the position of the motion blend and the current movement range.
E A341	0	Position of motion blend has already been passed Parameter `_WarnLatched` Bit 4	The current movement has passed beyond the position of the motion blend.	
E A342	1	Target velocity was not reached at motion blend position. Parameter `_SigLatched` Bit 4	The position of the motion blend was overtraveled, the target velocity was not reached.	Reduce the ramp velocity so that the target velocity is reached at the position of the motion blend.
E A347	0	Threshold for position deviation warning reached Parameter `_WarnLatched` Bit 8	External load or acceleration are too high.	Reduce external load or acceleration. Threshold can be adjusted via the parameter MON_p_dif_warn.
E A348	1	No analog reference value source selected Parameter `_SigLatched` Bit 4	No analog reference value selected	Select an analog reference value source.
E A34D	-	The function is not possible when Modulo is active.	The function cannot be executed when Modulo is active.	Deactivate Modulo to use the function.

Error number	Error class	Description	Cause	Correctives
E A34E	-	Target value for absolute movement not possible with defined modulo range and modulo handling.	If parameter 'MOD_Absolute' is set to: Shortest Distance: Target value is not in defined modulo range. Positive Direction: Target value is less than parameter 'MOD_Min'. Negative Direction: Target value is greater than parameter 'MOD_Max'.	Set a correct target value for absolute movement.
E A34F	-	Target position outside of modulo range. Corresponding movement within range performed instead.	The current setting of parameter 'MOD_AbsMultiRng' only allows for a movement within the modulo range.	Change the parameter 'MOD_AbsMultiRng' to allow for movements beyond the modulo range.
E A350	1	Change for jerk filter input position too great Parameter `_SigLatched` Bit 4	Operating mode Electronic Gear with processing method 'Position synchronization with compensation movement' has been activated which resulted in a position change greater than 0.25 revolutions.	Deactivate jerk filter processing for Electronic Gear or use processing method 'Position synchronization without compensation movement'.
E A351	1	Function cannot be executed with the current position scaling factor Parameter `_SigLatched` Bit 4	The positions scaling factor is set to a value less than 1rev/ 131072usr_p, which is less than the internal resolution. In the operating mode Cyclic Synchronous Position, the resolution is not set to 1rev/ 131072usr_p.	Use a different position scaling factor or deactivate the selected function.
E A355	1	Error during relative movement after capture (additional info = detailed error number) Parameter `_SigLatched` Bit 4	Movement was stopped by error.	Check the error memory or the parameter _LastError_Qual for additional information.
E A356	0	Function Relative Movement After Capture not assigned to a digital input.		Assign the function Relative Movement After Capture to a digital input.
E A357	-	Braking procedure still active	Command is not allowed when a braking procedure is active.	Wait until motor has come to a complete standstill.
E A358	1	Target position overtraveled with function Relative Movement After Capture Parameter `_SigLatched` Bit 4	Stopping distance too small or velocity too high at the point in time of the capture event.	Reduce the velocity.
E A359	0	Request cannot be processed since the relative movement after capture is still active		
E B100	0	RS485/Modbus: Unknown service Parameter `_WarnLatched` Bit 5	Unsupported Modbus service was received.	Check application on the Modbus master.
E B200	0	RS485/Modbus: Protocol error Parameter `_WarnLatched` Bit 5	Logical protocol error: Wrong length or unsupported subfunction.	Check application on the Modbus master.

Error number	Error class	Description	Cause	Correctives
E B201	2	RS485/Modbus: Node Guarding error Parameter `_SigLatched` Bit 5	Connection monitoring (parameter MBnode_guard) is <>0ms and a nodeguard event was detected.	Check application on the Modbus master or change value (set to 0ms or increase the parameter MBnode_guard monitoring time).
E B202	0	RS485/Modbus: Node Guarding warning Parameter `_WarnLatched` Bit 5	Connection monitoring (parameter MBnode_guard) is <>0ms and a Node Guarding event was detected.	Check application on the Modbus master or change value (set to 0ms or increase the parameter MBnode_guard monitoring time).

11 Parameters

11

This chapter provides an overview of the parameters which can be used for operating the product.

In addition, special parameters for communication via the fieldbus are described in the corresponding fieldbus manual.

⚠ WARNING

UNINTENDED BEHAVIOR CAUSED BY PARAMETERS

The behavior of the drive system is governed by numerous parameters. Unsuitable parameter values can trigger unintended movements or signals or deactivate monitoring functions.

- Never change a parameter unless you understand its meaning.
- Only start the system if there are no persons or obstructions in the hazardous area.
- When commissioning, carefully run tests for all operating states and potential fault situations.

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

11.1 Representation of the parameters

The way parameters are shown provides information required for unique identification, the default values and the properties of a parameter.

Structure of the parameter representation:

Parameter name **HMI menu** **HMI name**	**Description**	**Unit** **Minimum value** **Factory setting** **Maximum value**	**Data type** **R/W** **Persistent** **Expert**	**Parameter address via fieldbus**
Example_Name ConF → inF- Prn	Short description (cross reference) Selection values **1 / Selection value 1 / AbC1**: Explanation 1 **2 / Selection value 2 / AbC2**: Explanation 2 Description and details	A_{pk} 0.00 3.00 300.00	UINT32 R/W per. -	Fieldbus 1234:5_h

Parameter name The parameter name uniquely identifies a parameter.

HMI menu HMI menu shows the sequence of menus and commands to access the parameter via the HMI.

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Description Short description (cross reference)
The short description contains information on the parameter and a cross reference to the page that describes the use of the parameter.

Selection values
In the case of parameters which offer a selection of settings, the value to be entered via the fieldbus and the designation of the value for input via the commissioning software and the HMI are specified.
1 = Value via fieldbus
Selection value1 = Selection value via commissioning software
AbC1 = Selection value via HMI

Further description and details
Provides further information on the parameter.

Unit The unit of the value.

Minimum value The minimum value which can be entered.

Factory setting Factory settings when the product is shipped

Maximum value The maximum value which can be entered.

Data type If the minimum and the maximum values are not explicitly indicated, the valid range of values is determined by the data type.

Data type	Byte	Minumum value	Maximum value
INT8	1 Byte / 8 Bit	-128	127
UINT8	1 Byte / 8 Bit	0	255
INT16	2 Byte / 16 Bit	-32768	32767
UINT16	2 Byte / 16 Bit	0	65535
INT32	4 Byte / 32 Bit	-2147483648	2147483647
UINT32	4 Byte / 32 Bit	0	4294967295

R/W Indicates read and/or write values

"R/" values can only be read
"R/W" values can be read and written.

Persistent "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 a value is entered via the HMI, the device stores the value of the parameter automatically each time it is changed.

When changing a value via commissioning software or fieldbus, the user must explicitly store the changed value in the persistent memory.

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11.1.1 Decimal numbers for fieldbus

Entering values

Please note that parameter values are entered via the fieldbus without a decimal point. All decimal places must be entered.

Input examples:

Value	Commissioning software	Fieldbus
20	20	20
5.0	5.0	50
23.57	23.57	2357
1.000	1.000	1000

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11.2 List of parameters

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`_AccessInfo`	Current access channel Low byte: Value 0: Used by channel in high byte Value 1: Exclusively used by channel in high byte High byte: Current assignment of access channel Value 0: Reserved Value 1: I/O Value 2: HMI Value 3: Modbus RS485 Value 4: Fieldbus main channel Values 5 ... 12: Modbus TCP, CANopen second SDO or Profibus master class 2 Values 13 ... 28: Ethenet/IP explicit channels	- - - -	UINT16 R/- - -	Modbus 280
`_AI1_act` Mon AnA1	Analog 1: Value of input voltage (154)	mV -10000 - 10000	INT16 R/- - -	Modbus 2306
`_AI2_act` Mon AnA2	Analog 2: Value of input voltage (154)	mV -10000 - 10000	INT16 R/- - -	Modbus 2314
`_AT_J`	Moment of inertia of the complete system (174) Is automatically calculated during Autotuning. In increments of 0.1 kg cm^2.	kg cm^2 0.1 0.1 6553.5	UINT16 R/- per. -	Modbus 12056
`_AT_M_friction`	Friction torque of the system (173) Is determined during Autotuning. In increments of 0.01 A_{rms}.	A_{rms} - - -	UINT16 R/- - -	Modbus 12046
`_AT_M_load`	Constant load torque (173) Is determined during Autotuning. In increments of 0.01 A_{rms}.	A_{rms} - - -	INT16 R/- - -	Modbus 12048
`_AT_progress`	Progress of Autotuning (173)	% 0 0 100	UINT16 R/- - -	Modbus 12054
`_AT_state`	Autotuning status (173) Bit assignments: Bits 0 ... 10: Last processing step Bit 13: auto_tune_process Bit 14: auto_tune_end Bit 15: auto_tune_err	- - - -	UINT16 R/- - -	Modbus 12036

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_Cond_State4	Conditions for transition to operating state Ready To Switch On Signal state: 0: Condition not met 1: Condition met Bit 0: DC bus or mains voltage Bit 1: Inputs for safety function Bit 2: No configuration download ongoing Bit 3: Velocity greater than limit value Bit 4: Absolut position has been set Bit 5: Holding brake not manually released	- - - -	UINT16 R/- - -	Modbus 7244
_CTRL_ActParSet	Active controller parameter set (150) Value 1: Controller parameter set 1 is active Value 2: Controller parameter set 2 is active A controller parameter set is active after the time for the parameter switching (CTRL_ParChgTime) has elapsed.	- - - -	UINT16 R/- - -	Modbus 4398
_CTRL_KPid	Current controller d component P gain This value is calculated on the basis of the motor parameters. In increments of 0.1 V/A.	V/A 0.5 - 1270.0	UINT16 R/- per. -	Modbus 4354
_CTRL_KPiq	Current controller q component P gain This value is calculated on the basis of the motor parameters. In increments of 0.1 V/A.	V/A 0.5 - 1270.0	UINT16 R/- per. -	Modbus 4358
_CTRL_TNid	Current controller d component integral action time This value is calculated on the basis of the motor parameters. In increments of 0.01 ms.	ms 0.13 - 327.67	UINT16 R/- per. -	Modbus 4356
_CTRL_TNiq	Current controller q component integral action time This value is calculated on the basis of the motor parameters. In increments of 0.01 ms.	ms 0.13 - 327.67	UINT16 R/- per. -	Modbus 4360
_DCOMstatus	DriveCom status word Bits 0 ... 3: Status bits Bit 4: Voltage enabled Bits 5 ... 6: Status bits Bit 7: Warning Bit 8: HALT request active Bit 9: Remote Bit 10: Target reached Bit 11: Internal limit Bit 12: Operating mode-specific Bit 13: x_err Bit 14: x_end Bit 15: ref_ok The meaning of bit 11 can be set via the parameter DS402intLim.	- - - -	UINT16 R/- - -	Modbus 6916

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`_DEV_T_current` Mon tdEU	Current device temperature	°C - - -	INT16 R/- - -	Modbus 7204
`_DPL_BitShiftRefA16`	Bit shift for RefA16 for Drive Profile Lexium Velocity scaling may lead to values that cannot be represented as 16 bit values. If RefA16 is used, this parameter indicates the number of bits by which the value is shifted so that transmission is possible. The master must consider this value prior to transmission and shift the bits to the right accordingly. The number of bits is recalculated each time the power stage is enabled. Changed settings become active immediately.	- 0 0 12	UINT16 R/- - -	Modbus 6922
`_DPL_driveInput`	Drive Profile Lexium driveInput	- - - -	UINT16 R/- - -	Modbus 6992
`_DPL_driveStat`	Drive Profile Lexium driveStat	- - - -	UINT16 R/- - -	Modbus 6986
`_DPL_mfStat`	Drive Profile Lexium mfStat	- - - -	UINT16 R/- - -	Modbus 6988
`_DPL_motionStat`	Drive Profile Lexium motionStat	- - - -	UINT16 R/- - -	Modbus 6990
`_I_act` Mon iAct	Total motor current In increments of 0.01 A_{rms}.	A_{rms} - - -	INT16 R/- - -	Modbus 7686
`_Id_act_rms`	Actual motor current (d component, field weakening) In increments of 0.01 A_{rms}.	A_{rms} - - -	INT16 R/- - -	Modbus 7684
`_Id_ref_rms`	Reference motor current (d component, field weakening) In increments of 0.01 A_{rms}.	A_{rms} - - -	INT16 R/- - -	Modbus 7714

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`_Imax_act`	Currently effective current limitation Value of the currently effective current limitation. This is one of the following values (whichever is lowest): - CTRL_I_max (only during normal operation) - LIM_I_maxQSTP (only during Quick Stop) - LIM_I_maxHalt (only during Halt) - Current limitation via analog input - Current limitation via digital input - M_I_max (only if motor is connected) - PA_I_max Limitations caused by I2t monitoring are also taken into account. In increments of 0.01 A_{rms}.	A_{rms} - - -	UINT16 R/- - -	Modbus 7248
`_Imax_system`	Current limitation of the system This parameter specifies the maximum system current. This is the lower value of the maximum motor current and the maximum power stage current. If no motor is connected, only the maximum power stage current is considered in this parameter. In increments of 0.01 A_{rms}.	A_{rms} - - -	UINT16 R/- - -	Modbus 7246
`_InvalidParam`	Modbus address of parameter with invalid value In case of a configuration error, the Modbus address of the parameter with an invalid value is indicated here.	- - 0 -	UINT16 R/- - -	Modbus 7180
`_IO_act`	Physical status of the digital inputs and outputs Low byte: Bit 0: DI0 Bit 1: DI1 Bit 2: DI2 Bit 3: DI3 Bit 4: DI4 Bit 5: DI5 High byte: Bit 8: DQ0 Bit 9: DQ1 Bit 10: DQ2 Bit 11: DQ3 Bit 12: DQ4	- - - -	UINT16 R/- - -	Modbus 2050
`_IO_DI_act` Mon diMo	Status of digital inputs (231) Bit assignments: Bit 0: DI0 Bit 1: DI1 Bit 2: DI2 Bit 3: DI3 Bit 4: DI4 Bit 5: DI5	- - - -	UINT16 R/- - -	Modbus 2078

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`_IO_DQ_act` MOn doMo	Status of digital outputs (231) Bit assignments: Bit 0: DQ0 Bit 1: DQ1 Bit 2: DQ2 Bit 3: DQ3 Bit 4: DQ4	- - - -	UINT16 R/- - -	Modbus 2080
`_IO_STO_act` MOn StO	Status of the inputs for the safety function STO Coding of the individual signals: Bit 0: STO_A Bit 1: STO_B	- - - -	UINT16 R/- - -	Modbus 2124
`_Iq_act_rms` MOn qAct	Actual motor current (q component, generating torque) In increments of 0.01 A_{rms}.	A_{rms} - - -	INT16 R/- - -	Modbus 7682
`_Iq_ref_rms` MOn qrEF	Reference motor current (q component, generating torque) In increments of 0.01 A_{rms}.	A_{rms} - - -	INT16 R/- - -	Modbus 7712
`_LastError` MOn LFLt	Error causing a stop (error classes 1 to 4) Number of the current error. Any consequtive errors do not overwrite this error number. Example: If a limit switch error reaction caused an overvoltage error, this parameter would contain the number of the limit switch error. Exception: Errors of error class 4 overwrite existing entries.	- - 0 -	UINT16 R/- - -	Modbus 7178
`_LastWarning` MOn LWrn	Number of last warning (error class 0) Number of the most recent warning. If the warning becomes inactive again, the number is memorized until the next fault reset. Value 0: No warning occurred	- - - -	UINT16 R/- - -	Modbus 7186
`_M_BRK_T_apply`	Holding brake application time	ms - - -	UINT16 R/- - -	Modbus 3394
`_M_BRK_T_release`	Holding brake release time	ms - - -	UINT16 R/- - -	Modbus 3396

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_M_Encoder ConF → inF- SEnS	Encoder type of motor **1 / SinCos With HiFa / SChi** : SinCos with Hiperface **2 / SinCos Without HiFa / SCoh**: SinCos without Hiperface **3 / SinCos With Hall / SChA**: SinCos with Hall **4 / SinCos With EnDat / SCEn**: SinCos with EnDat **5 / EnDat Without SinCos / EndA**: EnDat without SinCos **6 / Resolver / rESo**: Resolver **7 / Hall / hALL**: Hall (not supported yet) **8 / BISS / biSS**: BISS High byte: Value 0: Rotary encoder Value 1: Linear encoder	- - - -	UINT16 R/- - -	Modbus 3334
_M_HoldingBrake	Holding brake identification Value 0: Motor without holding brake Value 1: Motor with holding brake	- - - -	UINT16 R/- - -	Modbus 3392
_M_I_0	Continuous stall current of motor In increments of 0.01 A_{rms}.	A_{rms} - - -	UINT16 R/- - -	Modbus 3366
_M_I_max ConF → inF- MiMA	Maximum current of motor In increments of 0.01 A_{rms}.	A_{rms} - - -	UINT16 R/- - -	Modbus 3340
_M_I_nom ConF → inF- Mino	Nominal current of motor In increments of 0.01 A_{rms}.	A_{rms} - - -	UINT16 R/- - -	Modbus 3342
_M_I2t	Maximum permissible time for maximum current of motor	ms - - -	UINT16 R/- - -	Modbus 3362
_M_Jrot	Moment of inertia of motor Units: Rotary motors: $kgcm^2$ Linear motors: kg In increments of 0.001 motor_f.	motor_f - - -	UINT32 R/- - -	Modbus 3352
_M_kE	Voltage constant kE of motor Voltage constant in Vrms at 1000 min^{-1}. Units: Rotary motors: Vrms/min^{-1} Linear motors: Vrms/(m/s) In increments of 0.1 motor_u.	motor_u - - -	UINT32 R/- - -	Modbus 3350
_M_L_d	Inductance d component of motor In increments of 0.01 mH.	mH - - -	UINT16 R/- - -	Modbus 3358

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_M_L_q	Inductance q component of motor In increments of 0.01 mH.	mH - - -	UINT16 R/- - -	Modbus 3356
_M_load Mon LdFM	Current load of motor (287)	% - - -	INT16 R/- - -	Modbus 7220
_M_M_0	Continuous stall torque of motor A value of 100 % in operating mode Profile Torque corresponds to this parameter. Units: Rotary motors: Ncm Linear motors: N	motor_m - - -	UINT16 R/- - -	Modbus 3372
_M_M_max	Maximum torque of motor In increments of 0.1 Nm.	Nm - - -	UINT16 R/- - -	Modbus 3346
_M_M_nom	Nominal torque/force of motor Units: Rotary motors: Ncm Linear motors: N	motor_m - - -	UINT16 R/- - -	Modbus 3344
_M_maxoverload	Maximum value of overload of motor (288) Maximum overload of motor during the last 10 seconds.	% - - -	INT16 R/- - -	Modbus 7222
_M_n_max ConF → inF- MnMA	Maximum permissible speed of rotation/ velocity of motor Units: Rotary motors: min^{-1} Linear motors: mm/s	motor_v - - -	UINT16 R/- - -	Modbus 3336
_M_n_nom	Nominal speed of rotation/velocity of motor Units: Rotary motors: min^{-1} Linear motors: mm/s	motor_v - - -	UINT16 R/- - -	Modbus 3338
_M_overload	Current overload of motor (I2t) (287)	% - - -	INT16 R/- - -	Modbus 7218
_M_Polepair	Number of pole pairs of motor	- - - -	UINT16 R/- - -	Modbus 3368
_M_PolePairPitch	Pole pair pitch of motor In increments of 0.01 mm.	mm - - -	UINT16 R/- - -	Modbus 3398
_M_R_UV	Winding resistance of motor In increments of 0.01 Ω.	Ω - - -	UINT16 R/- - -	Modbus 3354

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_M_T_current	Current motor temperature (286) No meaningful indication possible for switching temperature sensors (see parameter M_TempType for temperature sensor type)	°C - - -	INT16 R/- - -	Modbus 7202
_M_T_max	Maximum temperature of motor (286)	°C - - -	INT16 R/- - -	Modbus 3360
_M_Type ConF → inF- MtYP	Motor type Value 0: No motor selected Value >0: Connected motor type	- - - -	UINT32 R/- - -	Modbus 3332
_M_U_max	Maximum voltage of motor In increments of 0.1 V.	V - - -	UINT16 R/- - -	Modbus 3378
_M_U_nom	Nominal voltage of motor In increments of 0.1 V.	V - - -	UINT16 R/- - -	Modbus 3348
_n_act_ENC1	Actual speed of rotation of encoder 1	min^{-1} - - -	INT16 R/- - -	Modbus 7760
_n_act Mon nAct	Actual speed of rotation	min^{-1} - - -	INT16 R/- - -	Modbus 7696
_n_ref Mon nrEF	Reference speed of rotation	min^{-1} - - -	INT16 R/- - -	Modbus 7694
_OpHours Mon oPh	Operating hours counter	s - - -	UINT32 R/- - -	Modbus 7188
_p_absENC	Absolute position with reference to the encoder range (164) This value corresponds to the modulo position of the absolute encoder range. The value is no longer valid if the gear ratio of machine encoder and motor encoder is changed. A restart is required in such a case.	usr_p - - -	UINT32 R/- - -	Modbus 7710
_p_absmodulo	Absolute position with reference to internal resolution in internal units This value is based on encoder raw position with reference to internal resolution (131072 Inc).	Inc - - -	UINT32 R/- - -	Modbus 7708
_p_act_ENC1_int	Actual position of encoder 1 in internal units	Inc - - -	INT32 R/- - -	Modbus 7756

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`_p_act_ENC1`	Actual position of encoder 1	usr_p - - -	INT32 R/- - -	Modbus 7758
`_p_act_int`	Actual position in internal units NOTE: The actual position is not valid until the absolute position of the encoder at the specified interface has been determined. In the case of invalid absolute encoder position: _WarnLatched _WarnActive Bit 13: Absolute motor position not yet captured	Inc - - -	INT32 R/- - -	Modbus 7700
`_p_act`	Actual position NOTE: The actual position is not valid until the absolute position of the encoder at the specified interface has been determined. In the case of invalid absolute encoder position: _WarnLatched _WarnActive Bit 13: Absolute motor position not yet captured	usr_p - - -	INT32 R/- - -	Modbus 7706
`_p_addGEAR`	Initial position electronic gear When Electronic Gear is inactive, the reference position for the position controller can be determined here. This position is set when Electronic Gear is activated with the selection of 'Synchronization with compensation movement'.	Inc - - -	INT32 R/- - -	Modbus 7942
`_p_dif_load_peak_usr`	Maximum value of the load-dependent position deviation (275) This parameter contains the maximum load-dependent position deviation reached so far. A write access resets this value. Available as of firmware version V01.05 Changed settings become active immediately.	usr_p 0 - 2147483647	INT32 R/W - -	Modbus 7722
`_p_dif_load_peak`	Maximum value of the load-dependent position deviation (275) This parameter contains the maximum load-dependent position deviation reached so far. A write access resets this value. The parameter _p_dif_load_peak_usr allows you to enter the value in user-defined units.. In increments of 0.0001 revolution. Changed settings become active immediately.	revolution 0.0000 - 429496.7295	UINT32 R/W - -	Modbus 7734

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`_p_dif_load_usr`	Current load-dependent position deviation between reference and actual position (274) The load-dependent position deviation is the difference between the reference position and the actual position caused by the load. This value is used for following error monitoring. Available as of firmware version V01.05	usr_p -2147483648 - 2147483647	INT32 R/- - -	Modbus 7724
`_p_dif_load`	Current load-dependent position deviation between reference and actual position (274) The load-dependent position deviation is the difference between the reference position and the actual position caused by the load. This value is used for following error monitoring. The parameter _p_dif_load_usr allows you to enter the value in user-defined units. In increments of 0.0001 revolution.	revolution -214748.3648 - 214748.3647	INT32 R/- - -	Modbus 7736
`_p_dif_usr`	Current position deviation including dynamic position deviation Position deviation is the difference between reference position and actual position. The current position deviation consists of the load-dependent position deviation and the dynamic position deviation. Available as of firmware version V01.05	usr_p -2147483648 - 2147483647	INT32 R/- - -	Modbus 7720
`_p_dif`	Current position deviation including dynamic position deviation Position deviation is the difference between reference position and actual position. The current position deviation consists of the load-dependent position deviation and the dynamic position deviation. The parameter _p_dif_usr allows you to enter the value in user-defined units. In increments of 0.0001 revolution.	revolution -214748.3648 - 214748.3647	INT32 R/- - -	Modbus 7716
`_p_PTI_act`	Actual position at PTI interface Counted position increments at position interface PTI.	Inc -2147483648 - 2147483647	INT32 R/- - -	Modbus 2058
`_p_ref_int`	Reference position in internal units Value corresponds to the reference position of the position controller.	Inc - - -	INT32 R/- - -	Modbus 7698
`_p_ref`	Reference position Value corresponds to the reference position of the position controller.	usr_p - - -	INT32 R/- - -	Modbus 7704

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`_PAR_ScalingError`	Additional information on error during recalculation Coding: Bits 0 ... 15: Address of the parameter that caused the error Bits 16 ... 31: Reserved Changed settings become active immediately.	- - - -	UINT32 R/- - -	Modbus 1068
`_PAR_ScalingState`	Status of recalculation of the parameters with user-defined units **0 / Recalculation active**: Recalculation active **1 / reserved (1)**: reserved (1) **2 / Recalculation finished - no error**: Recalculation finished, no error **3 / Error during recalculation**: Error during recalculation **4 / Initialization successful**: Initialization successful **5 / reserved (5)**: reserved (5) **6 / reserved (6)**: reserved (6) **7 / reserved (7)**: reserved (7) Status of recalculation of the parameters with user-defined units which are recalculated with a changed scaling factor. Changed settings become active immediately.	- 0 2 7	UINT16 R/- - -	Modbus 1066
`_Power_mean`	Mean output power	W - - -	INT16 R/- - -	Modbus 7196
`_pref_acc`	Acceleration of reference value for profile generator Sign according to the changed speed value: Increased speed: Positive sign Reduced speed: Negative sign	usr_a - - -	INT32 R/- - -	Modbus 7954
`_pref_v`	Velocity of reference value for profile generator	usr_v - - -	INT32 R/- - -	Modbus 7950
`_prgNoDEV` ConF → inF- Prn	Firmware program number Example: PR0912.00 The value is provided as a decimal value: 91200	- - - -	UINT32 R/- - -	Modbus 258
`_prgRevDEV` ConF → inF- Prr	Firmware revision number The version format is XX.YY.ZZ. Part XX.YY is contained in parameter _prgVerDEV. Part ZZ is used for quality evolution and contained in this parameter. Example: V01.23.45 The value is provided as a decimal value: 45	- - - -	UINT16 R/- - -	Modbus 264

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_prgVerDEV ConF → inF- PrU	Firmware version number The version format is XX.YY.ZZ. Part XX.YY is contained in this parameter. Part ZZ is contained in parameter _prgRevDEV. Example: V01.23.45 The value is provided as a decimal value: 123	- - - -	UINT16 R/- - -	Modbus 260
_PS_I_max ConF → inF- PiMA	Maximum current of power stage In increments of 0.01 A_{rms}.	A_{rms} - - -	UINT16 R/- per. -	Modbus 4100
_PS_I_nom ConF → inF- Pino	Nominal current of power stage In increments of 0.01 A_{rms}.	A_{rms} - - -	UINT16 R/- per. -	Modbus 4098
_PS_load Mon LdFP	Current load of power stage (287)	% - - -	INT16 R/- - -	Modbus 7214
_PS_maxoverload	Maximum value of overload of power stage (287) Maximum overload of power stage during the last 10 seconds.	% - - -	INT16 R/- - -	Modbus 7216
_PS_overload_I2t	Current overload of power stage (I2t)	% - - -	INT16 R/- - -	Modbus 7212
_PS_T_current Mon tPS	Current power stage temperature (286)	°C - - -	INT16 R/- - -	Modbus 7200
_PS_T_max	Maximum power stage temperature (286)	°C - - -	INT16 R/- per. -	Modbus 4110
_PS_T_warn	Temperature warning threshold of power stage (286)	°C - - -	INT16 R/- per. -	Modbus 4108
_PS_U_maxDC	Maximum permissible DC bus voltage In increments of 0.1 V.	V - - -	UINT16 R/- per. -	Modbus 4102
_PS_U_minDC	Minimum permissible DC bus voltage In increments of 0.1 V.	V - - -	UINT16 R/- per. -	Modbus 4104
_PS_U_minStopDC	DC bus voltage low threshold for Quick Stop If this threshold is reached, the drive performs a Quick Stop. In increments of 0.1 V.	V - - -	UINT16 R/- per. -	Modbus 4116

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`_RAMP_p_act`	Actual position of profile generator	usr_p - - -	INT32 R/- - -	Modbus 7940
`_RAMP_p_target`	Target position of profile generator Absolute position value of the profile generator, calculated on the basis of the relative and absolute position values received.	usr_p - - -	INT32 R/- - -	Modbus 7938
`_RAMP_v_act`	Actual velocity of profile generator	usr_v - - -	INT32 R/- - -	Modbus 7948
`_RAMP_v_target`	Target velocity of profile generator	usr_v - - -	INT32 R/- - -	Modbus 7946
`_RES_load` Mon LdFb	Current load of braking resistor (287) Monitoring of internal and external braking resistor depending on parameter RESint_ext.	% - - -	INT16 R/- - -	Modbus 7208
`_RES_maxoverload`	Maximum value of overload of braking resistor (288) Maximum overload of braking resistor during the last 10 seconds.	% - - -	INT16 R/- - -	Modbus 7210
`_RES_overload`	Current overload of braking resistor (I2t) (288) Monitoring of internal and external braking resistor depending on parameter RESint_ext.	% - - -	INT16 R/- - -	Modbus 7206
`_RESint_P`	Nominal power of internal braking resistor	W - - -	UINT16 R/- per. -	Modbus 4114
`_RESint_R`	Resistance value of internal braking resistor In increments of 0.01 Ω.	Ω - - -	UINT16 R/- per. -	Modbus 4112
`_ScalePOSmax`	Maximum user-defined value for positions This value depends on ScalePOSdenom and ScalePOSnum.	usr_p - - -	INT32 R/- - -	Modbus 7956
`_ScaleRAMPmax`	Maximum user-defined value for accelerations and decelerations This value depends on ScaleRAMPdenom and ScaleRAMPnum.	usr_a - - -	INT32 R/- - -	Modbus 7960
`_ScaleVELmax`	Maximum user-defined value for velocities This value depends on ScaleVELdenom and ScaleVELnum.	usr_v - - -	INT32 R/- - -	Modbus 7958

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_tq_act	Actual torque value 100.0 % correspond to the continuous stall torque _M_M_0. In increments of 0.1 %.	% - - -	INT16 R/- - -	Modbus 7752
_Ud_ref	Reference motor voltage d component In increments of 0.1 V.	V - - -	INT16 R/- - -	Modbus 7690
_UDC_act Mon udcA	Voltage at DC bus In increments of 0.1 V.	V - - -	UINT16 R/- - -	Modbus 7198
_Udq_ref	Total motor voltage (vector sum d components and q components) Square root of ($\_Uq\_ref^2$ + $\_Ud\_ref^2$) In increments of 0.1 V.	V - - -	INT16 R/- - -	Modbus 7692
_Uq_ref	Reference motor voltage q component In increments of 0.1 V.	V - - -	INT16 R/- - -	Modbus 7688
_v_act_ENC1	Actual velocity of encoder 1	usr_v - - -	INT32 R/- - -	Modbus 7762
_v_act Mon VAct	Actual velocity	usr_v - - -	INT32 R/- - -	Modbus 7744
_v_PTI_act	Actual velocity at PTI interface Determined pulse frequency at position interface PTI.	Inc/s -2147483648 - 2147483647	INT32 R/- - -	Modbus 2060
_v_ref Mon VrEF	Reference velocity	usr_v - - -	INT32 R/- - -	Modbus 7742
_Vmax_act	Currently effective velocity limitation Value of the currently effective velocity limitation. This is one of the following values (whichever is lowest): - CTRL_v_max - M_n_max (only if motor is connected) - Velocity limitation via analog input - Velocity limitation via digital input	usr_v - - -	UINT32 R/- - -	Modbus 7250
_VoltUtil Mon udcr	Degree of utilization of DC bus voltage With a value of 100%, the drive operates at the voltage limit.	% - - -	INT16 R/- - -	Modbus 7718

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
AbsHomeRequest	Absolute positioning only after homing **0**: No **1**: Yes This parameter has no function if the parameter 'PP_ModeRangeLim' is set to '1' which allows overtraveling of the movement range (ref_ok is set to 0 when the range is overtraveled). Changed settings become active immediately.	- 0 0 1	UINT16 R/W per. -	Modbus 1580
AccessLock	Locking other access channels (192) Value 0: Allow control via other access channels Value 1: Lock control via other access channels Example: The access channel is used by the fieldbus. In this case, control via the commissioning software or the HMI is not possible. The access channel can only be locked after the current operating mode has terminated. Changed settings become active immediately.	- 0 0 1	UINT16 R/W - -	Modbus 284
AI1_I_max ConF → i-o- A1iL	Analog 1: Limitation of current at 10 V (269) In increments of 0.01 A_{rms}. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	A_{rms} 0.00 3.00 300.00	UINT16 R/W per. -	Modbus 2334
AI1_M_scale ConF → i-o- A1iS	Analog 1: Target torque at 10 V in operating mode Profile Torque (218) 100.0 % correspond to the continuous stall torque _M_M_0. By using a negative sign, you can invert the evaluation of the analog signal. In increments of 0.1 %. Changed settings become active immediately.	% -3000.0 100.0 3000.0	INT16 R/W per. -	Modbus 2340

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`AI1_mode` ConF → i-o- A1Mo	Analog 1: Type of usage (218) **0 / None / nonE**: No function **1 / Target Velocity / SPdS**: Target velocity for the velocity controller **2 / Target Torque / trqS**: Target torque for the current controller **3 / Velocity Limitation / LSPd**: Limitation of the velocity for the velocity controller **4 / Torque Limitation / Ltrq**: Limitation of the torque for the current controller Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 1 4	UINT16 R/W per. -	Modbus 2332
`AI1_offset` ConF → i-o- A1oF	Analog 1: Offset voltage (154) The analog input AI1 is corrected/offset by the offset value. If you have defined a zero voltage window, this window is effective in the zero pass range of the corrected analog input AI1. Changed settings become active immediately.	mV -5000 0 5000	INT16 R/W per. -	Modbus 2326
`AI1_Tau` ConF → i-o- A1Ft	Analog 1: Filter time constant First-order low pass (PT1) filter time constant for analog input AI1. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 0.00 327.67	UINT16 R/W per. -	Modbus 2308
`AI1_v_max`	Analog 1: Limitation of velocity at 10 V (267) The maximum velocity is limited to the setting in CTRL_v_max. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	usr_v 1 3000 2147483647	UINT32 R/W per. -	Modbus 2336
`AI1_v_scale`	Analog 1: Target velocity at 10 V in operating mode Profile Velocity (223) The maximum velocity is limited to the setting in CTRL_v_max. By using a negative sign, you can invert the evaluation of the analog signal. Changed settings become active immediately.	usr_v -2147483648 6000 2147483647	INT32 R/W per. -	Modbus 2338
`AI1_win` ConF → i-o- A1Wn	Analog 1: Zero voltage window (155) Threshold value up to which an input voltage value is treated as 0 V. Example: Value 20, this means a range from -20 ... +20 mV is treated as 0 mV. Changed settings become active immediately.	mV 0 0 1000	UINT16 R/W per. -	Modbus 2322

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
AI2_I_max ConF → i-o- A2iL	Analog 2: Limitation of current at 10 V (269) In increments of 0.01 A_{rms}. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	A_{rms} 0.00 3.00 300.00	UINT16 R/W per. -	Modbus 2344
AI2_M_scale ConF → i-o- A2iS	Analog 2: Target torque at 10 V in operating mode Profile Torque (219) 100.0 % correspond to the continuous stall torque _M_M_0. By using a negative sign, you can invert the evaluation of the analog signal. In increments of 0.1 %. Changed settings become active immediately.	% -3000.0 100.0 3000.0	INT16 R/W per. -	Modbus 2350
AI2_mode ConF → i-o- A2Mo	Analog 2: Type of usage (218) **0 / None / nonE**: No function **1 / Target Velocity / SPdS**: Target velocity for the velocity controller **2 / Target Torque / trqS**: Target torque for the current controller **3 / Velocity Limitation / LSPd**: Limitation of the velocity for the velocity controller **4 / Torque Limitation / Ltrq**: Limitation of the torque for the current controller Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 0 4	UINT16 R/W per. -	Modbus 2342
AI2_offset ConF → i-o- A2oF	Analog 2: Offset voltage (154) The analog input AI2 is corrected/offset by the offset value. If you have defined a zero voltage window, this window is effective in the zero pass range of the corrected analog input AI2. Changed settings become active immediately.	mV -5000 0 5000	INT16 R/W per. -	Modbus 2328
AI2_Tau ConF → i-o- A2Ft	Analog 2: Filter time constant First-order low pass (PT1) filter time constant for analog input AI2. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 0.00 327.67	UINT16 R/W per. -	Modbus 2352

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
AI2_v_max	Analog 2: Limitation of velocity at 10 V (267) The maximum velocity is limited to the setting in CTRL_v_max. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	usr_v 1 3000 2147483647	UINT32 R/W per. -	Modbus 2346
AI2_v_scale	Analog 2: Target velocity at 10 V in operating mode Profile Velocity (224) The maximum velocity is limited to the setting in CTRL_v_max. By using a negative sign, you can invert the evaluation of the analog signal. Changed settings become active immediately.	usr_v -2147483648 6000 2147483647	INT32 R/W per. -	Modbus 2348
AI2_win ConF → i-o- A2Wn	Analog 2: Zero voltage window (155) Threshold value up to which an input voltage value is treated as 0 V. Example: Value 20, this means a range from -20 ... +20 mV is treated as 0 mV. Changed settings become active immediately.	mV 0 0 1000	UINT16 R/W per. -	Modbus 2324
AT_dir oP → tun- StiM	Direction of movement for Autotuning (171) **1 / Positive Negative Home / Pnh**: Positive direction first, then negative direction with return to initial position **2 / Negative Positive Home / nPh**: Negative direction first, then positive direction with return to initial position **3 / Positive Home / P-h**: Positive direction only with return to initial position **4 / Positive / P--**: Positive direction only without return to initial position **5 / Negative Home / n-h**: Negative direction only with return to initial position **6 / Negative / n--**: Negative direction only without return to initial position Changed settings become active the next time the motor moves.	- 1 1 6	UINT16 R/W - -	Modbus 12040

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`AT_dis_usr`	Movement range for Autotuning (171) Range within which the control parameters are automatically optimized. The range is entered with reference to the current position. NOTE: In the case of "Movement in one direction only" (Parameter AT_dir), the specified range is used for each optimization step. The actual movement typically corresponds to 20 times the value, but it is not limited. The minimum value, the factory setting and the maximum value depend on the scaling factor. Available as of firmware version V01.05 Changed settings become active the next time the motor moves.	usr_p 1 32768 2147483647	INT32 R/W - -	Modbus 12068
`AT_dis`	Movement range for Autotuning (172) Range within which the control parameters are automatically optimized. The range is entered with reference to the current position. NOTE: In the case of "Movement in one direction only" (Parameter AT_dir), the specified range is used for each optimization step. The actual movement typically corresponds to 20 times the value, but it is not limited. The parameter AT_dis_usr allows you to enter the value in user-defined units. In increments of 0.1 revolution. Changed settings become active the next time the motor moves.	revolution 1.0 2.0 999.9	UINT32 R/W - -	Modbus 12038
`AT_mechanical`	Type of coupling of the system (172) **1 / Direct Coupling**: Direct coupling **2 / Belt Axis**: Belt axis **3 / Spindle Axis**: Spindle axis Changed settings become active the next time the motor moves.	- 1 2 3	UINT16 R/W - -	Modbus 12060
`AT_n_ref`	Jump of speed of rotation for Autotuning The parameter AT_v_ref allows you to enter the value in user-defined units. Available as of firmware version V01.05 Changed settings become active the next time the motor moves.	min^{-1} 10 100 1000	UINT32 R/W - -	Modbus 12044
`AT_start`	Autotuning start (172) Value 0: Terminate Value 1: Activate EasyTuning Value 2: Activate ComfortTuning Changed settings become active immediately.	- 0 - 2	UINT16 R/W - -	Modbus 12034

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`AT_v_ref`	Jump of velocity for Autotuning The minimum value, the factory setting and the maximum value depend on the scaling factor. Changed settings become active the next time the motor moves.	usr_v 1 100 2147483647	INT32 R/W - -	Modbus 12070
`AT_wait`	Waiting time between Autotuning steps (174) Changed settings become active the next time the motor moves.	ms 300 500 10000	UINT16 R/W - -	Modbus 12050
`BRK_AddT_apply`	Additional time delay for applying the holding brake (160) The overall time delay for applying the holding brake is the time delay from the electronic nameplate of the motor and the additional time delay in this parameter. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	ms 0 0 1000	INT16 R/W per. -	Modbus 1296
`BRK_AddT_release`	Additional time delay for releasing the holding brake (159) The overall time delay for releasing the holding brake is the time delay from the electronic nameplate of the motor and the additional time delay in this parameter. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	ms 0 0 400	INT16 R/W per. -	Modbus 1294
`CLSET_p_DiffWin_usr`	Position deviation for parameter set switching (253) If the position deviation of the position controller is less than the value of this parameter, the controller parameter set 2 is used. Otherwise, controller parameter set 1 is used. The minimum value, the factory setting and the maximum value depend on the scaling factor Changed settings become active immediately.	usr_p 0 164 2147483647	INT32 R/W per. -	Modbus 4426

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CLSET_p_DiffWin	Position deviation for parameter set switching (254) If the position deviation of the position controller is less than the value of this parameter, the controller parameter set 2 is used. Otherwise, controller parameter set 1 is used. The parameter CLSET_p_DiffWin_usr allows you to enter the value in user-defined units. In increments of 0.0001 revolution. Changed settings become active immediately.	revolution 0.0000 0.0100 2.0000	UINT16 R/W per. -	Modbus 4408
CLSET_ParSwiCond	Condition for parameter set switching (253) **0 / None Or Digital Input**: None or digital input function selected **1 / Inside Position Deviation**: Inside position deviation (value definition in parameter CLSET_p_DiffWin) **2 / Below Reference Velocity**: Below reference velocity (value definition in parameter CLSET_v_Threshol) **3 / Below Actual Velocity**: Below actual velocity (value definition in parameter CLSET_v_Threshol) In the case of parameter set switching, the values of the following parameters are changed gradually: - CTRL_KPn - CTRL_TNn - CTRL_KPp - CTRL_TAUnref - CTRL_TAUiref - CTRL_KFPp The following parameters are changed immediately after the time for parameter set switching (CTRL_ParChgTime): - CTRL_Nf1damp - CTRL_Nf1freq - CTRL_Nf1bandw - CTRL_Nf2damp - CTRL_Nf2freq - CTRL_Nf2bandw - CTRL_Osupdamp - CTRL_Osupdelay - CTRL_Kfric Changed settings become active immediately.	- 0 0 3	UINT16 R/W per. -	Modbus 4404

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CLSET_v_Threshol	Velocity threshold for parameter set switching (254) If the reference velocity or the actual velocity are less than the value of this parameter, the controller parameter set 2 is used. Otherwise, controller parameter set 1 is used. Changed settings become active immediately.	usr_v 0 50 2147483647	UINT32 R/W per. -	Modbus 4410
CLSET_winTime	Time window for parameter set switching (254) Value 0: Window monitoring deactivated. Value >0: Window time for the parameters CLSET_v_Threshol and CLSET_p_DiffWin. Changed settings become active immediately.	ms 0 0 1000	UINT16 R/W per. -	Modbus 4406
CTRL_GlobGain oP → tun- GAin	Global gain factor (affects parameter set 1) The global gain factor affects the following parameters of controller parameter set 1: - CTRL_KPn - CTRL_TNn - CTRL_KPp - CTRL_TAUnref The global gain factor is set to 100% - if the controller parameters are set to default - at the end of the Autotuning process - if the controller parameter set 2 is copied to set 1 via the parameter CTRL_ParSetCopy In increments of 0.1 %. Changed settings become active immediately.	% 5.0 100.0 1000.0	UINT16 R/W per. -	Modbus 4394
CTRL_I_max_fw	Maximum current for field weakening (d component) This value is only limited by the minimum/maximum parameter range (no limitation of this value by motor/power stage). The actual field weakening current is the minimum of CTRL_I_max_fw and one half of the lower value of the nominal current of the power stage and the motor. In increments of 0.01 A_{rms}. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	A_{rms} 0.00 0.00 300.00	UINT16 R/W per. expert	Modbus 4382

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL_I_max ConF → drC- iMAX	Current limitation (151) During operation, the actual current limit is one of the following values (whichever is lowest): - CTRL_I_max - M_I_max - PA_I_max - Current limitation via analog input - Current limitation via digital input Limitations caused by I2t monitoring are also taken into account. Default: PA_I_max at 8 kHz PWM frequency and 230/480 V mains voltage In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} 0.00 - 300.00	UINT16 R/W per. -	Modbus 4376
CTRL_KFAcc	Gain acceleration feed forward In increments of 0.1 %. Changed settings become active immediately.	% 0.0 0.0 350.0	UINT16 R/W per. expert	Modbus 4372
CTRL_ParChgTime	Period of time for parameter switching (150) In the case of parameter set switching, the values of the following parameters are changed gradually: - CTRL_KPn - CTRL_TNn - CTRL_KPp - CTRL_TAUnref - CTRL_TAUiref - CTRL_KFPp Such a parameter switching can be caused by - change of the active controller parameter set - change of the global gain - change of any of the parameters listed above - switching off the integral term of the velocity controller Changed settings become active immediately.	ms 0 0 2000	UINT16 R/W per. -	Modbus 4392
CTRL_ParSetCopy	Controller parameter set copying (255) Value 1: Copy controller parameter set 1 to set 2 Value 2: Copy controller parameter set 2 to set 1 If parameter set 2 copied to parameter set 1, the parameter CTRL_GlobGain is set to 100%. Changed settings become active immediately.	- 0.0 - 0.2	UINT16 R/W - -	Modbus 4396

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL_PwrUpParSet	Selection of controller parameter set at power up (250) **0 / Switching Condition**: The switching condition is used for parameter set switching **1 / Parameter Set 1**: Parameter set 1 is used **2 / Parameter Set 2**: Parameter set 2 is used The selected value is also written to CTRL_ParSetSel (non-persistent). Changed settings become active immediately.	- 0 1 2	UINT16 R/W per. -	Modbus 4400
CTRL_SelParSet	Selection of controller parameter set (non-persistent) (150) Coding see parameter: CTRL_PwrUpParSet Changed settings become active immediately.	- 0 1 2	UINT16 R/W - -	Modbus 4402
CTRL_SpdFric	Speed of rotation up to which the friction compensation is linear Changed settings become active immediately.	min^{-1} 0 5 20	UINT32 R/W per. expert	Modbus 4370
CTRL_TAUnact	Filter time constant to smooth velocity of motor The default value is calculated on the basis of the motor data. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 - 30.00	UINT16 R/W per. expert	Modbus 4368
CTRL_v_max ConF → drC- nMAX	Velocity limitation (153) During operation, the actual velocity limit is one of the following values (whichever is lowest): - CTRL_v_max - M_n_max - Velocity limitation via analog input - Velocity limitation via digital input Changed settings become active immediately.	usr_v 1 13200 2147483647	UINT32 R/W per. -	Modbus 4384

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`CTRL_VelObsActiv`	Activation of velocity observer **0 / Velocity Observer Off**: Velocity observer is off **1 / Velocity Observer Passive**: Velocity observer is on, but not used for motor control **2 / Velocity Observer Active**: Velocity observer is on and used for motor control Velocity observer control reduces velocity ripple and enhances controller bandwith. NOTE: It is important to set the correct dynamics and inertia values before activation. Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 0 2	UINT16 R/W per. expert	Modbus 4420
`CTRL_VelObsDyn`	Dynamics of velocity observer Dynamics of the velocity observer. This time constant should be much smaller than that of the velocity controller. In increments of 0.01 ms. Setting can only be changed if power stage is disabled. Changed settings become active immediately.	ms 0.03 0.25 200.00	UINT16 R/W per. expert	Modbus 4422
`CTRL_VelObsInert`	Inertia value for velocity observer System inertia that is used for velocity observer calculations. In the case of autotuning, the value of CTRL_SpdObsInert can be set equal to that of _AT_J. The default value of CTRL_SpdObsInert is the inertia of the mounted motor. Setting can only be changed if power stage is disabled. Changed settings become active immediately.	g cm^2 1 - 2147483648	UINT32 R/W per. expert	Modbus 4424
`CTRL_vPIDDPart`	PID velocity controller: D gain In increments of 0.1 %. Changed settings become active immediately.	% 0.0 0.0 400.0	UINT16 R/W per. expert	Modbus 4364
`CTRL_vPIDDTime`	PID velocity controller: Time constant of D term smoothing filter In increments of 0.01 ms. Changed settings become active immediately.	ms 0.01 0.25 10.00	UINT16 R/W per. expert	Modbus 4362

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL1_KFPp ConF → drC- FPP1	Velocity feed-forward (256) This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.1 %. Changed settings become active immediately.	% 0.0 0.0 200.0	UINT16 R/W per. -	Modbus 4620
CTRL1_Kfric	Friction compensation: Gain (257) In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} 0.00 0.00 10.00	UINT16 R/W per. expert	Modbus 4640
CTRL1_KPn ConF → drC- Pn1	Velocity controller P gain (177) The default value is calculated on the basis of the motor parameters. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.0001 A/min^{-1}. Changed settings become active immediately.	A/min^{-1} 0.0001 - 1.2700	UINT16 R/W per. -	Modbus 4610
CTRL1_KPp ConF → drC- PP1	Position controller P gain (183) The default value is calculated. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.1 1/s. Changed settings become active immediately.	1/s 2.0 - 900.0	UINT16 R/W per. -	Modbus 4614
CTRL1_Nf1bandw	Notch filter 1: Bandwidth (257) Definition of bandwidth: 1 - Fb/F0 In increments of 0.1 %. Changed settings become active immediately.	% 1.0 70.0 90.0	UINT16 R/W per. expert	Modbus 4628
CTRL1_Nf1damp	Notch filter 1: Damping (257) In increments of 0.1 %. Changed settings become active immediately.	% 55.0 90.0 99.0	UINT16 R/W per. expert	Modbus 4624
CTRL1_Nf1freq	Notch filter 1: Frequency (257) The filter is switched off at a value of 15000. In increments of 0.1 Hz. Changed settings become active immediately.	Hz 50.0 1500.0 1500.0	UINT16 R/W per. expert	Modbus 4626
CTRL1_Nf2bandw	Notch filter 2: Bandwidth (257) Definition of bandwidth: 1 - Fb/F0 In increments of 0.1 %. Changed settings become active immediately.	% 1.0 70.0 90.0	UINT16 R/W per. expert	Modbus 4634

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL1_Nf2damp	Notch filter 2: Damping (257) In increments of 0.1 %. Changed settings become active immediately.	% 55.0 90.0 99.0	UINT16 R/W per. expert	Modbus 4630
CTRL1_Nf2freq	Notch filter 2: Frequency (257) The filter is switched off at a value of 15000. In increments of 0.1 Hz. Changed settings become active immediately.	Hz 50.0 1500.0 1500.0	UINT16 R/W per. expert	Modbus 4632
CTRL1_Osupdamp	Overshoot suppression filter: Damping (257) The filter is switched off at a value of 0. In increments of 0.1 %. Changed settings become active immediately.	% 0.0 0.0 50.0	UINT16 R/W per. expert	Modbus 4636
CTRL1_Osupdelay	Overshoot suppression filter: Time delay (257) The filter is switched off at a value of 0. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 0.00 75.00	UINT16 R/W per. expert	Modbus 4638
CTRL1_TAUiref	Filter time constant of the reference current value filter (181) This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 0.50 4.00	UINT16 R/W per. -	Modbus 4618
CTRL1_TAUnref ConF → drC- tAu1	Filter time constant of the reference velocity value filter (178) This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 9.00 327.67	UINT16 R/W per. -	Modbus 4616
CTRL1_TNn ConF → drC- tin1	Velocity controller integral action time (177) The default value is calculated on the basis of CTRL_TAUiref. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 - 327.67	UINT16 R/W per. -	Modbus 4612

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL2_KFPp ConF → drC- FPP2	Velocity feed-forward (258) This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.1 %. Changed settings become active immediately.	% 0.0 0.0 200.0	UINT16 R/W per. -	Modbus 4876
CTRL2_Kfric	Friction compensation: Gain (258) In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} 0.00 0.00 10.00	UINT16 R/W per. expert	Modbus 4896
CTRL2_KPn ConF → drC- Pn2	Velocity controller P gain (177) The default value is calculated on the basis of the motor parameters. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.0001 A/min^{-1}. Changed settings become active immediately.	A/min^{-1} 0.0001 - 1.2700	UINT16 R/W per. -	Modbus 4866
CTRL2_KPp ConF → drC- PP2	Position controller P gain (183) The default value is calculated. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.1 1/s. Changed settings become active immediately.	1/s 2.0 - 900.0	UINT16 R/W per. -	Modbus 4870
CTRL2_Nf1bandw	Notch filter 1: Bandwidth (258) Definition of bandwidth: 1 - Fb/F0 In increments of 0.1 %. Changed settings become active immediately.	% 1.0 70.0 90.0	UINT16 R/W per. expert	Modbus 4884
CTRL2_Nf1damp	Notch filter 1: Damping (258) In increments of 0.1 %. Changed settings become active immediately.	% 55.0 90.0 99.0	UINT16 R/W per. expert	Modbus 4880
CTRL2_Nf1freq	Notch filter 1: Frequency (258) The filter is switched off at a value of 15000. In increments of 0.1 Hz. Changed settings become active immediately.	Hz 50.0 1500.0 1500.0	UINT16 R/W per. expert	Modbus 4882
CTRL2_Nf2bandw	Notch filter 2: Bandwidth (259) Definition of bandwidth: 1 - Fb/F0 In increments of 0.1 %. Changed settings become active immediately.	% 1.0 70.0 90.0	UINT16 R/W per. expert	Modbus 4890

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL2_Nf2damp	Notch filter 2: Damping (259) In increments of 0.1 %. Changed settings become active immediately.	% 55.0 90.0 99.0	UINT16 R/W per. expert	Modbus 4886
CTRL2_Nf2freq	Notch filter 2: Frequency (259) The filter is switched off at a value of 15000. In increments of 0.1 Hz. Changed settings become active immediately.	Hz 50.0 1500.0 1500.0	UINT16 R/W per. expert	Modbus 4888
CTRL2_Osupdamp	Overshoot suppression filter: Damping (259) The filter is switched off at a value of 0. In increments of 0.1 %. Changed settings become active immediately.	% 0.0 0.0 50.0	UINT16 R/W per. expert	Modbus 4892
CTRL2_Osupdelay	Overshoot suppression filter: Time delay (259) The filter is switched off at a value of 0. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 0.00 75.00	UINT16 R/W per. expert	Modbus 4894
CTRL2_TAUiref	Filter time constant of the reference current value filter (181) This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 0.50 4.00	UINT16 R/W per. -	Modbus 4874
CTRL2_TAUnref ConF → drC- tAu2	Filter time constant of the reference velocity value filter (179) This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 9.00 327.67	UINT16 R/W per. -	Modbus 4872
CTRL2_TNn ConF → drC- tin2	Velocity controller integral action time (177) The default value is calculated on the basis of CTRL_TAUiref. This parameter is switched gradually over the time defined in CTRL_ParChgTime. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 - 327.67	UINT16 R/W per. -	Modbus 4868

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`DCbus_compat`	DC bus compatibility LXM32 and ATV32 **0 / No DC bus or LXM32 only**: DC bus not used or only LXM32 connected via the DC bus **1 / DC bus with LXM32 and ATV32**: LXM32 and ATV32 connected via the DC bus NOTE: Connecting LXM32 drives and ATV32 drives via the DC bus may change the technical data. Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- 0 0 1	UINT16 R/W per. -	Modbus 1356
`DCOMcontrol`	DriveCom control word Refer to chapter Operation, Operating States, for bit coding information. Bit 0: Switch on Bit 1: Enable Voltage Bit 2: Quick Stop Bit 3: Enable Operation Bits 4 ... 6: Operating mode specific Bit 7: Fault Reset Bit 8: Halt Bit 9: Change on setpoint Bits 10 ... 15: Reserved (must be 0) Changed settings become active immediately.	- - - -	UINT16 R/W - -	Modbus 6914
`DI_0_Debounce`	Debounce time of DI0 **0 / No**: No software debouncing **1 / 0.25 ms**: 0.25 ms **2 / 0.50 ms**: 0.50 ms **3 / 0.75 ms**: 0.75 ms **4 / 1.00 ms**: 1.00 ms **5 / 1.25 ms**: 1.25 ms **6 / 1.50 ms**: 1.50 ms Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 6 6	UINT16 R/W per. -	Modbus 2112
`DI_1_Debounce`	Debounce time of DI1 **0 / No**: No software debouncing **1 / 0.25 ms**: 0.25 ms **2 / 0.50 ms**: 0.50 ms **3 / 0.75 ms**: 0.75 ms **4 / 1.00 ms**: 1.00 ms **5 / 1.25 ms**: 1.25 ms **6 / 1.50 ms**: 1.50 ms Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 6 6	UINT16 R/W per. -	Modbus 2114

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
DI_2_Debounce	Debounce time of DI2 **0 / No**: No software debouncing **1 / 0.25 ms**: 0.25 ms **2 / 0.50 ms**: 0.50 ms **3 / 0.75 ms**: 0.75 ms **4 / 1.00 ms**: 1.00 ms **5 / 1.25 ms**: 1.25 ms **6 / 1.50 ms**: 1.50 ms Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 6 6	UINT16 R/W per. -	Modbus 2116
DI_3_Debounce	Debounce time of DI3 **0 / No**: No software debouncing **1 / 0.25 ms**: 0.25 ms **2 / 0.50 ms**: 0.50 ms **3 / 0.75 ms**: 0.75 ms **4 / 1.00 ms**: 1.00 ms **5 / 1.25 ms**: 1.25 ms **6 / 1.50 ms**: 1.50 ms Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 6 6	UINT16 R/W per. -	Modbus 2118
DI_4_Debounce	Debounce time of DI4 **0 / No**: No software debouncing **1 / 0.25 ms**: 0.25 ms **2 / 0.50 ms**: 0.50 ms **3 / 0.75 ms**: 0.75 ms **4 / 1.00 ms**: 1.00 ms **5 / 1.25 ms**: 1.25 ms **6 / 1.50 ms**: 1.50 ms Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 6 6	UINT16 R/W per. -	Modbus 2120
DI_5_Debounce	Debounce time of DI5 **0 / No**: No software debouncing **1 / 0.25 ms**: 0.25 ms **2 / 0.50 ms**: 0.50 ms **3 / 0.75 ms**: 0.75 ms **4 / 1.00 ms**: 1.00 ms **5 / 1.25 ms**: 1.25 ms **6 / 1.50 ms**: 1.50 ms Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 6 6	UINT16 R/W per. -	Modbus 2122
DPL_dmControl	Drive Profile Lexium dmControl	- - - -	UINT16 R/W - -	Modbus 6974

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`DPL_intLim`	Setting for bit 9 of _DPL_motionStat and _actionStatus **0 / None**: Not used (reserved) **1 / Current Below Threshold**: Current threshold value **2 / Velocity Below Threshold**: Velocity threshold value **3 / In Position Deviation Window**: Position Deviation Window **4 / In Velocity Deviation Window**: Velocity Deviation Window **9 / Hardware Limit Switch**: Hardware limit switch **10 / RMAC active or finished**: Relative movement after capture is active or finished **11 / Standstill Window**: Standstill window Setting for bit 9 of the parameters _DPL_motionStat and _actionStatus Changed settings become active immediately. Available as of software version V01.08.xx.	- 0 11 11	UINT16 R/W per. -	Modbus 7018
`DPL_RefA16`	Drive Profile Lexium RefA16	- - - -	INT16 R/W - -	Modbus 6980
`DPL_RefB32`	Drive Profile Lexium RefB32	- - - -	INT32 R/W - -	Modbus 6978
`DS402intLim`	DS402 status word: Setting for bit 11 (internal limit) (261) **0 / None**: Not used (reserved) **1 / Current Below Threshold**: Current threshold value **2 / Velocity Below Threshold**: Velocity threshold value **3 / In Position Deviation Window**: Position deviation window **4 / In Velocity Deviation Window**: Velocity deviation window **9 / Hardware Limit Switch**: Hardware limit switch **10 / RMAC active or finished**: Relative movement after capture is active or finished **11 / Standstill Window**: Standstill window Setting for: - bit 11 of the parameter _DCOMstatus and - bit 10 of the parameters _motionStat and _actionStatus Changed settings become active immediately.	- 0 0 11	UINT16 R/W per. -	Modbus 6972

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`ENC1_adjustment`	Adjustment of absolute position of encoder 1 (164) The value range depends on the encoder type. Singleturn encoder: 0 ... max_pos_usr/rev. - 1 Singleturn encoder (shifted with parameter ShiftEncWorkRang): -(max_pos_usr/rev)/2 ... (max_pos_usr/rev.)/2 -1 Multiturn encoder: 0 ... (4096 * max_pos_usr/rev.) -1 Multiturn encoder (shifted with parameter ShiftEncWorkRang): -2048 * max_pos_usr/rev ... (2048 * max_pos_usr/rev.) -1 max_pos_usr/rev.: Maximum user-defined position for one encoder turn. This value is 16384 with the default scaling. NOTE: * If processing is to be performed with inversion of the direction of movement, this must be set before the encoder position is adjusted. * After the write access, a wait time of at least 1 second is required before the drive is switched off. * Changing this value also changes the position of the virtual index pulse and the index pulse for the encoder simulation. Changed settings become active the next time the product is switched on.	usr_p - - -	INT32 R/W - -	Modbus 1324
`ErrorResp_Flt_AC`	Error response to missing mains phase (290) **1 / Error Class 1**: Error class 1 **2 / Error Class 2**: Error class 2 **3 / Error Class 3**: Error class 3 Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 1 2 3	UINT16 R/W per. -	Modbus 1300
`ErrorResp_I2tRES`	Error response to 100% I2t braking resistor **0 / Warning**: Warning (error class 0) **1 / Error Class 1**: Error class 1 **2 / Error Class 2**: Error class 2 Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 0 2	UINT16 R/W per. -	Modbus 1348

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`ErrorResp_p_dif`	Error response to following error (276) **1 / Error Class 1**: Error class 1 **2 / Error Class 2**: Error class 2 **3 / Error Class 3**: Error class 3 Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 1 3 3	UINT16 R/W per. -	Modbus 1302
`ESIM_scale` ConF → i-o- ESSC	Resolution of encoder simulation (230) Resolution defines the number of increments per revolution (AB signal with quadruple evaluation). The index pulse is created once per revolution at an interval where signal A and signal B are high. Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	EncInc 8 4096 65535	UINT16 R/W per. -	Modbus 1322
`GEARdenom`	Denominator of gear ratio (210) See description GEARnum	- 1 1 2147483647	INT32 R/W per. -	Modbus 9734
`GEARdenom2`	Denominator of gear ratio number 2 (211) See description GEARnum	- 1 1 2147483647	INT32 R/W per. -	Modbus 9752
`GEARdir_enabl`	Enabled movement direction of gear processing (213) **1 / Positive**: Positive direction **2 / Negative**: Negative direction **3 / Both**: Both directions This allows you to activate a return movement lock function. Changed settings become active immediately.	- 1 3 3	UINT16 R/W per. -	Modbus 9738
`GEARjerklim` ConF → i-o- GFiL	Activation of jerk filter processing (271) **0 / Off / oFF**: Jerk filter deactivated. **1 / PosSyncOn / P_on**: Jerk filter active in processing modes with position synchronization. The jerk filter processing time must be activated via parameter RAMP_v_jerk. Setting can only be changed if power stage is disabled. Changed settings become active immediately. Available as of software version V01.02.05.	- 0 0 1	UINT16 R/W per. -	Modbus 9742

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
GEARnum	Numerator of gear ratio (210) GEARnum --------------------- = Gear ratio GEARdenom The new gear ratio is applied when the numerator value is supplied. Changed settings become active immediately.	- -2147483648 1 2147483647	INT32 R/W per. -	Modbus 9736
GEARnum2	Numerator of gear ratio number 2 (211) GEARnum2 --------------------- = Gear ratio GEARdenom2 The new gear ratio is applied when the numerator value is supplied. Changed settings become active immediately.	- -2147483648 1 2147483647	INT32 R/W per. -	Modbus 9754
GEARposChgMode	Consideration of position changes with inactive power stage (212) **0 / Off**: Position changes in states with inactive power stage are discarded. **1 / On**: Position changes in states with inactive power stage are considered. This setting has an effect only if gear processing is started in the mode 'Synchronization with compensation movement'. Changed settings become active the next time the power stage is enabled.	- 0 0 1	UINT16 R/W per. -	Modbus 9750
GEARratio ConF → i-o- GFAC	Selection of special gear ratios (210) **0 / Gear Factor / FAct**: Usage of gear ratio adjusted with GEARnum/GEARdenom **1 / 200 / 200**: 200 **2 / 400 / 400**: 400 **3 / 500 / 500**: 500 **4 / 1000 / 1000**: 1000 **5 / 2000 / 2000**: 2000 **6 / 4000 / 4000**: 4000 **7 / 5000 / 5000**: 5000 **8 / 10000 / 10.00**: 10000 **9 / 4096 / 4096**: 4096 **10 / 8192 / 8192**: 8192 **11 / 16384 / 16.38**: 16384 A change of the reference value by the specified value causes one motor revolution. Changed settings become active immediately.	- 0 0 11	UINT16 R/W per. -	Modbus 9740
HMIDispPara Mon SuPV	HMI display when motor moves **0 / OperatingState / StAt**: Operating state **1 / v_act / VAct**: Actual motor velocity **2 / I_act / iAct**: Actual motor current Changed settings become active immediately.	- 0 0 2	UINT16 R/W per. -	Modbus 14852

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMIlocked	Lock HMI (192) **0 / Not Locked / nLoc**: HMI not locked **1 / Locked / Loc**: HMI locked The following functions can no longer be started when the HMI is locked: - Parameter change - Jog - Autotuning - Fault Reset Changed settings become active immediately.	- 0 0 1	UINT16 R/W per. -	Modbus 14850
InvertDirOf-Count	Inversion of direction of counting at PTI interface (209) **0 / Inversion Off**: Inversion of direction of counting is off **1 / Inversion On**: Inversion of direction of counting is on Changed settings become active immediately.	- 0 0 1	UINT16 R/W per. -	Modbus 2062
InvertDirOfMove ConF → ACG- inMo	Inversion of direction of movement (163) **0 / Inversion Off / oFF**: Inversion of direction of movement is off **1 / Inversion On / on**: Inversion of direction of movement is on The limit switch which is reached with a movement in positive direction must be connected to the positive limit switch input and vice versa. Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- 0 0 1	UINT16 R/W per. -	Modbus 1560
IO_AutoEnable ConF → ACG- ioAE	Enabling the power stage at PowerOn **0 / Off / oFF**: After start-up, a rising edge with the signal input function Enable enables the power stage **1 / On / on**: After start-up, an active signal input with signal input function Enable enables the power stage **2 / AutoOn / Auto**: After start-up, the power stage is automatically enabled Changed settings become active the next time the power stage is enabled.	- 0 0 2	UINT16 R/W per. -	Modbus 1292

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IO_DQ_set`	Setting the digital outputs directly Write access to output bits is only active if the signal pin is available as an output and if the function of the output was set to 'Available as required'. Coding of the individual signals: Bit 0: DQ0 Bit 1: DQ1 Bit 2: DQ2 Bit 3: DQ3 Bit 4: DQ4	- - - -	UINT16 R/W - -	Modbus 2082
`IO_GEARmethod` ConF → ACG- ioGM	Processing mode for operating mode Electronic Gear (211) **1 / Position Synchronization Immediate / PoiM**: Position synchronization without compensation movement **2 / Position Synchronization Compensated / Poco**: Position synchronization with compensation movement **3 / Velocity Synchronization / VELo**: Velocity synchronization Changed settings become active the next time the motor moves.	- 1 1 3	UINT16 R/W per. -	Modbus 1326
`IO_I_limit` ConF → i-o- iLiM	Current limitation via input (269) A current limit can be activated via a digital input. In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} 0.00 0.20 300.00	UINT16 R/W per. -	Modbus 1614
`IO_JOGmethod` ConF → ACG- ioJG	Selection of jog method (204) **0 / Continuous Movement / coMo**: Jog with continuous movement **1 / Step Movement / StMo**: Jog with step movement Changed settings become active the next time the motor moves.	- 0 0 1	UINT16 R/W per. -	Modbus 1328
`IO_ModeSwitch` ConF → ACG- ioMS	Operating mode for signal input function Operating Mode Switch (199) **0 / None / nonE**: None **1 / Profile Torque / torq**: Profile Torque **2 / Profile Velocity / VELP**: Profile Velocity **3 / Electronic Gear / GEAr**: Electronic Gear Changed settings become active immediately.	- 0 0 3	UINT16 R/W per. -	Modbus 1630
`IO_v_limit`	Velocity limitation via input (267) A velocity limitation can be activated via a digital input. NOTE: In operating mode Profile Torque, the minimum velocity is internally limited to 100 min^{-1}. Changed settings become active immediately.	usr_v 1 10 2147483647	UINT32 R/W per. -	Modbus 1596

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IOdefaultMode` ConF → ACG- io-M	Operating mode (198) **0 / None / nonE**: None **1 / Profile Torque / torq**: Profile Torque **2 / Profile Velocity / VELP**: Profile Velocity **3 / Electronic Gear / GEAr**: Electronic Gear **5 / Jog / JoG**: Jog Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- 0 5 5	UINT16 R/W per. -	Modbus 1286
`IOfunct_DI0` ConF → i-o- di0	Function Input DI0 (234) **1 / Freely Available / nonE**: Available as required **2 / Fault Reset / FrES**: Fault reset after error **3 / Enable / EnAb**: Enables the power stage **4 / Halt / hALt**: Halt **6 / Current Limitation / iLiM**: Limits the current to parameter value **7 / Zero Clamp / CLMP**: Zero clamping **8 / Velocity Limitation / VLiM**: Limits the velocity to parameter value **9 / Jog Positive / JoGP**: Jog: Moves in positive direction **10 / Jog Negative / JoGn**: Jog: Moves in negative direction **11 / Jog Fast/Slow / JoGF**: Jog: Switches between slow and fast movement **12 / Gear Ratio Switch / GrAt**: Electronic Gear: Switches between two gear ratios **19 / Gear Offset 1 / GoF1**: Electronic Gear: Adds first gear offset **20 / Gear Offset 2 / GoF2**: Electronic Gear: Adds second gear offset **21 / Reference Switch (REF) / rEF**: Reference switch **22 / Positive Limit Switch (LIMP) / LiMP**: Positive limit switch **23 / Negative Limit Switch (LIMN) / LiMn**: Negative limit switch **24 / Switch Controller Parameter Set / CPAr**: Switches controller parameter set **25 / Inversion AI1 / A1iU**: Inverts analog input AI1 **26 / Inversion AI2 / A2iU**: Inverts analog input AI2 **27 / Operating Mode Switch / MSWt**: Switches operating mode **28 / Velocity Controller Integral Off / tnoF**: Switches off velocity controller integral term Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1794

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IOfunct_DI1` ConF → i-o- di1	Function Input DI1 (235) **1 / Freely Available / nonE**: Available as required **2 / Fault Reset / FrES**: Fault reset after error **3 / Enable / EnAb**: Enables the power stage **4 / Halt / hALt**: Halt **6 / Current Limitation / iLiM**: Limits the current to parameter value **7 / Zero Clamp / CLMP**: Zero clamping **8 / Velocity Limitation / VLiM**: Limits the velocity to parameter value **9 / Jog Positive / JoGP**: Jog: Moves in positive direction **10 / Jog Negative / JoGn**: Jog: Moves in negative direction **11 / Jog Fast/Slow / JoGF**: Jog: Switches between slow and fast movement **12 / Gear Ratio Switch / GrAt**: Electronic Gear: Switches between two gear ratios **19 / Gear Offset 1 / GoF1**: Electronic Gear: Adds first gear offset **20 / Gear Offset 2 / GoF2**: Electronic Gear: Adds second gear offset **21 / Reference Switch (REF) / rEF**: Reference switch **22 / Positive Limit Switch (LIMP) / LiMP**: Positive limit switch **23 / Negative Limit Switch (LIMN) / LiMn**: Negative limit switch **24 / Switch Controller Parameter Set / CPAr**: Switches controller parameter set **25 / Inversion AI1 / A1iV**: Inverts analog input AI1 **26 / Inversion AI2 / A2iV**: Inverts analog input AI2 **27 / Operating Mode Switch / MSWt**: Switches operating mode **28 / Velocity Controller Integral Off / tnoF**: Switches off velocity controller integral term Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1796

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IOfunct_DI2` ConF → i-o- di2	Function Input DI2 (236) **1 / Freely Available / nonE**: Available as required **2 / Fault Reset / FrES**: Fault reset after error **3 / Enable / EnAb**: Enables the power stage **4 / Halt / hALt**: Halt **6 / Current Limitation / iLiM**: Limits the current to parameter value **7 / Zero Clamp / CLMP**: Zero clamping **8 / Velocity Limitation / VLiM**: Limits the velocity to parameter value **9 / Jog Positive / JoGP**: Jog: Moves in positive direction **10 / Jog Negative / JoGn**: Jog: Moves in negative direction **11 / Jog Fast/Slow / JoGF**: Jog: Switches between slow and fast movement **12 / Gear Ratio Switch / GrAt**: Electronic Gear: Switches between two gear ratios **19 / Gear Offset 1 / GoF1**: Electronic Gear: Adds first gear offset **20 / Gear Offset 2 / GoF2**: Electronic Gear: Adds second gear offset **21 / Reference Switch (REF) / rEF**: Reference switch **22 / Positive Limit Switch (LIMP) / LiMP**: Positive limit switch **23 / Negative Limit Switch (LIMN) / LiMn**: Negative limit switch **24 / Switch Controller Parameter Set / CPAr**: Switches controller parameter set **25 / Inversion AI1 / A1iV**: Inverts analog input AI1 **26 / Inversion AI2 / A2iV**: Inverts analog input AI2 **27 / Operating Mode Switch / MSWt**: Switches operating mode **28 / Velocity Controller Integral Off / tnoF**: Switches off velocity controller integral term Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1798

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOfunct_DI3 ConF → i-o- di3	Function Input DI3 (237) **1 / Freely Available / nonE**: Available as required **2 / Fault Reset / FrES**: Fault reset after error **3 / Enable / EnAb**: Enables the power stage **4 / Halt / hALt**: Halt **6 / Current Limitation / iLiM**: Limits the current to parameter value **7 / Zero Clamp / CLMP**: Zero clamping **8 / Velocity Limitation / VLiM**: Limits the velocity to parameter value **9 / Jog Positive / JoGP**: Jog: Moves in positive direction **10 / Jog Negative / JoGn**: Jog: Moves in negative direction **11 / Jog Fast/Slow / JoGF**: Jog: Switches between slow and fast movement **12 / Gear Ratio Switch / GrAt**: Electronic Gear: Switches between two gear ratios **19 / Gear Offset 1 / GoF1**: Electronic Gear: Adds first gear offset **20 / Gear Offset 2 / GoF2**: Electronic Gear: Adds second gear offset **21 / Reference Switch (REF) / rEF**: Reference switch **22 / Positive Limit Switch (LIMP) / LiMP**: Positive limit switch **23 / Negative Limit Switch (LIMN) / LiMn**: Negative limit switch **24 / Switch Controller Parameter Set / CPAr**: Switches controller parameter set **25 / Inversion AI1 / A1iV**: Inverts analog input AI1 **26 / Inversion AI2 / A2iV**: Inverts analog input AI2 **27 / Operating Mode Switch / MSWt**: Switches operating mode **28 / Velocity Controller Integral Off / tnoF**: Switches off velocity controller integral term Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1800

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IOfunct_DI4` ConF → i-o- di4	Function Input DI4 (238) **1 / Freely Available / nonE**: Available as required **2 / Fault Reset / FrES**: Fault reset after error **3 / Enable / EnAb**: Enables the power stage **4 / Halt / hALt**: Halt **6 / Current Limitation / iLiM**: Limits the current to parameter value **7 / Zero Clamp / CLMP**: Zero clamping **8 / Velocity Limitation / VLiM**: Limits the velocity to parameter value **9 / Jog Positive / JoGP**: Jog: Moves in positive direction **10 / Jog Negative / JoGn**: Jog: Moves in negative direction **11 / Jog Fast/Slow / JoGF**: Jog: Switches between slow and fast movement **12 / Gear Ratio Switch / GrAt**: Electronic Gear: Switches between two gear ratios **19 / Gear Offset 1 / GoF1**: Electronic Gear: Adds first gear offset **20 / Gear Offset 2 / GoF2**: Electronic Gear: Adds second gear offset **21 / Reference Switch (REF) / rEF**: Reference switch **22 / Positive Limit Switch (LIMP) / LiMP**: Positive limit switch **23 / Negative Limit Switch (LIMN) / LiMn**: Negative limit switch **24 / Switch Controller Parameter Set / CPAr**: Switches controller parameter set **25 / Inversion AI1 / A1iV**: Inverts analog input AI1 **26 / Inversion AI2 / A2iV**: Inverts analog input AI2 **27 / Operating Mode Switch / MSWt**: Switches operating mode **28 / Velocity Controller Integral Off / tnoF**: Switches off velocity controller integral term Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1802

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOfunct_DI5 ConF → i-o- di5	Function Input DI5 (239) **1 / Freely Available / nonE**: Available as required **2 / Fault Reset / FrES**: Fault reset after error **3 / Enable / EnAb**: Enables the power stage **4 / Halt / hALt**: Halt **6 / Current Limitation / iLiM**: Limits the current to parameter value **7 / Zero Clamp / CLMP**: Zero clamping **8 / Velocity Limitation / VLiM**: Limits the velocity to parameter value **9 / Jog Positive / JoGP**: Jog: Moves in positive direction **10 / Jog Negative / JoGn**: Jog: Moves in negative direction **11 / Jog Fast/Slow / JoGF**: Jog: Switches between slow and fast movement **12 / Gear Ratio Switch / GrAt**: Electronic Gear: Switches between two gear ratios **19 / Gear Offset 1 / GoF1**: Electronic Gear: Adds first gear offset **20 / Gear Offset 2 / GoF2**: Electronic Gear: Adds second gear offset **21 / Reference Switch (REF) / rEF**: Reference switch **22 / Positive Limit Switch (LIMP) / LiMP**: Positive limit switch **23 / Negative Limit Switch (LIMN) / LiMn**: Negative limit switch **24 / Switch Controller Parameter Set / CPAr**: Switches controller parameter set **25 / Inversion AI1 / A1iV**: Inverts analog input AI1 **26 / Inversion AI2 / A2iV**: Inverts analog input AI2 **27 / Operating Mode Switch / MSWt**: Switches operating mode **28 / Velocity Controller Integral Off / tnoF**: Switches off velocity controller integral term Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1804

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOfunct_DQ0 ConF → i-o- do0	Function Output DQ0 (240) **1 / Freely Available / nonE**: Available as required **2 / No Fault / nFLt**: Signals operating states Ready To Switch On, Switched On and Operation Enable **3 / Active / Acti** : Signals operating state Operation Enable **5 / In Position Deviation Window / in-P**: Position deviation is within window **6 / In Velocity Deviation Window / in-V**: Velocity deviation is within window **7 / Velocity Below Threshold / Vthr**: Motor velocity below threshold **8 / Current Below Threshold / ithr**: Motor current below threshold **9 / Halt Acknowledge / hALt**: Halt acknowledgement **13 / Motor Standstill / MStd**: Motor at a standstill **14 / Selected Error / SErr**: One of the selected errors is active **16 / Selected Warning / SWrn**: One of the selected warnings is active Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1810
IOfunct_DQ1 ConF → i-o- do1	Function Output DQ1 (241) **1 / Freely Available / nonE**: Available as required **2 / No Fault / nFLt**: Signals operating states Ready To Switch On, Switched On and Operation Enable **3 / Active / Acti** : Signals operating state Operation Enable **5 / In Position Deviation Window / in-P**: Position deviation is within window **6 / In Velocity Deviation Window / in-V**: Velocity deviation is within window **7 / Velocity Below Threshold / Vthr**: Motor velocity below threshold **8 / Current Below Threshold / ithr**: Motor current below threshold **9 / Halt Acknowledge / hALt**: Halt acknowledgement **13 / Motor Standstill / MStd**: Motor at a standstill **14 / Selected Error / SErr**: One of the selected errors is active **16 / Selected Warning / SWrn**: One of the selected warnings is active Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1812

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IOfunct_DQ2` ConF → i-o- do2	Function Output DQ2 (241) **1 / Freely Available / nonE**: Available as required **2 / No Fault / nFLt**: Signals operating states Ready To Switch On, Switched On and Operation Enable **3 / Active / Acti** : Signals operating state Operation Enable **5 / In Position Deviation Window / in-P**: Position deviation is within window **6 / In Velocity Deviation Window / in-V**: Velocity deviation is within window **7 / Velocity Below Threshold / Vthr**: Motor velocity below threshold **8 / Current Below Threshold / ithr**: Motor current below threshold **9 / Halt Acknowledge / hALt**: Halt acknowledgement **13 / Motor Standstill / MStd**: Motor at a standstill **14 / Selected Error / SErr**: One of the selected errors is active **16 / Selected Warning / SWrn**: One of the selected warnings is active Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1814
`IOfunct_DQ3` ConF → i-o- do3	Function Output DQ3 (242) **1 / Freely Available / nonE**: Available as required **2 / No Fault / nFLt**: Signals operating states Ready To Switch On, Switched On and Operation Enable **3 / Active / Acti** : Signals operating state Operation Enable **5 / In Position Deviation Window / in-P**: Position deviation is within window **6 / In Velocity Deviation Window / in-V**: Velocity deviation is within window **7 / Velocity Below Threshold / Vthr**: Motor velocity below threshold **8 / Current Below Threshold / ithr**: Motor current below threshold **9 / Halt Acknowledge / hALt**: Halt acknowledgement **13 / Motor Standstill / MStd**: Motor at a standstill **14 / Selected Error / SErr**: One of the selected errors is active **16 / Selected Warning / SWrn**: One of the selected warnings is active Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1816

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOfunct_DQ4 ConF → i-o- do4	Function Output DQ4 (242) **1 / Freely Available / nonE**: Available as required **2 / No Fault / nFLt**: Signals operating states Ready To Switch On, Switched On and Operation Enable **3 / Active / Acti** : Signals operating state Operation Enable **5 / In Position Deviation Window / in-P**: Position deviation is within window **6 / In Velocity Deviation Window / in-V**: Velocity deviation is within window **7 / Velocity Below Threshold / Vthr**: Motor velocity below threshold **8 / Current Below Threshold / ithr**: Motor current below threshold **9 / Halt Acknowledge / hALt**: Halt acknowledgement **13 / Motor Standstill / MStd**: Motor at a standstill **14 / Selected Error / SErr**: One of the selected errors is active **16 / Selected Warning / SWrn**: One of the selected warnings is active Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- - - -	UINT16 R/W per. -	Modbus 1818
IOsigLIMN	Signal evaluation for negative limit switch (273) **0 / Inactive**: Inactive **1 / Normally closed**: Normally closed NC **2 / Normally open**: Normally open NO Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 1 2	UINT16 R/W per. -	Modbus 1566
IOsigLIMP	Signal evaluation for positive limit switch (272) **0 / Inactive**: Inactive **1 / Normally closed**: Normally closed NC **2 / Normally open**: Normally open NO Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 1 2	UINT16 R/W per. -	Modbus 1568

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`IOsigREF`	Signal evaluation for reference switch **1 / Normally Closed**: Normally closed NC **2 / Normally Open**: Normally open NO The reference switch is only active while a reference movement to the reference switch is processed. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 1 1 2	UINT16 R/W per. -	Modbus 1564
`JOGstep`	Distance for step movement (204) Changed settings become active the next time the motor moves.	usr_p 1 20 2147483647	INT32 R/W per. -	Modbus 10510
`JOGtime`	Wait time for step movement (204) Changed settings become active the next time the motor moves.	ms 1 500 32767	UINT16 R/W per. -	Modbus 10512
`JOGv_fast` oP → JoG- JGhi	Velocity for fast movement (203) The adjustable value is internally limited to the current parameter setting in RAMP_v_max. Changed settings become active immediately.	usr_v 1 180 2147483647	UINT32 R/W per. -	Modbus 10506
`JOGv_slow` oP → JoG- JGLo	Velocity for slow movement (203) The adjustable value is internally limited to the current parameter setting in RAMP_v_max. Changed settings become active immediately.	usr_v 1 60 2147483647	UINT32 R/W per. -	Modbus 10504
`LIM_HaltReaction` ConF → ACG- htYP	Halt option code (262) **1 / Deceleration Ramp / dEcE**: Deceleration ramp **3 / Torque Ramp / torq**: Torque ramp Type of deceleration for Halt. Setting of deceleration ramp with parameter RAMP_v_dec. Setting of torque ramp with parameter LIM_I_maxHalt. If a deceleration ramp is already active, the parameter cannot be written. Changed settings become active immediately.	- 1 1 3	INT16 R/W per. -	Modbus 1582

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
LIM_I_maxHalt ConF → ACG- hcur	Current value for Halt (152) This value is only limited by the minimum/ maximum value range (no limitation of this value by motor/power stage). In the case of a Halt, the actual current limit (_Imax_actual) is one of the following values (whichever is lowest): - LIM_I_maxHalt - M_I_max - PA_I_max Further current reductions caused by I2t monitoring are also taken into account during a Halt. Default: PA_I_max at 8 kHz PWM frequency and 230/480 V mains voltage In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} - - -	UINT16 R/W per. -	Modbus 4380
LIM_I_maxQSTP ConF → FLt- qcur	Current value for Quick Stop (152) This value is only limited by the minimum/ maximum value range (no limitation of this value by motor/power stage). In the case of a Quick Stop, the actual current limit (_Imax_actual) is one of the following values (whichever is lowest): - LIM_I_maxQSTP - M_I_max - PA_I_max Further current reductions caused by I2t monitoring are also taken into account during a Quick Stop. Default: PA_I_max at 8 kHz PWM frequency and 230/480 V mains voltage In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} - - -	UINT16 R/W per. -	Modbus 4378

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
LIM_QStopReact ConF → FLt- qtYP	Quick Stop option code (264) **6 / Deceleration ramp (Quick Stop) / dEc**: Use deceleration ramp and remain in operating state 7 Quick Stop **7 / Torque ramp (Quick Stop) / tor**: Use torque ramp and remain in operating state 7 Quick Stop Type of deceleration for Quick Stop. Setting of deceleration ramp with parameter RAMPquickstop. Setting of torque ramp with parameter LIM_I_maxQSTP. If a deceleration ramp is already active, the parameter cannot be written. Changed settings become active immediately.	- 6 6 7	INT16 R/W per. -	Modbus 1584
Mains_reactor	Mains reactor **0 / No**: No **1 / Yes**: Yes Value 0: No mains reactor connected. The nominal power of the power stage is reduced. Value 1: A mains reactor is connected. Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 0 1	UINT16 R/W per. -	Modbus 1344
MBaddress ConF → Con- MbAd	Modbus address Valid addresses: 1 to 247 Changed settings become active the next time the product is switched on.	- 1 1 247	UINT16 R/W per. -	Modbus 5640
MBbaud ConF → Con- Mbbd	Modbus baud rate **9600 / 9600 Baud / 9.6**: 9600 Baud **19200 / 19200 Baud / 19.2**: 19200 Baud **38400 / 38400 Baud / 38.4**: 38400 Baud Changed settings become active the next time the product is switched on.	- 9600 19200 38400	UINT16 R/W per. -	Modbus 5638
Mfb_ResRatio	Transformation ratio Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- 0.3 - 1.0	UINT16 R/W - -	Modbus 23598

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`MON_ChkTime` ConF → i-o- tthr	Monitoring of time window (279) Adjustment of a time for monitoring of position deviation, speed deviation, speed value and current value. If the monitored value is in the permissible range during the adjusted time, the monitoring function delivers a positive result. The status can be output via a parameterizable output. Changed settings become active immediately.	ms 0 0 9999	UINT16 R/W per. -	Modbus 1594
`MON_commutat`	Commutation monitoring (289) **0 / Off**: Commutation monitoring off **1 / On**: Commutation monitoring on Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 1 1	UINT16 R/W per. -	Modbus 1290
`MON_GroundFault`	Ground fault monitoring (292) **0 / Off**: Ground fault monitoring off **1 / On**: Ground fault monitoring on In exceptional cases, deactivation may be necessary, for example: - Long motor cables Deactivate ground fault monitoring if it responds in an unwanted way. Changed settings become active the next time the product is switched on.	- 0 1 1	UINT16 R/W per. expert	Modbus 1312
`MON_I_Threshold` ConF → i-o- ithr	Monitoring of current threshold (284) The system checks whether the drive is below the defined value during the period set with MON_ChkTime. The status can be output via a parameterizable output. The parameter _Iq_act_rms is used as comparison value. In increments of 0.01 A_{rms}. Changed settings become active immediately.	A_{rms} 0.00 0.20 300.00	UINT16 R/W per. -	Modbus 1592
`MON_IO_SelErr1`	First number for the signal output function Selected Error Changed settings become active immediately.	- 0 0 65535	UINT16 R/W per. -	Modbus 15116
`MON_IO_SelErr2`	Second number for the signal output function Selected Error Changed settings become active immediately.	- 0 0 65535	UINT16 R/W per. -	Modbus 15118
`MON_IO_SelWar1`	First number for the signal output function Selected Warning Changed settings become active immediately.	- 0 0 65535	UINT16 R/W per. -	Modbus 15120

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
MON_IO_SelWar2	Second number for the signal output function Selected Warning Changed settings become active immediately.	- 0 0 65535	UINT16 R/W per. -	Modbus 15122
MON_MainsVolt	Detection and monitoring of mains phases (291) **0 / Automatic Mains Detection**: Automatic detection and monitoring of mains voltage **1 / DC-Bus Only (Mains 1~230 V / 3~480 V)**: DC bus supply only, corresponding to mains voltage 230 V (single-phase) or 480 V (three phases) **2 / DC-Bus Only (Mains 1~115 V / 3~208 V)**: DC bus supply only, corresponding to mains voltage 115 V (single-phase) or 208 V (three phases) **3 / Mains 1~230 V / 3~480 V**: Mains voltage 230 V (single-phase) or 480 V (three phases) **4 / Mains 1~115 V / 3~208 V**: Mains voltage 115 V (single-phase) or 208 V (three phases) Value 0: As soon as a mains voltage detected, the device automatically checks whether the mains voltage is 115 V or 230 V in the case of single-phase devices or 208 V or 400/480 V in the case of three-phase devices. Values 1 ... 2: If the device is supplied only via the DC bus, the parameter has to be set to the voltage value corresponding to the mains voltage of the supplying device. There is no mains voltage monitoring. Values 3 ... 4: If the mains voltage is not detected properly during start-up, the mains voltage to be used can be selected manually. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 0 4	UINT16 R/W per. expert	Modbus 1310
MON_p_dif_load_usr	Maximum load-dependent position deviation (following error) (276) The load-dependent position deviation is the difference between the reference position and the actual position caused by the load. The minimum value, the factory setting and the maximum value depend on the scaling factor. Available as of firmware version V01.05 Changed settings become active immediately.	usr_p 1 16384 2147483647	INT32 R/W per. -	Modbus 1660

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`MON_p_dif_load`	Maximum load-dependent position deviation (following error) (276) The load-dependent position deviation is the difference between the reference position and the actual position caused by the load. The parameter MON_p_dif_load_usr allows you to enter the value in user-defined units. In increments of 0.0001 revolution. Changed settings become active immediately.	revolution 0.0001 1.0000 200.0000	UINT32 R/W per. -	Modbus 1606
`MON_p_dif_warn`	Maximum load-dependent position deviation (warning) (275) 100.0 % correspond to the maximum position deviation (following error) as specified by means of parameter MON_p_dif_load. Changed settings become active immediately.	% 0 75 100	UINT16 R/W per. -	Modbus 1618
`MON_p_DiffWin_usr`	Monitoring of position deviation (279) The system checks whether the drive is within the defined deviation during the period set with MON_ChkTime. The status can be output via a parameterizable output. The minimum value, the factory setting and the maximum value depend on the scaling factor. Available as of firmware version V01.05 Changed settings become active immediately.	usr_p 0 16 2147483647	INT32 R/W per. -	Modbus 1662
`MON_p_DiffWin`	Monitoring of position deviation (279) The system checks whether the drive is within the defined deviation during the period set with MON_ChkTime. The status can be output via a parameterizable output. The parameter MON_p_DiffWin_usr allows you to enter the value in user-defined units. In increments of 0.0001 revolution. Changed settings become active immediately.	revolution 0.0000 0.0010 0.9999	UINT16 R/W per. -	Modbus 1586

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`MON_p_win_usr`	Standstill window, permissible control deviation The control deviation for the standstill window time must be within this range for a standstill of the drive to be detected. Processing of the standstill window must be activated via the parameter MON_p_winTime. The minimum value, the factory setting and the maximum value depend on the scaling factor. Changed settings become active immediately.	usr_p 0 16 2147483647	INT32 R/W per. -	Modbus 1664
`MON_p_win`	Standstill window, permissible control deviation The control deviation for the standstill window time must be within this range for a standstill of the drive to be detected. Processing of the standstill window must be activated via the parameter MON_p_winTime. The parameter MON_p_win_usr allows you to enter the value in user-defined units. In increments of 0.0001 revolution. Changed settings become active immediately.	revolution 0.0000 0.0010 3.2767	UINT16 R/W per. -	Modbus 1608
`MON_p_winTime`	Standstill window, time Value 0: Monitoring of standstill window deactivated Value >0: Time in ms during which the control deviation must be in the standstill window Changed settings become active immediately.	ms 0 0 32767	UINT16 R/W per. -	Modbus 1610
`MON_p_winTout`	Timeout time for standstill window monitoring Value 0: Timeout monitoring deactivated Value >0: Timeout time in ms Standstill window processing values are set via MON_p_win and MON_p_winTime. Time monitoring starts when the target position (reference position of position controller) is reached or when the profile generator has finished processing. Changed settings become active immediately.	ms 0 0 16000	UINT16 R/W per. -	Modbus 1612

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
MON_SW_Limits	Monitoring of software limit switches **0 / None**: Deactivated **1 / SWLIMP**: Activation of software limit switches positive direction **2 / SWLIMN**: Activation of software limit switches negative direction **3 / SWLIMP+SWLIMN**: Activation of software limit switches both directions Monitoring of software limit switches only works in case of successful homing (ref_ok = 1). Changed settings become active immediately.	- 0 0 3	UINT16 R/W per. -	Modbus 1542
MON_swLimN	Negative position limit for software limit switch Refer to description 'MON_swLimP' Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	usr_p - -2147483648 -	INT32 R/W per. -	Modbus 1546
MON_swLimP	Positive position limit for software limit switch If a user-defined value entered is outside of the permissible range, the limit switch limits are automatically set to the maximum user-defined value. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	usr_p - 2147483647 -	INT32 R/W per. -	Modbus 1544
MON_tq_win	Torque window, permissible deviation The torque window can only be activated in operating mode Profile Torque. In increments of 0.1 %. Changed settings become active immediately.	% 0.0 3.0 3000.0	UINT16 R/W per. -	Modbus 1626
MON_tq_winTime	Torque window, time Value 0: Torque window monitoring deactivated Changing the value causes a restart of torque monitoring. NOTE: Torque window is only used in operating mode Profile Torque. Changed settings become active immediately.	ms 0 0 16383	UINT16 R/W per. -	Modbus 1628

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`MON_v_DiffWin`	Monitoring of velocity deviation (281) The system checks whether the drive is within the defined deviation during the period set with MON_ChkTime. The status can be output via a parameterizable output. Changed settings become active immediately.	usr_v 1 10 2147483647	UINT32 R/W per. -	Modbus 1588
`MON_v_Threshold`	Monitoring of velocity threshold (282) The system checks whether the drive is below the defined value during the period set with MON_ChkTime. The status can be output via a parameterizable output. Changed settings become active immediately.	usr_v 1 10 2147483647	UINT32 R/W per. -	Modbus 1590
`MON_v_win`	Velocity window, permissible deviation Changed settings become active immediately.	usr_v 1 10 2147483647	UINT32 R/W per. -	Modbus 1576
`MON_v_winTime`	Velocity window, time Value 0: Velocity window monitoring deactivated Changing the value causes a restart of velocity monitoring. Changed settings become active immediately.	ms 0 0 16383	UINT16 R/W per. -	Modbus 1578
`MON_v_zeroclamp`	Velocity limit for Zero Clamp (271) A Zero Clamp operation is only possible if the reference velocity is below the Zero Clamp velocity limit. Changed settings become active immediately.	usr_v 0 10 2147483647	UINT32 R/W per. -	Modbus 1616
`MT_dismax_usr`	Maximum permissible distance If the reference value is active and the maximum permissible distance is exceeded, an error of error class 1 is generated. The value 0 switches off monitoring. The minimum value, the factory setting and the maximum value depend on the scaling factor. Available as of firmware version V01.05 Changed settings become active the next time the motor moves.	usr_p 0 16384 2147483647	INT32 R/W - -	Modbus 11796

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`MT_dismax`	Maximum permissible distance If the reference value is active and the maximum permissible distance is exceeded, an error of error class 1 is generated. The value 0 switches off monitoring. The parameter MT_dismax_usr allows you to enter the value in user-defined units. In increments of 0.1 revolution. Changed settings become active the next time the motor moves.	revolution 0.0 1.0 999.9	UINT16 R/W - -	Modbus 11782
`OFS_Ramp`	Acceleration and deceleration for offset movement (213) Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	usr_a 1 600 2147483647	UINT32 R/W per. -	Modbus 9996
`OFSp_RelPos1`	Relative offset position 1 for offset movement (212) Changed settings become active immediately.	Inc -2147483648 0 2147483647	INT32 R/W per. -	Modbus 10000
`OFSp_RelPos2`	Relative offset position 2 for offset movement (212) Changed settings become active immediately.	Inc -2147483648 0 2147483647	INT32 R/W per. -	Modbus 10004
`OFSv_target`	Target velocity for offset movement (212) The maximum possible value is 5000 if the user-defined scaling factor of the velocity scaling is 1. This applies to all user-defined scaling factors. Example: If the user-defined scaling factor of the velocity scaling is 2 (ScaleVELnum = 2, ScaleVELdenom = 1), the maximum possible value is 2500. Changed settings become active immediately.	usr_v 1 60 2147483647	UINT32 R/W per. -	Modbus 9992

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PAR_CTRLreset ConF → FCS- rESC	Reset controller parameters **0 / No /** no: No **1 / Yes /** YES: Yes Reset of all controller parameters. The current controller parameters are recalculated on the basis of the motor data of the connected motor. NOTE: Current and velocity limitations are not reset. Therefore, a user parameter reset is required. NOTE: The new settings are not saved to the EEPROM. Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 0 1	UINT16 R/W - -	Modbus 1038
PAR_ScalingStart	Recalculation of parameters with user-defined units The parameters with user-defined units can be recalculated with a changed scaling factor. Value 0: Inactive Value 1: Initialize recalculation Value 2: Start recalculation Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 0 2	UINT16 R/W - -	Modbus 1064
PAReeprSave	Save parameter values to EEPROM Value 1: Save all persistent parameters The currently set parameters are saved to the non-volatile memory (EEPROM). The saving process is complete when the parameter is read and 0 is returned. Changed settings become active immediately.	- - - -	UINT16 R/W - -	Modbus 1026
PARfactorySet ConF → FCS- rStF	Restore factory settings (default values) **No /** no: No **Yes /** YES: Yes All parameters are set to their default values, these are saved to the EEPROM. Restoring the factory settings is possible via the HMI or the commissioning software. The saving process is complete when the parameter is read and 0 is returned. Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- 0 - 1	 R/W - -	

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PARuserReset ConF → FCS- rESu	Reset user parameters **0 / No / no**: No **65535 / Yes / YES**: Yes Bit 0: Set persistent user and controller parameters to default values Bits 1 ... 15: Reserved All parameters are reset with the exception of: - Communication parameters - Inversion of direction of movement - Selection of signal type for position interface PTI - Defined operating mode - Settings of encoder simulation - Functions of digital inputs and outputs NOTE: The new settings are not saved to the EEPROM. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 - 65535	UINT16 R/W - -	Modbus 1040
PP_ModeRangeLim	Absolute movement beyond movement range **0 / NoAbsMoveAllowed**: Absolute movement beyond movement range is not possible **1 / AbsMoveAllowed**: Absolute movement beyond movement range is possible Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 0 1	UINT16 R/W per. -	Modbus 8974
PP_OpmChgType	Change to operating mode Profile Position during movements **0 / WithStandStill**: Change with standstill **1 / OnTheFly**: Change without standstill Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 0 1	UINT16 R/W per. -	Modbus 8978

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Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`PTI_pulse_filter`	Filter time for input signals at the PTI interface A signal at the PTI interface is only evaluated if it is available for a time that is longer than the set filter time. For example, if an interference pulse is available for a period shorter than the set filter time, the interference pulse is not evaluated. The interval between 2 signals must also be greater than the set filter time. In increments of 0.01 µs. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	µs 0.00 0.25 13.00	UINT16 R/W per. expert	Modbus 1374
`PTI_signal_type` ConF → i-o- ioPi	Selection of signal type for PTI interface (209) **0 / A/B Signals / Ab**: Signals ENC_A and ENC_B (quadruple evaluation) **1 / P/D Signals / Pd**: Signals PULSE and DIR **2 / CW/CCW Signals / cwcc**: Signals CW and CCW Setting can only be changed if power stage is disabled. Changed settings become active the next time the product is switched on.	- 0 0 2	UINT16 R/W per. -	Modbus 1284
`PTO_mode`	Type of usage of PTO interface (230) **0 / Off**: PTO interface disabled **1 / Esim pAct Enc 1**: Encoder simulation based on actual position of encoder 1 **2 / Esim pRef**: Encoder simulation based on reference position values (_p_ref) **3 / PTI Signal**: Directly the signal from PTI interface Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 1 3	UINT16 R/W per. -	Modbus 1342
`RAMP_tq_enable`	Activation of the motion profile for torque (219) **0 / Profile Off**: Profile off **1 / Profile On**: Profile on The motion profile for torque can be activated or deactivated for the operating mode Profile Torque. In all other operating modes, the motion profile for torque is inactive. Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 0 1	UINT16 R/W per. -	Modbus 1624

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`RAMP_tq_slope`	Slope setting of the motion profile for torque (219) 100.0 % correspond to the continuous stall torque _M_M_0. In increments of 0.1 %/s. Changed settings become active immediately.	%/s 0.1 10000.0 3000000.0	UINT32 R/W per. -	Modbus 1620
`RAMP_v_acc`	Acceleration of the motion profile for velocity (244) Writing the value 0 has no effect on the parameter. Changed settings become active the next time the motor moves.	usr_a 1 600 2147483647	UINT32 R/W per. -	Modbus 1556
`RAMP_v_dec`	Deceleration of the motion profile for velocity (244) The minimum value depends on the operating mode: Operating modes with minimum value 1: Electronic Gear (velocity synchronization) Profile Velocity Operating modes with minimum value 120: Jog Writing the value 0 has no effect on the parameter. Changed settings become active the next time the motor moves.	usr_a 1 600 2147483647	UINT32 R/W per. -	Modbus 1558
`RAMP_v_enable`	Activation of the motion profile for velocity (244) **0 / Profile Off**: Profile off **1 / Profile On**: Profile on The motion profile for velocity can be activated or deactivated for the operating modes Profile Velocity and Electronic Gear (velocity synchronization). Setting can only be changed if power stage is disabled. Changed settings become active immediately.	- 0 0 1	UINT16 R/W per. -	Modbus 1622

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMP_v_jerk ConF → drC- JEr	Jerk limitation of the motion profile for velocity (270) **0 / Off /** oFF: Off **1 / 1 /** 1: 1 ms **2 / 2 /** 2: 2 ms **4 / 4 /** 4: 4 ms **8 / 8 /** 8: 8 ms **16 / 16 /** 16: 16 ms **32 / 32 /** 32: 32 ms **64 / 64 /** 64: 64 ms **128 / 128 /** 128: 128 ms Adjustments can only be made if the operating mode is inactive (x_end=1). Changed settings become active the next time the motor moves.	ms 0 0 128	UINT16 R/W per. -	Modbus 1562
RAMP_v_max ConF → ACG- nrMP	Maximum velocity of the motion profile for velocity (244) If a greater reference speed is set in one of these operating modes, it is automatically limited to RAMP_v_max. This way, commissioning at limited speed is easier to perform. Setting can only be changed if power stage is disabled. Changed settings become active the next time the motor moves.	usr_v 1 13200 2147483647	UINT32 R/W per. -	Modbus 1554
RAMPaccdec	Acceleration and deceleration for the Drive Profile Lexium High word: Acceleration Low word: Deceleration The values are internally multiplied by 10 (example: 1 = 10 min^{-1}/s). Write access changes the values in RAMP_v_acc and RAMP_v_dec. The limit values are checked on the basis of the values indicated for these parameters. If the value cannot be represented as a 16 bit value, the value is set to 65535 (maximum UINT16 value). Changed settings become active the next time the motor moves.	- - - -	UINT32 R/W - -	Modbus 1540
RAMPquickstop	Deceleration ramp for Quick Stop (264) Deceleration ramp for a software stop or an error with error class 1 or 2. Changed settings become active the next time the motor moves.	usr_a 1 6000 2147483647	UINT32 R/W per. -	Modbus 1572
RESext_P ConF → ACG- Pobr	Nominal power of external braking resistor (169) Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	W 1 10 32767	UINT16 R/W per. -	Modbus 1316

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RESext_R ConF → ACG- rbr	Resistance value of external braking resistor (169) The minimum value depends on the power stage. In increments of 0.01 Ω. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	Ω - 100.00 327.67	UINT16 R/W per. -	Modbus 1318
RESext_ton ConF → ACG- tbr	Maximum permissible switch-on time of external braking resistor (169) Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	ms 1 1 30000	UINT16 R/W per. -	Modbus 1314
RESint_ext ConF → ACG- Eibr	Selection of internal or external braking resistor (169) **0 / Internal Braking Resistor / int**: Internal braking resistor **1 / External Braking Resistor / Eht**: External braking resistor Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 0 1	UINT16 R/W per. -	Modbus 1298
ScalePOSdenom	Position scaling: Denominator (227) Refer to numerator (ScalePOSnum) for a description. A new scaling is activated when the numerator value is supplied. Setting can only be changed if power stage is disabled.	usr_p 1 16384 2147483647	INT32 R/W per. -	Modbus 1550
ScalePOSnum	Position scaling: Numerator (227) Specification of the scaling factor: Motor revolutions -- User-defined units [usr_p] A new scaling is activated when the numerator value is supplied. Setting can only be changed if power stage is disabled. Changed settings become active immediately.	revolution 1 1 2147483647	INT32 R/W per. -	Modbus 1552

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
`ScaleRAMPdenom`	Ramp scaling: Denominator (229) Refer to numerator (ScaleRAMPnum) for a description. A new scaling is activated when the numerator value is supplied. Setting can only be changed if power stage is disabled.	usr_a 1 1 2147483647	INT32 R/W per. -	Modbus 1632
`ScaleRAMPnum`	Ramp scaling: Numerator (229) Setting can only be changed if power stage is disabled. Changed settings become active immediately.	min^{-1}/s 1 1 2147483647	INT32 R/W per. -	Modbus 1634
`ScaleVELdenom`	Velocity scaling: Denominator (228) Refer to numerator (ScaleVELnum) for a description. A new scaling is activated when the numerator value is supplied. Setting can only be changed if power stage is disabled.	usr_v 1 1 2147483647	INT32 R/W per. -	Modbus 1602
`ScaleVELnum`	Velocity scaling: Numerator (228) Specification of the scaling factor: Speed of rotation of motor [min^{-1}] -- User-defined units [usr_v] A new scaling is activated when the numerator value is supplied. Setting can only be changed if power stage is disabled. Changed settings become active immediately.	min^{-1} 1 1 2147483647	INT32 R/W per. -	Modbus 1604
`ShiftEncWorkRang`	Shifting of the encoder working range (167) **0 / Off**: Shifting off **1 / On**: Shifting on Value 0: Position values are between 0 ... 4096 revolutions. Value 1: Position values are between -2048 ... 2048 revolutions. After activating the shifting function, the position range of a multiturn encoder is shifted for half of the range. Example for the position range of a multiturn encoder with 4096 revolutions. Changed settings become active the next time the product is switched on.	- 0 0 1	UINT16 R/W per. -	Modbus 1346

Parameter name HMI menu HMI name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
SimAbsolutePos ConF → ACG- qAbS	Simulation of absolute position at power cycling **0 / Simulation Off / oFF**: Do not use the last mechanical position after power cycling **1 / Simulation On / on**: Use last mechanical position after power cycling This parameter defines the way position values are handled over a power cycle and allows for the simulation of an absolute position encoder using singleturn encoders. If this function is activated, the device saves the relevant position data before a shutdown to restore the mechanical position the next time it is switched on. In the case of singleturn encoders, the position can be restored if the motor shaft is not moved by more than 0.25 revolutions while the drive is off. In the case of multiturn encoders, the permissible shaft movement while the drive is off can be much greater, depending on the type of multiturn encoder. For this function to work, the drive may only be shut down while the motor is at a standstill and the motor shaft must not be moved outside of the permissible range (for example, use a brake). Changed settings become active immediately.	- 0 0 1	UINT16 R/W per. -	Modbus 1350

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12 Accessories and spare parts

12

12.1 Commissioning tools

Description	Order no.
Commissioning software Lexium CT can be downloaded at: www.schneider-electric.com	-
PC connection kit, serial connection between drive and PC, USB-A to RJ45	TCSMCNAM3M002P
Multiloader, device for copying the parameter settings to a PC or to another drive	VW3A8121
Modbus cable, 1 m, 2 x RJ45	VW3A8306R10
External graphic display terminal	VW3A1101

12.2 Memory cards

Description	Order no.
Memory card for copying parameter settings	VW3M8705
25 memory cards for copying parameter settings	VW3M8704

12.3 Application nameplate

Description	Order no.
Application name plate to be clipped onto the top of the drive, size 38.5 mm x 13 mm for label size 1.5 inches x 0.5 inches, 50 pieces	VW3M2501

12.4 Adapter cable for encoder signals LXM05/LXM15 to LXM32

Description	Order no.
Encoder adapter cable Molex 10-pin (LXM05) to RJ45 10-pin (LXM32), 1 m	VW3M8111R10
Encoder adapter cable D15-SUB (LXM15) to RJ45 10-pin (LXM32), 1 m	VW3M8112R10

12.5 Cables for PTO and PTI

Description	Order no.
Signal cable 2 x RJ45, PTO to PTI, 0.3 m	VW3M8502R03
Signal cable 2 x RJ45, PTO to PTI, 1.5 m	VW3M8502R15
Signal cable 1 x RJ45, other cable end open, for connecting PTI in the control cabinet, 3 m	VW3M8223R30

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12.6 Motor cables

12.6.1 Motor cables 1.5 mm^2

For BMH070, BMH100 (flange 70 mmand 100 mm).

Description	Order no.
Motor cable 1.5 m, [(4 x 1.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5101R15
Motor cable 3 m, [(4 x 1.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5101R30
Motor cable 5 m, [(4 x 1.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5101R50
Motor cable 10 m, [(4 x 1.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5101R100
Motor cable 15 m, [(4 x 1.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5101R150
Motor cable 20 m, [(4 x 1.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5101R200
Motor cable 25 m, [(4 x 1.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5101R250
Motor cable 50 m, [(4 x 1.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5101R500
Motor cable 75 m, [(4 x 1.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5101R750
Motor cable 25 m, [(4 x 1.5 mm^2) + (2 x 1 mm^2)] shielded; both cable ends open	VW3M5301R250
Motor cable 50 m, [(4 x 1.5 mm^2) + (2 x 1 mm^2)] shielded; both cable ends open	VW3M5301R500
Motor cable 100 m, [(4 x 1.5 mm^2) + (2 x 1 mm^2)] shielded; both cable ends open	VW3M5301R1000

12.6.2 Motor cables 2.5 mm^2

For BMH140, (flange 140 mm).

Description	Order no.
Motor cable 1.5 m, [(4 x 2.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5102R15
Motor cable 3 m, [(4 x 2.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5102R30
Motor cable 5 m, [(4 x 2.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5102R50
Motor cable 10 m, [(4 x 2.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5102R100
Motor cable 15 m, [(4 x 2.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5102R150
Motor cable 20 m, [(4 x 2.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5102R200
Motor cable 25 m, [(4 x 2.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5102R250
Motor cable 50 m, [(4 x 2.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5102R500
Motor cable 75 m, [(4 x 2.5 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M23, other cable end open	VW3M5102R750

Description	Order no.
Motor cable 25 m, [(4 x 2.5 mm^2) + (2 x 1 mm^2)] shielded; both cable ends open	VW3M5302R250
Motor cable 50 m, [(4 x 2.5 mm^2) + (2 x 1 mm^2)] shielded; both cable ends open	VW3M5302R500
Motor cable 100 m, [(4 x 2.5 mm^2) + (2 x 1 mm^2)] shielded; both cable ends open	VW3M5302R1000

12.6.3 Motor cables 4 mm^2

For BMH205, (flange 205 mm).

Description	Order no.
Motor cable 3 m, [(4 x 4 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M40, other cable end open	VW3M5103R30
Motor cable 5 m, [(4 x 4 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M40, other cable end open	VW3M5103R50
Motor cable 10 m, [(4 x 4 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M40, other cable end open	VW3M5103R100
Motor cable 15 m, [(4 x 4 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M40, other cable end open	VW3M5103R150
Motor cable 20 m, [(4 x 4 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M40, other cable end open	VW3M5103R200
Motor cable 25 m, [(4 x 4 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M40, other cable end open	VW3M5103R250
Motor cable 50 m, [(4 x 4 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M40, other cable end open	VW3M5103R500
Motor cable 75 m, [(4 x 4 mm^2) + (2 x 1 mm^2)] shielded; motor end 8-pin circular connector M40, other cable end open	VW3M5103R750
Motor cable 25 m, [(4 x 4 mm^2) + (2 x 1 mm^2)] shielded; both cable ends open	VW3M5303R250
Motor cable 50 m, [(4 x 4 mm^2) + (2 x 1 mm^2)] shielded; both cable ends open	VW3M5303R500
Motor cable 100 m, [(4 x 4 mm^2) + (2 x 1 mm^2)] shielded; both cable ends open	VW3M5303R1000

12.7 Encoder cables

Suitable for BMH motors:

Description	Order no.
Encoder cable 1.5 m, [3 x (2 x 0.14 mm^2) + (2 x 0.34 mm^2)] shielded; motor end 12-pin circular connector M23, device end 10-pin connector RJ45	VW3M8102R15
Encoder cable 3 m, [3 x (2 x 0.14 mm^2) + (2 x 0.34 mm^2)] shielded; motor end 12-pin circular connector M23, device end 10-pin connector RJ45	VW3M8102R30
Encoder cable 5 m, [3 x (2 x 0.14 mm^2) + (2 x 0.34 mm^2)] shielded; motor end 12-pin circular connector M23, device end 10-pin connector RJ45	VW3M8102R50
Encoder cable 10 m, [3 x (2 x 0.14 mm^2) + (2 x 0.34 mm^2)] shielded; motor end 12-pin circular connector M23, device end 10-pin connector RJ45	VW3M8102R100
Encoder cable 15 m, [3 x (2 x 0.14 mm^2) + (2 x 0.34 mm^2)] shielded; motor end 12-pin circular connector M23, device end 10-pin connector RJ45	VW3M8102R150
Encoder cable 20 m, [3 x (2 x 0.14 mm^2) + (2 x 0.34 mm^2)] shielded; motor end 12-pin circular connector M23, device end 10-pin connector RJ45	VW3M8102R200
Encoder cable 25 m, [3 x (2 x 0.14 mm^2) + (2 x 0.34 mm^2)] shielded; motor end 12-pin circular connector M23, device end 10-pin connector RJ45	VW3M8102R250
Encoder cable 50 m, [3 x (2 x 0.14 mm^2) + (2 x 0.34 mm^2)] shielded; motor end 12-pin circular connector M23, device end 10-pin connector RJ45	VW3M8102R500

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Description	Order no.
Encoder cable 75 m, [3 x (2 x 0.14 mm^2) + (2 x 0.34 mm^2)] shielded; motor end 12-pin circular connector M23, device end 10-pin connector RJ45	VW3M8102R750
Encoder cable 25 m, [3 x (2 x 0.14 mm^2) + (2 x 0.34 mm^2)] shielded; both cable ends open	VW3M8222R25
Encoder cable 50 m, [3 x (2 x 0.14 mm^2) + (2 x 0.34 mm^2)] shielded; both cable ends open	VW3M8222R500
Encoder cable 100 m, [3 x (2 x 0.14 mm^2) + (2 x 0.34 mm^2)] shielded; both cable ends open	VW3M8222R1000
D9-SUB (male) connector, for encoder module resolver	AEOCON011
Encoder cable100 m, [5*(2*0.25 mm^2)] and [1*(2*0.5 mm^2)] shielded; both cable ends open	VW3M8221R1000
Encoder cable 1 m, shielded; HD15 D-SUB (male); other cable end open	VW3M4701
Encoder cable 5 m, shielded; HD15 D-SUB (male); other cable end open	VW3M4705

12.8 Connector

Description	Order no.
Encoder connector (cable end) for motor M23, 5 pcs	VW3M8214
Encoder connector (cable end) for drive RJ45 (10 pins), 5 pcs	VW3M2208
Motor connector (cable end) M23, 1.5 ... 2.5 mm^2, 5 pcs	VW3M8215
Motor connector (cable end) M40, 4 mm^2, 5 pcs	VW3M8217

Tools The tools required for cable assembly can be ordered directly from the manufacturer.

- Crimping tool for encoder connector M23:
  Coninvers SF-Z0007 www.coninvers.com
- Crimping tools for encoder connector RJ45 10 pins:
  Yamaichi Y-ConTool-11, Y-ConTool-20, Y-ConTool-30
  www.yamaichi.com
- Crimping tool for power connector M23/M40:
  Coninvers SF-Z0008 www.coninvers.com

12.9 External braking resistors

Description	Order no.
Braking resistor IP65; 10 Ω; maximum continuous power 400 W; 0.75 m connection cable, UL	VW3A7601R07
Braking resistor IP65; 10 Ω; maximum continuous power 400 W; 2 m connection cable, UL	VW3A7601R20
Braking resistor IP65; 10 Ω; maximum continuous power 400 W; 3 m connection cable, UL	VW3A7601R30
Braking resistor IP65; 27 Ω; maximum continuous power 100 W; 0.75 m connection cable, UL	VW3A7602R07
Braking resistor IP65; 27 Ω; maximum continuous power 100 W; 2 m connection cable, UL	VW3A7602R20
Braking resistor IP65; 27 Ω; maximum continuous power 100 W; 3 m connection cable, UL	VW3A7602R30
Braking resistor IP65; 27 Ω; maximum continuous power 200 W; 0.75 m connection cable, UL	VW3A7603R07
Braking resistor IP65; 27 Ω; maximum continuous power 200 W; 2 m connection cable, UL	VW3A7603R20
Braking resistor IP65; 27 Ω; maximum continuous power 200 W; 3 m connection cable, UL	VW3A7603R30
Braking resistor IP65; 27 Ω; maximum continuous power 400 W; 0.75 m connection cable, UL	VW3A7604R07
Braking resistor IP65; 27 Ω; maximum continuous power 400 W; 2 m connection cable, UL	VW3A7604R20
Braking resistor IP65; 27 Ω; maximum continuous power 400 W; 3 m connection cable, UL	VW3A7604R30

Description	Order no.
Braking resistor IP65; 72 Ω; maximum continuous power 100 W; 0.75 m connection cable, UL	VW3A7605R07
Braking resistor IP65; 72 Ω; maximum continuous power 100 W; 2 m connection cable, UL	VW3A7605R20
Braking resistor IP65; 72 Ω; maximum continuous power 100 W; 3 m connection cable, UL	VW3A7605R30
Braking resistor IP65; 72 Ω; maximum continuous power 200 W; 0.75 m connection cable, UL	VW3A7606R07
Braking resistor IP65; 72 Ω; maximum continuous power 200 W; 2 m connection cable, UL	VW3A7606R20
Braking resistor IP65; 72 Ω; maximum continuous power 200 W; 3 m connection cable, UL	VW3A7606R30
Braking resistor IP65; 72 Ω; maximum continuous power 400 W; 0.75 m connection cable	VW3A7607R07
Braking resistor IP65; 72 Ω; maximum continuous power 400 W; 2 m connection cable	VW3A7607R20
Braking resistor IP65; 72 Ω; maximum continuous power 400 W; 3 m connection cable	VW3A7607R30
Braking resistor IP65; 100 Ω; maximum continuous power 100 W; 0.75 m connection cable	VW3A7608R07
Braking resistor IP65; 100 Ω; maximum continuous power 100 W; 2 m connection cable	VW3A7608R20
Braking resistor IP65; 100 Ω; maximum continuous power 100 W; 3 m connection cable	VW3A7608R30
Braking resistor IP20; 15 Ω; maximum continuous power 2500 W; connection terminals, UL	VW3A7704
Braking resistor IP20; 10 Ω; maximum continuous power 2500 W; connection terminals, UL	VW3A7705

12.10 DC bus accessories

Description	Order no.
LXM ATV DC bus connection cable, pre-assembled, 0.1 m, 5 pieces	VW3M7101R01
DC bus connector kit, connector housing and contacts, 10 pieces	VW3M2207

12.11 Mains reactors

Description	Order no.
Mains reactor 1~; 50-60Hz; 7A; 5mH; IP00	VZ1L007UM50
Mains reactor 1~; 50-60Hz; 18A; 2mH; IP00	VZ1L018UM20
Mains reactor 3~; 50-60Hz; 16A; 2mH; IP00	VW3A4553
Mains reactor 3~; 50-60Hz; 30A; 1mH; IP00	VW3A4554

12.12 External mains filters

Description	Order no.
Mains filter 1~; 9 A; 115/230 VAC for LXM32	VW3A4420
Mains filter 1~; 16 A; 115/230 VAC for LXM32	VW3A4421
Mains filter 3~; 15A; 208/400/480VAC for LXM32	VW3A4422
Mains filter 3~; 25A; 208/400/480VAC for LXM32	VW3A4423

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12.13 Spare parts connectors, fans, cover plates

Description	Order no.
Connector kit LXM32C: 3 x AC power stage supply (230/400 V_{ac}), 1 x control supply, 3 x digital inputs/outputs (4-pin), 2 x motor (10 A / 24 A), 1 x holding brake	VW3M2201
Cooling fan kit 40 mm x 40 mm, plastic housing, with connection cable	VW3M2401
Cooling fan kit 60 mm x 60 mm, plastic housing, with connection cable	VW3M2402
Cooling fan kit 80 mm x 80 mm, plastic housing, with connection cable	VW3M2403

13 Service, maintenance and disposal

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The product may only be repaired by a Schneider Electric customer service center. No warranty or liability is accepted for repairs made by unauthorized persons.

13.1 Service address

If you cannot resolve an error yourself please contact your sales office. Have the following details available:

- Nameplate (type, identification number, serial number, DOM, ...)
- Type of error (with LED flash code or error number)
- Previous and concomitant circumstances
- Your own assumptions concerning the cause of the error

Also include this information if you return the product for inspection or repair.

If you have any questions please contact your sales office. Your sales office staff will be happy to give you the name of a customer service office in your area.

http://www.schneider-electric.com

13.2 Maintenance

Check the product for pollution or damage at regular intervals.

13.2.1 Lifetime STO safety function

The STO safety function is designed for a lifetime of 20 years. After this period, the data of the safety function are no longer valid. The expiry date is determined by adding 20 years to the DOM shown on the nameplate of the product.

▶ This date must be included in the maintenance plan of the system.

Do not use the safety function after this date.

Example The DOM on the nameplate of the product is shown in the format DD.MM.YY, for example 31.12.08. (31 December 2008). This means: Do not use the safety function after December 31, 2028.

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13.3 Replacing devices

⚠ WARNING

UNINTENDED BEHAVIOR

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

- Do NOT operate the drive system with unknown settings or data.
- Verify that the stored data and settings are correct.
- When commissioning, carefully run tests for all operating states and potential error situations.
- Verify the functions after replacing the product and also after making changes to the settings or data.
- Only start the system if there are no persons or obstructions in the hazardous area.

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

Prepare a list with the parameters required for the functions used.

Observe the following procedure when replacing devices.

- ▶ Save all parameter settings. To do so, use a memory card, see chapter 7.8 "Memory Card", page 185, or save the data to a PC using the commissioning software, see chapter 7.5 "Commissioning software", page 146.
- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Label all connections and remove all connection cables (unlock connector locks).
- ▶ 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".
- ▶ If the product to be installed has previously been used in a different system or application, you must restore the factory settings before commissioning the product.
- ▶ Commission the product as per chapter 7 "Commissioning".

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13.4 Changing the motor

⚠ WARNING

UNEXPECTED MOVEMENT

Drive systems may perform unexpected movements because of incorrect connection or other errors.

- Operate the device with approved motors only. Even if motors are similar, different adjustment of the encoder system may be a source of hazards.
- Even if the connectors for power connection and encoder match mechanically, this does NOT imply that they may be used.

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

▶ 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".

If the connected motor is replaced by another motor, the motor data set is read again. If the device detects a different motor type, the controller parameters are recalculated and the HMI displays MOt. See chapter 10.3.3 "Acknowledging a motor change", page 303 for additional information.

If the motor is replaced, the encoder parameters must also be re-adjusted, see chapter 7.6.9 "Setting parameters for encoder", page 164.

Changing the motor type temporarily

▶ If you want to operate the new motor type only temporarily via the device, press ESC at the HMI.

◁ The newly calculated controller parameters are not saved to the EEPROM. This way, you can resume operation with the original motor using the saved controller parameters.

Changing the motor type permanently

▶ If you want to operate the new motor type permanently via this device, press the navigation button at the HMI.

◁ The newly calculated controller parameters are saved to the EEPROM.

See also chapter 10.3.3 "Acknowledging a motor change", page 303.

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13.5 Shipping, storage, disposal

Note the ambient conditions on page 21.

Shipping The product must be protected against shocks during transportation. If possible, use the original packaging for shipping.

Storage The product may only be stored in spaces where the specified permissible ambient conditions are met.
Protect the product from dust and dirt.

Disposal The product consists of various materials that can be recycled. Dispose of the product in accordance with local regulations.

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14 Glossary

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14.1 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

14.1.1 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	-

14.1.2 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	/ 0.45359237	/ 0.02834952	/ 14.5939	-	* 1000
g	/ 453.59237	/ 28.34952	/ 14593.9	/ 1000	-

14.1.3 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	/ $9.807*10^{-3}$	* $100*10^{3}$	-

14.1.4 Power

	HP	W
HP	-	* 746
W	/ 746	-

14.1.5 Rotation

	min^{-1} (RPM)	rad/s	deg./s
min^{-1} (RPM)	-	* π / 30	* 6
rad/s	* 30 / π	-	* 57.295
deg./s	/ 6	/ 57.295	-

14.1.6 Torque

	lb·in	lb·ft	oz·in	Nm	kp·m	kp·cm	dyne·cm
lb·in	-	/ 12	* 16	* 0.112985	* 0.011521	* 1.1521	* $1.129*10^6$
lb·ft	* 12	-	* 192	* 1.355822	* 0.138255	* 13.8255	* $13.558*10^6$
oz·in	/ 16	/ 192	-	* $7.0616*10^{-3}$	* $720.07*10^{-6}$	* $72.007*10^{-3}$	* 70615.5
Nm	/ 0.112985	/ 1.355822	/ $7.0616*10^{-3}$	-	* 0.101972	* 10.1972	* $10*10^6$
kp·m	/ 0.011521	/ 0.138255	/ $720.07*10^{-6}$	/ 0.101972	-	* 100	* $98.066*10^6$
kp·cm	/ 1.1521	/ 13.8255	/ $72.007*10^{-3}$	/ 10.1972	/ 100	-	* $0.9806*10^6$
dyne·cm	/ $1.129*10^6$	/ $13.558*10^6$	/ 70615.5	/ $10*10^6$	/ $98.066*10^6$	/ $0.9806*10^6$	-

14.1.7 Moment of inertia

	lb·in²	lb·ft²	kg·m²	kg·cm²	kp·cm·s²	oz·in²
lb·in²	-	/ 144	/ 3417.16	/ 0.341716	/ 335.109	* 16
lb·ft²	* 144	-	* 0.04214	* 421.4	* 0.429711	* 2304
kg·m²	* 3417.16	/ 0.04214	-	* $10*10^3$	* 10.1972	* 54674
kg·cm²	* 0.341716	/ 421.4	/ $10*10^3$	-	/ 980.665	* 5.46
kp·cm·s²	* 335.109	/ 0.429711	/ 10.1972	* 980.665	-	* 5361.74
oz·in²	/ 16	/ 2304	/ 54674	/ 5.46	/ 5361.74	-

14.1.8 Temperature

	°F	°C	K
°F	-	(°F - 32) * 5/9	(°F - 32) * 5/9 + 273.15
°C	°C * 9/5 + 32	-	°C + 273.15
K	(K - 273.15) * 9/5 + 32	K - 273.15	-

14.1.9 Conductor cross section

AWG	1	2	3	4	5	6	7	8	9	10	11	12	13
mm²	42.4	33.6	26.7	21.2	16.8	13.3	10.5	8.4	6.6	5.3	4.2	3.3	2.6

AWG	14	15	16	17	18	19	20	21	22	23	24	25	26
mm²	2.1	1.7	1.3	1.0	0.82	0.65	0.52	0.41	0.33	0.26	0.20	0.16	0.13

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14.2 Terms and Abbreviations

See chapter 2.7 "Standards and terminology" for information on the pertinent standards on which many terms are based. Some terms and abbreviations may have specific meanings with regard to the standards.

AC Alternating current

Actual position Current position of moving components in the drive system.

CCW **C**ounter **C**lock**w**ise.

CW **C**lock**w**ise.

DC Direct current

DC bus Circuit that supplies the power stage with energy (direct voltage).

DOM **D**ate **o**f **m**anufacturing: The nameplate of the product shows the date of manufacture in the format DD.MM.YY or in the format DD.MM.YYYY. Example:
31.12.09 corresponds to December 31, 2009
31.12.2009 corresponds to December 31, 2009

Degree of protection 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).

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

Drive system System consisting of controller, power stage and motor.

EMC Electromagnetic compatibility

Electronic gear Calculation of a new output velocity for the motor movement based on the input velocity and the values of an adjustable gear ratio; calculated by the drive system.

Encoder Sensor for detection of the angular position of a rotating component. Installed in a motor, the encoder shows the angular position of the rotor.

Error Discrepancy between a computed, observed or measured value or condition and the specified or theoretically correct value or condition.

Error class Classification of errors into groups. The different error classes allow for specific responses to errors, for example by severity.

Factory setting Factory settings when the product is shipped

Fatal error In the case of fatal error, the product is no longer able to control the motor so that the power stage must be immediately disabled.

Fault Fault is a state that can be caused by an error. Further information can be found in the pertinent standards such as IEC 61800-7, ODVA Common Industrial Protocol (CIP).

Fault reset A function used to restore the drive to an operational state after a detected error is cleared by removing the cause of the error so that the error is no longer active.

Holding brake The holding brake in the motor has the task of holding the current motor position when the power stage is disabled, even if external forces act (for example, in the case of a vertical axis). The holding brake is not a safety function.

The signals of the holding brake meet the PELV requirements.

I/O Inputs/outputs

I^2t monitoring 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.

IT mains Mains in which all active components are isolated from ground or are grounded by a high impedance. IT: isolé terre (French), isolated ground. Opposite: Grounded mains, see TT/TN mains

Inc Increments

Index pulse Signal of an encoder to reference the rotor position in the motor. The encoder returns one index pulse per revolution.

Internal units Resolution of the power stage at which the motor can be positioned. Internal units are specified in increments.

Limit switch Switches that signal overtravel of the permissible range of travel.

PC Personal Computer

PELV Protective Extra Low Voltage, low voltage with isolation. For more information: IEC 60364-4-41

PLC Programmable logic controller

Parameter Device data and values that can be read and set (to a certain extent) by the user.

Persistent Indicates whether the value of the parameter remains in the memory after the device is switched off.

Power stage The power stage controls the motor. The power stage generates current for controlling the motor on the basis of the positioning signals from the controller.

Pulse/direction signals Digital signals with variable pulse frequencies which signal changes in position and direction of movement via separate signal wires.

Quick Stop Function which can be used for fast deceleration of the motor via a command or in the event of an error.

RCD RCD residual current device.

rms "Root Mean Square" value of a voltage (V_{rms}) or a current (A_{rms})

RS485 Fieldbus interface as per EIA-485 which enables serial data transmission with multiple devices.

Scaling factor This factor is the ratio between an internal unit and a user-defined unit.

TT mains, TN mains Grounded mains, differ in terms of the ground connection (PE conductor connection). Opposite: Ungrounded mains, see IT mains.

User-defined unit Unit whose reference to motor movement can be determined by the user via parameters.

Warning If the term is used outside the context of safety instructions, a warning alerts to a potential problem that was detected by a monitoring function. A warning does not cause a transition of the operating state.

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