ILE2K EtherNet/IP

Lexium Integrated Drive
Product manual

V1.00, 09.2009

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".

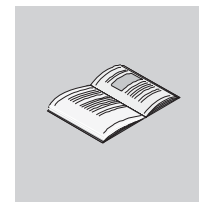Some products are not available in all countries.
For information on the availability of products, please consult the catalog.

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.
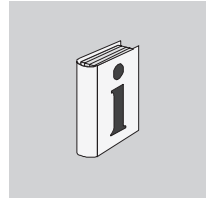
Table of contents

0198441113676, V1.00, 09.2009

About this manual

This manual is valid for ILE2K 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 product.

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`. A list of the parameters can be found in the product manual in the chapter Parameters.

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 $\overline{STO\_A}$ or $\overline{STO\_B}$.

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

Reference documents
- The CIP Networks Library
  Volume 1
  Common Industrial Protocol

- The CIP Networks Library
  Volume 3
  DeviceNet Adaption of CIP

- DeviceNet terms of Usage Agreement

  http://www.odva.org

User Association   **O**pen **D**eviceNet **V**endor **A**ssociation (ODVA)

http://www.odva.org

1 Introduction

1

1.1 Device overview
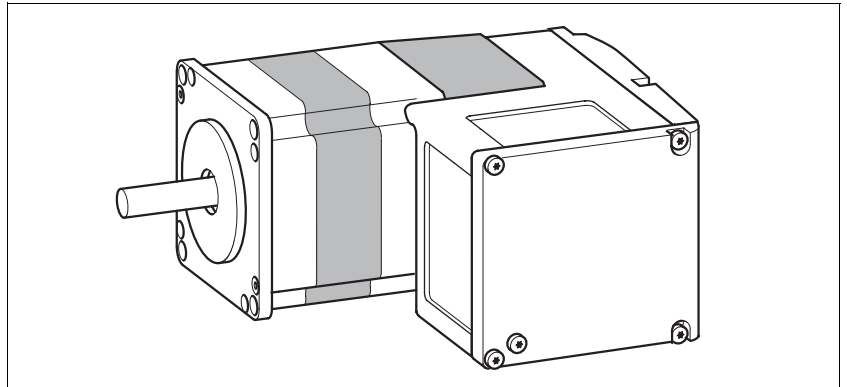
Figure 1.1 Device overview

The "Lexium Integrated Drive" consists of a brushless DC motor with integrated gearbox and integrated electronics. The product integrates interfaces, control electronics and the power stage.

The "Lexium Integrated Drive" moves the motor according to the commands received by a fieldbus master, for example, a PLC or a PC.

Safety function 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. This reduces the system costs and the response times.

Drive profile The product supports 2 drive profiles:

• CIP "Generic Profile"

• "Drive Profile Lexium"

1.2   Components and interfaces
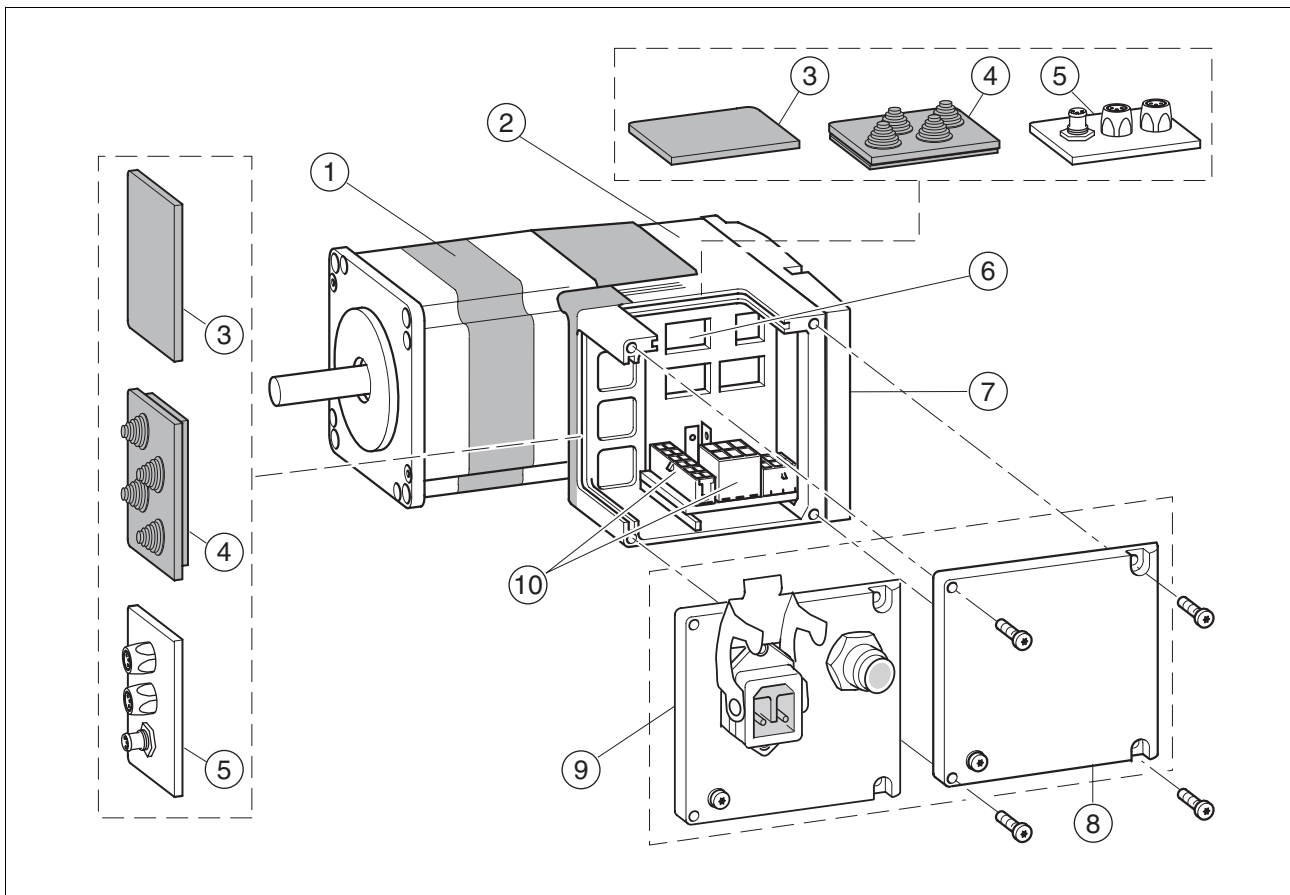
Figure 1.2   Components and interfaces

(1)   Brushless DC motor
(2)   Electronics housing
(3)   Insert for sealing (accessory)
(4)   Insert with cable entry (accessory)
(5)   I/O insert with industrial connector (accessory)
(6)   Parameter switches for settings
(7)   Cover of electronics housing, must not be removed
(8)   Cover of connector housing, to be removed for installation
(9)   Cover with industrial connector for VDC supply voltage and
             IN/OUT fieldbus connection (optional)
(10)   Electrical interfaces

1.2.1   Components

Motor   The motor is a brushless direct current motor with permanent magnet excitation with an internal resolution of 12 increments per revolution. The motor has a high detent torque, therefore a brake is not required for most applications.

Gearbox   The motor can be operated with a spur wheel gear.

The following gear ratios are available:

- Three-stage, 18:1 (160:9)

- Three-stage 38:1 (75:2)

- Four-stage 54:1 (490:9)

- Four-stage 115:1 (3675:32)

The motor can also be operated with a worm gear with hollow shaft.

The following gear ratios are available:

- Two-stage 24:1 (525:22)

- Three-stage 54:1 (1715:32)

- Three-stage 92:1 (735:5)

- Three-stage 115:1 (3675:32)

Electronics The electronic system comprises control electronics and power stage. Control electronics and power stage have a common power supply and are not galvanically isolated.

The product can be parameterized and controlled via the fieldbus interface.

4 digital 24V signals are also available. Each of these signals can be used as an input or output.

Encoder   The product operates with a BLDC encoder. When you switch off the product, the position of the singleturn encoder and the number of revolutions are saved internally.

For the correct motor position to be available again after the motor is switched on, the motor must not be turned when it is off.

Scaling of the product is set to 12 user-defined units per revolution because the motor physically engages at 12 rotor settings per revolution.

1.2.2   Interfaces

Supply voltage VDC

The supply voltage VDC supplies the control electronics and the power stage.

Fieldbus interface

The product features an EtherNet/IP fieldbus interface. This fieldbus interface is used for controlling and commissioning the drive.

Commissioning interface (RS485)

A commissioning interface is provided in addition to the fieldbus interface. The commissioning interface is used to commission the drive. You can also use the commissioning software to monitor the drive during operation.

It is possible to establish simultaneous connections via the commissioning interface and the fieldbus.

24 V signal interface

4 digital 24V signals are available. Each of these signals can be used as an input or output.

The 24V signals are available to the master controller. However, it is also possible to parameterize special functions such as connection of limit switches.

1.3　Nameplate

The nameplate contains the following data:
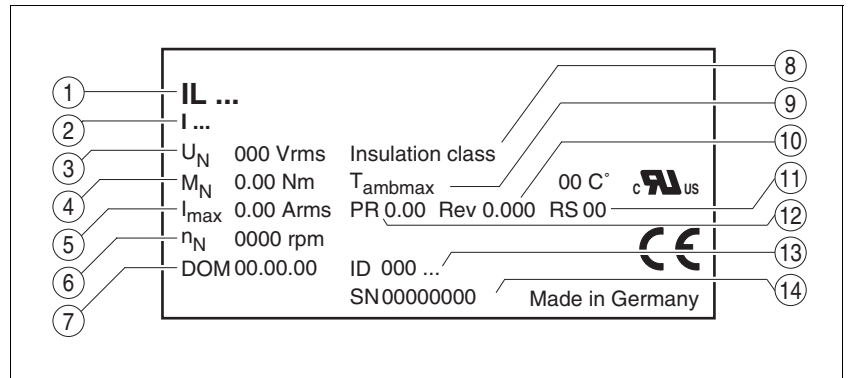
Figure 1.3　　Nameplate

(1)　　　　Type code
(2)　　　　Type code (old designation)
(3)　　　　Nominal voltage
(4)　　　　Nominal torque
(5)　　　　Maximum input current
(6)　　　　Nominal speed
(7)　　　　Date of manufacture
(8)　　　　Thermal class
(9)　　　　Maximum ambient air temperature
(10)　　　Software revision
(11)　　　Hardware revision
(12)　　　Firmware number
(13)　　　Material number
(14)　　　Serial number

1.4   Type code

| ILE | 2 | K | 66 | 1 | P | B | 1 | F | 0 | -- |

Motor
ILE = Brushless DC motor

Supply voltage
2 = 24 ... 48 V_{dc}

Communication interface
K = EtherNet/IP

Size
66 = 66 mm

Length
1 = 1 stack
2 = 2 stacks

Winding
P = Medium speed of rotation/medium torque

Connection version
B = Printed circuit board connector
C = Industrial connector

Position capture
1 = BLDC encoder

Holding brake
A = Without holding brake

Gearbox [1]
0 = Without gearbox
1 = Spur wheel gear 18:1 (160:9)
2 = Spur wheel gear 38:1 (75:2)
3 = Spur wheel gear 54:1 (490:9)
4 = Spur wheel gear 115:1 (3675:32)
5 = Worm gear with hollow shaft 24:1 (525:22)
6 = Worm gear with hollow shaft 54:1 (1715:32)
7 = Worm gear with hollow shaft 92:1 (735:5)
8 = Worm gear with hollow shaft 115:1 (3675:32)

Reserved

1) Not available for length 2.

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

Customized product   In the case of a customized product, position 9 is an "S".
Positions 10 ... 13 are the number of the customized product.

Example: IL••••••S1234--

1.5   Documentation and literature references

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

Reference documents   • [1] The CIP Networks Library
Volume 1
Common Industrial Protocol
Edition 3.1

• [2] The CIP Networks Library
Volume 2
EtherNet/IP Adaption of CIP
Edition 1.4

• [3] EtherNet/IP terms of Usage Agreement
ODVA: http://www.odva.org

User Association   **O**pen **D**eviceNet **V**endor **A**ssociation (ODVA)

http://www.odva.org

Recommended literature for further reading

• Ellis, George: Control System Design Guide. Academic Press

• Kuo, Benjamin; Golnaraghi, Farid: Automatic Control Systems. John Wiley & Sons

• Schiffer, Viktor, Rockwell Automation: The Common Industrial Protocol (CIP^{TM}) and the Family of CIP Networks. Publication Number: PUB00123R0, Open DeviceNet Vendor Association, Inc. (ODVA)

• Recommended IP Addressing Methods for EtherNet/IP Devices. Publication Number: PUB00028R0, Version 1.0, June 10, 2003, EtherNet/IP Implementors Workshop, Open DeviceNet Vendor Association (ODVA) ControlNet International (CI)

• Network Infrastructure for EtherNet/IPTM, Introduction and Considerations. Publication Number: PUB00035R0, Open DeviceNet Vendor Association, Inc. (ODVA)

• Performance Test Terminology for EtherNet/IP Devices. Publication Number: PUB00080R11, Version 1.1, March 14, 2005, EtherNet/IP Implementors Workshop ODVA

• IPv4 Address Conflict Detection for EtherNet/IP Devices. Publication Number: PUB00127R0, Version 1.5, June 6, 2006

• The CIP Advantage^{TM} Technology Overview Series. Publication Number: PUB00138R2, Open DeviceNet Vendor Association, Inc. (ODVA)

• Media Planning and Installation Manual. Publication Number: PUB00148R0, Open DeviceNet Vendor Association, Inc. (ODVA)

1.6 Declaration of conformity

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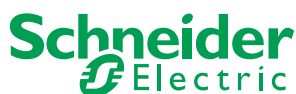
SCHNEIDER ELECTRIC MOTION DEUTSCHLAND GmbH & Co. KG
Breslauer Str. 7   D-77933 Lahr

EC DECLARATION OF CONFORMITY
YEAR 2008

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

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

Designation:	Motors with integrated control electronics
Type:	ILA, ILE, ILS
Product number:	0x6600xxxxxxx, 0x6610xxxxxxx, 0x66206xxxxxx, 0x66307xxxxxx 0x6640xxxxxxx, 0x66606xxxxxx, 0x66707xxxxxx
Applied harmonized standards, especially:	EN ISO 13849-1:2006, Performance Level "d" (category 3) EN 61800-3:2004, second environment EN 62061:2005, SILcl 2 EN 61508:2001, SIL 2
Applied national standards and technical specifications, especially:	UL 508C Product documentation
Company stamp:	Schneider Electric Motion Deutschland GmbH & Co. KG Postfach 11 80 · D-77901 Lahr Breslauer Str. 7 · D-77933 Lahr
Date/ Signature:	10 July 2008
Name/ Department:	Wolfgang Brandstätter/Development

1.7   TÜV certificate for functional safety

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 motor with an integrated drive 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.

2.3   Hazard categories

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

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

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

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

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

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

2.4   Basic information

⚠ **WARNING**

UNEXPECTED MOVEMENT

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

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

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

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

⚠ **WARNING**

LOSS OF CONTROL

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

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

---

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

> ### ⚠ WARNING
>
> **UNEXPECTED BEHAVIOR AND DESTRUCTION OF SYSTEM COMPO-NENTS**
>
> When you work on the wiring and when you unplug or plug in connec-tors, this may cause unexpected behavior and destruction of system components.
>
> •   Switch the power supply off before working on the wiring.
>
> **Failure to follow these instructions can result in death, serious injury or equipment damage.**

2.5   Functional safety

Using the safety functions integrated in this product requires careful planning. For more information see chapter5.4 "Safety function STO ("Safe Torque Off")" on page 52.

2.6   Standards and terminology

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

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

Among others, these standards include:

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

- IEC 61800-7 series: "Adjustable speed electrical power drive systems - Part 7-1: Generic interface and use of profiles for power drive systems - Interface definition"

- IEC 61158 series: "Industrial communication networks - Fieldbus specifications"

- IEC 61784 series: "Industrial communication networks - Profiles"

- IEC 61508 series: "Functional safety of electrical/electronic/programmable electronic safety-related systems"

Also see the glossary at the end of this manual.

3 Technical Data

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 Certifications

Product certifications:

Certified by	Assigned number	Validity
TÜV Nord	SAS-1728/08	2013-01-09
UL	File E 153659	-

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

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

3.2 Ambient conditions

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

Ambient temperature [1]	[°C]	0 ... 40
Ambient temperature with current reduction of 2 % per Kelvin [1]	[°C]	40 ... 55

1) Limit values with flanged motor (for example,. steel plate 300x300x10 mm)

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

Temperature

Max. temperature of power stage [1]	[°C]	105
Max. temperature of motor [2]	[°C]	110

1) Can be read via parameter
2) Measured on the surface

Relative humidity   The following relative humidity is permissible during operation:

Relative humidity	[%]	15 ... 85

Installation altitude   The installation altitude is defined as height above sea level.

Installation altitude without derating	[m]	<1000

Vibration and shock

Vibration, sinusoidal	As per IEC 60068-2-6 0.15 mm (from 10 Hz ... 60 Hz) 20 m/s^2 (from 60 Hz ... 500 Hz)
Shock, semi-sinusoidal	As per IEC 60068-2-27 150 m/s^2 (11 ms)

EMC

Emission	IEC 61800-3: category C2 IEC 61000-6-4 EN 55022: Class A
Noise immunity	IEC 61800-3: second environment

3.3 Mechanical data

3.3.1 Degree of protection

IP degree of protection   The product has the following IP degree of protection as per IEC 60529.
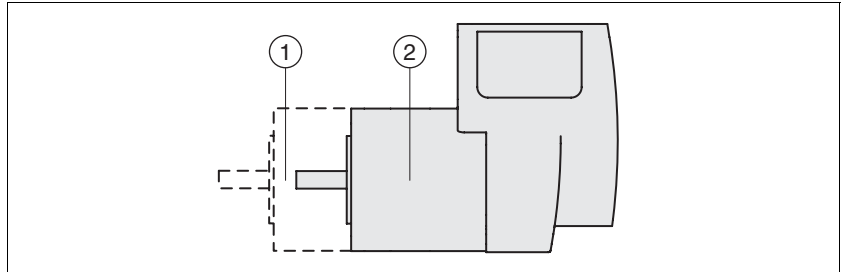
Figure 3.1   IP degree of protection

Item		Degree of protection
1	Shaft bushing	IP41
	Shaft bushing with GBX gearbox (accessory)	IP54
2	Housing, except shaft bushing	IP54

The total degree of protection is determined by the component with the lowest degree of protection.

Overview of IP degrees of protection

First digit		Second digit	
Protection against intrusion of objects		**Protection against intrusion of water**	
0	No protection	0	No protection
1	External objects >50 mm	1	Vertically falling dripping water
2	External objects >12 mm	2	Dripping water falling at an angle (75 ° ... 90 °)
3	External objects >2.5 mm	3	Spraying water
4	External objects >1 mm	4	Splashing water
5	Dust-protected	5	Water jets
6	Dust-tight	6	Heavy sea
		7	Immersion
		8	Submersion

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.

3.3.2 Mounting position

Mounting position   The following mounting positions are defined and approved as per IEC 60034-7:

- IM B5 drive shaft horizontal
- IM V1 drive shaft vertical, shaft end down
- IM V3 drive shaft vertical, shaft end up

3.3.3 Dimensions
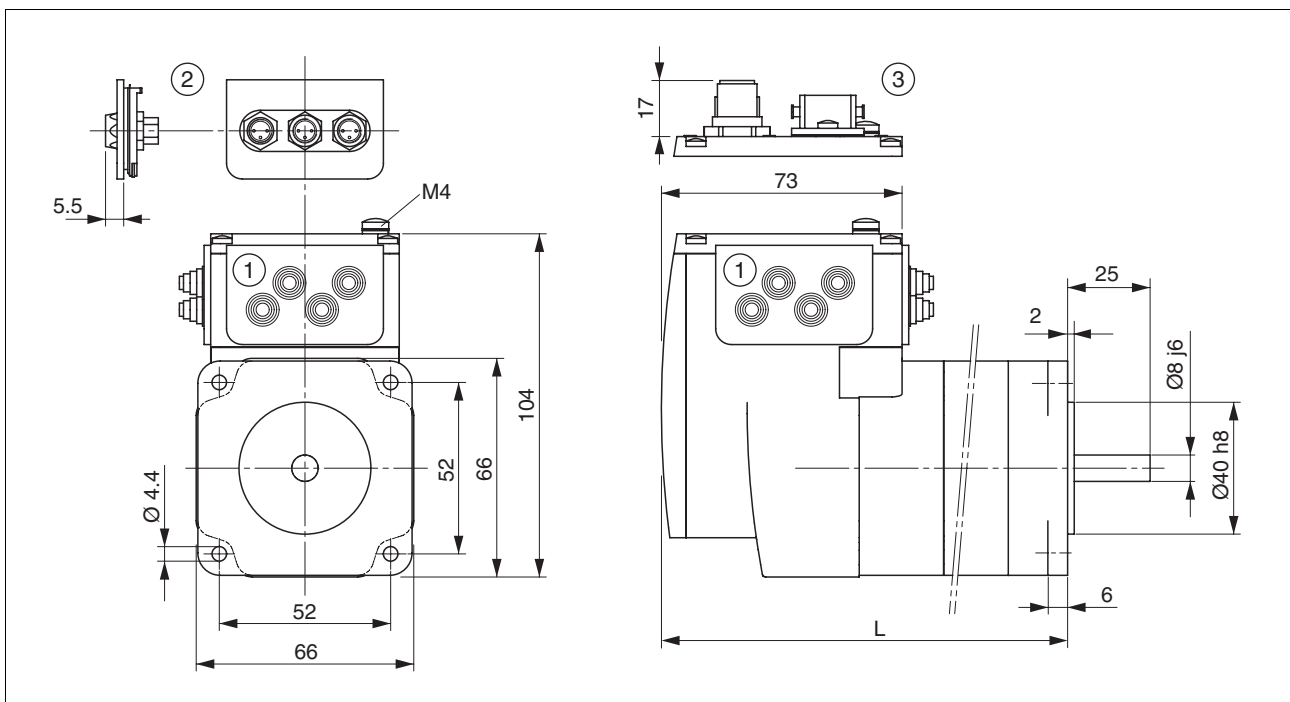
Figure 3.2   Dimensions

(1)   Insert with cable entry (accessory)
(2)   Insert kit (accessory)
(3)   Industrial connector (option)

Total length L

ILE••661...		P•1A0
L	[mm]	122

ILE••662...		P•1A0
L	[mm]	140
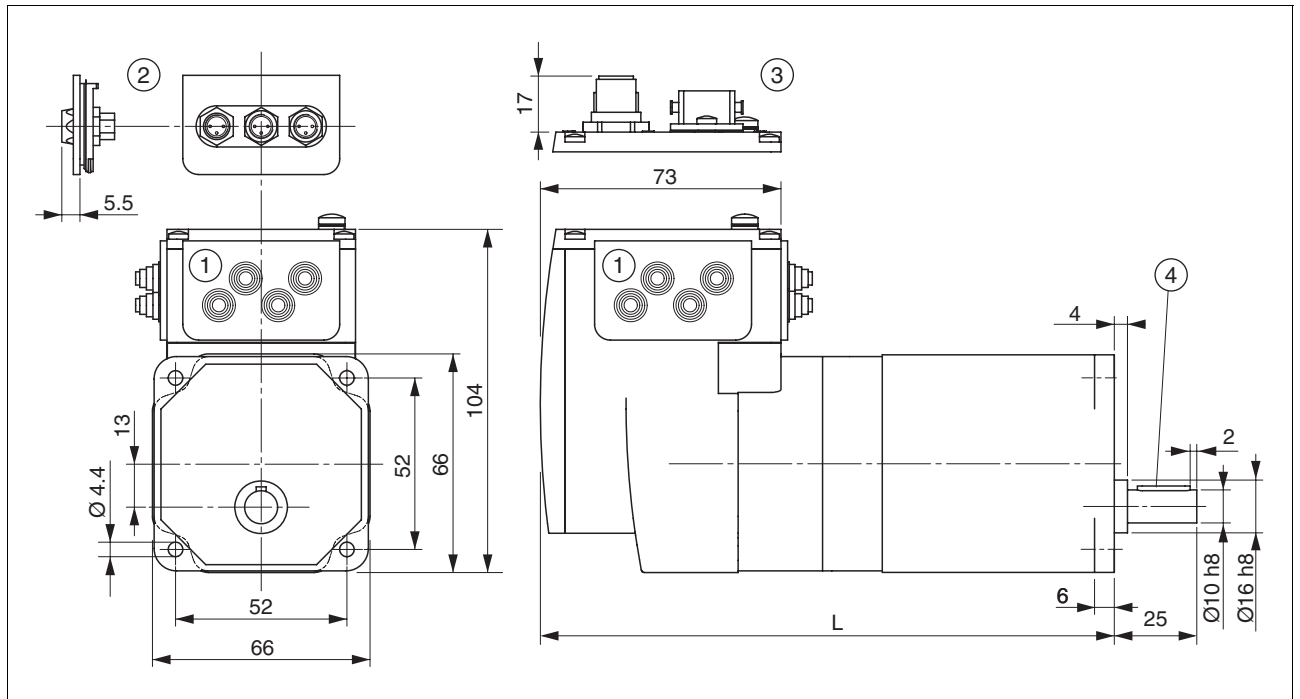
Figure 3.3   Dimensions

(1)   Insert with cable entry (accessory)
(2)   Insert kit (accessory)
(3)   Industrial connector (option)
(4)   Parallel key

Total length L

ILE••661...		P•1A1	P•1A2	P•1A3	P•1A4
L	[mm]	174	174	174	174
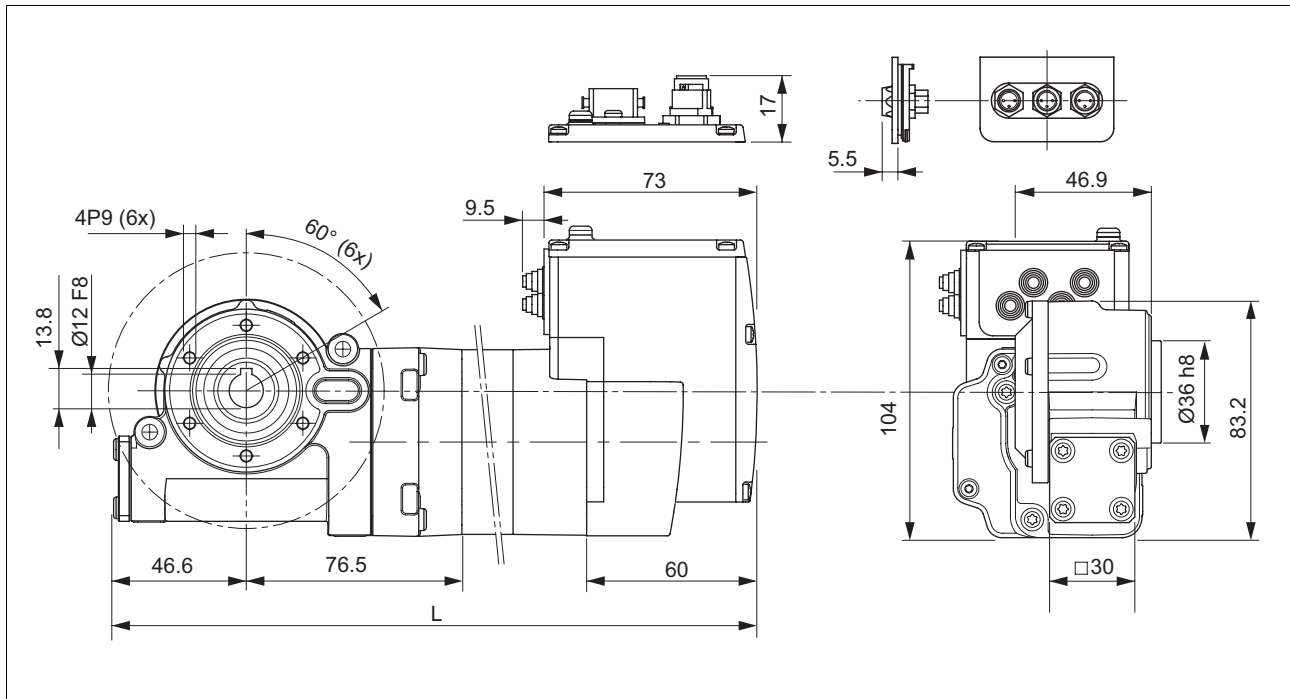
Figure 3.4   Dimensions

(1)   Insert with cable entry (accessory)
(2)   Insert kit (accessory)
(3)   Industrial connector (option)

Total length L

ILE••661...		P•1A6	P•1A7	P•1A8
L	[mm]	229	229	229

3.4   Electrical Data

Overview of printed circuit board connectors
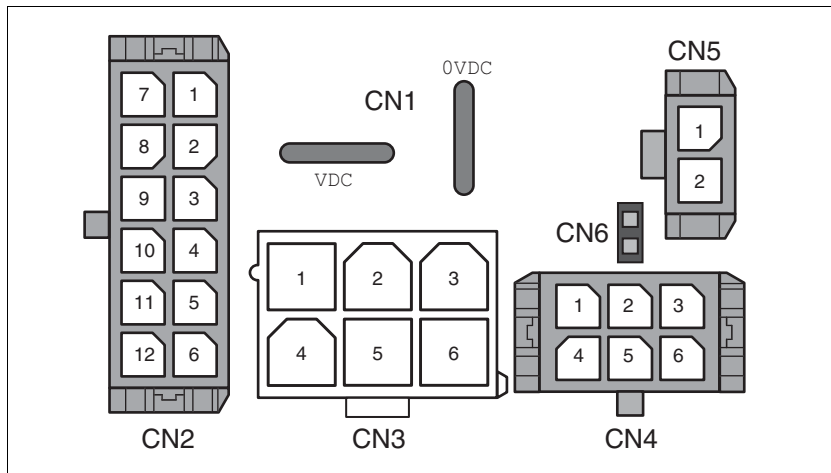
Figure 3.5   Overview of printed circuit board connectors

3.4.1   Supply voltage VDC at CN1

		ILE2•66•
Nominal voltage [1]	[V_{dc}]	24 / 48
Limit values [1]	[V_{dc}]	18 ... 55.2
Ripple at nominal voltage	[V_{pp}]	≤3.6
Max. continuous current input [2] Winding type P	[A]	5.5
Peak input current Winding type P	[A]	7
Fuse to be connected upstream [3]	[A]	≤16

1) If the product is to be used in compliance with UL 508C, note the information provided in chapter 3.5 "Conditions for UL 508C".
2) The actual power requirement is often significantly lower, because the maximum possible motor torque is usually not required for operation of a system.
3) See chapter 5.2.1 "Supply voltage"

Inrush current   Charging current for capacitor C=1500 µF

3.4.2   Fieldbus interface at CN2

EtherNet/IP signals   The EtherNet/IP signals comply with the IEEE 802.3 standard and are galvanically isolated.

Transmission rate	[MBit]	10 / 100
Transmission protocol		Modbus TCP

3.4.3   Commissioning interface (RS485) at CN3

RS485 signals   The RS485 signals comply with the RS485 standard and are not galvanically isolated.

Transmission rate	[kBaud]	9.6 / 19.2 / 38.4
Transmission protocol		Modbus RTU

3.4.4   24V signal interface at CN4

Signal inputs   The signal inputs are not protected against reverse polarity and not galvanically isolated.

Logic 0 (U_{low})	[V]	-3 ... +4.5
Logic 1 (U_{high})	[V]	+15 ... +30
Input current (typical at 24 V)	[mA]	2
Debounce time LIO1 ... LIO4	[ms]	1.25 ... 1.5

Signal outputs   The signal inputs are short-circuit protected and not galvanically isolated.

Nominal voltage	[V]	24
Voltage range	[V]	23 ... 25
Maximum current per output	[mA]	100
Maximum total current	[mA]	200
Suitable for inductive loads	[mH]	1000
Voltage drop at 50 mA load	[V]	≤1

3.4.5 STO safety function at CN5 and CN6

The signal inputs are not galvanically isolated.

Logic 0 (U_{low})	[V]	-3 ... +4.5
Logic 1 (U_{high})	[V]	+15 ... +30
Input current $\overline{STO\_A}$ ($\overline{PWRR\_A}$) (typical at 24 V)	[mA]	≤10
Input current $\overline{STO\_B}$ ($\overline{PWRR\_B}$) (typical at 24V)	[mA]	≤3
Debounce time	[ms]	1 ... 5
Detection of signal difference between $\overline{STO\_A}$ ($\overline{PWRR\_A}$) and $\overline{STO\_B}$ ($\overline{PWRR\_B}$)	[s]	<1
Response time (until shutdown of power stage)	[ms]	<50
Permitted test pulse width of upstream devices	[ms]	<1

Data for maintenance plan and safety calculations

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

Lifetime (IEC 61508)		20 years
SFF (IEC 61508) Safe Failure Fraction	[%]	47
HFT (IEC 61508) Hardware Fault Tolerance Type A subsystem		1
Safety integrity level IEC 61508 IEC 62061		SIL2 SILCL2
PFH (IEC 61508) Probability of Dangerous Hardware Failure per Hour	[1/h]	$5.223*10^{-9}$
PL (ISO 13849-1) Performance Level		d (Category 3)
$MTTF_d$ (ISO 13849-1) Mean Time to Dangerous Failure		1995 years
DC (ISO 13849-1) Diagnostic Coverage	[%]	90

3.5 Conditions for UL 508C

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

Ambient temperature during operation

Surrounding air temperature [1]	[°C]	0 ... 40
Surrounding air temperature with current reduction of 2 % per Kelvin [1]	[°C]	40 ... 55

1) Limit values with flanged motor (for example,. steel plate 300x300x10 mm)

Pollution degree   Use in an environment with pollution degree 2.

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

Wiring   Use at least 60/75 °C copper conductors.

Fuse to be connected upstream   The product was tested with a 15 A circuit breaker. The product must be fused in the end use application either with a UL-listed 15 A circuit breaker or a fuse for "Branch Circuit Protection" as per UL 248 with a maximum of 15 A_{dc}.

4   Basics

<div style="text-align: right">

4

</div>

4.1   Functional safety

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

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

Working with IEC 61508

IEC 61508 standard

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

SIL, Safety Integrity Level

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

PFH, Probability of a dangerous hardware failure per hour

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

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

HFT and SFF   Depending on the SIL for the safety system, the IEC 61508 standard re-
quires a specific hardware fault tolerance HFT in connection with a spe-
cific 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 tol-
erance 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 soft-
ware, 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.

4.2 EtherNet/IP technology

EtherNet/IP devices are based on the same technology as devices on Ethernet networks in the computer world. For many applications, components from the existing company network can be used. However, it is recommended to use industrial switches for time-critical applications. This manual is not intended to convey basic knowledge, for example in terms of network topology, data security or address assignment.

4.2.1 Data security

The larger the network into which the product is integrated, the greater the risk of unauthorized external access. The operator of the local network must take appropriate measures to prevent unauthorized access. Contact your network administrator prior to commissioning the product.

4.2.2 Basics

The ODVA is in charge of the specifications for the EtherNet/IP network and EtherNet/IP data terminal equipment. For more information on the ODVA see:

http://www.odva.org

Number of nodes   The number of nodes in an EtherNet/IP network is theoretically unlimited; it depends on the subnet size and on whether or not a CIP router is used. For example, 254 nodes are possible in a class C subnet.

Cable length   The maximum cable length is 100 m between EtherNet/IP terminal points and 90 m between infrastructure components. See the document CIP Vol.2, chapter 8-9.2.3.6 for detailed length information for the Industrial Level.

Drive profiles   The product supports 2 drive profiles:

- CIP "Generic Profile"
- Vendor-specific profile

The vendor-specific drive profile is described in chapter 8 "Operation".

Communication means   The product supports the following communication means from the EtherNet/IP specification:

- CIP "Generic Profile" (Device Type = 0_h)
- Group 2 servers
- UCMM enabled devices
- Master-slave connections
    - "Explicit Message"
    - "Polled I/O Connection"
    - Full "Fragmentation Protocol" support
    - Dynamic establishment of 2 "Explicit Connections" and one "I/O Connection"

Data link layer   The EtherNet/IP data link layer uses the transmission mechanisms as per IEEE 802.3 Standard Ethernet specification (edition 2002). This makes it possible to use a wide selection of available Ethernet components.

Physical layer

Industrial EtherNet/IP specifies minimum requirements in terms of ambient conditions, cabling and connectors, based on IEC, ANSI, TIA and EIA standards.

The connectors required for Industrial EtherNet/IP include M12-4 connectors, D-coded. Use shielded or unshielded CAT5e or CAT6 cables for Industrial Ethernet/IP.

Copper media may be used only for distances up to 100 m.

Terms: Object class, instance, attribute, service

The EtherNet/IP approach is object-oriented. CIP defines object classes; one or more instances (objects) can be derived from such object classes. The attributes of an object class or the instance derived from it contain the various parameters. Services are actions that are possible with these attributes.

Example

Class	Instance	Attribute	Attribute value	Service
Motor data	Motor_1	MaxSpeed	4000 min^{-1}	Get
Motor data	Motor_2	MaxSpeed	3000 min^{-1}	Get

CIP object model

The following object classes from the CIP object model are available:

Object class	Class ID	Instance ID
Identity Object	1 (01$_h$)	1
Message Router Object	2 (02$_h$)	1
Assembly Object	4 (04$_h$)	103 = Output Assembly, consuming 113 = Input Assembly, producing
Connection Manager Object	6 (06$_h$)	1= Explicit Message
Vendor-specific objects	101 ... 163 (65$_h$ ... A3$_h$)	1
Port Object	244 (F4$_h$)	1
TCP/IP Object	245 (F5$_h$)	1
Ethernet Link Object	246 (F6$_h$)	2

The vendor-specific class IDs 101 to 163 correspond to the object dictionary (class ID = object group + 100). The attributes of a class correspond to the subindex entry within the object group.

Communication model

EtherNet/IP uses the producer-consumer communication model. All nodes check the bus as to whether a data packet with the Identifier they support is available. Data packets that are sent by producers can only be received by the consumers of these packets.

Groups of connections

EtherNet/IP is a connection-oriented network. Connections must be established and managed between two nodes. There are 4 connection groups with different priorities:

Group 1	Top-priority process data (highest priority)
Group 2	Simple master-slave connections
Group 3	Explicit Messages
Group 4	Reserved group (lowest priority)

Electronic Data Sheet An EDS file is a file in ASCII format. This file contains device-specific and vendor-specific descriptions of the parameters for a device. The EDS file also contains the fieldbus-specific communication parameters. The EDS file is required for commissioning.

4.2.3   Encapsulation

EtherNet/IP is based entirely on existing TCP/IP and UDP/IP technologies that are used without any modification. TCP/IP is used for the transmission of Explicit Messages while UDP/IP is used for I/O Messaging.

4.2.4   Messaging and message types

EtherNet/IP uses two types of messaging: Explicity Messaging and Implicit (I/O data) Messaging.

EtherNet/IP defines several message types for communication. The product described here uses the "Explicit Message" and "I/O Message" message types.

Explicit Messages Explicit Messaging connections are point-to-point connections between two network nodes that are used for transactions of the type request - response. These connections are used to address parts of a device which are accessible via the network. The data field of Explicit Messages contains both protocol data and application-specific commands.

I/O messages I/O Messages, also referred to as Implicit Messages, are transmitted via UDP/IP. I/O Message connections are often established as One-to-Many relationships in the producer-consumer Multicast model of Ether-Net/IP. The data fields of I/O Messages contain no protocol information, but only time-critical I/O data. I/O Messages are a lot smaller than Explicit Messages, thus allowing for much faster processing. These messages are used to to transport application-specific I/O data over the network at regular intervals. The meaning of the data is pre-defined at the time the connection is established. I/O Messages can contain so-called Assemblies of several parameters that can be transmitted with a single message. The parameters for configuring EtherNet/IP communication are described in chapter7 "Commissioning". Hands-on examples can be found in chapter 9 "Examples".

Command processing: Transmit data and receive data The master sends a command to the drive system (slave) to execute a motion command, activate functions or request information from the slave. The slave executes the command and acknowledges it with a response message that may contain an error message if an error occurred.

The master device can send new commands as soon as it has received acknowledgement concerning the current command. Acknowledgement information and error messages are included in the transmitted data in bit-coded form.

The master must then continuously monitor for completion of the processing command by evaluating the acknowledgment from the slave. I/O messages are a special case. I/O messages are not acknowledged from the slave.

4.2.5   Data structure

The data frame with transmit and receive data and byte, word and dou-ble-word values is shown in hexadecimal notation. Hexadecimal values are indicated as such by means of an "h" behind the numerical value, for example, "31_h", decimal values have no special identification. Note the different counting format of bits (0 ... 7, right to left) and bytes (0 ... xx, left to right)
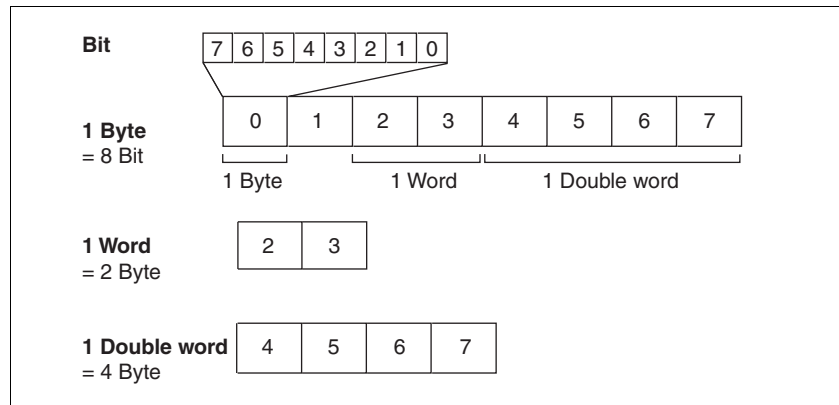
Figure 4.1   Data structure

4.2.6 Communication via Explicit Message

An Explicit Message (EtherNet/IP-specific or vendor-specific) is used to read or write an individual parameter. See chapter 11 "Parameters" for an overview of the parameters.

The parameter is accessed by means of Class.Instance.Attribute as per CIP. See chapter 11.2 "List of parameters" for the CIP addresses.

Example: Reading the status word actionStatus (CIP 128.1.4)

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_actionStatus	Action word Signal status: 0: not activated 1: activated Bit 0: Warning Bit 1: Error class 1 Bit 2: Error class 2 Bit 3: Error class 3 Bit 4: Error class 4 Bit 5: Reserved Bit 6: Drive is at standstill (<9 [1/min]) Bit 7: Drive rotates clockwise Bit 8: Drive rotates counter-clockwise Bit 9: Reserved Bit 10: Reserved Bit 11: Profile generator idle (reference speed is 0) Bit 12: Profile generator decelerates Bit 13: Profile generator accelerates Bit 14: Profile generator moves at constant speed Bit 15: Reserved	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7176 CIP 128.1.4

4.2.7   Communication via I/O Messages

An I/O Message is used for realtime exchange of process data. I/O messages lend themselves for motion commands. Transmission is very fast because the data is sent without administration data and a transmission acknowledgement from the recipient is not required.

The master can control the operating states of the slave by means of I/O Message, for example, enable and disable the power stage, trigger a "Quick Stop", reset errors and activate operating modes.

Changing operating states and activating operating modes must be done separately. An operating mode can usually only be activated if the operating state is already "Operation Enabled".

A new operating mode can only be activated when the motor is at a standstill.

Output, Input   Output and Input refer to the direction of data transmission from the perspective of the master.

- Output: Commands from the master to the slave

- Input: Status messages from the slave to the master

Assembly   I/O Messages contain a collection (Assembly) of different parameters that are transmitted with a single message.

The following Assemblies are defined for EtherNet/IP:

- Output Assembly, instance 103

- Input Assembly, instance 113

Polled I/O Connection   The Assemblies are used in a Polled I/O Connection . A Polled I/O Connection is initiated by the master with a Poll Command. The Slave responds with a Poll Response.

Hands-on examples for using the Assemblies can be found in chapter 9 "Examples".

4.2.8   "Drive Profile Lexium" assemblies

Output - Input   Output and input refer to the direction of data transmission from the perspective of the master.

- Output: Commands from the master to the slave

- Input: Status messages from the slave to the master

4.2.8.1   Output Assembly, instance 103

The table below shows the memory image for Output Assembly data. For a description of the parameters, see chapter 11.2 "List of parameters".

Byte	Meaning	Data type	Parameter address CIP
0	Attribute (SubIndex)	BYTE	Implicit parameter channel
1	Command (AK)	BYTE	
2 ... 3	Class (Index)	INT	
4 ... 7	Data	DINT	
8 ... 11	ref_32	DINT	
12 ... 13	ref_16	INT	
14	ModeControl	BYTE	
15	DriveControl	BYTE	
16 ... 19	RAMPacc	DINT	CIP 106.1.10
20 ... 23	RAMPdecel	DINT	CIP 106.1.11
24 ... 39	Reserved		

ModeControl

The operating modes are controlled by means of the ModeControl entry.

	MT		action			mode		
Bit	7	6	5	4	3	2	1	0

Bit	Name	Description
0 ... 3	MODE	Indicates the currently selected operating mode 1: Jog 2: Homing 3: Profile Position 4: Profile Velocity 7: Speed Control
4 ... 6	ACTION	Operating mode-dependent action
7	MT	Handshake via "Mode Toggle"

The following table shows the possible operating modes and the associated reference values:

Mode	Action	modeCtrl* Bit 0..6	Description	Reference value Ref_16	Reference value Ref_32
1	0	01h	Jog	Corresponds to parameter JOGactivate	-

Mode	Action	modeCtrl* Bit 0..6	Description	Reference value Ref_16	Reference value Ref_32
2	0	02h	Homing: Position setting	-	Position for position setting Corresponds to parameter HMp_homeusr
	1	12h	Homing: Reference movement	Homing method Corresponds to parameter HMmethod	-
3	0	03h	Profile Position: Absolute positioning	Target velocity Corresponds to parameter PPn_target	Target position Corresponds to parameter PPp_absusr
	1	13h	Profile Position: Relative positioning with reference to the currently set target position	Target velocity Corresponds to parameter PPn_target	Target position Corresponds to parameter PPp_relprefusr
	2	23h	Profile Position: Relative positioning with reference to the current motor position	Target velocity Corresponds to parameter PPn_target	Target position Corresponds to parameter PPp_relpactusr
4	0	04h	Profile Velocity	Target velocity Corresponds to parameter PPn_target	-
7	1	17h	Speed Control	Reference velocity Corresponds to parameter SPEEDn_target	-

The value 0 in modeCtrl is a special case: If during transmission all bits 0..7 are zero, the following data is not processed; no error message is generated.

If operating mode, reference position and reference velocity are transmitted simultaneously with one access, data consistency is required. For this reason, the drive evaluates the operating mode data only if ModeToggle (bit 7) was toggled.

Toggling means that since the last transmission a change from 0 to 1 or from 1 to 0 has been detected for this bit.

The controller must enter the following values to activate an operating mode or to change reference values:

1. Enter the reference values in the fields ref_16 and ref_32 (0 must be entered in unused fields)

2. Select the operating mode with modeCtrl bits 0...3 (mode)

3. Select the action for this operating mode with modeCtrl bits 4..6 (action)

4. Toggle modeCtrl bit 7 (MT)

DriveControl

DriveControl controls the operating states. A rising edge triggers a function. Changes are processed immediately.

	CU	CH	SH	0	FR	QS	EN	DI
Bit	15	14	13	12	11	10	9	8

Bit	Name	Meaning
8	DI	Disable power stage
9	EN	Enable power stage
10	QS	Execute "Quick Stop" function
11	FR	Execute "Fault Reset" function
12	-	Reserved
13	SH	Execute "Halt" function
14	CH	Clear "Halt" function
15	CU	Resume operating mode interrupted by "Halt"

The value 0 is a special case: If during transmission all bits have the value 0, this corresponds to a Disable command and the power stage is disabled.

Handling of errors   If requests for controlling the state machine cannot be executed by the drive, the drive ignores such requests.

Example: Transmission of a Quick Stop request in state 4 "Ready To Switch On".

Treatment of ambivalent bit combinations: Bit 8 has precedence over bit 9.

Bit 13 has precedence over bit 14 and bit 15.

Bit 10 has precedence over bit 11.

RAMPacc / RAMPdecel

The double words "RAMPacc" and "RAMPdecel" are used to set the acceleration and the deceleration. They correspond to the parameters of the same name.

4.2.8.2 Input Assembly, instance 113

The table below shows the memory image for Input Assembly data. For a description of the parameters, see chapter 11.2 "List of parameters".

Byte	Meaning	Data type	Parameter address CIP
0	Attribute (SubIndex)	BYTE	Implicit parameter channel
1	Command (AK)	BYTE	
2 ... 3	Class (Index)	INT	
4 ... 7	Data	DINT	
12 ... 13	Special functions	INT	
14 ... 15	ActionWord	INT	
16	Digital IO	BYTE	
17	ModeState	BYTE	
18 ... 19	DriveState	INT	
20 ... 23	_p_actusr	DINT	CIP 130.1.13
24 ... 27	_n_act	DINT	CIP 130.1.8

Byte	Meaning	Data type	Parameter address CIP
28 ... 43	Reserved		

Special Function

The data range is reserved in the case of this product.

Action Word

Structure of the Action Word:

	0	CNST	ACC	DEC	TAR0	0	PWIN	MOTN
Bit	15	14	13	12	11	10	9	8

	MOTP	MOTZ	0	0	0	0	0	0
Bit	7	6	5	4	3	2	1	0

Meaning of the bits

MOTZ	Motion Zero: Current velocity is 0
MOTP	Motion Positive: Motor moves in positive direction
MOTN	Motion Negative : Motor moves in negative direction
PWIN	Inside position window
TAR0	Profile generator: Target velocity is 0
DEC	Profile generator: Deceleration
ACC	Profile generator: Acceleration
CNST	Profile generator: Constant movement

Digital IO

Drive Input indicates the current levels of the inputs at the drive.

Structure Drive Input

	0	0	I_5	I_4	I_3	I_2	I_1	I_0
Bit	7	6	5	4	3	2	1	0

Meaning of the bits

I_0	LIO1, input positive limit switch
I_1	LIO2, input negative limit switch
I_2	LIO3, available as required
I_3	LIO4, input reference switch
I_4	STO_A
I_5	STO_B

If the signals are forced to specific levels, these forced levels are output here. Forcing is only possible with the commissioning software.

ModeState

`modeStat` indicates the current processing state of the operating modes.

	MT	ME	RF	0		mode		
Bit	7	6	5	4	3	2	1	0

Bit	Name	Description
0 ... 3	MODE	Indicates the currently selected operating mode 1: Jog 2: Homing 3: Profile Position 4: Profile Velocity 7: Speed Control
4	-	Reserved
5	RF	Is set if operating mode Homing was successfully completed
6	ME	Is set if a request from a master was rejected
7	MT	Handshake via "Mode Toggle"

Synchronized processing is possible with the request bit ModeToggle (MT) that is written to the drive and the status bits ModeToggle (MT) along with ModeError (ME). Synchronized means that the controller waits for response from the drive and acts appropriately.

If a request for an operating mode cannot be processed, the drive rejects processing and sets `modeStat`, bit 6 (`ModeError`). This does not interrupt the current process. To determine the cause of the error, the controller can read the error number from the parameter `ModeError` by means of an access via the parameter channel.

DriveState

The state is returned by means of DriveState:

Structure DriveState, byte 18

	x_Error	x_End	x_Info	0	0	0	0	Halt
Bit	15	14	13	12	11	10	9	8

Structure DriveState, byte 19

	Warn	Fault		0		State		
Bit	7	6	5	4	3	2	1	0

Bit	Name	Meaning
0 ... 3	STATE	Current operating state
6	FAULT	An error has occurred
7	WARN	A warning was generated
8	HALT	"Halt" function is active
9 ... 12	-	Reserved
13	x_info	Additional information on operating mode
14	x_end	Termination identifier operating mode
15	x_err	Error identifier operating mode

_p_act

The double word "_p_act" is used to provide information on the current motor position. The value corresponds to the parameter _p_act.

_n_act

The double word "_n_act" is used to provide information on the current velocity. The value corresponds to the parameter _n_act.

5 Engineering

5

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

5.1 Configurable inputs and outputs

This product has digital inputs and outputs that can be configured. This standard assignment can be adapted to the requirements of the customer's installation. See chapter 8.6.7 "Configurable inputs and outputs" for additional information.

5.2 External power supply units

> ⚠ **DANGER**
>
> **ELECTRIC SHOCK CAUSED BY INCORRECT POWER SUPPLY UNIT**
>
> The VDC and +24VDC supply voltages are 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.**

5.2.1 Supply voltage

General The power supply unit must be rated for the power requirements of the drive. The input current can be found in the technical data.

The actual power requirements are often significantly lower because the maximum possible motor torque is usually not required for normal operation of a system.

When designing the system, note that the input current of the drive is higher during the motor acceleration phase than during constant movement.

Protection against reverse polarity In the case of reverse polarity, the supply voltage is short-circuited. The product is continuous short circuit-proof up to a short-circuit current of a maximum of 15 A. If the power is supplied by a transformer power supply unit, several hundred amperes may flow for a short period of time in the event of reverse polarity; the drive is rated for this and will not be damaged if proper fusing is provided.

Fuse: a circuit-breaker (16 A, trip characteristic B) or a blade fuse (FKS, max. 15 A) or a fuse (5 mm x 20 mm, 10 A slow-blow).

Regeneration condition   Note the following for drives with large external mass moments of inertia or for highly dynamic applications:

Motors return regeneration energy during deceleration. The DC bus can store a limited amount of energy in the capacitors. Connecting additional capacitors to the DC bus increases the amount of energy that can be stored.

If the capacity of the capacitors is exceeded, the excess energy must be discharged via internal or external braking resistors. If the energy is not discharged, an overvoltage monitor will shut off the power stage.

Overvoltages can be limited by adding a braking resistor with a corresponding braking resistor controller. This converts the regenerated energy to heat energy during deceleration.

Braking resistor controllers can be found in chapter 12 "Accessories and spare parts". See the product manual for a description of the braking resistor controller.

⚠ WARNING

LOSS OF CONTROL DUE TO REGENERATION CONDITION

Regeneration conditions resulting from braking or external driving forces may increase the VDC supply voltage to an unexpected level. Components not rated for this voltage may be destroyed or cause misoperation.

- Verify that all VDC consumers are rated for the voltage occurring during regeneration conditions (for example limit switches).
- Use only power supply units that will not be damaged by regeneration conditions.
- Use a braking resistor controller, if necessary.

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

Internal 24V signal power supply   An internal 24V power supply for the sensor system is integrated in the product.

The internal 24V signal power supply must not be connected to the internal 24V signal power supply of another product.

5.3 Ground design

The ground connections of all interfaces are galvanically connected, including the ground for the VDC supply voltage.

The following points must be considered when you wire the drives in a system:

- The voltage drop in the VDC power supply lines must be kept as low as possible (less than 1 V). At higher ground potential differences between different drives, the communication / control signals may be affected.

- If the distance between the system components is greater, it is recommended to use decentralized power supply units close to the individual drives to supply the VDC voltage. However, the ground connections of the individual power supply units must be connected with the largest possible conductor cross section.

- The internal 24V signal power supply must not be connected in parallel with the internal 24V signal power supply of a different drive.

- If the master controller (for example, PLC) does not have galvanically isolated outputs, you must verify that the current of the VDC supply voltage has no path back to the power supply unit via the master controller. The master controller ground must therefore be connected to the VDC power supply ground at a single point only. This is usually the case in the control cabinet. Therefore, the ground contacts of the various signal connectors of the drive are not connected; the connection is already made via the ground of the VDC supply voltage.

- If the controller uses a galvanically isolated interface for communication with the drives, the ground of this interface must be connected to the signal ground of the first drive. This ground may only be connected to one drive to avoid ground loops. This also applies to a galvanically isolated CAN connection.

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

5.4   Safety function STO ("Safe Torque Off")

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

5.4.1   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.

"Power Removal"   The STO safety function ("Safe Torque Off") is also known as "Power Removal".

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.

5.4.2   Function

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

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

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

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

5.4.3   Requirements for using the safety function

<table>
<tr><td colspan="2" align="center">⚠ WARNING</td></tr>
<tr><td colspan="2">

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.
</td></tr>
</table>

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

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

Behavior of holding brake   Triggering the STO safety function means that the delay time for motors with holding brake is not effective. The motor cannot generate holding torque to bridge the time to application of the holding brake. 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.

Protected cable installation

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

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

Protected cable installation possibilities:

- Use separate cables for two signals. Any additional wires in these cables may only carry voltages according to PELV.

- Use a shielded cable. The grounded shield is designed to dissipate the external voltage in the case of damages and to trip the fuse in this way.

- Use a separately grounded shield. If there are other wires in the cable, the two signals must be isolated from these wires by a grounded, separate shield.

Data for maintenance plan and safety calculations

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

Lifetime (IEC 61508)		20 years
SFF (IEC 61508) Safe Failure Fraction	[%]	47
HFT (IEC 61508) Hardware Fault Tolerance Type A subsystem		1
Safety integrity level IEC 61508 IEC 62061		SIL2 SILCL2
PFH (IEC 61508) Probability of Dangerous Hard-ware Failure per Hour	[1/h]	$5.223*10^{-9}$
PL (ISO 13849-1) Performance Level		d (Category 3)
MTTF$_d$ (ISO 13849-1) Mean Time to Dangerous Failure		1995 years
DC (ISO 13849-1) Diagnostic Coverage	[%]	90

Hazard and risk analysis

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

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

5.4.4   Application examples STO

Example of category 0 stop   Application without EMERGENCY STOP module, category 0 stop.
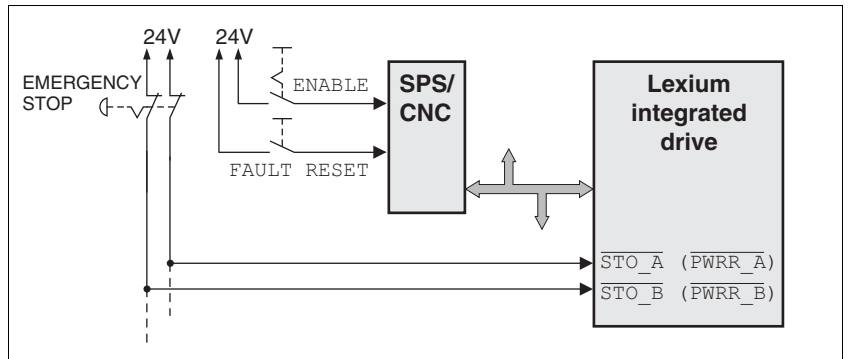
Figure 5.1   Example of category 0 stop

Please note:

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

Example of category 1 stop   Application with EMERGENCY STOP module, category 1 stop.
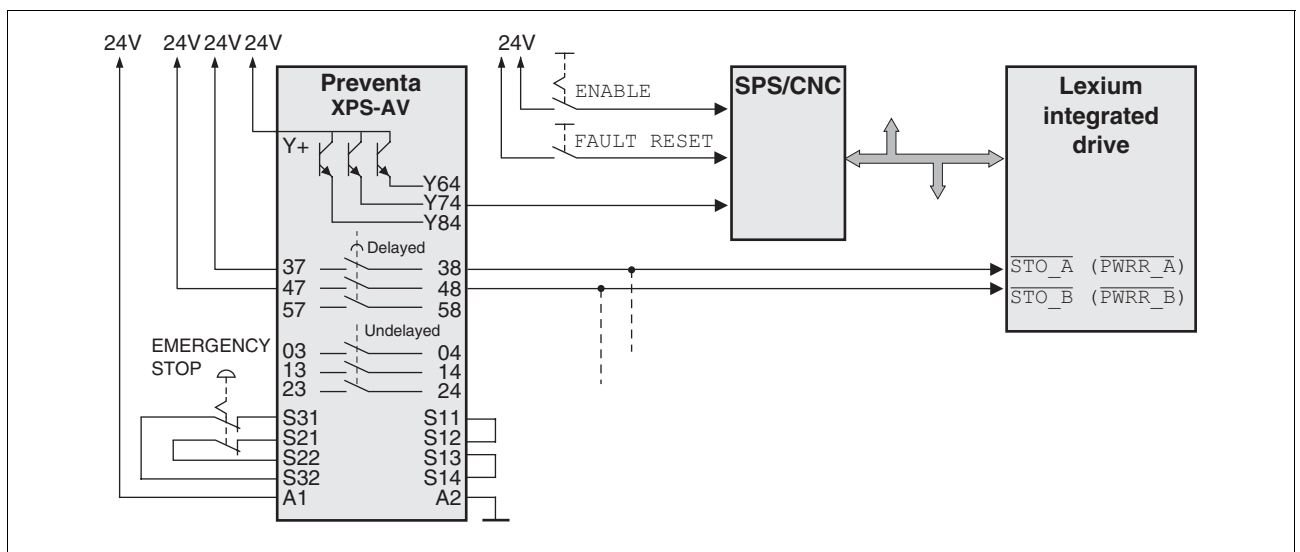
Figure 5.2   Example of category 1 stop

Please note:

- The master controller must immediately trigger a controlled stop, e.g. via the "Quick Stop" function.

- The inputs $\overline{STO\_A}$ ($\overline{PWRR\_A}$) and $\overline{STO\_B}$ ($\overline{PWRR\_B}$) must be switched off with a time delay. The delay is set at the EMERGENCY STOP safety module. If the motor has not yet stopped when the delay time has elapsed, it coasts down in an uncontrolled way (uncontrolled stop).

- The specified minimum current and the permissible maximum current of the relay must be observed if the relay outputs of the EMERGENCY STOP module are used.

5.5   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
Blocking error	Error message if, in spite of maximum current, the motor shaft does not move for the time set with this parameter.
Data link	Error response if the link becomes inoperative
Limit switch signals	Monitors for permissible range of travel
I^2t limitation	Power limitation in the case of overloads for the motor, the output current, the output power and the braking resistor.
Following error	Monitors for difference between actual motor position and reference position
Overvoltage and undervoltage	Monitors for overvoltage and undervoltage of the supply voltage
Motor overload	Monitors for excessively high current in the motor phases
Overtemperature	Monitors the device for overtemperature

For a description of the monitoring functions, see chapter 8.6.1 "Monitoring functions", page 133.

6   Installation

6

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⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are EMERGENCY STOP, overtravel stop, power outage and restart.

- Separate or redundant control paths must be provided for critical functions.

- System control paths may include communication links. Consideration must be given to the implication of unanticipated transmission delays or failures of the link.

- Observe the accident prevention regulations and local safety guidelines. [1]

- Each implementation of the product must be individually and thoroughly tested for proper operation before being placed into service.

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

</div>

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

<div style="border:1px solid">

⚠ CAUTION

RISK OF INJURY WHEN THE PRINTED CIRCUIT BOARD CONNECTORS ARE REMOVED

- Before removing the connectors, you must unlocked them.

    – Supply voltage VDC:
      Unlock by pulling at the connector housing

    – Others:
      Unlock by pressing the connector lock

- Only pull the connector housing (not the cable).

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

</div>

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

6.1 Electromagnetic compatibility, EMC

> ### ⚠ WARNING
>
> **SIGNAL AND DEVICE INTERFERENCE**
>
> Signal interference can cause unexpected responses of device.
>
> - Install the wiring in accordance with the EMC requirements.
> - Verify compliance with the EMC requirements.
>
> **Failure to follow these instructions can result in death, serious injury or equipment damage.**

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

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

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

EMC measures	Effect
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.
Ground the product via the motor flange or with a ground strap to the ground connection at the cover of the connector housing.	Reduces emissions, increases immunity.
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
Connect large surface areas of cable shields, use cable clamps and ground straps	Reduces emissions.

Shielding The following cables must be shielded:

- Fieldbus cable
- STO safety function,
  see the requirements in chapter 5.4.3 "Requirements for using the safety function"

The following cables do not need to be shielded:

- Supply voltage `VDC`
- 24 V signal interface

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

6.2   Mechanical installation

> ### ⚠ WARNING
>
> **MOTOR DAMAGE AND LOSS OF CONTROL**
>
> Shock or strong pressure applied to the motor shaft may destroy the motor.
>
> - Protect the motor shaft during handling and transportation.
> - Avoid shocks to the motor shaft during mounting.
> - Do not press parts onto the shaft. Mount parts to the shaft by glueing, clamping, shrink-fitting or screwing.
>
> **Failure to follow these instructions can result in death, serious injury or equipment damage.**

> ### ⚠ WARNING
>
> **MOTOR WITHOUT BRAKING EFFECT**
>
> If power outage 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.**

> ### ⚠ CAUTION
>
> **HOT SURFACES**
>
> Depending on the operation, the surface may heat up to more than 100°C (212°F).
>
> - Do not allow contact with the hot surfaces.
> - Do not allow flammable or heat-sensitive parts in the immediate vicinity.
> - Consider the measures for heat dissipation described.
> - Check the temperature during test runs.
>
> **Failure to follow these instructions can result in injury or equipment damage.**

To install a drive in locations difficult to access, it may be useful to carry out the electrical installation first and then install the fully wired drive.

Heat dissipation   The motor may become very hot, for example in the case of incorrect arrangement of multiple motors. The surface temperature of the motor must not exceed 110 °C during continuous operation.

- Verify that the maximum temperature is not exceeded.

- Verify that there is sufficient heat dissipation, for example by means of good ventilation or heat dissipation via the motor flange.

Mounting   The motor is designed to be mounted using four M5 screws. The motor flange must be mounted on a flat surface to avoid mechanical tension from being transmitted to the housing.

Painted surfaces have an insulating effect. During mounting verify that the motor flange is mounted in such a way as to allow for good conductivity (electrical and thermal).

Mounting distances   No minimum clearances are required for installation. However, note that the motor can become very hot.

Observe the bending radii of the cables used.

Ambient conditions   Observe the permissible ambient conditions.

6.3   Electrical installation

⚠ WARNING

UNEXPECTED BEHAVIOR CAUSED BY FOREIGN OBJECTS

Foreign objects, deposits or humidity can cause unexpected behavior.

- Keep foreign objects from getting into the product.
- Do not remove the cover of the electronics housing. Only remove the connector housing cover.
- Verify correct seat of seals and cable entries.

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

⚠ WARNING

LOSS OF SAFETY FUNCTION CAUSED BY FOREIGN OBJECTS

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

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

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

⚠ WARNING

DAMAGE TO SYSTEM COMPONENTS AND LOSS OF CONTROL

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

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

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

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

6.3.1   Wiring examples

The following figure shows a typical wiring example. The limit switches and the reference switch are supplied via the internal 24V signal power supply.
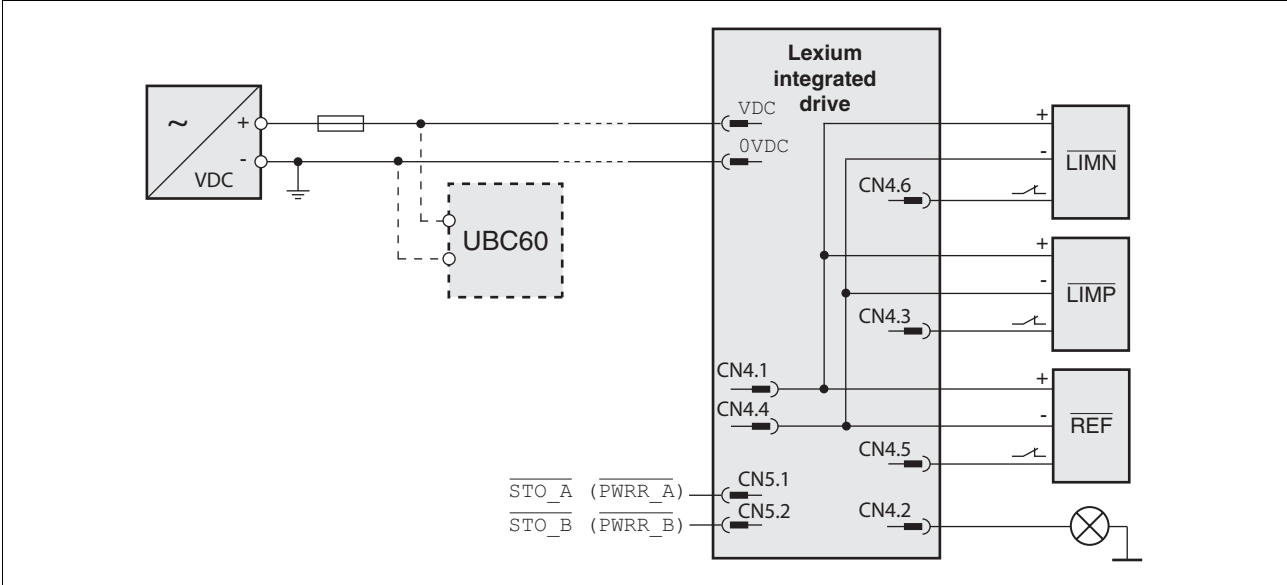
Figure 6.1   Wiring example

The UBC60 braking resistor controller is available as an accessory, see chapter 12 "Accessories and spare parts".

6.3.2 Overview of connections

Overview of printed circuit board connectors

The following figure shows the pin assignment of the interfaces with the connector housing cover open.
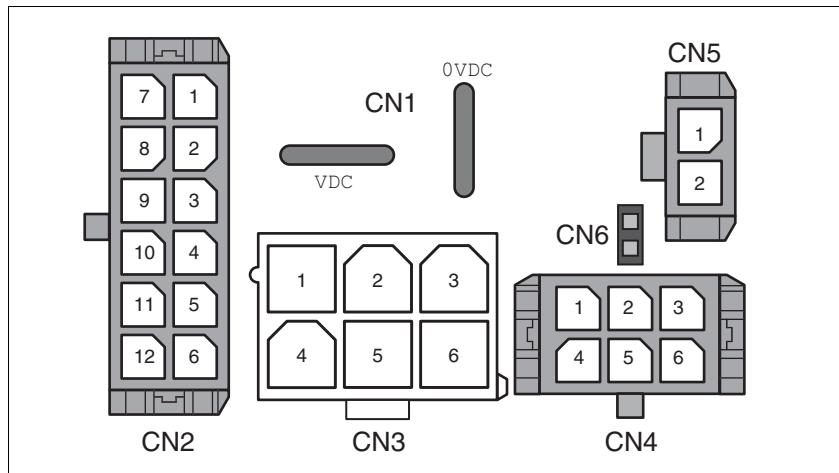
Figure 6.2   Overview of connections

Connection	Assignment
CN1	Supply voltage VDC
CN2	Fieldbus interface
CN3	Commissioning interface
CN4	24V signals
CN5	Safety function STO
CN6	Jumper for disabling STO safety function

The drive can be connected via cable entries or industrial connectors.

6.3.3   Connection via cable entry

The cable specifications and pin assignments can be found in the chapters that describe the connections.

Preparing and fastening cables
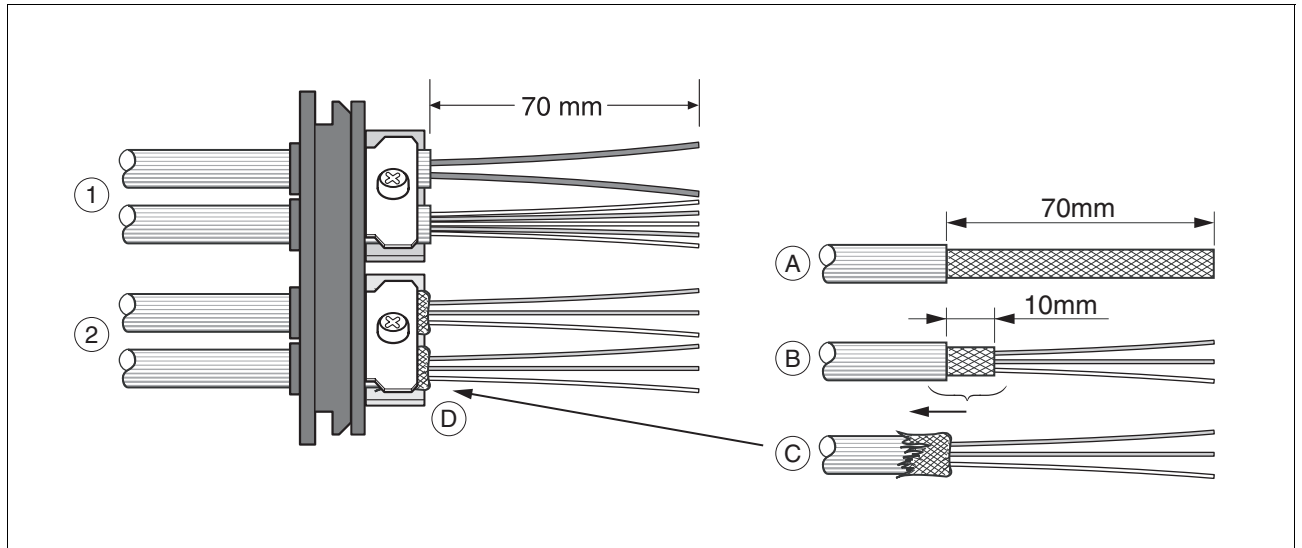
Figure 6.3   Fastening the cable in the cable entry

(1)   Unshielded cable
(2)   Shielded cable

▶ Trim the cable bushings to fit the cable.

   NOTE: The specified degree of protection IP54 can only be achieved with properly trimmed cable bushings.

▶ (A) Strip the jacket of all cables; length 70 mm.

▶ (B) Shorten the shield to a rest of 10 mm.

▶ (C) Slide the shield braiding back over the cable jacket.

▶ (D) Loosen the strain relief.

▶ Push the cables though the strain relief.

▶ Glue EMC shielding foil around the shield.

▶ Pull the cable back to the strain relief.

▶ Fasten the strain relief.

Mounting connectors   The table below lists the parts and data required for assembly. Connector housings and crimp contacts are included in the accessories kit. See also chapter 12 "Accessories and spare parts".

Only use the special tool listed in the Accessories chapter to release single crimp contacts from the connector housing.

Connection	Conductor cross section of the crimp contact [mm²]	Stripping length [mm]	Manufacturer's crimp contact no.	Crimping tool	Connector manufacturer	Connector type
CN1	0.75 ... 1.5 (AWG 18 ... 16) 2.5 ... 4.0 (AWG 12)	5 ... 65 ... 6	160773-6 341001-6	654174-1	Tyco Electronics	Positive Lock 1-926 522-1
CN2	0.14 ... 0.6 (AWG 24 ... 20)	2.5 ... 3.0	43030-0007	69008-0982	Molex	Micro-Fit 3.0 43025-1200
CN3	0.25 ... 1.0 (AWG 24 ... 18)	3.0 ... 3.5	39-00-0060	69008-0724	Molex	Mini-Fit Jr. 39-01-2065
CN4	0.14 ... 0.6 (AWG 24 ... 20)	2.5 ... 3.0	43030-0007	69008-0982	Molex	Micro-Fit 3.0 43025-0600
CN5	0.14 ... 0.6 (AWG 24 ... 20)	2.5 ... 3.0	43030-0007	69008-0982	Molex	Micro-Fit 3.0 43645-0200

Prepare the cable for connection as follows:

▶ Strip the ends of the cable.

▶ Attach cable lugs and crimp contacts. Verify that you have the correct crimp contacts and the matching crimping tool.

▶ Slide the cable lugs and crimp contacts straight into the connector until they snap in place.
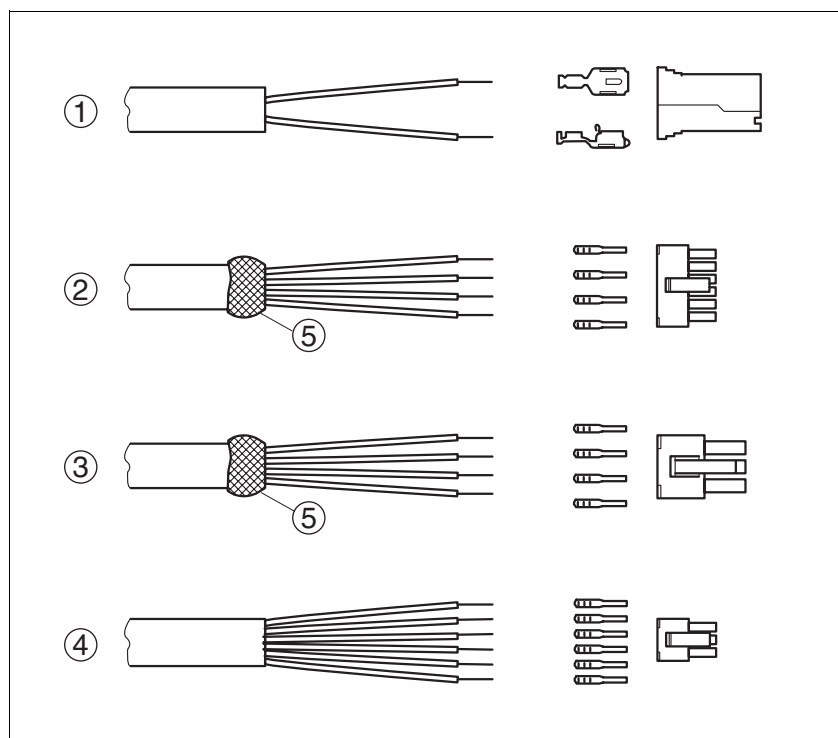
Figure 6.4   Connectors, cable lugs and crimp contacts

(1)   CN1 supply voltage `VDC`
(2)   CN2 fieldbus
(3)   CN3 commissioning
(4)   CN4 24V signals
(5)   Shield wire with EMC shield foil

Mounting the cable entry
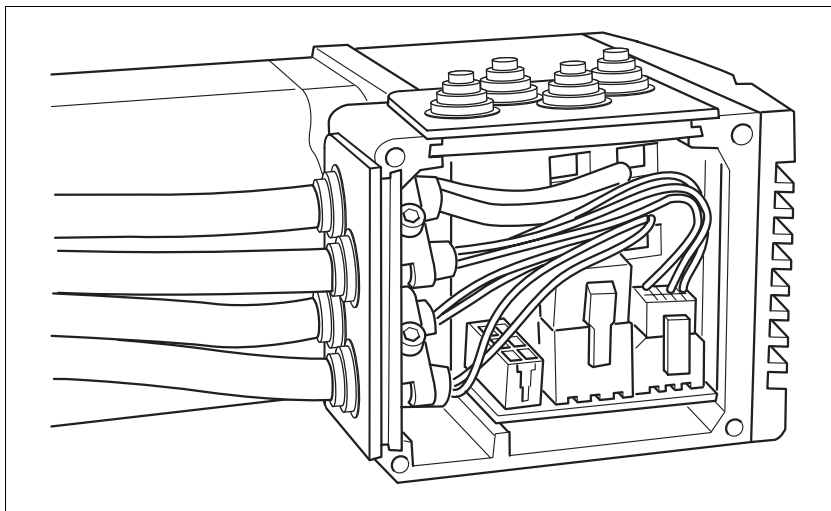
Figure 6.5   Inserting the cable entries

▶ Unscrew the connector housing cover.

   NOTE: Shipping locks made of cardboard must not be used for operating the drive.

▶ First adjust the parameter switches as these are difficult to access once the cables are connected.

   For a description of the parameter switches, see the chapters describing the connections.

▶ Connect the plug of the assembled cable to the matching socket. The plugs cannot be turned out of position and must click into place when being plugged in.

   Only pull the connector housing (not the cable).

▶ Plug the cable entry into one of the two cutouts provided. The side to be used for the cable entry depends on the space available in your system.

   NOTE: The pointed corners of the cable entry must point in the direction of the connector housing cover. Degree of protection IP54 is not reached if the cable entry is mounted the other way around.
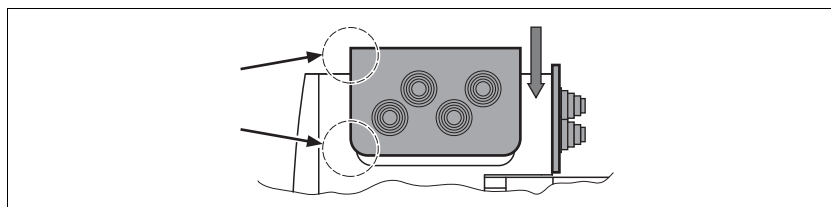
▶ Close the cutout that is not used with a sealing insert for cutouts.

▶ Finally, screw the connector housing cover back into place.

   If screws are lost use M3x12 only.

6.3.4   Connection with industrial connectors

Interface	Connector used
Supply voltage VDC	Hirschmann STASEI 200
EtherNet/IP fieldbus	Circular connector M12 , 4-pin, D-coded
24V signal inputs and out-puts	Circular connector M8, 3-pin
Safety function STO	Circular connector M8, 4-pin

Because the requirements are different depending on the system con-figuration, pre-assembled cables specially designed for Ethernet field-bus connections can be procured from various suppliers.

Information on pre-assembled cables, connector kits and recommended suppliers can be found in chapter 12 "Accessories and spare parts".

6.3.5   Connection of `VDC` supply voltage

⚠ DANGER

ELECTRIC SHOCK CAUSED BY INCORRECT POWER SUPPLY UNIT

The `VDC` and `+24VDC` supply voltages are connected with many exposed signal connections in the drive system.

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

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

⚠ WARNING

LOSS OF CONTROL DUE TO REGENERATION CONDITION

Regeneration conditions resulting from braking or external driving forces may increase the `VDC` supply voltage to an unexpected level. Components not rated for this voltage may be destroyed or cause misoperation.

- Verify that all `VDC` consumers are rated for the voltage occurring during regeneration conditions (for example limit switches).
- Use only power supply units that will not be damaged by regeneration conditions.
- Use a braking resistor controller, if necessary.

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

⚠ WARNING

DAMAGE TO SYSTEM COMPONENTS AND LOSS OF CONTROL

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

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

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

<table>
<tr><td colspan="2" align="center">CAUTION</td></tr>
</table>

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.

Cable specifications and terminal

Two different crimp contacts are available for different conductor cross sections, see chapter 6.3.3 "Connection via cable entry".

Minimum conductor cross section	[mm^2]	0.75 (AWG 18)
Maximum connection cross section	[mm^2]	4.0 (AWG 12)
Stripping length	[mm]	5 ... 65 ... 6

Crimp contact 1607736-6 Minimum connection cross section Maximum connection cross section	[mm^2]	 0.75 (AWG 18) 1.5 (AWG 16)
Crimp contact 341001-6 Minimum connection cross section Maximum connection cross section	[mm^2]	 2.5 (AWG 12) 4.0 (AWG 12)

Unshielded cables may be used for the VDC supply voltage. Twisted pair is not required.

▶ Use pre-assembled cables to reduce the risk of wiring errors.

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

Connecting the cables

▶ Note the specified technical data.

▶ Note the information provided in chapters 5.2 "External power supply units" and 5.3 "Ground design".

▶ Install fuses for the power supply cable accordance with the selected conductor cross section / wire gauge (note the inrush currents).

Pin assignment printed circuit board
connector
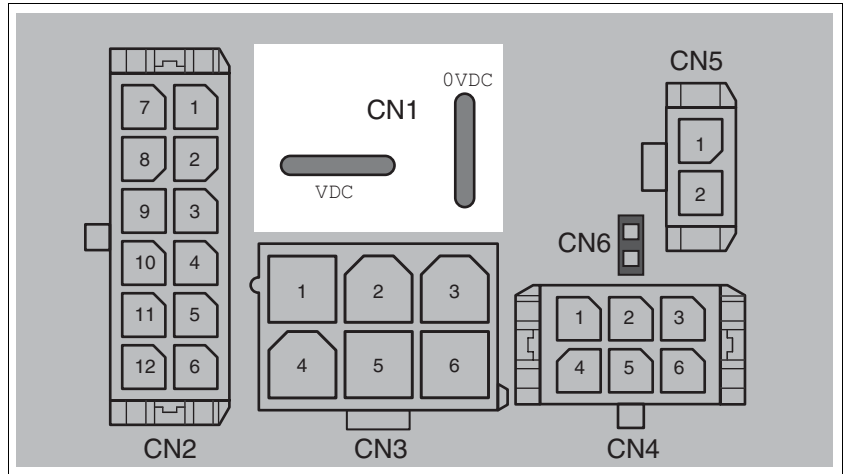
Figure 6.6   Pin assignment supply voltage

Signal	Meaning	Number [1]
VDC	Supply voltage	1
0VDC	Reference potential to VDC	2

1) Information relates to pre-assembled cables

You can crimp together two wires to supply multiple drives via one DC bus. Two different crimp contacts are available for different conductor cross sections, see chapter 6.3.3 "Connection via cable entry".

Pin assignment industrial connector
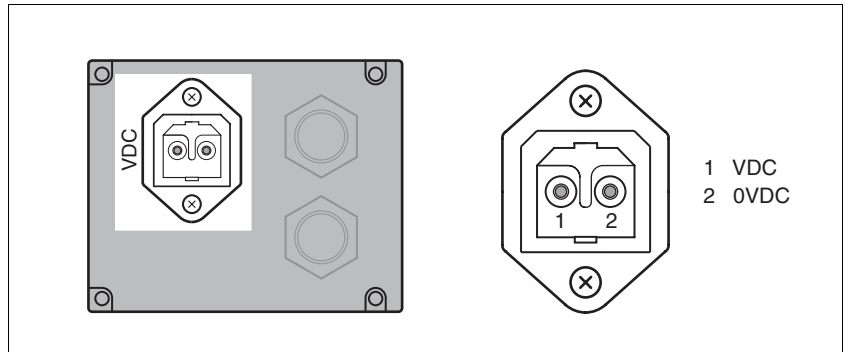
Figure 6.7   Pin assignment supply voltage

Pin	Signal	Meaning	Number [1]
1	VDC	Supply voltage	1
2	0VDC	Reference potential to VDC	2

1) Information relates to pre-assembled cables

6.3.6   Connection to Ethernet fieldbus interface

Function   The Ethernet fieldbus interface allows you to network the product as a slave in an Ethernet network.

Cable specifications   ▶ Use equipotential bonding conductors, see page 59.

▶ Use pre-assembled cables to reduce the risk of wiring errors.

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

Pin assignment female M12 connector
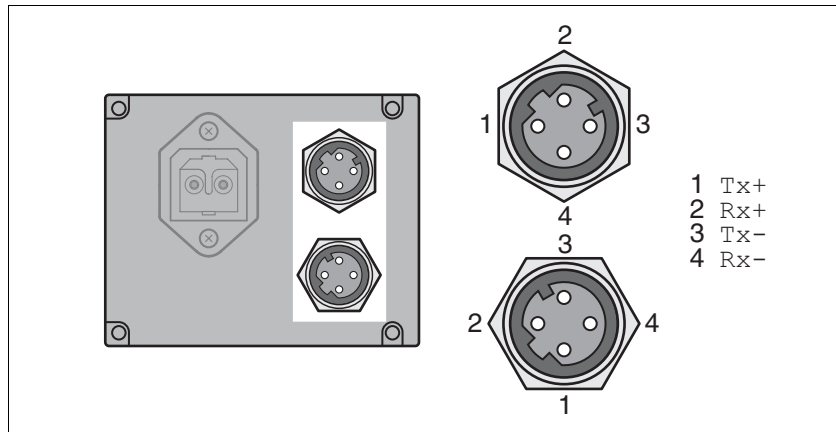
Figure 6.8   Pin assignment female M12 connector

Pin assignment industrial connector
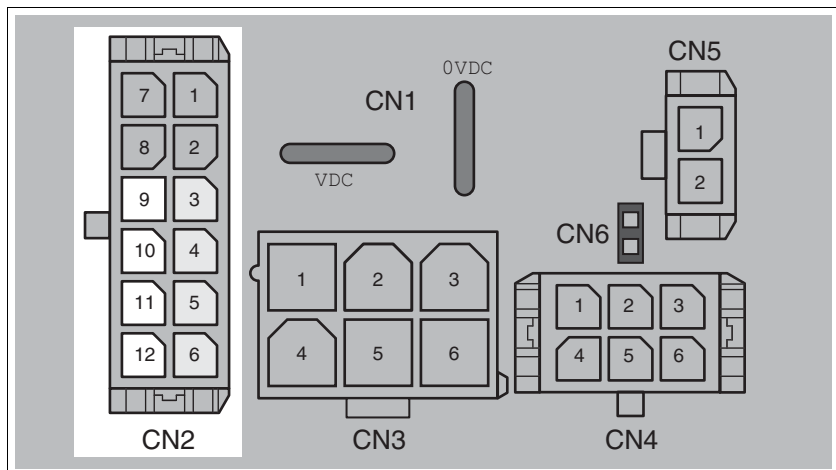
Figure 6.9   Pin assignment printed circuit board connector

Pin	Signal	Meaning (from the perspective of the drive)
CN2.9	Tx+	Fieldbus Tx+ port 0
CN2.10	Tx-	Fieldbus Tx- port 0
CN2.11	Rx+	Fieldbus Rx+ Port 0
CN2.12	Rx-	Fieldbus Rx- Port 0

Second connection for daisy chain wiring

Pin	Signal	Meaning (from the perspective of the drive)
CN2.3	Tx+	Fieldbus Tx+ port 1
CN2.4	Tx-	Fieldbus Tx- port 1
CN2.5	Rx+	Fieldbus Rx+ port 1
CN2.6	Rx-	Fieldbus Rx- port 1

Cable assignment   The cable assignment can be crossover which implies the following pin assignment:

- Tx+ to Rx+

- Tx- to Rx-

- Rx+ to Tx+

- Rx- to Tx-
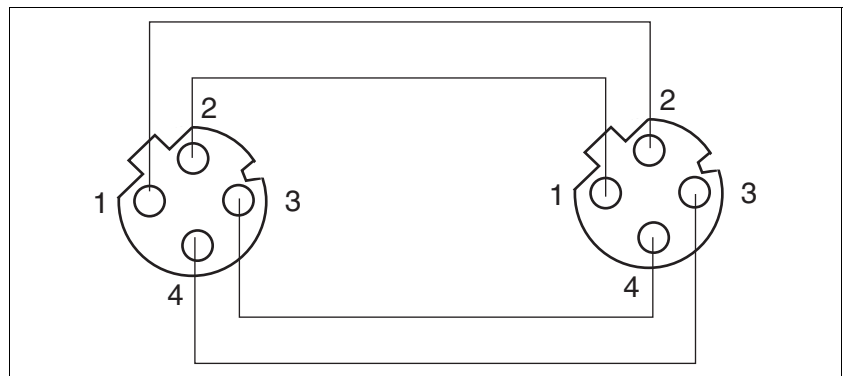
Figure 6.10   Pin assignment M12 to M12
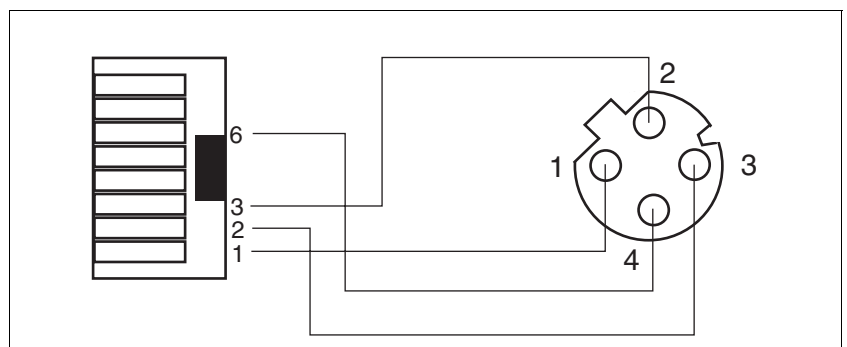
Figure 6.11   Pin assignment RJ45 to M12

Setting the address   Each device on the network is identified by a unique, adjustable node address.

Setting the address is explained in the commissioning chapter, see:

Chapter 7.2.1 "Setting the IP address"

6.3.7   Commissioning interface (RS485) connection

Commissioning interface (RS485)   A commissioning interface is provided in addition to the fieldbus interface. The commissioning interface is used to commission the drive. You can also use the commissioning software to monitor the drive during operation.

It is possible to establish simultaneous connections via the commissioning interface and the fieldbus.

Cable specifications and terminal

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

Maximum cable length	[m]	400
Minimum conductor cross section	[mm^2]	0.25 (AWG 22)
Maximum connection cross section	[mm^2]	1.0 (AWG 18)
Stripping length	[mm]	3.0 ... 3.5

▶ Use equipotential bonding conductors, see page 59.

▶ Use pre-assembled cables to reduce the risk of wiring errors.

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

Setting the address   The node address, baud rate and data format are set using parameters.

Factory settings:

- Node address: 1
- Baud rate: 19200
- Data format: 8 bit, even parity, 1 stop bit

Pin assignment printed circuit board connector
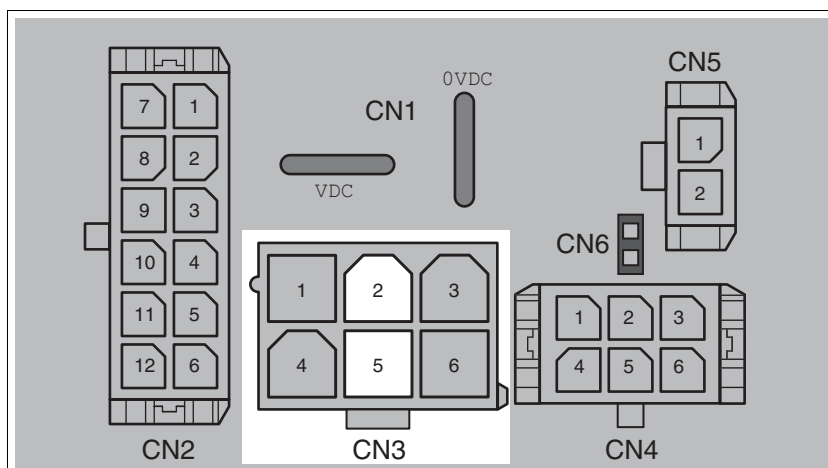
Figure 6.12   Pin assignment printed circuit board connector

Pin	Signal	Meaning
2	+RS485	RS485 interface
5	−RS485	RS485 interface

6.3.8   24V signal interface connection

┌───┐
│   ⚠ **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. │
│   │
│ • Before you can use the limit switches, you must enable them. │
│   │
│ **Failure to follow these instructions can result in death, serious injury or equipment damage.** │
└───┘

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

Internal 24V signal power supply   An internal 24V power supply for the sensor system is integrated in the product.

The internal 24V signal power supply must not be connected to the internal 24V signal power supply of another product.

Cable specifications and terminal

Minimum conductor cross section	[mm^2]	0.2 (AWG 24)
Maximum connection cross section	[mm^2]	0.6 (AWG 20)
Stripping length	[mm]	2.5 ... 3.0

▶ Use pre-assembled cables to reduce the risk of wiring errors.

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

Configuration   Different functions can be assigned to the digital signal inputs and outputs. For a detailed description, see chapter 8.6.7 "Configurable inputs and outputs".

Factory settings   The following table provides an overview of the factory settings.

Pin	Signal	Factory setting	I/O
CN4.3	LIO1	Input Positive limit switch (LIMP)	I
CN4.6	LIO2	Input Negative limit switch (LIMN)	I
CN4.2	LIO3	Input Free available	I
CN4.5	LIO4	Input Reference switch (REF)	I

Pin assignment printed circuit board connector
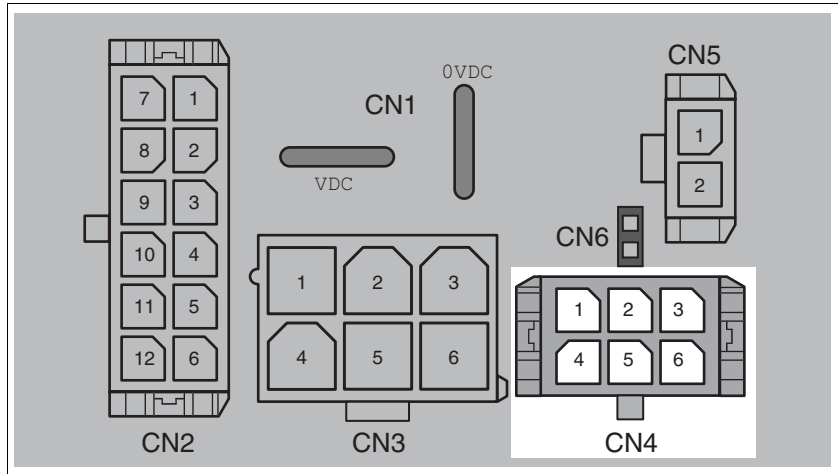
Figure 6.13   Pin assignment printed circuit board connector

Pin	Signal	Meaning	I/O
1	+24VDC_OUT	The internal 24V signal power supply may be used to supply the sensor system (for example, limit switches)	O
2	LIO3	Freely usable input / output	I/O
3	LIO1	Freely usable input / output	I/O
4	0VDC	Internally connected to CN1.0VDC	
5	LIO4	Freely usable input / output	I/O
6	LIO2	Freely usable input / output	I/O

6.3.9 Connection of STO safety function

⚠ **WARNING**
LOSS OF SAFETY FUNCTION
Incorrect usage may cause a hazard due to the loss of the safety function.
• Observe the requirements for using the safety function.
Failure to follow these instructions can result in death or serious injury.

Requirements   For information and requirements relating to the "STO" safety function, see page 52.

Cable specifications and terminal   • Shielded cable corresponding to the requirements for protected layout of wires

Minimum conductor cross section	[mm^2]	0.34 (AWG 20)
Maximum connection cross section	[mm^2]	0.6 (AWG 20)
Stripping length	[mm]	2.5 ... 3.0

▶ Use equipotential bonding conductors, see page 59.

▶ Use pre-assembled cables to reduce the risk of wiring errors.

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

The cable available as an accessory is a special cable that is only available with a connector. The shield of the cable is connected to the grounded housing of the drive via the metal connector. It is sufficient to connect one end of the cable to the grounded housing.

Pin assignment printed circuit board connector
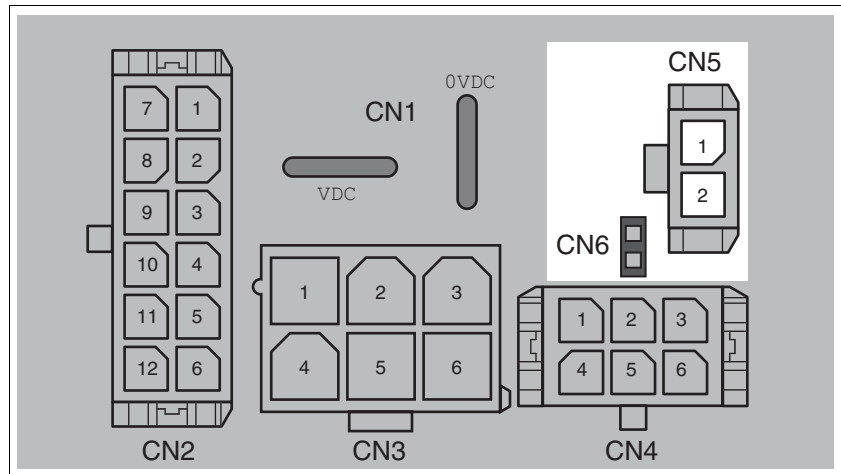
Figure 6.14   Pin assignment of safety function

Pin	Signal	Meaning
CN5.1	STO_A (PWRR_A)	Safety function STO "Safe Torque Off" (IEC/EN 61800-5-2)
CN5.2	STO_B (PWRR_B)	Safety function STO "Safe Torque Off" (IEC/EN 61800-5-2)
CN6		Jumper plugged in: STO disabled Jumper removed: STO enabled

NOTE: Jumper CN5 cannot be plugged in as long as jumper CN6 is still plugged in (mechanical lock).

Connecting the safety function
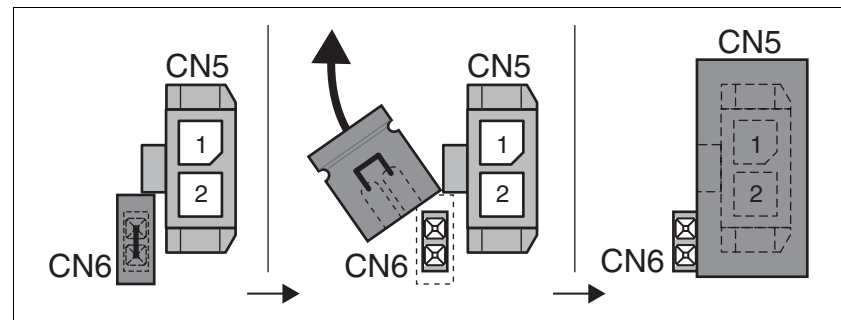
▶ Remove jumper CN6.

▶ Connect the connector to CN5.

6.4   Connection accessories

6.4.1   Accessory "Insert kit, 3x I/O"

The accessory makes the signals LIO1, LIO2 and LIO4 available outside of the device via industrial connectors.
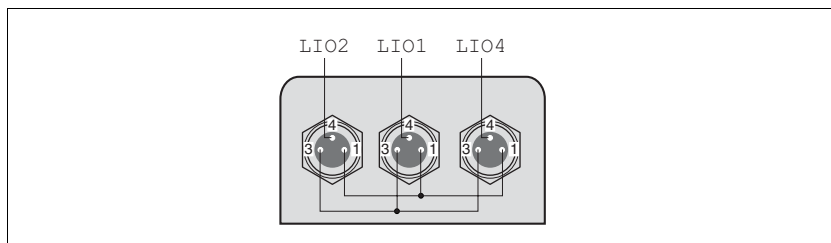
Figure 6.15   Pin assignment

Pin 1 is internally connected to CN4.1 (+24VDC_OUT).

Pin 3 is internally connected to CN4.4 (0VDC).

6.4.2   Accessory "Insert kit, 2x I/O, 1x STO in"

The accessory makes the signals LIO1, LIO2 and the signals of the STO safety function available outside of the device via industrial connectors.
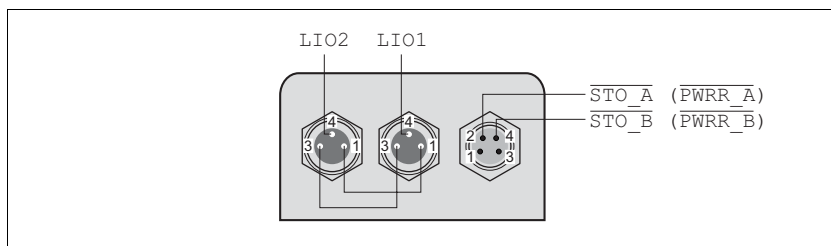
Figure 6.16   Pin assignment

Pin 1 is internally connected to CN4.1 (+24VDC_OUT).

Pin 3 is internally connected to CN4.4 (0VDC).

6.4.3   Accessory "Insert kit, 1x STO in, 1x STO out"

The accessory makes the signals of the STO safety function available outside of the device via industrial connectors.
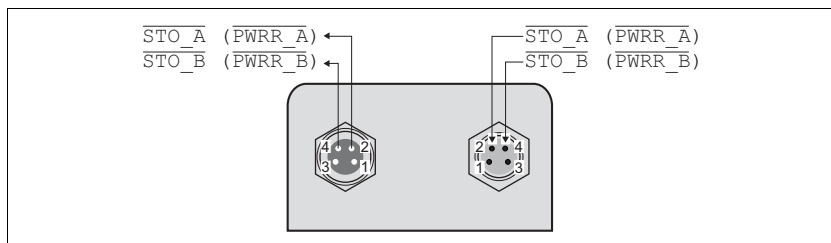
Figure 6.17   Pin assignment

6.4.4   Accessory "Insert kit, 4x I/O, 1x STO in, 1x STO out"

The accessory makes the signals `LIO1`, `LIO2`, `LIO3` and `LIO4` and the signals of the STO safety function available outside of the device via industrial connectors.
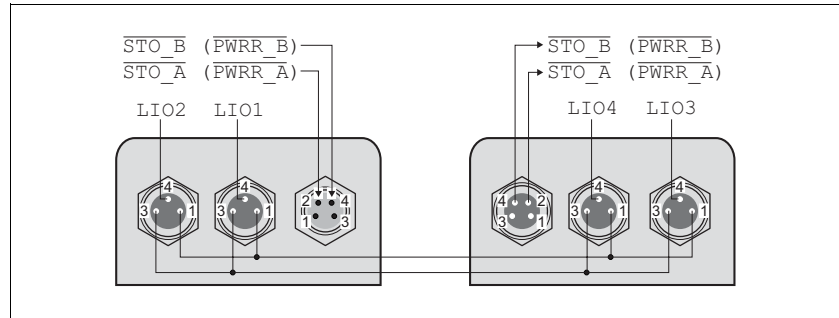
Figure 6.18   Pin assignment

Pin 1 is internally connected to CN4.1 (`+24VDC_OUT`).

Pin 3 is internally connected to CN4.4 (`0VDC`).

6.5   Checking wiring

Verify proper installation:

▶ Did you properly install and connect all cables and connectors?

▶ Are there any live, exposed cables?

▶ Did you properly connect the signal wires?

▶ Did you properly install all seals (degree of protection IP54)?

7 Commissioning

7

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

UNINTENDED CONSEQUENCES OF EQUIPMENT OPERATION

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

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

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

⚠ WARNING

LOSS OF CONTROL

The product is unable to detect an interruption of the network link if connection monitoring is not active.

• Verify that connection monitoring is on.

• The shorter the time for monitoring, the faster the detection of the interruption.

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

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

MOTOR WITHOUT BRAKING EFFECT

If power outage 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

ROTATING PARTS

Rotating parts may cause injuries and may catch clothing or hair. Loose parts or parts that are unbalanced may be flung.

• Verify correct mounting and installation of all rotating parts.

• Use a cover to help protect against rotating parts.

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

⚠ WARNING

FALLING PARTS

The motor may move, tip and crash down as a result of the reaction torque.

• Mount the motor securely so it will not break loose during strong acceleration.

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

> ⚠ **CAUTION**
>
> **HOT SURFACES**
>
> Depending on the operation, the surface may heat up to more than 100°C (212°F).
>
> • Do not allow contact with the hot surfaces.
> • Do not allow flammable or heat-sensitive parts in the immediate vicinity.
> • Consider the measures for heat dissipation described.
> • Check the temperature during test runs.
>
> **Failure to follow these instructions can result in injury or equipment damage.**

7.1 Overview

This chapter describes the commissioning procedure for the drive.

The following components are required for commissioning:

- Electronic Data Sheet file EDS, see:

  http://www.schneider-electric.com

- Configuration software RSLogix 5000
- Commissioning software Lexium CT, see

  http://www.schneider-electric.com

- Fieldbus converter for the commissioning software Lexium CT

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

To be done   ▶ Carry out all of the steps below in the specified order.

To be done ...	Page
6.5 "Checking wiring"	80
7.2.1 "Setting the IP address"	85
7.2.4 "Adding the product to Control Logix or Compact Logix with RSLogix"	95

▶ Carry out the following steps using the commissioning software.

To be done ...	Page
7.2.5 "Setting basic parameters and limit values"	101
7.2.6 "Digital inputs / outputs"	103
7.2.7 "Testing the signals of the limit switches"	104
7.2.8 "Testing the safety function STO"	105
7.2.9 "Checking the direction of movement"	106

7.2 Commissioning procedure

> ### ⚠ WARNING
>
> **LOSS OF CONTROL DUE TO UNSUITABLE PARAMETER VALUES**
>
> Unsuitable parameter values may disable monitoring functions and trigger unexpected movements or responses of signals.
>
> - Prepare a list with the parameters required for the functions used.
> - Check the parameters before operation.
> - Only start the system if there are no persons or obstructions in the hazardous area.
>
> **Failure to follow these instructions can result in death, serious injury or equipment damage.**

7.2.1 Setting the IP address

The product ships with the IP address 192.168.100.10.

For commissioning several products, you must first set a separate IP address for each product. You can set the IP address using the rotary switches as described on page 87. Only after that, a new product can be added to the network.

Double IP address Each device on the network must have a unique IP address. If an IP address is assigned more than once, this error is indicated by the flashing status LED (4 times per cycle) after the device is switched on.

NOTE: LEDs may be difficult to access once the product is installed.

See chapter 10.2.2 "Error indication with LEDs" for additional information on the LEDs.

Possibilities of setting the IP address There are 4 different ways of setting the IP address of the product during booting:

- DHCP address assignment by means of a "DeviceName", page 87
- DHCP address assignment via the MAC address, page 88
- Using the IP address from the EEPROM, page 88
- Deriving the IP address from the MAC address, page 88

Interfaces There are 2 interfaces for setting the IP address:

- For a basic configuration without software, the device provides two rotary switches.
- The commissioning software or the Web server must be used for an extended configuration.

Initial commissioning via PC You can connect to the product with a PC and configure it. The PC and the product must be in the same subnet for this. For initial commissioning, the PC must be set to an IP address 192.168.100.xxx with xxx being any value between 1 and 254 except for 10 (factory default of the product).

Contact your network administrator if you have questions concerning details.

7.2.1.1 Rotary switches for setting the IP address

The two rotary switches for setting the IP address have the following positions and functions:
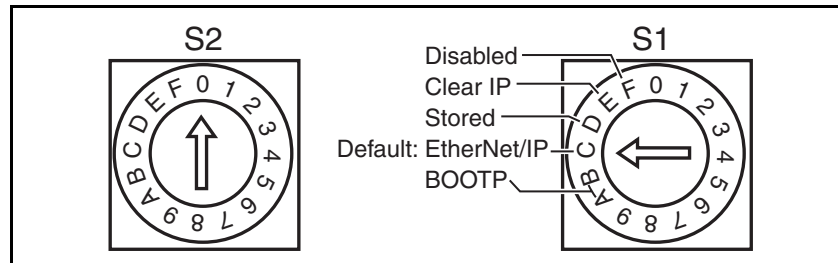
Figure 7.1   Settings of the rotary switches

ID	Name of switch function	Function	Valid position S2	Valid position S1
1	Device Name	There must be a DHCP server. It obtains its IP address via the DeviceName.	0 - F	0 - 9
2	BOOTP	There must be a DHCP server or a BOOTP server. It obtains its IP address via the MAC address.	Any	A, B
3	EtherNet/IP Default	The product tries to obtain its IP address via DHCP. If an IP address cannot be obtained within a period of 120 seconds, the IP address is loaded from the EEPROM. If there is no DHCP server, the boot time is extended by approximately 120 seconds.	Any	C
3	Stored	The IP parameters stored in the EEPROM are used.	Any	D,
4	Clear IP	The IP parameters stored in the EEPROM are deleted. Only the last byte of the IP address can be set. The first 3 bytes are initialized with 192.168.100.	Any	E
5	Disabled	The rotary switch settings are deactivated.	Any	F

7.2.1.2 Setting the IP address via the rotary switches

The default setting for the first 3 bytes is 192.168.100. The last byte is set with the rotary switches. Procedure:

▶ Switch off the product.

▶ Set the rotary switch S1 to "Clear IP".

▶ Switch on the product.

◁ The first 3 bytes are set to the default values when the product is switched on.

▶ Wait until the status LED indicates "No valid IP parameters after a Clear IP" (2x flash).

▶ The set the last byte of the IP address by means of the two rotary switches S1 and S2.

The number is the result of 10 * S2 + S1. A 0 must not be assigned. The product only accepts values from 1 to 159.

▶ After having set the desired IP address, wait until the status LED indicates "Ready without error" (Steady ON).

If, after that, you change the settings of the rotary switches to select a different IP address, the status LED indicates "No valid IP parameters after a Clear IP" (2x flash) again.

▶ Switch off the product when the status LED indicates "Ready without error" (Steady ON).

▶ Set the rotary switch S1 to "Stored". The position of rotary switch S2 is not evaluated.

▶ Switch on the product.

◁ The new IP address has been assigned to the product.

7.2.1.3 DHCP address assignment via the DeviceName

To assign the IP address via the DeviceName, a DHCP server must be available on the network. The DHCP server must support the Device-Name configuration.

The DeviceName is the string "Lexium-ILx-" and a three-digit number. This number results from the setting of the two rotary switches S1 and S2:

DeviceName = "Lexium-ILx-" + ASCII (10 * S2 + S1)

▶ Proceed as described in chapter 7.2.1.2 "Setting the IP address via the rotary switches" to set the rotary switches.

It is not possible to set this configuration via the commissioning software.

7.2.1.4 DHCP address assignment via the MAC address

To assign the IP address via the MAC address, a DHCP/BOOTP server must be available on the network. The MAC address is shown in the drive next to the connectors.

Rotary switch S1 must be set to **BOOTP**. The position of rotary switch S2 is not evaluated.

▶ Proceed as described in chapter 7.2.1.2 "Setting the IP address via the rotary switches" to set the rotary switches.

It is not possible to set this configuration via the commissioning software.

The DHCP/BOOTP server must manage a list that links each MAC address with an IP address so each product has a different, unique IP address.

7.2.1.5 Loading the IP address from the EEPROM

In this case, the IP configuration is loaded from the EEPROM.

Rotary switch S1 must be set to "Stored". The position of rotary switch S2 is not evaluated.

The commissioning software or the integrated Web server allows you to change the IP configuration. After a re-start of the product, the new IP configuration is used.

7.2.1.6 Deriving the IP address from the MAC address

With this setting, the same IP address may be assigned to different devices.

Rotary switch S1 must be set to **Disabled**. The position of rotary switch S2 is not evaluated.

▶ Proceed as described in chapter 7.2.1.2 "Setting the IP address via the rotary switches" to set the rotary switches.

It is not possible to set this configuration via the commissioning software.

The IP address is derived from the from the factory IPAddr (see table below) and the MAC address. The MAC address is shown in the drive next to the connectors.

Parameter		Value
IPAddr	=	192.168.100.xxx
SubnetMask	=	255.255.255.0
Gateway	=	IPAddr

The last byte of the IP address results from the last byte of the MAC address of the product.

Examples   A MAC address of xx-xx-xx-xx-xx-06$_h$ results in the IP address 192.168.100.**6**.

A MAC address of xx-xx-xx-xx-xx-A7$_h$ results in the IP address 192.168.100.**167**.

Exceptions   The value range of the last byte of the MAC address is 00$_h$ ... FF$_h$ (0 ... 255). With the preset subnet mask, 0 is the network address and 255 the Broadcast address. This means that these two addresses cannot be used. This results in the following exception handling:

- If the last byte of the MAC address is 00$_h$, the IP address assigned is 192.168.100.**1**.

- If the last byte of the MAC address is FF$_h$ (255), the IP address assigned is 192.168.100.**254**.

7.2.2 Lexium CT commissioning software

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

Source of commissioning software

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

http://www.schneider-electric.com

Functions of the commissioning software

The functions of the commissioning software include:

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

System requirements

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

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

Online help

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

Establishing a connection to the device

The Ethernet interface of the product supports Modbus TCP. This allows you to establish a connection to the product for commissioning purposes. Use to commissioning software to do so.
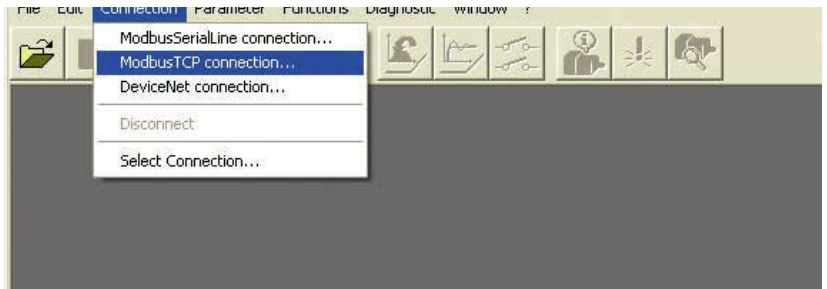
Figure 7.2   Selecting a Modbus TCP connection
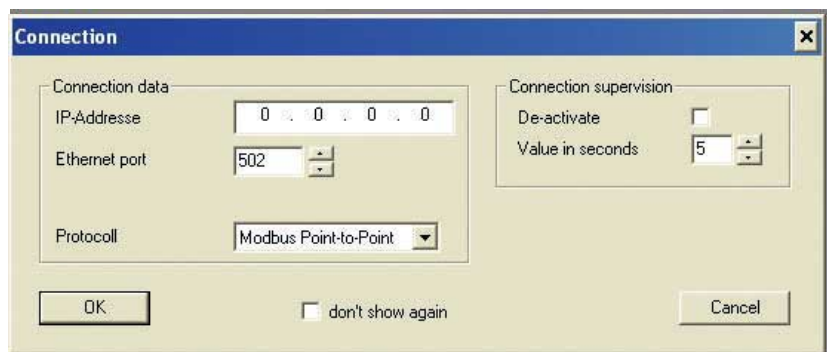
Figure 7.3   Entering the connection data

▶ Enter the IP address of the product in the field **IP Address**.

▶ Enter the value **502** in the field **Ethernet Port**.

7.2.3 Web server

The product features an integrated web server. This web server allows the product to be configured without the commissioning software.

Connecting ■ The product must have a valid IP address.

▶ Start an Internet browser.

▶ Enter the IP address of the product in the address bar.

Password-protected access ▶ Connect as described above.

▶ Click the **Maintenance** tab and then the appropriate submenu.

▶ Enter the following in the fields (uppercase): **Username** -> "USER" and **Password** -> "USER".

After authentication, the system displays the main page. Access to the main page is blocked after three unsuccessful attempts.

Parameters are entered in a way similar to Lexium CT.

▶ Click the **Write** button to send the parameters to the drive.

▶ After that, click the **Save** button to save the parameters to the non-volatile memory of the drive.

A warning is displayed if you have not yet saved the values.

0198441113676, V1.00, 09.2009

User interface The user interface of the Web server is structured as shown on the screenshot below:

Figure 7.4   User interface

(1)   Main menu
(2)   Submenu
(3)   Content

Web server functions General access:

• Diagnostics

• Display the manual

Password-protected access:

• Display parameters

• Change parameters
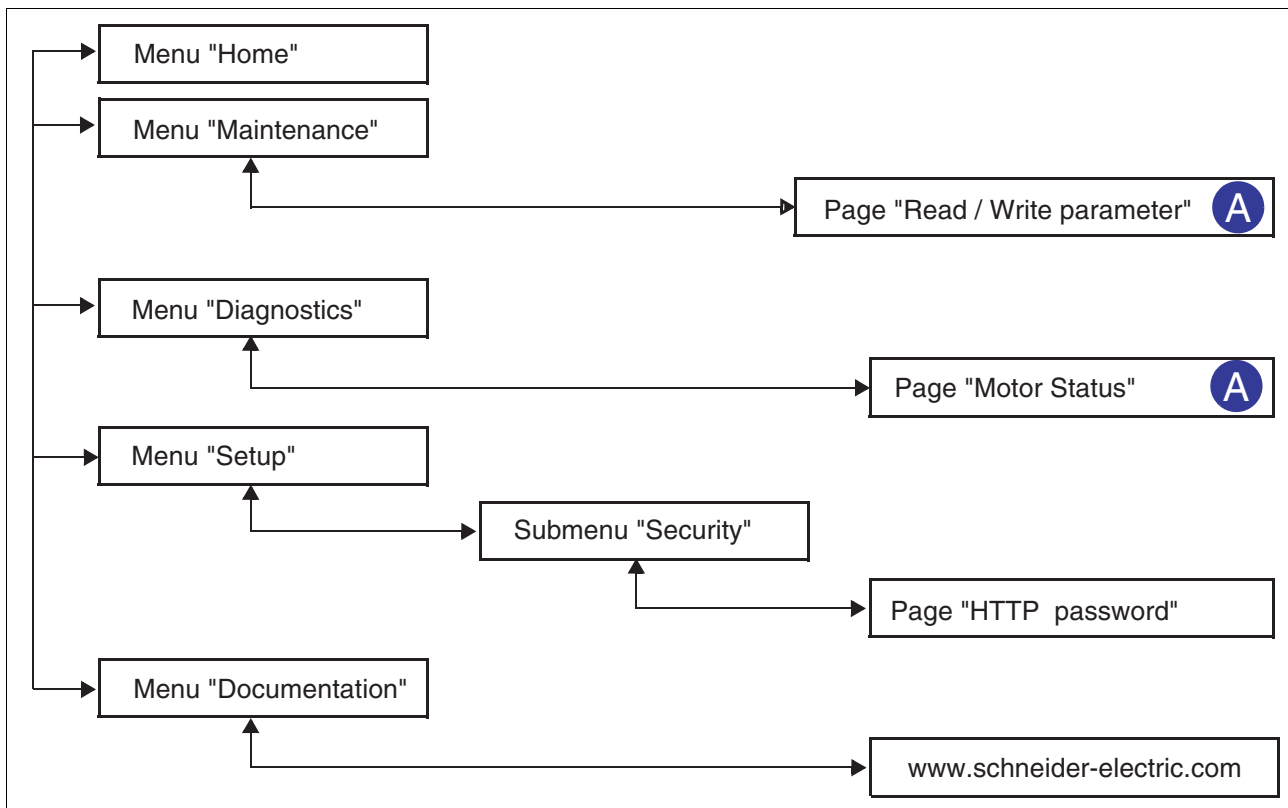
Figure 7.5 Web server page structure

Menu	Page	Function
HOME	English	Homepage
MAINTENANCE	Read / write parameters	Edit motor and communication parameters
DIAGNOSTICS	Ethernet Statistics	View communication statistics
		Product identification
SETUP	[Security] HTTP password	Change the password for access to the Web server (HTTP password). The HTTP password cannot be reset via the website, but only via the menu item **Restore Factory Defaults**.
DOCUMENTATION	References	Link to the website http://www.schneider-electric-motion.com

7.2.4   Adding the product to Control Logix or Compact Logix with RSLogix

To add the product to Control Logix or Compact Logix, use the configuration software RSLogix 5000, node **I/O Configuration** (Figure 7.6: Control Logix, Figure 7.7: Compact Logix).
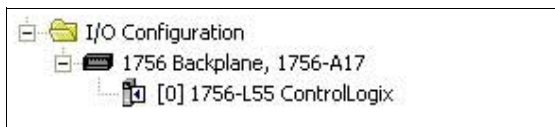
Figure 7.6   RSLogix 5000 - "I/O Configuration", Control Logix
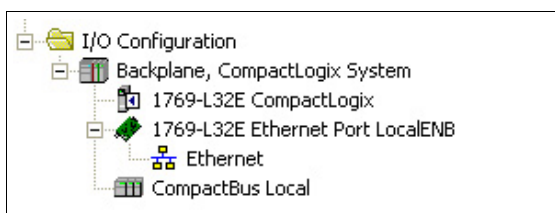
Figure 7.7   RSLogix 5000 - "I/O Configuration", Compact Logix

As opposed to Control Logix, Compact Logix does not require the addition of an Ethernet Bridge. If you use Verwendung vom Compact Logix, go directly to the section "Adding and configuring the product".

Nur Control Logix: Adding and configuring an Ethernet Bridge

▶   In the context menu of **1756 Backplane ...**, select the item **New Module**.
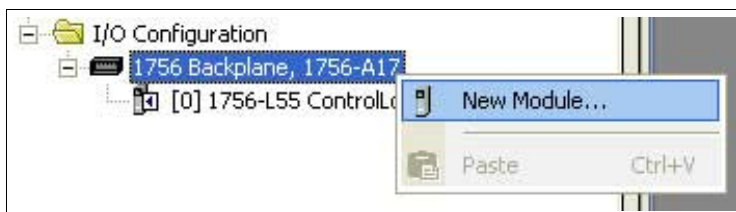
Figure 7.8   RSLogix 5000 - "New Module"

▶ Double-click **Communications**.
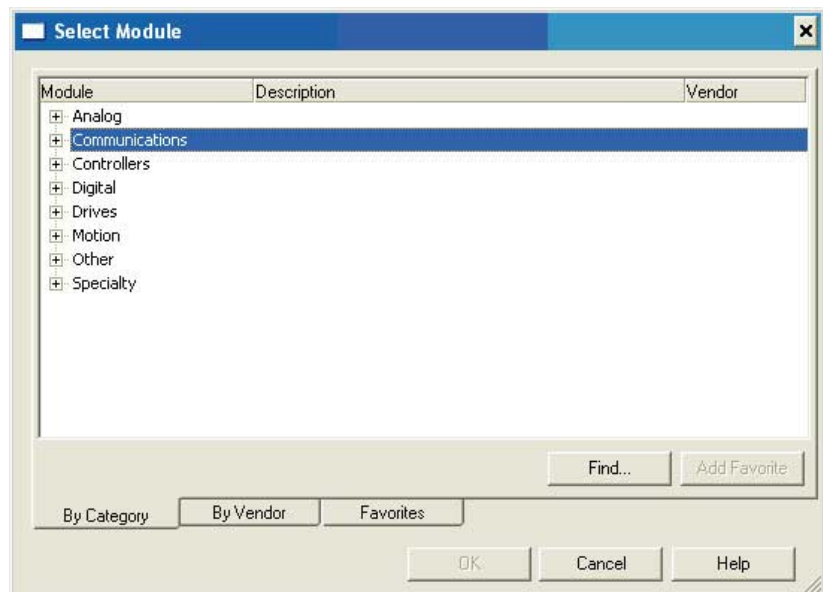
Figure 7.9   RSLogix 5000 - "Communications"

▶ Select an Ethernet Bridge (example shows "1756-ENBT/A").
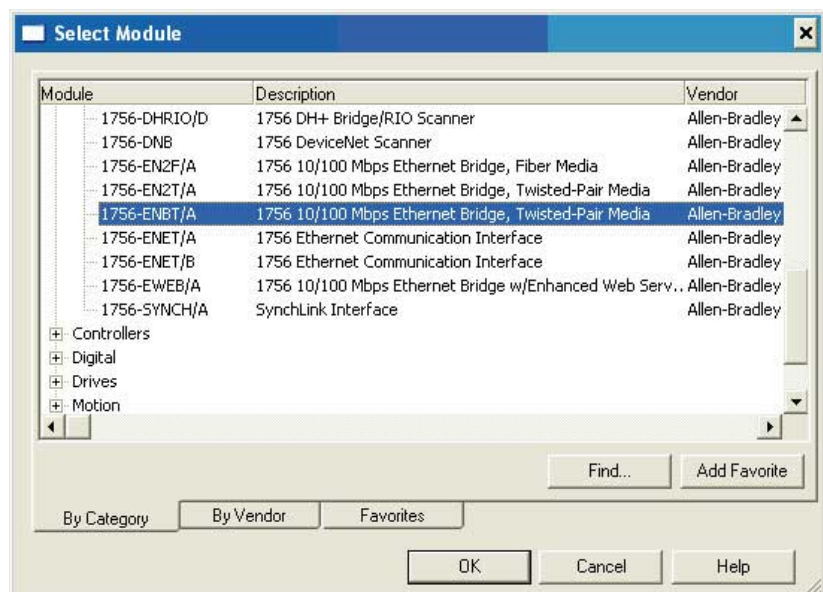
Figure 7.10   RSLogix 5000 - "Ethernet Bridge"

▶ Confirm with **OK**.

◁ The window **Select Major Revision** is displayed.

▶ Enter the revision number in the field **Major Revision** (example shows "3".
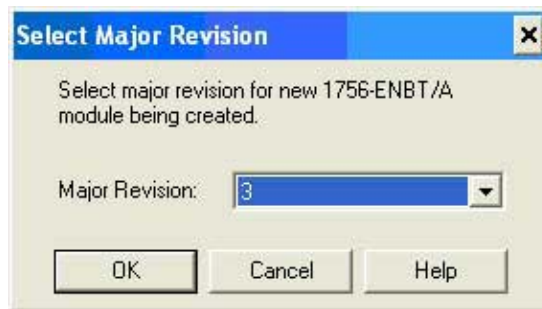
Figure 7.11   RSLogix 5000 - "Select Major Revision"

▶ Confirm with **OK**.

◁ The window **New Module** for configuration of the master is displayed.

▶ Enter any name in the field **Name**.

▶ Enter the slot in the field **Slot**.

▶ Enter the revision number in the field **Revision**.

▶ Enter the IP address in the field **IP Address**.
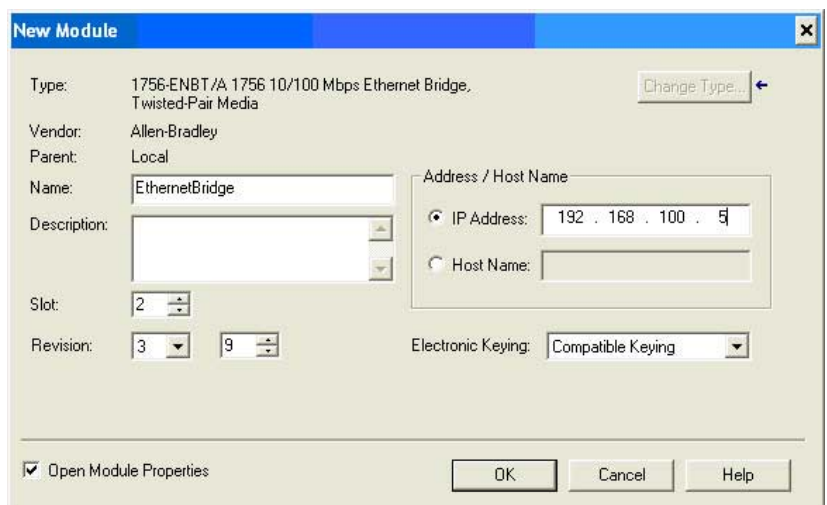
Figure 7.12   RSLogix 5000 - "New Module"

▶ Confirm with **OK**.

◁ The **I/O Configuration** now contains the Ethernet Bridge.
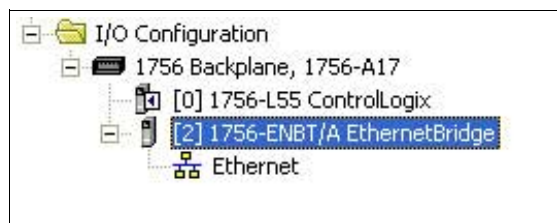
Figure 7.13   RSLogix 5000 - "New Module" for Control Logix

Adding and configuring the product   ▶ Control Logix only: In the context menu of **1756-ENBT/A Ethernet Bridge**, select the item **New Module**.
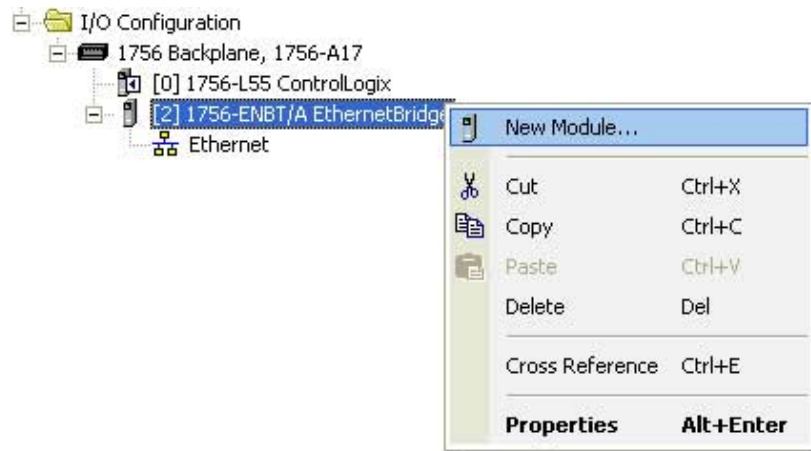
Figure 7.14   RSLogix 5000 - "New Module" for Control Logix

▶ Compact Logix only: In the context menu of **Ethernet**, select the item **New Module**.
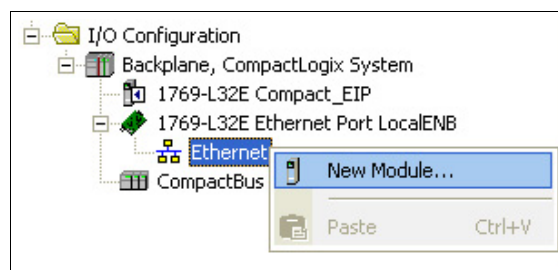
Figure 7.15   RSLogix 5000 - "New Module" for Compact Logix

▶ Double-click **Communications**.
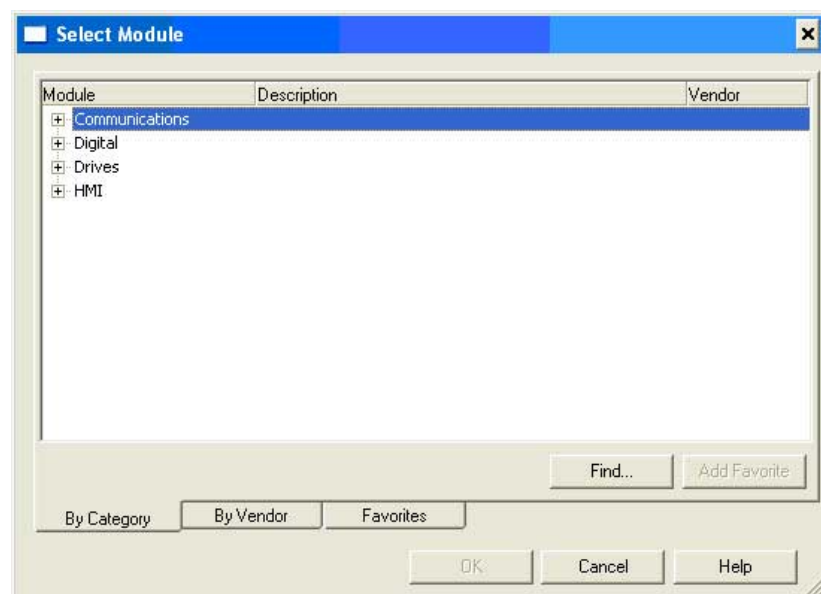
Figure 7.16   RSLogix 5000 - "Communications"

▶ Select the item "ETHERNET-MODULE".
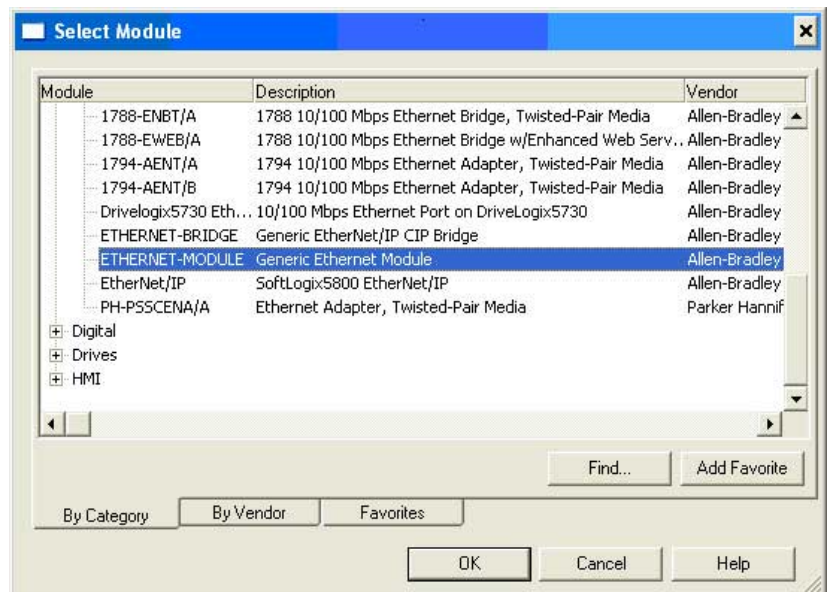
Figure 7.17   RSLogix 5000 - "ETHERNET MODULE"

▶ Confirm with **OK**.

◁ The window **New Module** for configuring the product is displayed.

▶ Enter any name in the field **Name**.

▶ From the **Comm. Format** listbox, select the "Data - DINT".

  NOTE: When you display this window again, the listbox **Comm. Format** is grayed.

▶ Enter the previously set IP address in the field **IP Adress**.

  See chapter 7.2.1 "Setting the IP address".

▶ The option **Open Module Properties** must be checked.
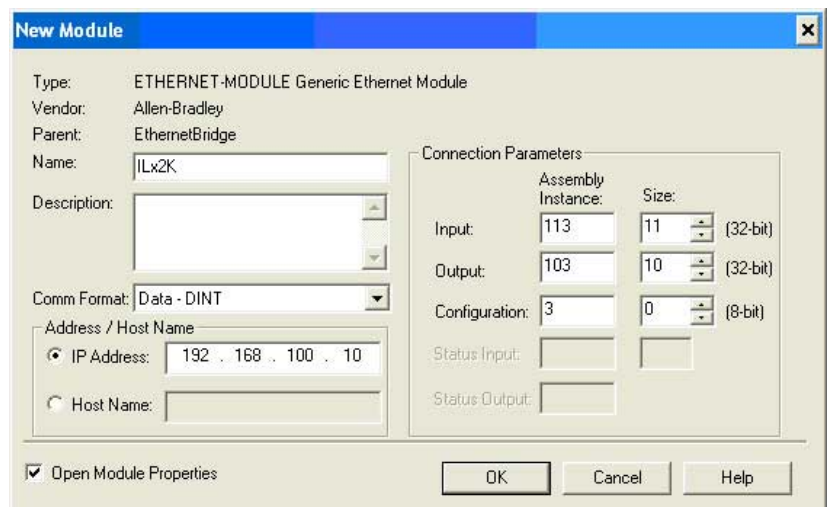
Figure 7.18   RSLogix 5000 - "Module Properties - Connection"

▶ Confirm with **OK**.

◁ The window **Module Properties** with the tab **Connection** is displayed.

▶ In the field **Requested Packet Interval (RPI)**, enter a value for the cycle time in ms I/O Messages (default: 10 ms).

The selectable cycle time depends on the number of network devices and the number of hub levels.
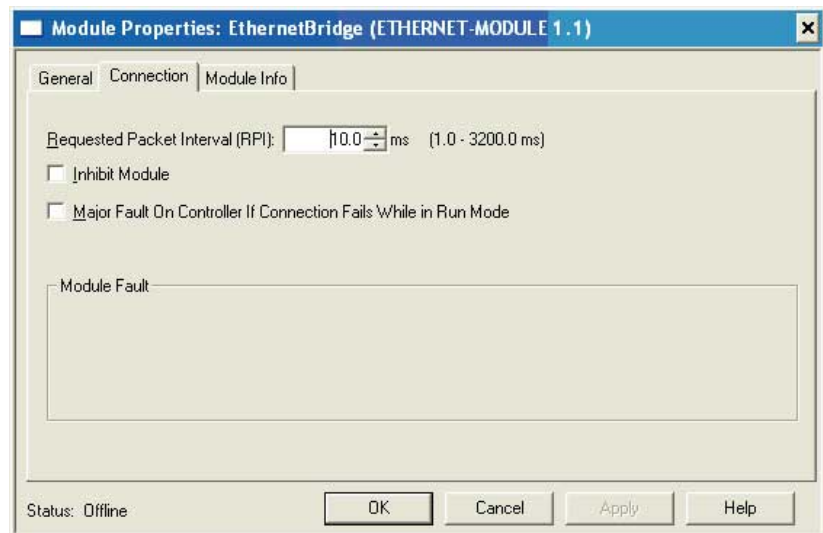
Figure 7.19   RSLogix 5000 - "I/O Configuration"

▶ Confirm with **OK**.

◁ The **I/O Configuration** shows the product (Figure 7.20: Control Logix, Figure 7.21: Compact Logix).
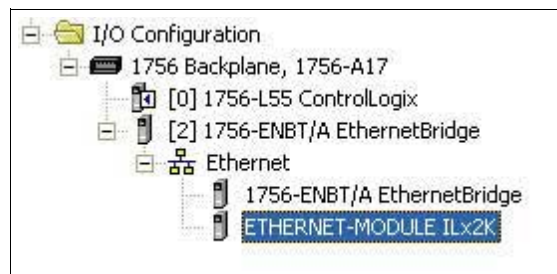
Figure 7.20   RSLogix 5000 - "I/O Configuration" with Control Logix
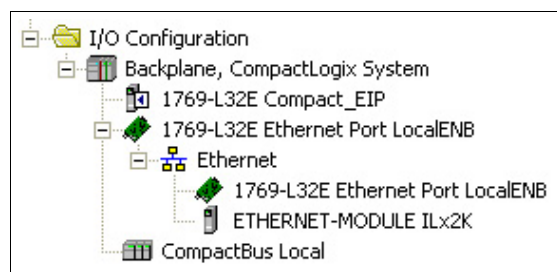
Figure 7.21   RSLogix 5000 - "I/O Configuration" with Compact Logix

7.2.5 Setting basic parameters and limit values

⚠ **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.

The description contains parameters you do not need if you use the library. For diagnostics purposes, these parameters can be read with the function block "MC_ReadParameter_ETH_ILx2".

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.

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".

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL_I_max	Current limitation The value must not exceed the maximum permissible current of the motor or the power stage. Default: M_I_max	A_{pk} 0.00 - 299.99	UINT16 UINT16 R/W per. -	Modbus 4610 CIP 118.1.1
LIM_I_maxQSTP	Current limitation for Quick Stop Max. current during braking via torque ramp due to an error of error classes 1 or 2 and when a software stop is triggered. Maximum and default settings depend on the motor and the power stage (settings M_I_max and PA_I_max) In increments of 0.01Apk	A_{pk} - - -	UINT16 UINT16 R/W per. -	Modbus 4362 CIP 117.1.5
LIM_I_maxHalt	Current limitation for Halt Max. current during braking after Halt or when an operating mode is terminated. Maximum and default settings depend on the motor and the power stage (settings M_I_max and PA_I_max) In increments of 0.01Apk	A_{pk} - - -	UINT16 UINT16 R/W per. -	Modbus 4364 CIP 117.1.6

Limitation of speed of rotation   The parameter CTRL_n_max can be used to limit the maximum speed of rotation.

▶ Use the parameter CTRL_n_max to set the maximum speed of rotation of the motor.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL_n_max	Speed limitation The set value must not exceed the maximum motor speed. Default: maximum motor speed (see M_n_max)	min^{-1} 0 - 13200	UINT16 UINT16 R/W per. -	Modbus 4612 CIP 118.1.2

7.2.6 Digital inputs / outputs

The device has 4 configurable 24V signals. These 24V signals can each be configured as either an input or an output.

The configuration of the 24V signals is described in chapter 8.6.7 "Configurable inputs and outputs".

Factory settings   The following table provides an overview of the factory settings.

Pin	Signal	Factory setting	I/O
CN4.3	LIO1	Input Positive limit switch (LIMP)	I
CN4.6	LIO2	Input Negative limit switch (LIMN)	I
CN4.2	LIO3	Input Free available	I
CN4.5	LIO4	Input Reference switch (REF)	I

Signal level   The _IO_LIO_act parameter provides information on the current signal level of the 24V signals.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_IO_LIO_act	Status of digital inputs/outputs (103) Coding of the individual signals: Bit 0: LIO1 Bit 1: LIO2 ...	- - 0 -	UINT16 UINT16 R/- - -	Modbus 2090 CIP 108.1.21

7.2.7   Testing the signals of the 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.
>
> • Before you can use the limit switches, you must enable them.
>
> **Failure to follow these instructions can result in death, serious injury or equipment damage.**

■ You must have configured the functions "Negative limit switch (LIMN)" and "Positive limit switch (LIMP)", see chapter 8.6.7 "Configurable inputs and outputs".

▶ Set up the limit switches in such a way as to keep the drive from overtraveling the limit switches.

▶ Trigger the limit switches manually.

◁ The commissioning software displays an error condition caused by a limit switch.

The appropriate parameters can be used to release the limit switches and to set the evaluation to active 0 or active 1, see chapter 8.6.1 "Monitoring functions".

If possible, use normally closed contacts so that a wire break can be signaled as an error.

7.2.8 Testing the safety function STO

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

- ■ Supply voltage switched off.

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

- ■ Supply voltage switched on.

- ▶ Enable the power stage (without motor movement).

- ▶ Trigger the safety function. $\overline{\text{STO\_A}}$ ($\overline{\text{PWRR\_A}}$) and $\overline{\text{STO\_B}}$ ($\overline{\text{PWRR\_B}}$) must be switched off simultaneously (time offset <1s).

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

- ▶ Verify that the `IO_AutoEnable` parameter is set to "off" to avoid unexpected restart.

- ▶ Check the behavior of the drive during fault conditions.

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

Operation without STO   You must perform the following steps if you do not want to use the STO safety function.

- ▶ Check whether the jumper CN6 is connected.

7.2.9   Checking the direction of movement

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.

▶ Start the operating mode Jog.

▶ Start a movement with positive direction of rotation.

◁ The motor shaft rotates with positive direction of rotation.

▶ Start a movement with negative direction of rotation.

◁ The motor shaft rotates with negative direction of rotation.

▶ If the arrow and direction of rotation do not match, correct this with the `POSdirOfRotat` parameter, see chapter 8.6.8 "Reversal of direction of rotation".

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.

The description contains parameters you do not need if you use the library. For diagnostics purposes, these parameters can be read with the function block "MC_ReadParameter_ETH_ILx2".

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.

8.1   Overview of operating modes

Operating modes and reference value supply

The following table shows an overview of the operating modes and the way reference values are supplied.

Operating mode	Reference values	Description
Jog	Fieldbus commands	Page 115
Speed Control	Fieldbus commands	Page 117
Profile Position	Fieldbus commands	Page 118
Profile Velocity	Fieldbus commands	Page 120
Homing	Fieldbus commands	Page 121

Reference value for control loop

The following table shows the relationship between operating mode, control loop and the use of the profile generator.

Operating mode	Control loop	Profile generator
Jog	Position controller	Active
Speed Control	Velocity controller	Inactive
Profile Position	Position controller	Active
Profile Velocity	Position controller	Active
Homing	Position controller	Active

8.2 Access control

The device has several access channels. Using an access channel, you can control the device (for example, state transitions or motor movements).

An access channel can be assigned exclusive access control. With exclusive access control, you can only control the device via this access channel.

The device has the following access channels:

- Ethernet fieldbus
- Commissioning software
- Signal inputs

8.2.1 Access control via Ethernet fieldbus

You can use the AccessLock parameter to restrict access control to the fieldbus. In this case, the product can no longer be controlled via another access channel.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
AccessLock	Locking other access channels 0: Release other access channels 1: Lock other access channels The fieldbus can lock active access to the device via the following access channels with this parameter: - Input signals - Commissioning software Processing of the input signal HALT cannot be locked.	- 0 - 1	UINT16 UINT16 R/W - -	Modbus 316 CIP 101.1.30

8.2.2 Access control via commissioning software

With the "Access" field, you can restrict access control to the commissioning software. In this case, the product can no longer be controlled via another access channel.

8.2.3 Access control via signal inputs

You can control the device using the functions of the signal inputs LIO1 ... LIO3. Control is not possible while another access channel has exclusive access control.

Exceptions:

- The functions "Halt", "Positive limit switch (LIMP)", "Negative limit switch (LIMN)" and "Reference switch (REF)" remain effective.
- The digital signal inputs $\overline{STO\_A}$ ($\overline{PWRR\_A}$) and $\overline{STO\_B}$ ($\overline{PWRR\_B}$) remain effective.

8.3   Operating states

8.3.1   State diagram

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

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

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

Graphic representation   The state diagram is shown graphically as a flow chart.
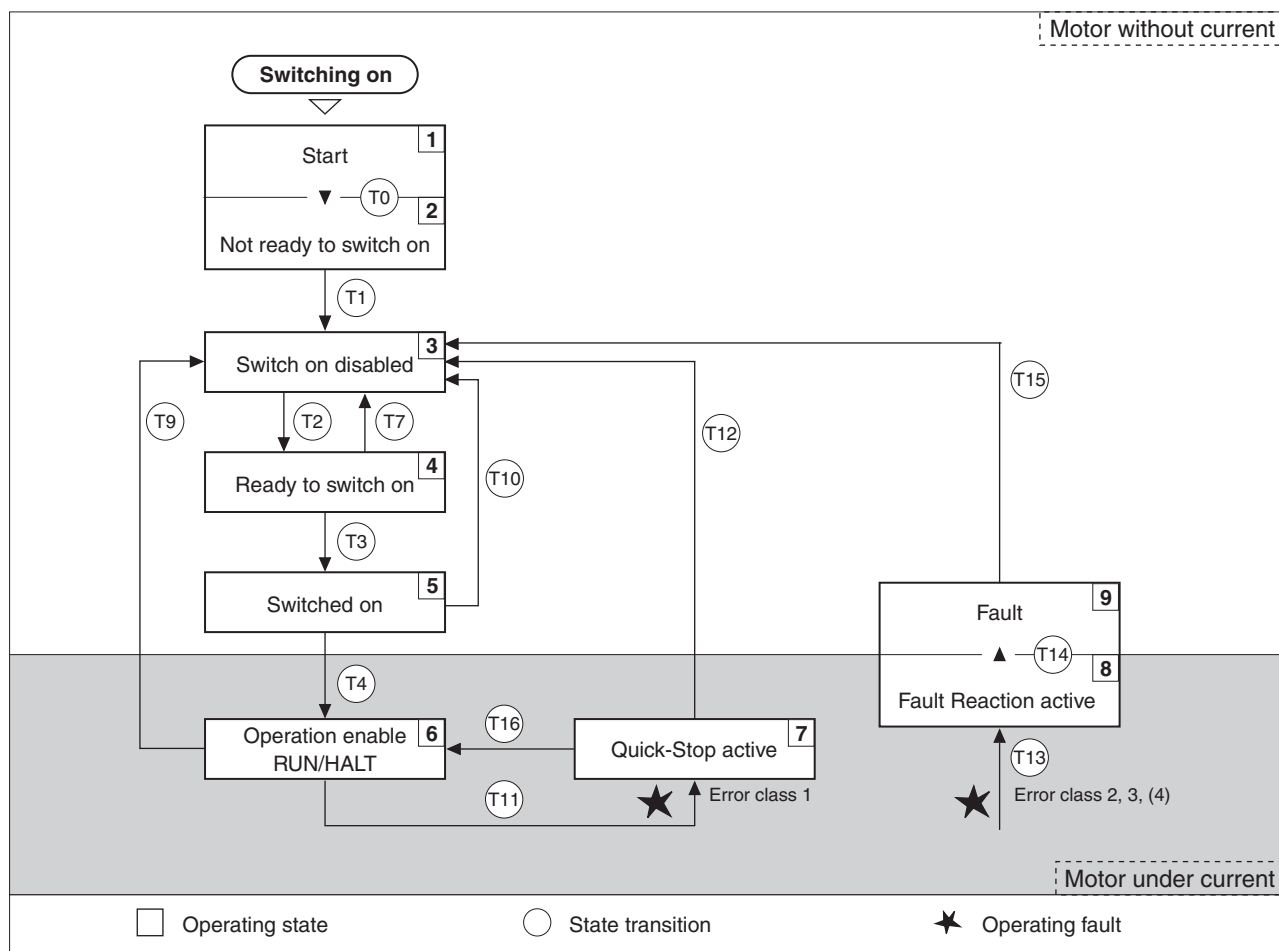
Figure 8.1   State diagram

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 disabled
3, 4 or Safety function STO	**x** -> **8** -> **9**	Power stage is disabled immediately, even if "Quick Stop" is still active.

An error can be triggered by a temperature sensor, for example. The device cancels the motion command and starts the error response, for example deceleration and stopping with "Quick Stop" or disabling the power stage. Subsequently, the operating state changes to **9** Fault.

To exit the **9** Fault operating state, the cause of the error must be remedied and a Fault Reset must be executed.

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

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

Transi-tion	Operating state	Condition / event [1] [2]	Response
T0	**1-> 2**	• Device electronics successfully initialized	
T1	**2-> 3**	• Parameter successfully initialized	
T2	**3 -> 4**	• No undervoltage Encoder successfully checked Actual velocity: <1000 min^{-1} STO signals = +24V (or jumper CN6 plugged in)	
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	-
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 initiate a state transition it is sufficient if one condition is met
2) Fieldbus commands only with fieldbus control mode

8.3.2   Indicating the operating states

You can indicate the current operating state via the signal outputs, the commissioning software or the fieldbus.

Signal outputs   Indication of the operating states via the signal outputs must be configured, see chapter 8.6.7 "Configurable inputs and outputs".

State	"No fault"	"Active"
2: Not ready to switch on	0	0
3: Switch on disabled	0	0
4: Ready to switch on	1	0
5: Switched on	1	0
6: Operation enable	1	1
7: Quick Stop activ	0	0
8: Fault Reaction active	0	0
9: Fault	0	0

Commissioning software   For a detailed description, see the "Lexium CT commissioning software" product manual.

Fieldbus   The parameter `actionStatus` indicates the current operating state.

8.4   Indicating, starting and changing operating modes

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

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

An operating mode is terminated if the motor has reached the target position or if it is stopped by the functions "Quick Stop" or "Halt". If an error occurs during the movement which causes the current operating mode to be canceled, the movement can be resumed or you can change to a different operating mode after the cause of the error has been removed.

Changing operating states and activating operating modes must be done separately. An operating mode can usually only be activated if the operating state is already **6** Operation Enabled.

8.4.1   Indicating and monitoring the operating mode

You can display and monitor the current operating mode using the commissioning software or the fieldbus.

Commissioning software   For a detailed description, see the "Lexium CT commissioning software" product manual.

Fieldbus   The current operating mode is indicated with the "modeStat" byte.

8.5   Operating modes

8.5.1   Operating mode Jog

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

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

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

The illustration below shows an overview.
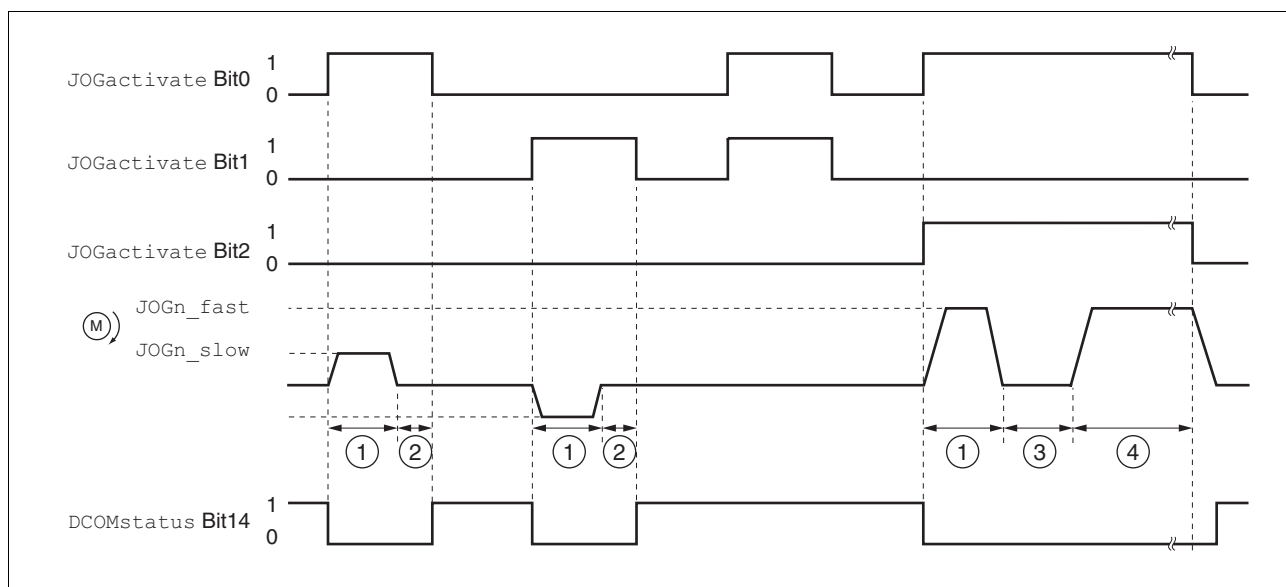
Figure 8.2   Jog, slow and fast

(1)   Distance unit
(2)   t < waiting time
(3)   t > waiting time
(4)   Continuous movement

The distance unit, waiting time and velocity levels can be set. If the distance is zero, the jog movement starts directly with continuous movement irrespective of the waiting time.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
JOGactivate	Activation of jog (116) Bit0 : Positive direction of rotation Bit1 : Negative direction of rotation Bit2 : 0=slow 1=fast If both bits for the direction of rotation are activated at the same time, no movement is started. If a jog movement is running, the simultaneous activation of the bits for the direction of rotation has no effect.	- 0 0 7	R/W - -	
JOGn_slow	Speed for slow jog The adjustable value is internally limited to the current parameter setting in RAMPn_max.	min^{-1} 1 60 13200	UINT16 UINT16 R/W per. -	Modbus 10504 CIP 141.1.4
JOGn_fast	Speed for fast jog The adjustable value is internally limited to the current parameter setting in RAMPn_max.	min^{-1} 1 180 13200	UINT16 UINT16 R/W per. -	Modbus 10506 CIP 141.1.5
JOGstepusr	Jog distance prior to continuous run 0: Direct activation of continuous run >0: Positioning distance per jog cycle	usr 0 1 2147483647	INT32 INT32 R/W per. -	Modbus 10510 CIP 141.1.7
JOGtime	Wait time prior to continuous run This time is only effective if you have set a jog distance not equal to 0, otherwise the drive immediately starts a continuous run.	ms 1 500 32767	UINT16 UINT16 R/W per. -	Modbus 10512 CIP 141.1.8

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

- the direction signal is inactive

- the operating mode has been interrupted by "Halt" or an error

Further options   For further settings and functions for the operating mode, see page 133.

8.5.2　Operating mode Speed control

Overview of Speed Control　In the Speed Control operating mode, a reference value for the speed of rotation of the motor is preset.

Transitions between two velocities follow the adjusted control loop parameters.

Setting limit values　See chapter 7.2.5 "Setting basic parameters and limit values" for setting the limitation of the current and the speed of rotation.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
SPEEDn_target	Reference speed in operating mode speed control The internal maximum speed is limited to the current setting in CTRL_n_max.	min^{-1} -30000 0 30000	INT16 INT16 R/W - -	Modbus 8456 CIP 133.1.4

Terminating the operating mode　Processing is terminated by:

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

8.5.3   Operating mode Profile Position

In Profile Position operating mode, a movement with an adjustable motion profile is performed from a start position to a target position. The value of the target position can be specified as either a relative or an absolute position.

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

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

In the case of a relative positioning, the positioning distance is specified relatively with reference to the current axis position or the target position.
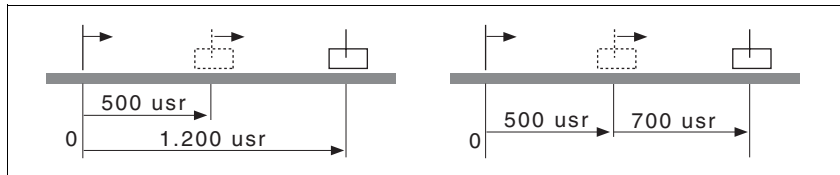
Figure 8.3   Absolute positioning (left) and relative positioning (right)Absolute positioning (left) and relative positioning (right)
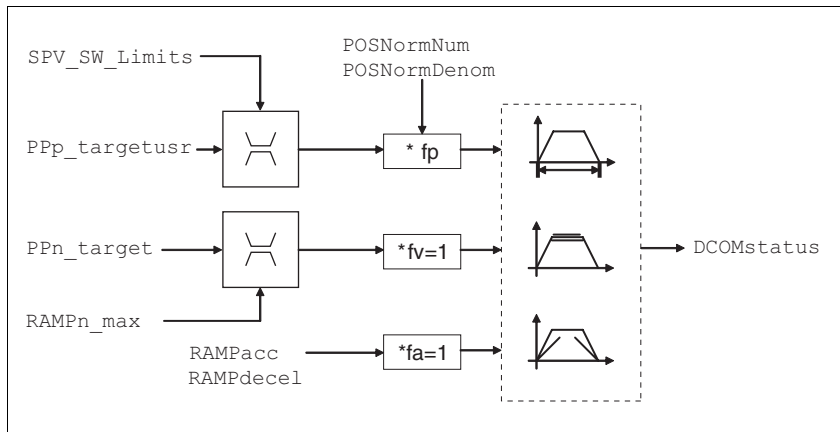
Figure 8.4   Operating mode Profile Position, effect of adjustable parameters

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

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_p_actusr	Actual motor position in user units	usr - 0 -	INT32 INT32 R/- - -	Modbus 7706 CIP 130.1.13
_p_actRAMPusr	Actual position of motion profile generator In user units	usr - 0 -	INT32 INT32 R/- - -	Modbus 7940 CIP 131.1.2

Target position   A new position value is assigned with the parameter `PPp_targetusr`.

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

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

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PPn_target	Reference speed in operating mode profile position The maximum value is limited to the current setting in CTRL_n_max. The adjustable value is internally limited to the current parameter setting in RAMPn_max.	min^{-1} 1 60 13200	R/W - -	
AbsHomeRequest	Absolute positioning only after homing **0 / no**: No **1 / yes**: Yes	- 0 1 1	UINT16 UINT16 R/W per. -	Modbus 1580 CIP 106.1.22
PPp_absusr	Target position absolute of operating mode profile position Min./max values depend on: - Scaling factor - Software limit switches (if they are activated)	usr - 0 -	R/W - -	
PPp_relpactusr	Target position relative to current motor position Min./max values depend on: - Position normalization factor - Software limit switches (if they are activated) In the case of active positioning in Profile Position mode, relative positioning refers to the current motor position. The absolute user position limits can only be overrun if the drive is at standstill when the movement starts (x_end=1). In this case, implicit position setting to position 0 is performed.	usr - 0 -	R/W - -	
PPp_relprefusr	Target position relative to the current target position Min./max values depend on: - Position normalization factor - Software limit switches (if they are activated) In the case of active positioning in operating mode Profile Position, relative positioning refers to the target position of the current movement. The absolute user position limits can only be overrun if the drive is at standstill when the movement starts (x_end=1). In this case, implicit position setting to position 0 is performed.	usr - 0 -	R/W - -	

8.5.4 Operating mode Profile Velocity

In the operating mode Profile Velocity, the drive accelerates to an adjustable target speed of rotation. You can set a motion profile with values for acceleration and deceleration ramps.

Overview The following overview shows the function principle of the parameters which can be set for the Profile Velocity operating mode.
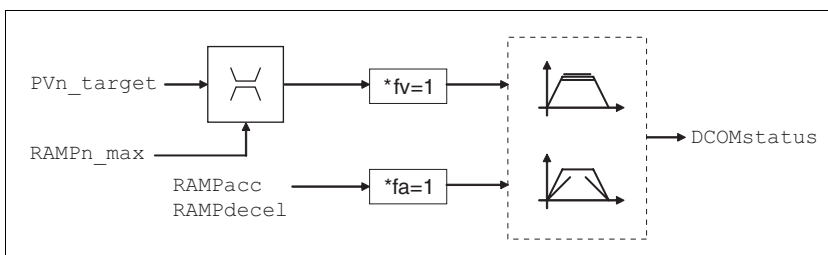
Figure 8.5   Operating mode Profile Velocity, effects of adjustable parameters

Reference velocity The reference velocity is assigned via the parameter PVn_target in min^{-1} and can be changed during the movement. The operating mode is not limited by the positioning range limits. New velocity values are accepted immediately during the execution of a running motion command.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PVn_target	Reference speed of operating mode profile velocity The maximum value is limited to the current setting in CTRL_n_max. The adjustable value is internally limited to the current parameter setting in RAMPn_max.	min^{-1} -13200 - 13200	R/W - -	

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

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_n_act	Actual motor speed	min^{-1} - 0 -	INT16 INT16 R/- - -	Modbus 7696 CIP 130.1.8
_n_actRAMP	Actual speed of motion profile generator	min^{-1} - 0 -	INT32 INT32 R/- - -	Modbus 7948 CIP 131.1.6

8.5.5 Operating mode Homing

Overview of Homing

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

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

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

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

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

Homing is only required during commissioning. The absolute position is saved when the device is switched off; it is available again when the device is switched on.

Types of reference movements

There are 4 standard types of reference movements:

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

Reference movements are possible with or without index pulse.

- Reference movement without index pulse
  Movement from the switching edge to a distance distance from switching edge

- Reference movement with index pulse
  Movement from the switching edge to the closest index pulse of the motor. The current motor position can be read via the parameter `_p_absENCusr`. The index pulse is at position value 0.

Operating mode terminated

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

When the power stage is disabled, the valid reference point is retained.

Description

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

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMmethod	Homing method (122) **0 / deactivate**: Deactivated **1 / LIMN indexpuls**: LIMN with index pulse **2 / LIMP indexpuls**: LIMP with index pulse **7 / REFpos indexpuls**: REF+ with index pulse, inv., outside **8 / REFneg indexpuls**: REF+ with index pulse, inv., inside **9**: REF+ with index pulse, not inv., inside **10**: REF+ with index pulse, not inv., outside **11**: REF- with index pulse, inv., outside **12**: REF- with index pulse, inv., inside **13**: REF- with index pulse, not inv., inside **14**: REF- with index pulse, not inv., outside **17 / LIMN**: LIMN **18 / LIMP**: LIMP **23 / REFpos**: REF+, inv., outside **24**: REF+, inv., inside **25**: REF+, not inv., inside **26**: REF+, not inv., outside **27 / REFneg**: REF-, inv., outside **28**: REF-, inv., inside **29**: REF-, not inv., inside **30**: REF-, not inv., outside **33**: Index pulse neg. direction **34**: Index pulse pos. Direction Abbreviations: REF+: Search movement in pos. direction REF-: Search movement in pos. direction inv.: Invert direction in switch not inv.: Direction not inverted in switch outside: Index pulse / distance outside switch inside: Index pulse / distance inside switch	- 0 - 35	R/W - -	

Use the parameter IOsigREF to set the evaluation of the reference switch $\overline{\text{REF}}$ to active 0 or active 1. A release of the switch is not required.

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

If possible, use normally closed contacts so that a wire break can be signaled as an error.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOsigRef	Signal evaluation REF **1 / normally closed**: Normally closed NC **2 / normally open**: Normally open NO The reference switch is only activated (to REF) while homing is processed.	- 1 1 2	UINT16 UINT16 R/W per. -	Modbus 1564 CIP 106.1.14

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOsigLimN	Signal evaluation LIMN **0 / inactive**: Inactive **1 / normally closed**: Normally closed NC **2 / normally open**: Normally open NO	- 0 1 2	UINT16 UINT16 R/W per. -	Modbus 1566 CIP 106.1.15
IOsigLimP	Signal evaluation LIMP **0 / inactive**: Inactive **1 / normally closed**: Normally closed NC **2 / normally open**: Normally open NO	- 0 1 2	UINT16 UINT16 R/W per. -	Modbus 1568 CIP 106.1.16

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

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMn	Speed of rotation for search of switch The adjustable value is internally limited to the current parameter setting in RAMPn_max.	min^{-1} 1 600 13200	UINT16 UINT16 R/W per. -	Modbus 10248 CIP 140.1.4
HMn_out	Speed of rotation for moving away from switch The adjustable value is internally limited to the current parameter setting in RAMPn_max.	min^{-1} 1 60 3000	UINT16 UINT16 R/W per. -	Modbus 10250 CIP 140.1.5

The parameter HMp_homeusr can be used to specify a desired position value, which is set at the reference point after a successful reference movement. This position value defines the current motor position at the reference point. This also defines the zero point.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMp_homeusr	Position at reference point After a successful reference movement, this position is automatically set at the reference point.	usr -2147483648 0 2147483647	INT32 INT32 R/W per. -	Modbus 10262 CIP 140.1.11

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

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMoutdisusr	Maximum distance for search for switching edge 0: Monitoring of distance inactive >0: Maximum distance in user-defined units After detection of the switch, the drive starts to search for the defined switching edge. If it is not found within the distance defined here, the reference movement is canceled with an error.	usr 0 0 2147483647	INT32 INT32 R/W per. -	Modbus 10252 CIP 140.1.6
HMsrchdisusr	Max. search distance after overrun of switch 0: Search distance processing disabled >0: Search distance in user units The switch must be activated again within this search distance, otherwise the reference movement is canceled.	usr 0 0 2147483647	INT32 INT32 R/W per. -	Modbus 10266 CIP 140.1.13

8.5.5.1 Reference movement without index pulse

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

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

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMdisusr	Distance from switching edge to reference point After the drive 'leaves' the switch, it is positioned into the working area by a defined distance. This target point is defined as the reference point. The parameter is only effective during reference movements without index pulse search.	usr 1 24 2147483647	INT32 INT32 R/W per. -	Modbus 10254 CIP 140.1.7

Reference movement to limit switch The following illustration shows a reference movement to the negative limit switch with distance from the switching edge (HMmethod = 17).
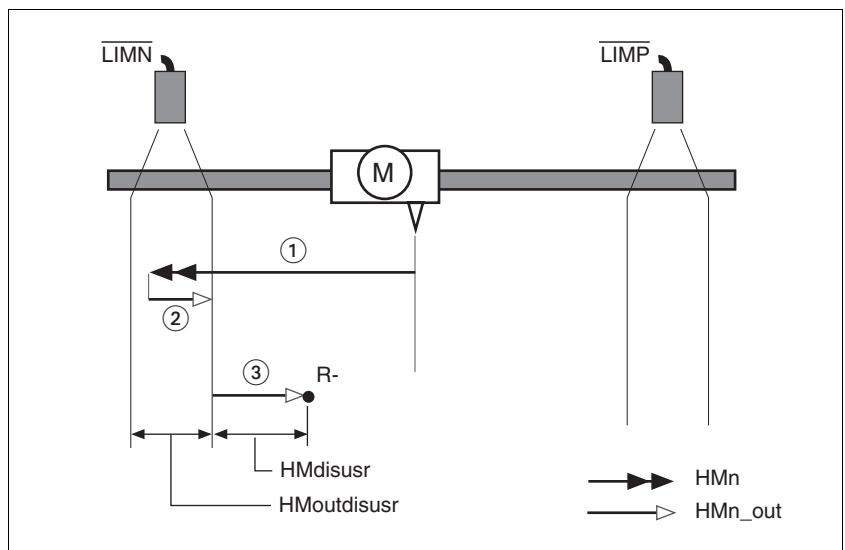
Figure 8.6   Reference movement to the negative limit switch

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

Reference movement to reference switch

The following illustration shows reference movements to the reference switch with distance from the switching edge (`HMmethod` =27 to 30).
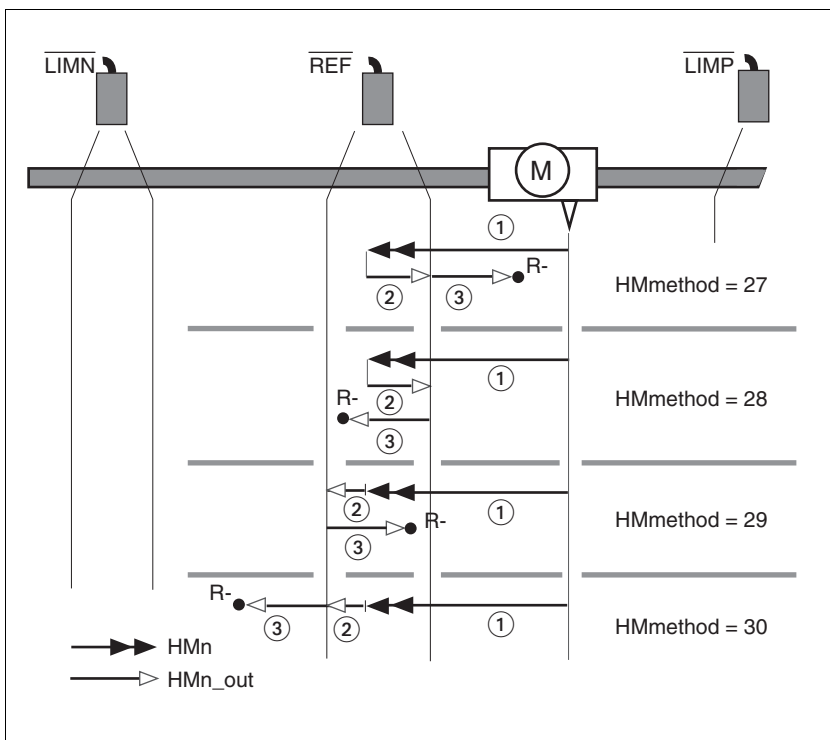
Figure 8.7   Reference movements to the reference switch

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

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

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

- Additional movement when the unit moves through the switch range (A2, B2).
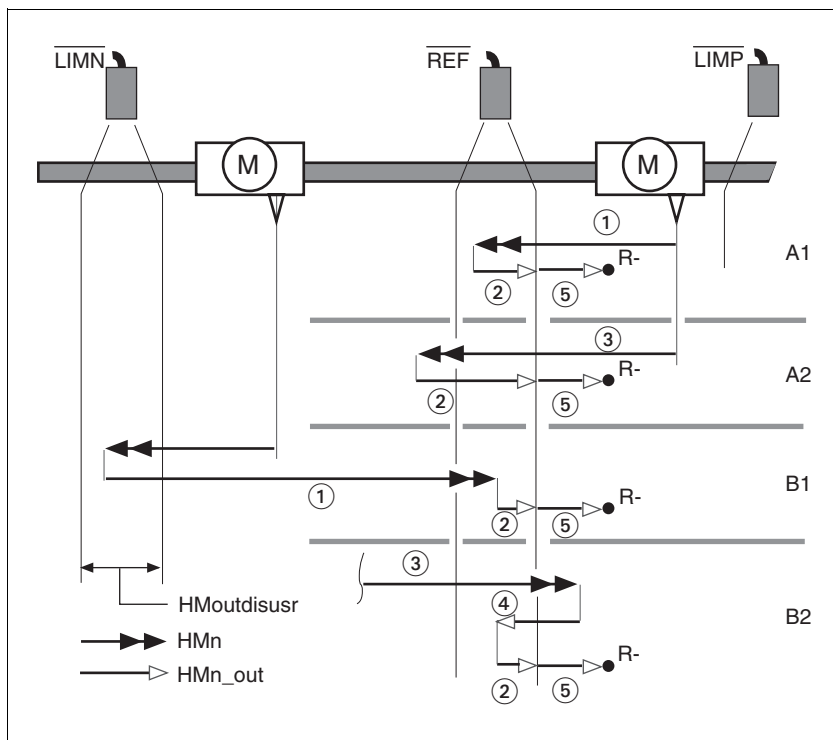
Figure 8.8   Reference movements to the reference switch

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

8.5.5.2 Reference movement with index pulse

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

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

The value should be >0.05.

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

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

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMdisREFtoIDX	Distance from switching edge to index pulse This read value delivers the difference between the index pulse position and the position at the switching edge of the limit or reference switch. It allows to check the distance between the index pulse and the switching edge and serves as a criterion for determining whether the reference movement with index pulse processing can be reproduced. In increments of 1/10000 revolutions	revolution - 0.0000 -	INT32 INT32 R/- - -	Modbus 10264 CIP 140.1.12

Reference movement to limit switch The following illustration shows a reference movement to the positive limit switch with movement to the first index pulse (`HMmethod` = 2).
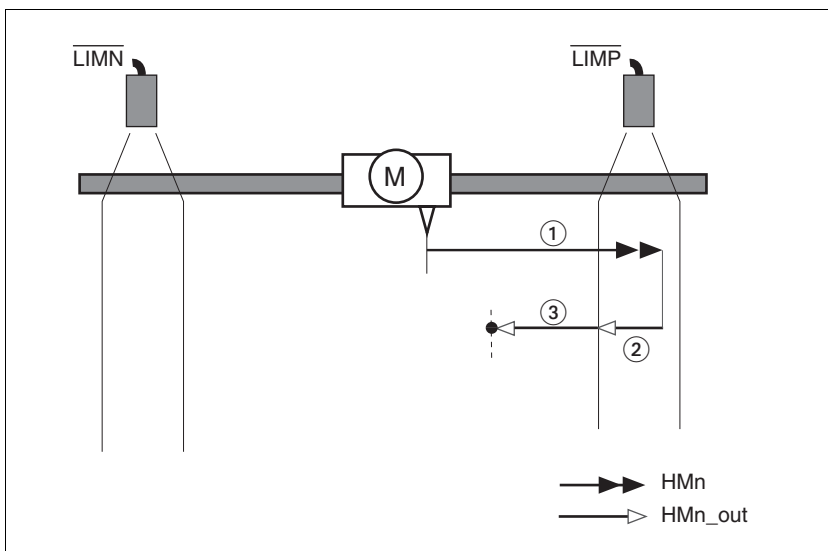
Figure 8.9   Reference movement to the positive limit switch

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

Reference movement to reference switch

The following illustration shows reference movements to the reference switch with movement to the frist index pulse (HMmethod = 11 to 14).
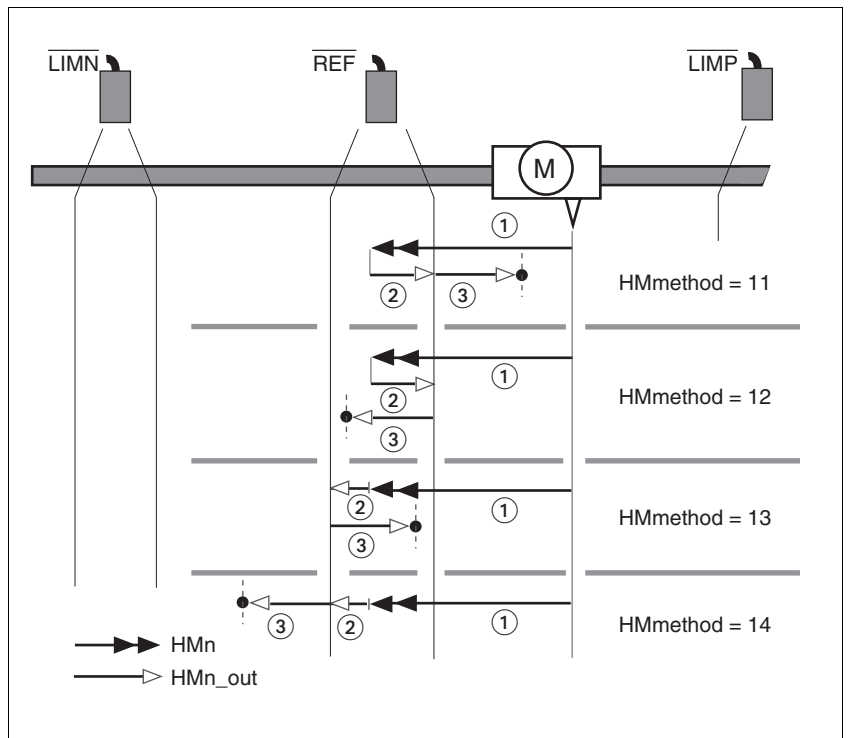
Figure 8.10   Reference movements to the reference switch

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

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

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

- Additional movement when the unit moves through the switch range (A2, B2).
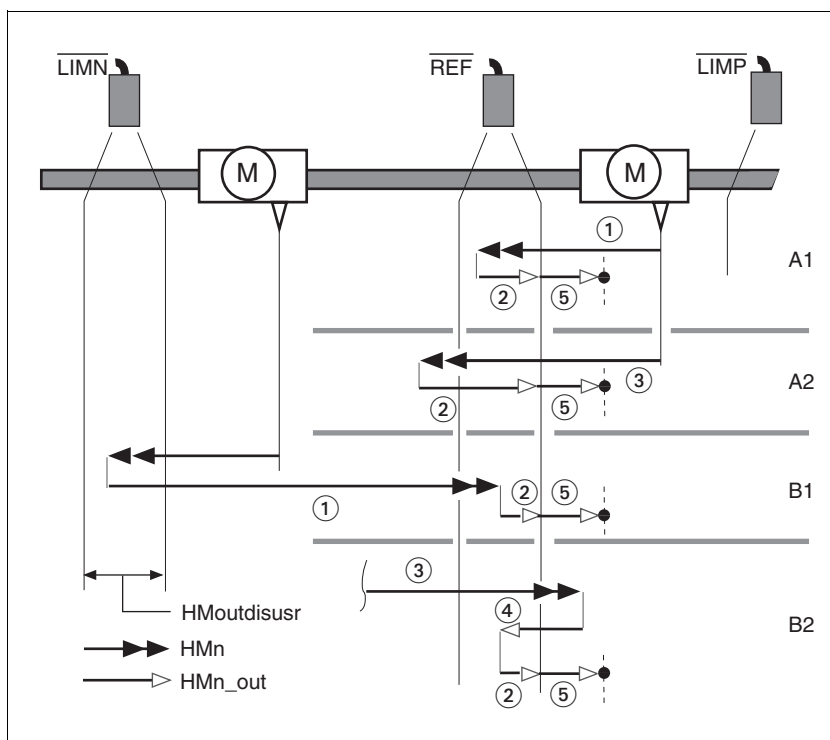
Figure 8.11   Reference movements to the reference switch

(1)   Movement to reference switch at search speed

(2)   Movement to switching edge at speed for moving away from switch

(3)   Excessively fast movement to reference switch at search speed

(4)   Return movement to switch range at speed for moving away from switch

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

8.5.5.3 Reference movement to the index pulse

Description The motor moves from the current motor position to the index pulse.

Reference movement to index pulse The following illustration shows reference movements to the index pulse (`HMmethod` = 33 and 34).
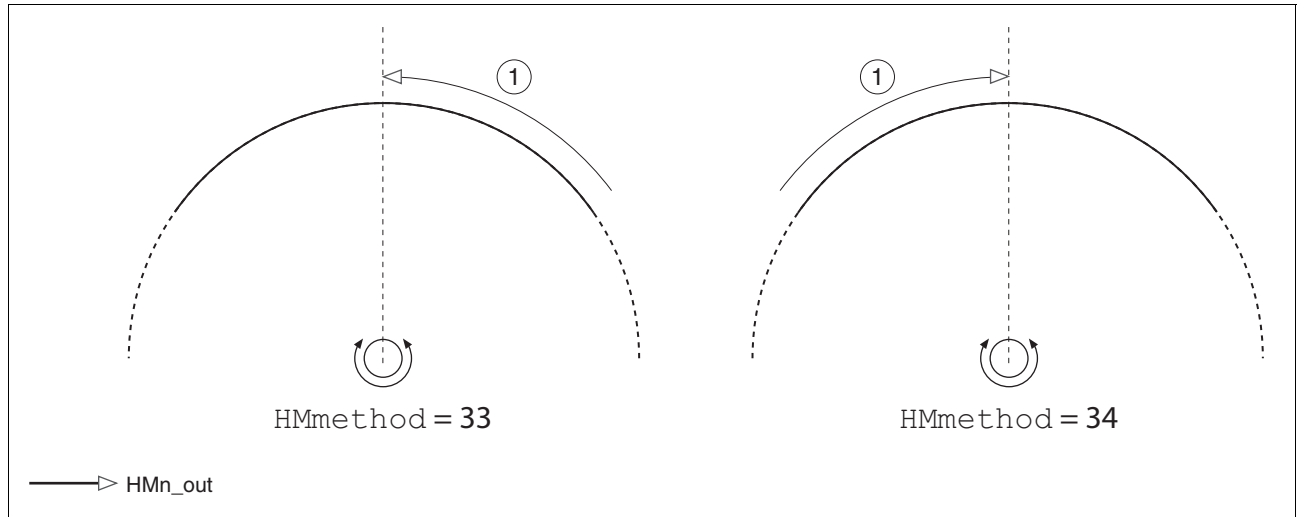
Figure 8.12 Reference movements to the index pulse

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

8.5.5.4 Homing by position setting

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

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

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMp_setpusr	Position setting to position setting position (132) Action object: write access triggers position setting. Only possible if the motor is at standstill. Position scaling is not considered.	usr -2147483648 - 2147483647	R/W - -	

Example Position setting can be used to carry out a continuous motor movement without exceeding the positioning limits.
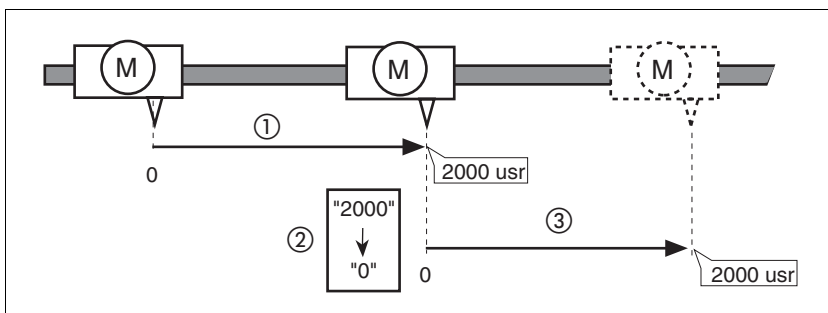
Figure 8.13   Positioning by 4000 usr units with position setting

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

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

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

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_p_refusr	Reference position in user units Value corresponds to the reference position of the position controller.	usr - 0 -	INT32 INT32 R/- - -	Modbus 7704 CIP 130.1.12

8.6 Functions

8.6.1 Monitoring functions

8.6.1.1 Status monitoring of the control loops
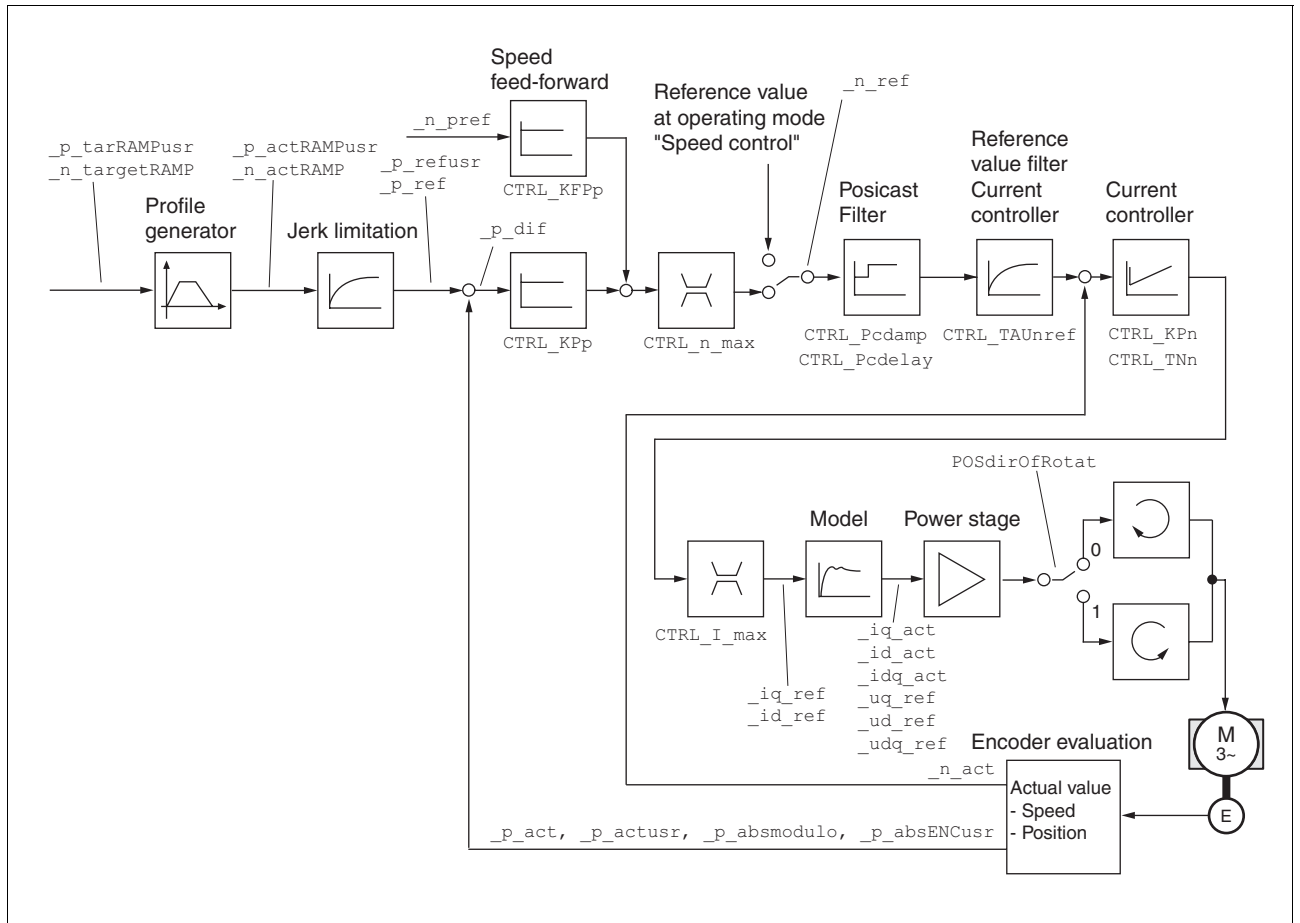
Figure 8.14   Status monitoring of the control loops

8.6.1.2 Positioning range

Positioning range The motor can be moved to any point on the axis within the positioning range by means of absolute positioning.

The current position of the motor can be read with the parameter `_p_actusr`.
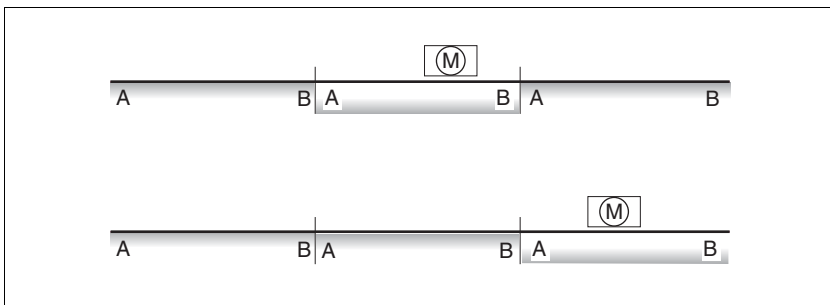
Figure 8.15   Positioning range

With the default scaling, the positioning limits are:

(A)   -786432   usr
(B)   786431   usr

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

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

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

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

The determining factor for position monitoring of the software limit switch range is the reference position of the position controller. Therefore, depending on the controller settings, the motor may stop before it reaches the limit switch position.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
SPVswLimPusr	Positive position limit for software limit switch If a user value entered is outside of the permissible user range, the limit switch limits are automatically set to the max. user value.	usr - 2147483647 -	INT32 INT32 R/W per. -	Modbus 1544 CIP 106.1.4
SPVswLimNusr	Negative position limit for software limit switch Refer to description 'SPVswLimPusr'	usr - -2147483648 -	INT32 INT32 R/W per. -	Modbus 1546 CIP 106.1.5

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
SPV_SW_Limits	Monitoring of software limit switches **0 / none**: None (default) **1 / SWLIMP**: Activation of software limit switches positive direction **2 / SWLIMN**: Activation of software limit switches negative direction **3 / SWLIMP+SWLIMN**: Activation of software limit switches both directions Monitoring of software limit switches only works in case of successful homing (ref_ok = 1).	- 0 0 3	UINT16 UINT16 R/W per. -	Modbus 1542 CIP 106.1.3

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.

- Before you can use the limit switches, you must enable them.

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

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

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

If possible, use normally closed contacts so that a wire break can be signaled as an error.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOsigLimN	Signal evaluation LIMN **0 / inactive**: Inactive **1 / normally closed**: Normally closed NC **2 / normally open**: Normally open NO	- 0 1 2	UINT16 UINT16 R/W per. -	Modbus 1566 CIP 106.1.15

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOsigLimP	Signal evaluation LIMP **0 / inactive**: Inactive **1 / normally closed**: Normally closed NC **2 / normally open**: Normally open NO	- 0 1 2	UINT16 UINT16 R/W per. -	Modbus 1568 CIP 106.1.16
IOsigRef	Signal evaluation REF **1 / normally closed**: Normally closed NC **2 / normally open**: Normally open NO The reference switch is only activated (to REF) while homing is processed.	- 1 1 2	UINT16 UINT16 R/W per. -	Modbus 1564 CIP 106.1.14

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

8.6.1.3 Monitoring internal signals

Temperature monitoring   Sensors monitor the temperature of motor and power stage. All temperature limit values are permanently set. If the temperature of a component approaches its permissible temperature limit, the device generates a warning message. If the temperature exceeds the limit value for more than 5 seconds, the power stage is disabled and the controller switches off. The device signals a temperature error.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_Temp_act_PA	Power stage temperature	°C - 0 -	INT16 INT16 R/- - -	Modbus 7200 CIP 128.1.16
PA_T_max	Maximum permissible power stage temperature	°C - 0 -	INT16 INT16 R/- per. -	Modbus 4110 CIP 116.1.7
PA_T_warn	Temperature warning threshold of power stage	°C - 0 -	INT16 INT16 R/- per. -	Modbus 4108 CIP 116.1.6

I^2t monitoring   If the device operates with high peak currents, temperature monitoring with sensors can be too sluggish. I^2t monitoring allows the controller to anticipate a rise in temperature and to reduce the current to the nominal value when the I^2t limit value is exceeded.

When the value falls below the limit value, the device can be operated with maximum performance again.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_I2t_act_M	Current motor overload	% - 0 -	INT16 INT16 R/- - -	Modbus 7218 CIP 128.1.25
_I2t_mean_M	Motor load	% - 0 -	INT16 INT16 R/- - -	Modbus 7220 CIP 128.1.26

Following error The drive monitors the so-called position deviation at 1ms intervals. The position deviation is the difference between the current reference position and the actual position. If the value of this position difference exceeds the limit value set in parameter SPV_P_maxDiff, this will cause an immediate stop (following error) with an error class that can be parameterized.

Select the limit value in parameter SPV_P_maxDiff considerably greater than the maximum position deviation that may occur during normal operation. This way, a following error will only occur in case of errors, for example, in the case of excessively high external load torques or inoperative encoder.

The maximum control deviation that occurred during operation can be determined with the parameter _p_DifPeak; it can be compared to the maximum permissible position deviation. This allows you to determine how far away the product was from the shut-off limit.

In addition, you can change the error class for a following error, see also chapter 8.6.1 "Monitoring functions".

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_p_DifPeak	Value of the maximum tracking error of the position controller The tracking error is the current position control deviation. See SPV_p_maxDiff for more information. A write access resets this value.	revolution 0.0000 - 429496.7295	UINT32 UINT32 R/W - -	Modbus 4382 CIP 117.1.15
_p_dif	Current deviation between reference and actual position Corresponds to the current control deviation of the position controller.	revolution -214748.3648 - 214748.3647	INT32 INT32 R/- - -	Modbus 7716 CIP 130.1.18
SPV_p_maxDiff	Max. permissible tracking error of the position controller The tracking error is the current position control deviation.	revolution 0.0001 1.0000 200.0000	UINT32 UINT32 R/W per. -	Modbus 4636 CIP 118.1.14

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

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_SigActive	Current status of monitoring signals See _SigLatched for more details on the bit codes.	- - 0 -	UINT32 UINT32 R/- - -	Modbus 7182 CIP 128.1.7
_SigLatched	Saved status of monitoring signals Signal status: 0: Not activated 1: Activated Bit assignments: Bit 0: General fault Bit 1: Limit switches (LIMP/LIMN/REF) Bit 2: Out of range (SW limit switches, tuning) Bit 3: Quickstop via fieldbus Bit 4: Inputs STO are 0 Bit 5: Reserved Bit 6: RS485 fault Bit 7: CAN fault Bit 8: Ethernet fault Bit 9: Frequency of reference signal too high Bit 10: Fault current operating mode Bit 11: Reserved Bit 12: Profibus fault Bit 13: Reserved Bit 14: Undervoltage DC bus Bit 15: Overvoltage DC bus Bit 16: Mains phase missing Bit 17: Motor connection fault Bit 18: Motor overcurrent/short circuit Bit 19: Motor encoder fault Bit 20: Undervoltage 24VDC Bit 21: Overtemperature (power stage, motor) Bit 22: Tracking error Bit 23: Max. speed exceeded Bit 24: Inputs STO different Bit 25: Reserved Bit 26: Reserved Bit 27: Reserved Bit 28: Reserved Bit 29: EEPROM fault Bit 30: System booting (Hardware fault or parameter error) Bit 31: System error (e.g. watchdog) Monitoring functions are product-dependent.	- - 0 -	UINT32 UINT32 R/- - -	Modbus 7184 CIP 128.1.8
_WarnActive	Active warnings, bit-coded See _WarnLatched for more details on the bit codes.	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7190 CIP 128.1.11

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_WarnLatched	Saved warnings, bit-coded Saved warning bits are deleted in the case of a FaultReset. Bits 10, 11, 13 are deleted automatically. Signal status: 0: Not activated 1: Activated Bit assignments: Bit 0: General warning (see _LastWarning) Bit 1: Temperature of power stage high Bit 2: Temperature of motor high Bit 3: Reserved Bit 4: Power stage overload (I^2t) Bit 5: Motor overload (I^2t) Bit 6: Braking resistor overload (I^2t) Bit 7: CAN warning Bit 8: Motor encoder warning Bit 9: RS485 protocol warning Bit 10: STO_A (PWRR_A) and/or STO_B (PWRR_B) Bit 11: DC bus undervoltage/missing mains phase Bit 12: Profibus warning Bit 13: Position not yet valid (position capture still running) Bit 14: Ethernet warning Bit 15: Reserved Monitoring functions are product-dependent.	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7192 CIP 128.1.12
_actionStatus	Action word Signal status: 0: not activated 1: activated Bit 0: Warning Bit 1: Error class 1 Bit 2: Error class 2 Bit 3: Error class 3 Bit 4: Error class 4 Bit 5: Reserved Bit 6: Drive is at standstill (<9 [1/min]) Bit 7: Drive rotates clockwise Bit 8: Drive rotates counter-clockwise Bit 9: Reserved Bit 10: Reserved Bit 11: Profile generator idle (reference speed is 0) Bit 12: Profile generator decelerates Bit 13: Profile generator accelerates Bit 14: Profile generator moves at constant speed Bit 15: Reserved	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7176 CIP 128.1.4
_StopFault	Error number of last stop fault	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7178 CIP 128.1.5

Setting error responses   The responses of the device to errors are subdivided into error classes; the error class can be set for a number of monitoring functions. This allows you to tune the error response of the device to operation requirements.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
SPV_Flt_pDiff	Error response to tracking error **1 / ErrorClass1**: Error class 1 **2 / ErrorClass2**: Error class 2 **3 / ErrorClass3**: Error class 3	- 1 3 3	UINT16 UINT16 R/W per. -	Modbus 1302 CIP 105.1.11

8.6.2 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.** │
└───┘

Description   Scaling translates user units to internal units of the device, and vice versa. The device saves position values in user-defined units.
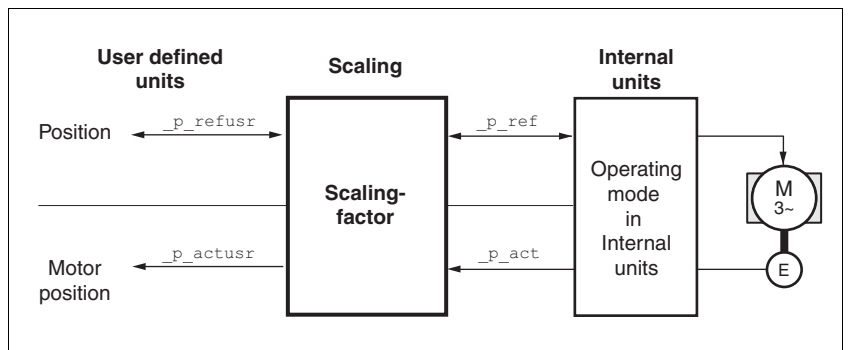
Figure 8.16   Scaling

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

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

Figure 8.17   Representation of the scaling factor

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

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

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

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
POSscaleNum	Numerator of position scaling Specification of the scaling factor: Motor revolutions [U] -- Change of user position [usr] A new scaling is activated when the numerator value is supplied. User limit values may be reduced due to the calculation of an internal factor.	revolution 1 1 2147483647	INT32 INT32 R/W per. -	Modbus 1552 CIP 106.1.8
POSscaleDenom	Denominator of position scaling Refer to numerator (POSscaleNum) for a description. A new scaling is activated when the numerator value is supplied.	usr 1 12 2147483647	INT32 INT32 R/W per. -	Modbus 1550 CIP 106.1.7

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

Default scaling   A value of 12 user-defined units per motor revolution is set as the default scaling.

Note concerning motor standstill   The motor has a physical detent of 12 motor positions per revolution. A reference position between the detents can be obtained by using a scaling value with more than 12 user-defined units per revolution.

Due to the high cogging torque of the motor, the position controller does not actively set the motor to a reference position between 2 detent positions. When the motor comes to a standstill it moves to one of the 12 detent positions. The resulting small position deviation is ignored by the position controller.

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

- Scaling corresponds to default scaling
  1 motor revolution = 12 user-defined units

  => Every motor position can be approached.

- Scaling is less than the default scaling
  1 motor revolution = 6 user-defined units

  => Every second motor position can be approached.

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

If the parameters are not adjusted, this may, for example, cause an incorrect reference movement since the distance to the switching edge of

the limit switch or reference switch is no longer sufficient to leave the switching range.

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

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

Figure 8.18   Calculation of the scaling factor, example 1

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

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

This means: 1 usr = 0.01 mm * 1 rev / 100 mm =1/10000 revolutions.

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

Figure 8.19   Calculation of the scaling factor, example 2

Example 3   Setting positioning in 1/1000 rad
1rad = 1 rev/(2*π)
π = 3.1416 (rounded)

User value = 1 usr

Device value = 1/(2*π*1000) U

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

Figure 8.20   Calculation of the scaling factor, example 3

8.6.3   Motion profile

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

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

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

Ramp steepness   The steepness of the ramp determines the speed changes of the motor per time unit. The ramp steepness can be set for the acceleration ramp via the parameter RAMPacc and for the deceleration ramp via RAMPdecel.
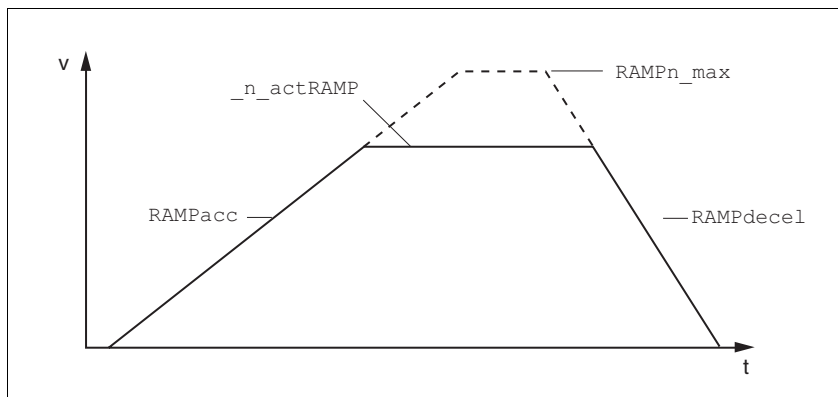
Figure 8.21   Acceleration and deceleration ramps

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMPacc	Acceleration of profile generator	min⁻¹/s 1 600 3000000	UINT32 UINT32 R/W per. -	Modbus 1556 CIP 106.1.10
RAMPdecel	Deceleration of profile generator	min⁻¹/s 750 750 3000000	UINT32 UINT32 R/W per. -	Modbus 1558 CIP 106.1.11
RAMPn_max	Limitation of ref. speed for op. modes with profile generation The parameter is active in the following operating modes: - Profile position - Profile velocity - Homing - Jog If a greater reference speed is set in one of these operating modes, it is automatically limited to RAMPn_max. This way, commissioning at limited speed is easier to perform.	min⁻¹ 60 13200 13200	UINT16 UINT16 R/W per. -	Modbus 1554 CIP 106.1.9

Jerk limitation Jerk limitation removes sudden changes in the acceleration to obtain smooth, virtually jerk-free changes of the speed of rotation.
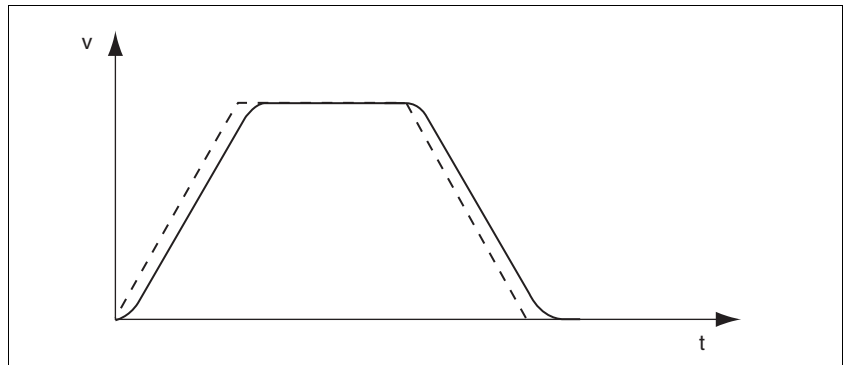
Figure 8.22 Speed curve with and without (dotted) jerk limitation

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

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

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

RAMP_TAUjerk	Jerk limitation
	
	0 / off: Off
	1 / 1: 1 ms
	2 / 2: 2 ms
	4 / 4: 4 ms
	8 / 8: 8 ms
	16 / 16: 16 ms
	32 / 32: 32 ms
	64 / 64: 64 ms
	128 / 128: 128 ms
	
	Limits the acceleration change (jerk) of the reference position generation during the positioning transitions:
	    Standstill - acceleration
	    Acceleration - constant speed
	    Constant speed - deceleration
	    Deceleration - standstill
	
	Processing in the following operating modes:
	- Profile velocity
	- Profile position
	- Jog
	- Homing
	
	Adjustments can only be made if the operating mode is inactive (x_end=1).
		ms
		0
		0
		128
			UINT16
			UINT16
			R/W
			per.
			-
				Modbus 1562
				CIP 106.1.13

8.6.4 Quick Stop

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

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

The motor can be decelerated via a deceleration ramp or a maximum current. Use the parameter LIM_QStopReact to set the type of deceleration.

▶ Set the type of deceleration with the LIM_QStopReact parameter.

▶ Use parameter RAMPquickstop to define a required deceleration ramp or parameter LIM_I_maxQSTP to set a required maximum current.

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

The current for the moment ramp should be set in such a way that the drive comes to a standstill with the required deceleration.

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

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

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

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

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
LIM_QStopReact	Type of deceleration for Quick Stop (146) **6 / Deceleration ramp**: Deceleration ramp **7 / Torque ramp**: Torque ramp Setting of deceleration ramp with parameter RAMPquickstop. Setting of torque ramp with parameter LIM_I_maxQSTP. The deceleration ramp is only available for operating modes with profile generator. The torque ramp is used in the operating modes without profile generator.	- 6 7 7	INT16 INT16 R/W per. -	Modbus 1584 CIP 106.1.24
RAMPquickstop	Deceleration ramp for Quick Stop (146) Deceleration of the drive when a software stop is triggered or if an error of error class 1 has occurred.	min^{-1}/s 200 6000 3000000	UINT32 UINT32 R/W per. -	Modbus 1572 CIP 106.1.18

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
LIM_I_maxQSTP	Current limitation for Quick Stop Max. current during braking via torque ramp due to an error of error classes 1 or 2 and when a software stop is triggered. Maximum and default settings depend on the motor and the power stage (settings M_I_max and PA_I_max) In increments of 0.01Apk	A_{pk} - - -	UINT16 UINT16 R/W per. -	Modbus 4362 CIP 117.1.5

8.6.5   Halt

Function principle   The "Halt" function is an interruption function used to stop the motor and temporarily interrupt operation.

Internal position adjustment is performed once the drive comes to a standstill. Position control is activated and the motor is stopped with the power stage remaining enabled.

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

The "Halt" function can be activated by any source (such as commissioning software or signal input).

The motor can be decelerated via a deceleration ramp or a maximum current. Use the parameter `LIM_HaltReaction` to set the type of deceleration.

▶ Set the type of deceleration with the `LIM_HaltReaction` parameter.

▶ Use parameter `RAMPdecel` to define a required deceleration ramp or parameter `LIM_I_maxHalt` to set a required maximum current.

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

The current for the moment ramp should be set in such a way that the drive comes to a standstill with the required deceleration.

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

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

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
LIM_HaltReaction	Type of deceleration for halt (148) **1 / Deceleration ramp**: Deceleration ramp **3 / Torque ramp**: Torque ramp Setting of deceleration ramp with parameter RAMPdecel. Setting of torque ramp with parameter LIM_I_maxHalt. The deceleration ramp is only available for operating modes with profile generator. The torque ramp is used in the operating modes without profile generator.	- 1 3 3	INT16 INT16 R/W per. -	Modbus 1582 CIP 106.1.23

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMPdecel	Deceleration of profile generator	min^{-1}/s 750 750 3000000	UINT32 UINT32 R/W per. -	Modbus 1558 CIP 106.1.11
LIM_I_maxHalt	Current limitation for Halt Max. current during braking after Halt or when an operating mode is terminated. Maximum and default settings depend on the motor and the power stage (settings M_I_max and PA_I_max) In increments of 0.01Apk	A$_{pk}$ - - -	UINT16 UINT16 R/W per. -	Modbus 4364 CIP 117.1.6

8.6.6   Standstill window

The standstill window allows you to monitor whether the motor has reached the target position.

If the control deviation $\_p\_dif$ of the position controller remains in the standstill window after the end of the positioning for the period STANDpwinTime, the device signals the end of processing (x_end = 0->1).
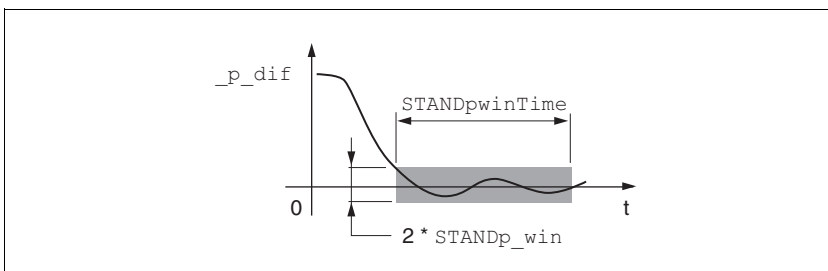
Figure 8.23   Standstill window

The parameters STANDp_win and STANDpwinTime define the size of the window.

The parameter STANDpwinTout can be used to set the period of time after which an error is signaled if the standstill window was not reached.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
STANDp_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 'STANDpwinTime.	revolution 0.0000 0.0400 3.2767	UINT16 UINT16 R/W per. -	Modbus 4370 CIP 117.1.9
STANDpwinTime	Standstill window, time 0: Monitoring of standstill window deactivated >0: Time in ms during which the control deviation must be in the standstill window	ms 0 0 32767	UINT16 UINT16 R/W per. -	Modbus 4372 CIP 117.1.10
STANDpwinTout	Timeout time for standstill window monitoring 0 : Timeout monitoring deactivated >0 : Timeout time in ms Standstill window processing values are set via STANDp_win and STANDpwinTime. Time monitoring starts when the target position (reference position of position controller) is reached or when the profile generator has finished processing.	ms 0 0 16000	UINT16 UINT16 R/W per. -	Modbus 4374 CIP 117.1.11

8.6.7 Configurable inputs and 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.**

Description Different signal functions can be assigned to the digital signal inputs and digital signal outputs.

The parameters `IOfunct_LIO1 ... IOfunct_LIO4` are available to configure the function.

Factory settings The following table provides an overview of the factory settings.

Pin	Signal	Factory setting	I/O
CN4.3	LIO1	Input Positive limit switch (LIMP)	I
CN4.6	LIO2	Input Negative limit switch (LIMN)	I
CN4.2	LIO3	Input Free available	I
CN4.5	LIO4	Input Reference switch (REF)	I

Current state The `_IO_LIO_act` parameter indicates the current status of the digital signal inputs or outputs.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_IO_LIO_act	Status of digital inputs/outputs (151) Coding of the individual signals: Bit 0: LIO1 Bit 1: LIO2 ...	- - 0 -	UINT16 UINT16 R/- - -	Modbus 2090 CIP 108.1.21

8.6.7.1   Description of functions for signal inputs

Input Free available	The function has no device-internal functionality. The signal input can be read as required via the parameter `_IO_LIO_act`.
Input Fault reset	An error message is reset with the function, see chapter 8.3 "Operating states".
Input Enable	The power stage is enabled with the function, see chapter 8.3 "Operating states".
Input Halt	The function triggers a "Halt", see chapter 8.6.5 "Halt".
Input Jog positive	The function performs a jog movement with positive direction of rotation, see chapter 8.5.1 "Operating mode Jog".
Input Jog negative	The function performs a jog movement with negative direction of rotation, see chapter 8.5.1 "Operating mode Jog".
Input Jog fast/slow	The function switches between slow and fast jog, see chapter 8.5.1 "Operating mode Jog".
Input Reference switch (REF)	The function defines the way the reference switch operates. See chapter .See chapter 8.5.5 "Operating mode Homing".
Input Positiv limit switch (LIMP)	The function defines the way the positive limit switch operates. See chapter 8.5.5 "Operating mode Homing" and chapter 8.6.1.2 "Positioning range".
Input Negative limit switch (LIMN)	The function defines the way the negative limit switch operates. See chapter 8.5.5 "Operating mode Homing" and chapter 8.6.1.2 "Positioning range".

8.6.7.2   Description of functions for signal outputs

Output Free available	The function lets you directly set an output via parameter `IO_LO_set`.
Output No fault	The function provides information on the error state, see chapter 8.3.2 "Indicating the operating states".
Output Active	The function provides the "Operation Enabled" operating state signal, see chapter 8.3.2 "Indicating the operating states".

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IO_LO_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: LO1_OUT Bit 1: LO2_OUT ...	- - 0 -	UINT16 UINT16 R/W - -	Modbus 2082 CIP 108.1.17

8.6.7.3   Configuration of the signal inputs and outputs

The table below provides an overview of the signal inputs and outputs to which a function can be assigned.

Functions for signal inputs

Function	Signal
No function / free available	`LIO1, LIO2, LIO3, LIO4`
Fault reset	`LIO1, LIO2, LIO3, LIO4`
Enable	`LIO1, LIO2, LIO3, LIO4`
Halt	`LIO1, LIO2, LIO3, LIO4`
Jog positive	`LIO1, LIO2, LIO3, LIO4`
Jog negative	`LIO1, LIO2, LIO3, LIO4`
Jog fast/slow	`LIO1, LIO2, LIO3, LIO4`
Reference switch (REF)	`LIO1, LIO2, LIO3, LIO4`
Positiv limit switch (LIMP)	`LIO1`
Negative limit switch (LIMN)	`LIO2`

Functions for signal outputs

Function	Jog
No function / free available	`LIO1, LIO2, LIO3, LIO4`
No fault	`LIO1, LIO2, LIO3, LIO4`
Active	`LIO1, LIO2, LIO3, LIO4`

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOfunct_LIO1	Function Input/Output LIO1 (153) **1 / Input Free available**: Available as required **2 / Input Fault reset**: Reset fault (local control mode only) **3 / Input Enable**: Enable (local control mode only) **4 / Input Halt**: Halt **9 / Input Jog positive**: Jog right/positive **10 / Input Jog negative**: Jog left/negative **11 / Input Jog fast/slow**: Jog fast/slow **20 / Input Reference switch (REF)**: Reference switch (REF) **21 / Input Positive limit switch (LIMP)**: Positive limit switch (LIMP) **101 / Output Free available**: Available as required **102 / Output No fault**: No fault **103 / Output Active**: Ready	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1826 CIP 107.1.17

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOfunct_LIO2	Function Input/Output LIO2 (154) **1 / Input Free available**: Available as required **2 / Input Fault reset**: Reset fault (local control mode only) **3 / Input Enable**: Enable (local control mode only) **4 / Input Halt**: Halt **9 / Input Jog positive**: Jog right/positive **10 / Input Jog negative**: Jog left/negative **11 / Input Jog fast/slow**: Jog fast/slow **20 / Input Reference switch (REF)**: Reference switch (REF) **22 / Input Negative limit switch (LIMN)**: Negative limit switch (LIMN) **101 / Output Free available**: Available as required **102 / Output No fault**: No fault **103 / Output Active**: Ready	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1828 CIP 107.1.18
IOfunct_LIO3	Function Input/Output LIO3 (154) **1 / Input Free available**: Available as required **2 / Input Fault reset**: Reset fault (local control mode only) **3 / Input Enable**: Enable (local control mode only) **4 / Input Halt**: Halt **9 / Input Jog positive**: Jog right/positive **10 / Input Jog negative**: Jog left/negative **11 / Input Jog fast/slow**: Jog fast/slow **20 / Input Reference switch (REF)**: Reference switch (REF) **101 / Output Free available**: Available as required **102 / Output No fault**: No fault **103 / Output Active**: Ready	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1830 CIP 107.1.19
IOfunct_LIO4	Function Input/Output LIO4 (154) **1 / Input Free available**: Available as required **2 / Input Fault reset**: Reset fault (local control mode only) **3 / Input Enable**: Enable (local control mode only) **4 / Input Halt**: Halt **9 / Input Jog positive**: Jog right/positive **10 / Input Jog negative**: Jog left/negative **11 / Input Jog fast/slow**: Jog fast/slow **20 / Input Reference switch (REF)**: Reference switch (REF) **101 / Output Free available**: Available as required **102 / Output No fault**: No fault **103 / Output Active**: Ready	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1832 CIP 107.1.20

8.6.8 Reversal of direction of rotation

The parameter POSdirOfRotat can be used to reverse the direction of rotation of the motor. Note that changed settings do not become active until after the device is switched off and on again.

Connect the limit switch that limits the working range for positive direction of rotation to $\overline{\text{LIMP}}$. Connect the limit switch that limits the working range for negative direction of rotation to $\overline{\text{LIMN}}$.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
POSdirOfRotat	Definition of direction of rotation **0 / clockwise**: Clockwise **1 / counter clockwise**: Counter-clockwise Meaning: At positive speeds, the drive rotates clockwise (looking at the motor shaft at the flange). NOTE: If you use limit switches, you must interchange the limit switch connections after changing the settings. The limit switch which is reached with a jog movement in positive direction must be connected to the LIMP input and vice versa. NOTE: Changed settings do not become active until the unit is switched on the next time.	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 1560 CIP 106.1.12

8.6.9 Restoring default values

All parameter values set by the user are lost in this process. The commissioning software allows you to save the parameter values set for a device as a configuration file.

8.6.9.1 Resetting user-defined parameters

Parameter `PARuserReset` is used to reset all parameter values to the default values, except for the communication parameters.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PARuserReset	Reset user parameters Bit 0 = 1: Set persistent parameters to default values. All parameters are reset with the exception of: - Communication parameters - Definition of the direction of rotation - Signal selection position interface - I/O functions NOTE: The new settings are not saved to the EEPROM!	- 0 - 7	UINT16 UINT16 R/W - -	Modbus 1040 CIP 104.1.8

8.6.9.2 Restoring the factory settings

Factory settings via commissioning software

The factory settings are loaded via the menu items Configuration => Factory Settings. The parameter values are reset to the default values. The new settings only become active until after the device is switched off and on again.

▶ Disconnect the product from the the fieldbus in order to avoid conflicts by simultaneous access.

9   Examples

9

9.1   Wiring examples

The following figure shows a typical wiring example. The limit switches and the reference switch are supplied via the internal 24V signal power supply.
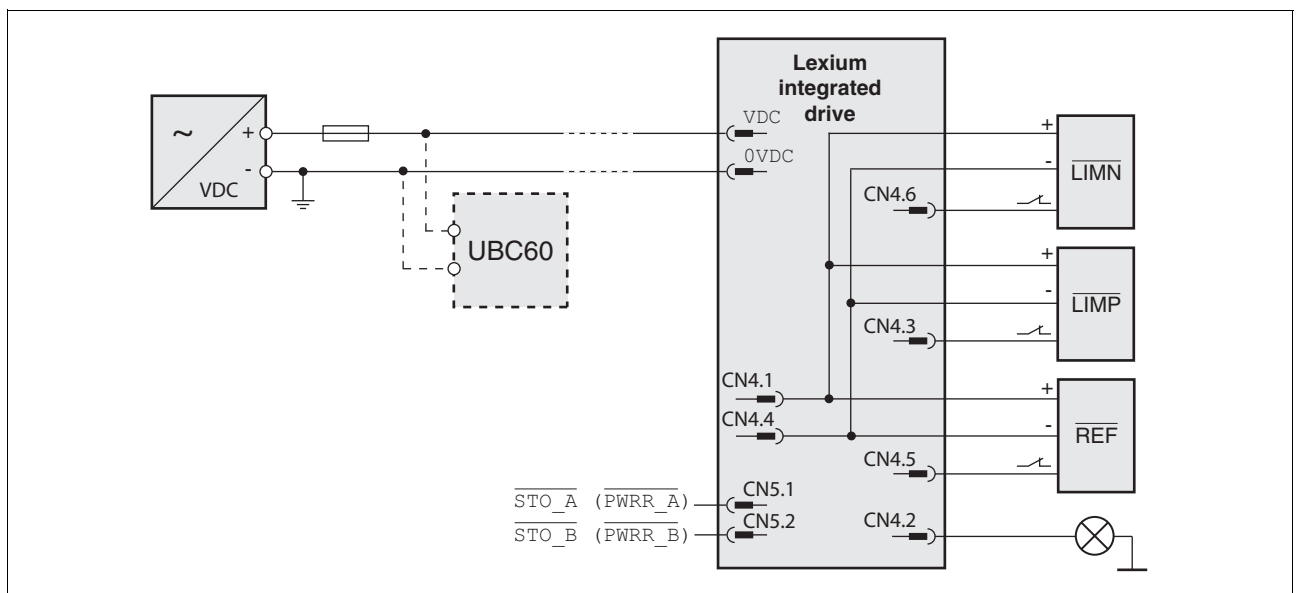
Figure 9.1   Wiring example

The UBC60 braking resistor controller is available as an accessory, see chapter 12 "Accessories and spare parts".

9.2   Wiring of the "STO safety function"

Using the safety functions integrated in this product requires careful planning. For more information see chapter5.4 "Safety function STO ("Safe Torque Off")" on page 52.

10 Diagnostics and troubleshooting

10

10.1 Service

If you cannot resolve an error yourself please contact your sales office. Have the following details available:

- Nameplate (type, identification number, serial number, DOM, ...)

- Type of error (such as LED flash code or error number)

- Previous and concomitant circumstances

- Your own assumptions concerning the cause of the error

Also include this information if you return the product for inspection or repair.

10.2 Error indication

The last cause of error and the last 10 error messages are stored. You can display the last 10 error messages using the commissioning software and the fieldbus.

See chapter 10.4 "Table of error numbers" for a description of the error numbers.

Asynchronous errors   Asynchronous errors are triggered by internal monitoring (for example, temperature) or by external monitoring (for example, switch). An error response is initiated if an asynchronous error occurs.

Asynchronous errors are indicated in the following way:

- Transition to operating state "Quick Stop" or to operating state "Fault".

- Information in parameter `actionStatus`

- Error number is written to parameter `StopFault`

Synchronous errors   Synchronous errors occur as direct errors in response to a fieldbus command. Synchronous errors comprise:

- Error during execution of an action command or control command

- Parameter value outside the permissible value range

- Invalid action command or control command during processing

- Access to unknown parameter

For a detailed description of the synchronous errors, see chapter 10.2.6 "Synchronous errors".

10.2.1 State diagram

For a detailed description of the state diagram, see chapter 8 "Operation", page 110.

10.2.2 Error indication with LEDs

Operating states   The LEDs indicate error messages and warnings. They show the operating states in coded form.
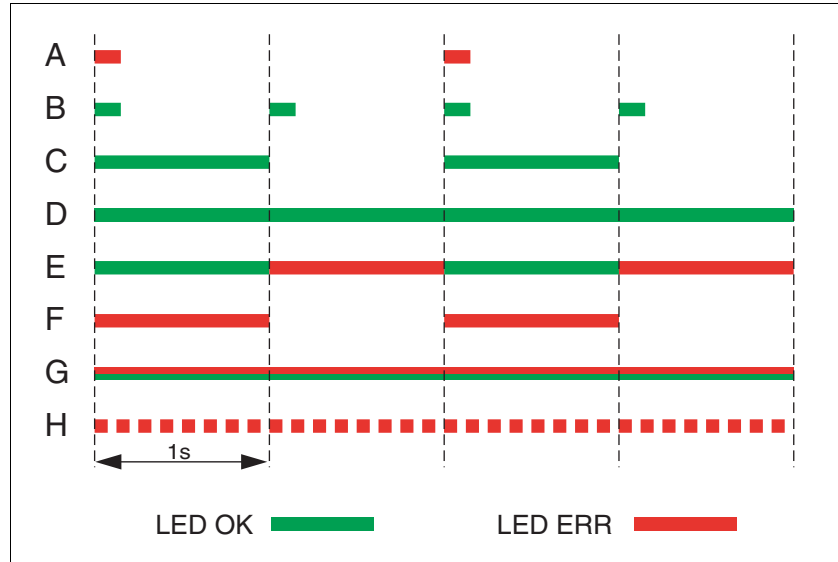
Figure 10.1   Error indication via LEDs, LED OK (green), LED ERR (red)

Operating states

(A)	**1**	Start
	2	Not Ready To Switch On
(B)	**3**	Switch On Disabled
(C)	**4**	Ready To Switch On
	5	Switched On
(D)	**6**	Operation Enabled
(E)	**7**	Quick Stop Active
	8	Fault Reaction Active
(F)	**9**	Fault
(G)		Firmware not available
(H)		Internal error

LEDs for EtherNet/IP   The LEDs indicate the EtherNet/IP communication status of the device and the EtherNet/IP communication status of the network. Meaning of the LED codes:

LED code	Short description	Meaning
Steady Off	No power supply	No power is supplied to the device.
Steady Green	Device operational	The device is operating correctly.
Flashing Green	Standby	The device has not been configured.
Flashing Red	Recoverable error	The device has detected a recoverable error, for example, an incorrect or inconsistent configuration.
Steady Red	Irrecoverable error	The device has detected a non-recoverable error.
Flashing Green / Red	Self-test	The device is performing its power up testing.

Table 10.1 Bicolor LED for EtherNet/IP communication status of the device

LED code	Short description	Meaning
Steady Off	No power supply, no IP address	The device does not have an IP address (or is powered off).
Steady Green	No connections	The device has no established connections, but has obtained an IP address.
Flashing Green	Connected	The device has at least one established connection (this includes the Message Router).
Flashing Red	Connection timeout	One or more of the connections in which this device is the target has timed out. This status is left only if all timed out connections are reestablished or if the device is reset.
Steady Red	Duplicate IP	The device has detected that its IP address is already in use.
Flashing Green / Red	Self-test	The device is performing its power up testing.

Table 10.2 Bicolor LED for EtherNet/IP communication status of the network

10.2.3 Error indication using the commissioning software

- You need a PC with the commissioning software and a working connection to the product.

▶ Select "Diagnostics - Error memory". A dialog box which shows the error messages is displayed.

The commissioning software shows a 4 digit error number in the list of the error memory with a prefixed "E".

The error messages are displayed along with the status, error class, time when the error occurred and a short description. The "Additional information " lets you verify the exact conditions when the error occurred.

▶ Correct the error and reset the error message.
In the case of errors of class 4, you must switch off the controller supply voltage and switch it on again.

10.2.4 Error indication via the fieldbus

The description contains parameters you do not need if you use the library. For diagnostics purposes, these parameters can be read with the function block "MC_ReadParameter_ETH_ILx2".

Last cause of error   The parameter _StopFault allows you to read the error number of the last error. If there is no error, the value of the parameter is 0. If an error occurs, the error is written to the error memory along with other status information. In the case of subsequent errors, only the triggering cause of error is stored.

Error memory   The error memory is an error history of the last 10 errors; it is not cleared even if the device is switched off. The following parameters allow you to manage the error memory:

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
FLT_del_err	Clear error memory 1: Delete all entries in the error memory The clearing process is completed if a 0 is returned after a read access.	- 0 - 1	UINT16 UINT16 R/W - -	Modbus 15112 CIP 159.1.4
FLT_MemReset	Reset error memory read pointer 1: Set error memory read pointer to oldest error entry.	- 0 - 1	UINT16 UINT16 R/W - -	Modbus 15114 CIP 159.1.5

The error memory can only be read sequentially. The parameter FLT_MemReset must be used to reset the read pointer. Then the first error entry can be read. The read pointer is automatically set to the next

entry. A new read access delivers the next error entry. If the error number 0 is returned, there is no additional error entry.

Position of the entry	Meaning
1	1st error entry, oldest message
2	2nd error entry, later message
...	...
10	10th error entry. In the case of 10 error entries, the most recent message is contained here.

An error entry consists of several pieces of information which can be read using different parameters. When you read an error entry, the error number must be read first with the parameter FLT_err_num.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
FLT_err_num	Error number Reading this parameter copies the entire error entry (error class, time of occurrence of error, ...) to an intermediate memory from which all elements of the error can then be read. In addition, the read pointer of the error memory is automatically set to the next error entry.	- 0 - 65535	UINT16 UINT16 R/- - -	Modbus 15362 CIP 160.1.1
FLT_class	Error class 0: Warning (no response) 1: Error (Quick Stop -> state 7) 2: Error (Quick Stop -> state 8, 9) 3: Fatal error (state 9, can be acknowledged) 4: Fatal error (state 9, cannot be acknowledged)	- 0 - 4	UINT16 UINT16 R/- - -	Modbus 15364 CIP 160.1.2
FLT_Time	Error time With reference to operating hours counter	s 0 - 536870911	UINT32 UINT32 R/- - -	Modbus 15366 CIP 160.1.3
FLT_Qual	Error additional information This entry contains additional information on the error, depending on the error number. Example: a parameter address	- 0 - 65535	UINT16 UINT16 R/- - -	Modbus 15368 CIP 160.1.4

10.2.5 Response in the case of invalid communication objects

The description contains parameters you do not need if you use the library. For diagnostics purposes, these parameters can be read with the function block "MC_ReadParameter_ETH_ILx2".

The parameter Ethnet.RteErrorBehv allows you to define the error response to an attempt to write invalid communication objects.

The default parameter value is 0. Invalid write commands are not executed. There is no error response.

If the parameter value is 1, the product perform a Quick Stop.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
EthErrBehv	Error behavior for realtime Ethernet data **0 / Warning**: Warning (no error response) **1 / ErrorClass1**: Error class 1 (Quick Stop) Sets the error class for incorrect realtime Ethernet data	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 6412 CIP 125.1.6

10.2.6 Synchronous errors

Explicit Error Response

If an Explicit Request message cannot be processed by the slave, the master receives an error message in the associated Explicit Response. This response message contains 2 bytes:

- General Error Code
- Additional Error Code

Errors can be read with object 100.1.1. If the general error code has the value $=1F_h$, the field "additional error code" contains vendor-specific error numbers in coded form.

Response during I/O connection

The slave responds to an incorrect I/O command in the next I/O response by setting bit 6 (ME, ModeError) in byte modeStat. This does not interrupt the current process. To determine the cause of the error, the master can read the error number with the object 100.1.1 by means of an explicit access.

The error indication is reset during the next valid data transmission.

Table of general error codes

The error codes that can be contained in the "General Error Code" field are listed in the following table:

Error code	Name [1]	Meaning
00_h	Success	The service was successfully executed by the specified object.
01_h	Connection failure	A connection-specific service has not been successful along the connection path.
02_h	Resource unavailable	Resources that the object required to execute the requested service were not available.
03_h	Invalid parameter value	See status code 20_h, which is the preferred value for this condition.
04_h	Path segment error	The path segment identifier or segment syntax could not be interpreted by the processing node. Path processing is terminated when a path segment error is detected.
05_h	Path destination unknown	The path refers to an object class, an instance or a structure element that is unknown or not contained in the processing node. Path processing is terminated if an error is detected that is due to an unknown path destination.
06_h	Partial transfer	Only part of the expected data was transmitted.
07_h	Connection lost	The connection for message transmission was interrupted.
08_h	Service not supported	The requested service was not implemented or was not defined for this object class or this instance.
09_h	Invalid attribute value	Invalid attribute data was detected
$0A_h$	Attribute list error	An attribute in the response "Get_Attribute_List" or "Set_Attribute_List" has a status that is not zero.
$0B_h$	Already in requested mode/state	The object is already in the mode/state that was requested by the service
$0C_h$	Object state conflict	The object cannot execute the requested service in its current mode/state
$0D_h$	Object already exists	The requested instance of the object to be created already exists.
$0E_h$	Attribute not settable	A request to change an attribute that cannot be set was received.
$0F_h$	Privilege violation	Checking of an authorization/privilege has not been successful
10_h	Device state conflict	The requested service cannot be executed in the current mode/state of the device.
11_h	Reply data too large	The data volume for transmission in the response buffer is larger than the allocated response buffer

Error code	Name [1]	Meaning
12_h	Fragmentation of a primitive value	The service has specified an operation that results in fragmentation of the original data value, i.e. half a REAL data type.
13_h	Not enough data	The service did not deliver enough data to execute the specified operation.
14_h	Attribute not supported	The attribute specified in the request is not supported
15_h	Too much data	The service delivered more data than expected
16_h	Object does not exist	The specified object does not exist in the device.
17_h	Service fragmentation sequence not in progress	The fragmentation sequence for this service is not currently activated for this data.
18_h	No stored attribute data	The attribute data of this object were not saved before the requested service.
19_h	Store operation failure	The attribute data of this object was not saved, because an error occurred during the attempt.
$1A_h$	Routing failure, request packet too large	The request packet of the service was too large to be transmitted to the destination on a network along the path. The routing device had to cancel the service.
$1B_h$	Routing failure, response packet too large	The response packet of the service was too large to be transmitted from the destination on a network along the path. The routing device had to cancel the service.
$1C_h$	Missing attribute list entry data	The service did not provide an attribute in an attribute list that was required to allow the service to carry out the requested behavior.
$1D_h$	Invalid attribute value list	The service returns the list of the attributes provided with the status information for the invalid attributes.
$1E_h$	Embedded service error	An embedded service resulted in an error.
$1F_h$	Vendor specific error	An error with a vendor-specific error number has been detected. The "Additional Code" field (additional error code) of the response message contains the error number.
		If "Additional Code" contains the value "FE", the vendor-specific error number can be read with the object 100.1.1.
		If the "Additional Code" contains a value other than "FE", the error number can be directly generated by prepending "$A3_h$". Example: Error Code = $1F_h$ Additional Code = 08_h Error code = $A308_h$ (operating state **9** Fault).
20_h	Invalid parameter	A parameter assigned to the request was invalid. This code is used if a parameter does not meet the requirements of this specification and/or the requirements defined in an application object specification.
21_h	Write-once value or medium already written	An attempt was made either to write data again to a write-once medium (e. g. WORM drive, PROM) that already contained data, or to change a specified value that cannot be changed.
22_h	Invalid Reply Received	An invalid reply was received (for example, the service reply code is not the same as the request code or the reply is shorter than the expected minimum length of the reply). This status code may also be used for other causes of invalid responses.
23_h - 24_h		Reserved by CIP for future extensions
25_h	Key Failure in path	The key segment that was inserted in the path as the first segment does not match the destination module. The object-specific status indicates the part of the key test that has not been successful.
26_h	Path Size Invalid	The size of the path that was sent with the service request is either not large enough to allow for routing of the request, or it contained too much routing data.
27_h	Unexpected attribute in list	An attempt was made to set an attribute that cannot be set at this time.
28_h	Invalid Member ID	The member ID specified in the request does not exist in the specified class/instance/attribute

Error code	Name [1]	Meaning
29$_h$	Member not settable	A request to change a member that cannot be set was received.
2A$_h$	Group 2 only server general failure	Service or attribute is not supported (attribute cannot be set)
2B$_h$ - CF$_h$	-	Reserved by CIP for future extensions
D0$_h$ -FF$_h$	Reserved for Object Class and service errors	This error code range is used to indicate errors related to object classes. Use this range only if none of the error codes listed in this table exactly represents the detected error.

1) See: The CIP Networks Library, Volume 1, Common Industrial Protocol, Appendix B

10.3   Troubleshooting

10.3.1   Fieldbus communication

A properly operating fieldbus is essential for evaluating operating and error messages.

Checking connections   If the product cannot be addressed via the fieldbus, check the following.

▶ System power supply

▶ Power supply connections

▶ Fieldbus cables and wiring

▶ Fieldbus connection

▶ Wiring of limit switches, if applicable

Fieldbus function test   ▶ If the connections are correct, check the settings for the fieldbus addresses.

▶ Ping (Windows command line command) each network device, for example, "ping 192.168.100.10" to the network device with the IP address 192.168.100.10.

▶ After correct configuration of the transmission data, test fieldbus mode.

Addressing, parameterization   If it is impossible to connect to a device, check the following:

▶ Addressing

Each network device must have a unique address.

▶ Parameterization

"Vendor ID" and "Product Code" must match the values stored in the EDS file.

10.3.2   Troubleshooting of errors sorted by error bit

The description contains parameters you do not need if you use the library. For diagnostics purposes, these parameters can be read with the function block "MC_ReadParameter_ETH_ILx2".

To facilitate troubleshooting, the error numbers are categorized by so-called error bits. The error bits can be read using the parameter _SigLatched. Signal status "1" indicates an error or warning message.

Error bit	Meaning	Error class	Cause	Troubleshooting
0	General error	0		
1	Limit switch (LIMP/LIMN/ REF)	1	Limit switch is or was activated, line interrupted	Move drive into movement range, match positioning data to axis range, special message in error memory
2	Movement range exceeded (software limit switch, tuning range)	1	Motor not in range of travel	Check range of travel, home the drive again
3	"Quick Stop" via fieldbus	1	Fieldbus command	
4	Inputs $\overline{STO\_A}$ ($\overline{PWRR\_A}$) and $\overline{STO\_B}$ ($\overline{PWRR\_B}$) are "0"	3	"STO" safety function was triggered	Check guard door, cabling
6	RS485 fieldbus error, Modbus		Interruption of fieldbus communication, RS485 only, for example Modbus	Check the communication cables, check the fieldbus, check the communication parameters.
9	Incorrect reference signals (frequency too high)		Frequency too high, interference	EMC requirements, do not exceed maximum frequency (technical data)
10	Error in processing of the current operating mode	2	Processing error	For detailed information see additional information in the error memory
14	DC bus undervoltage	2	DC bus voltage below threshold value for "Quick Stop"	Check DC bus voltage
		3	DC bus voltage below threshold value for switching off the drive	
15	DC bus overvoltage	3	DC bus overvoltage, deceleration too fast	Extend braking process, use external braking resistor
18	Motor overload	3	Phase current too high	Reduce load
20	Undervoltage controller supply voltage		Controller supply voltage has fallen below the minimum value	Check controller supply voltage. Check for short-term voltage dips during load changes
21	Temperature of power stage too high	3	Power stage overheated	Reduce load
22	Following error	par.	Following error	Reduce external load or acceleration, error response is adjustable via "Flt_pDiff"
24	Inputs $\overline{STO\_A}$ ($\overline{PWRR\_A}$) and $\overline{STO\_B}$ ($\overline{PWRR\_B}$) are different	4	Interruption of the signal wires	Check signal cable and signal connection, check signal source, replace
29	EEPROM error	3-4	Checksum in EEPROM incorrect	Run a "First Setup", save the user-defined parameters to the EEPROM, contact your local sales office
30	System start-up error (hardware or parameter error)	3-4	Cause of error as indicated	Resolution depends on indicated cause of error

Error bit	Meaning	Error class	Cause	Troubleshooting
31	Internal system error (e. g. Watchdog)	4	Internal system error	Switch device off and on, replace device
			System error, e.g. division by 0 or timeout checks, inadequate EMC	Comply with EMC measures, switch device off and on, contact your local sales office

10.4   Table of error numbers

The cause of the error for each error message is contained in the parameter `FLT_err_num` in the form of a code. The following table shows the the error numbers and their meanings. If "par." is shown with the error class, the error class is parameterizable.

Error number categories:

Error number	Error in area
E 1xxx	General errors
E 2xxx	Overcurrent errors
E 3xxx	Voltage errors
E 4xxx	Temperature errors
E 5xxx	Hardware errors
E 6xxx	Software errors
E 7xxx	Interface errors, wiring errors
E 8xxx	Fieldbus errors CANopen
E Axxx	Drive errors, motion errors
E Bxxx	Communication errors

Information on error bits and troubleshooting can be found on page 169.

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 number	Class	Bit	Description, cause and correctives
E 1100	-	-	Parameter out of permissible range
E 1101	-	-	Parameter does not exist Fault signaled by parameter management: parameter (index) does not exist.
E 1102	-	-	Parameter does not exist Fault signaled by parameter management: parameter (subindex) does not exist.
E 1103	-	-	Parameter write not permissible (READ only) Write access to read only parameter.

Error number	Class	Bit	Description, cause and correctives
E 1104	-	-	Write access denied (no access authorization)
			Parameter only accessible at expert level.
			The write access level expert is required.
E 1106	-	-	Command not allowed while power stage is active
			Command not allowed while the power stage is enabled (state "OperationEnable" or "QuickStopActive").
			Disable the power stage and repeat the command.
E 1107	-	-	Access via other interface blocked
			Access occupied by another channel (e.g.: commissioning software is active and fieldbus access was tried at the same time).
			Check the channel that blocks the access.
E 110B	3	30	Initialization error (additional info=Modbus register address)
			Error detected at power enable parameter check e.g. reference speed value for profile position is greater than max. allowed speed of drive.
			Value in additional error info shows the Modbus register address of the parameter where the initialization error was detected.
E 110E	-	-	Parameter changed that requires a restart of the drive
			Only displayed by the commissioning software. A parameter modification requires the drive to be switched off and on.
			Restart the drive to activate the parameter functionality. Check the parameter chapter for the parameter that required a restart of the drive.
E 110F	-	-	Function not available in this type of device
			The specific type of device does not support this function or this parameter value.
			Check if you have the correct device type, in particular type of motor, type of encoder, holding brake.
E 1300	3	4	Safety function STO activated
			The safety function STO was activated in "Operation enable" state.
			Reset the fault; check the wiring of the STO inputs.
E 1301	4	24	STO_A (PWRR_A) and STO_B (PWRR_B) different level
			The levels of the inputs STO_A (PWRR_A) and STO_B (PWRR_B) were different for more than 1 second.
			The drive has to be switched off and the reason fixed (e.g.: check emergency stop active) before it is switched on.
E 1312	-	-	Limit or reference switch signal in I/O functions not defined
			Reference movements require limit switches. These limit switches are not assigned to inputs.
			Assign the LIMP, LIMN and REF functions to the inputs.
E 2300	3	18	Power stage overcurrent
			Motor short circuit and deactivation of the power stage.
			Check the motor power connection.
E 3200	3	15	DC bus overvoltage
			Excessive regeneration during braking.
			Check deceleration ramp, check dimensioning of drive and braking resistor.
E 3201	3	14	DC bus undervoltage (switch-off threshold)
			Power supply loss, poor power supply.

Error number	Class	Bit	Description, cause and correctives
E 3202	2	14	DC bus undervoltage (Quick Stop threshold) Power supply loss, poor power supply.
E 4100	3	21	Power stage overtemperature Transistors overtemperature: ambient temperature is too high, fan is inoperative, dust. Improve the heat dissipation.
E 4101	0	1	Warning power stage overtemperature Transistors overtemperature: ambient temperature is too high, fan is inoperative, dust. Improve the heat dissipation.
E 4302	0	5	Motor overload (I2t) warning The current has exceeded the nominal value for an extended period of time.
E 610D	-	-	Error in selection parameter Wrong parameter value selected. Check the value to be written.
E 7328	4	19	Motor encoder sends: position capture errors Encoder signals internal position capturing fault. Contact technical support or replace the motor.
E 7329	0	8	Motor encoder sends: Warning EMC, encoder signals internal warning. Contact technical support or replace the motor.
E 7338	0	13	No valid motor absolute position Warning to inform you that absolute position has not yet been determined. Depending on application, fix the absolute position. Device still usable and all functions are OKAY.
E 7500	0	9	RS485/Modbus: overrun error EMC; cabling problem. Check cables.
E 7501	0	9	RS485/Modbus: framing error EMC; cabling problem. Check cables.
E 7502	0	9	RS485/Modbus: parity error EMC; cabling problem. Check cables.
E 7503	0	9	RS485/Modbus: receive error EMC; cabling problem. Check cables.
E 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.

Error number	Class	Bit	Description, cause and correctives
E A301	-	-	Drive in state 'Quick Stop active'
			Error with error class 1 occurred. Drive stopped with Quick Stop command.
E A302	1	1	Interruption by LIMP
			LIMP was activated because working range was exceeded, misoperation of limit switch or signal disturbance.
			Check application. Check limit switch function and connection.
E A303	1	1	Interruption by LIMN
			LIMN was activated because working range was exceeded, misoperation of limit switch or signal disturbance.
			Check application. Check limit switch function and connection.
E A305	-	-	Power stage cannot be activated in the current operating state (state diagram)
			Fieldbus: trying to enable the power stage in operating state "Not ready to switch on".
			Refer to the state diagram in the operation chapter of the manual.
E A306	1	3	Interruption by user-initiated software stop
			Drive is in state "Quick Stop active" due to a software stop request. The activation of a new operating mode is not possible, the error code is sent as the response to the activation command.
			Clear break condition with command Fault Reset.
E A307	-	-	Interruption by internal software stop
			In homing and jog modes, the movement is internally interrupted using an internal software stop. The activation of a new operating mode is not possible, the error code is sent as the response to the activation command.
			Clear break condition with command Fault Reset.
E A308	-	-	Drive in state 'Fault'
			Error with error class 2 or higher occurred.
			Check error code (HMI or commissioning tool), remove error condition and clear error state with command Fault Reset.
E A309	-	-	Drive not in state 'Operation Enable'
			A command which requires the state "Operation enable" was sent (e.g.: opmode change).
			Set drive to state "OperationEnable" and repeat the command.
E A310	-	-	Power stage not active
			Command is not possible because the power stage is not enabled (state "Operation Enabled" or "Quick Stop").
			Set drive to a state with the power stage enabled, refer to the state diagram in the operation chapter of the manual.
E A313	-	-	Position overrun, reference point is therefore no longer defined (ref_ok=0)
			The position range limits were exceeded which resulted in a loss of the reference point. An absolute movement cannot be made until the definition of a new reference point.
			Define a new reference point by means of homing mode.
E A314	-	-	No reference position
			Command needs a defined reference point (ref_ok=1).
			Define a new reference point by means of homing mode.

Error number	Class	Bit	Description, cause and correctives
E A315	-	-	Homing active
			Command not possible if homing is active.
			Wait until homing movement is finished.
E A317	-	-	Drive is not at standstill
			Command sent which is not allowed when the motor is not at a standstill e.g. - change of software limit switches - change of handling of monitoring signals - setting of reference point - teach in of data set
			Wait until 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	2	Manual tuning/Autotuning: drive moved out of permissible range
			The motor exceeds the parameterized maximum allowed position range.
			Check allowed position range value and time interval.
E A31A	-	-	Manual tuning/Autotuning: amplitude/offset too high
			Amplitude plus offset for tuning exceed internal speed 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. Homing position value is set outside the range of the software limits.
			Set correct position values.
E A31D	-	-	Speed range overflow ('CTRL_n_max')
			The reference speed value was set to a value greater than the max. speed defined in 'CTRL_n_max'.
			Increase the value of 'CTRL_n_max' or reduce the reference speed value.
E A31E	1	2	Interruption by positive software limit switch
			Command not possible because of overtravel of positive software limit switch.
			Jog back to software limit range.
E A31F	1	2	Interruption by negative software limit switch
			Command not possible because of overrun of negative software limit switch.
			Jog back to software limit range.
E A320	par.	22	Tracking error too high
			External load or acceleration are too high.
			Reduce external load or acceleration, error response is adjustable via 'Flt_pDiff'.

Error number	Class	Bit	Description, cause and correctives
E A324	1	10	Error during homing (additional info = detailed error number) Homing movement was stopped by an error, the detailed reason is indicated by the additional info in the error buffer. Possible sub error codes: EA325 EA326 EA327 EA328 EA329
E A325	1	10	Limit switch to be approached not enabled Homing to LIMP or LIMN and limit switches are disabled. Enable limit switch via 'IOsigLimP' or 'IOsigLimN'.
E A326	1	10	REF switch not found between LIMP and LIMN REF input switch defective or not correctly connected. Check the function and wiring of the REF switch.
E A327	1	10	Reference movement to REF without direction reversal, improper enabling of limit switch LIM Search of REF without direction reversal in positive (negative) direction with LIMP (LIMN) activated. Check the function and wiring of the LIMP (LIMN) switch.
E A328	1	10	Reference movement to REF without direction reversal, overrun of LIM or REF not permissible Search of REF without direction reversal and REF or LIM overtravel. Reduce homing speed ('HMn') or increase deceleration ('RAMPdecel'). Check the function and wiring of LIMP, LIMN and REF switch.
E A329	1	10	More than one signal LIMP/LIMN/REF active REF or LIM not connected correctly or supply voltage for switches too low. Check the wiring and 24VDC supply voltage.
E A32A	1	10	Ext. monitoring signal LIMP with neg. direction of rotation Start reference movement with neg. direction of rotation (e.g. reference movement to LIMN) and activate the LIMP switch (switch in opposite direction of movement). Check correct connection and function of limit switch. Activate a jog movement with negative direction of rotation (target limit switch must be connected to the inputs LIMN).
E A32B	1	10	Ext. monitoring signal LIMN with pos. direction of rotation Start reference movement with pos. direction of rotation (e.g. reference movement to LIMP) and activate the LIMN switch (switch in opposite direction of movement). Check correct connection and function of limit switch. Activate a jog movement with positive direction of rotation (target limit switch must be connected to the inputs LIMP).
E A32C	1	10	REF error (switch signal briefly enabled or switch overtraveled) Switch signal disturbance. Motor subjected to vibration or shock when stopped after activation of the switch signal. Check supply voltage, cabling and function of switch. Check motor reaction after stopping and optimize controller settings.

Error number	Class	Bit	Description, cause and correctives
E A32D	1	10	LIMP error (switch signal briefly enabled or switch overtraveled)
			Switch signal disturbance. Motor subjected to vibration or shock when stopped after activation of the switch signal.
			Check supply voltage, cabling and function of switch. Check motor reaction after stopping and optimize controller settings.
E A32E	1	10	LIMN error (switch signal briefly enabled or switch overtraveled)
			Switch signal disturbance. Motor subjected to vibration or shock when stopped after activation of the switch signal.
			Check supply voltage, cabling and function of switch. Check motor reaction after stopping and optimize controller settings.
E A330	-	-	Reference movement to index pulse cannot be reproduced. Index pulse is too close to the switch
			The position difference between the change of the switch signal and the occurrence of the index pulse is too low.
			Change mounting point of limit switch (the optimum is a position one half of a motor revolution away from the current mechanical position, direction towards the outside of the working range).
E A332	1	10	Jog error (additional info = detailed error number)
			Jog movement was stopped by error.
			For additional info, check the detailed error number in the error buffer.
E A334	2	0	Timeout at Standstill window monitor
			Position deviation after movement finished greater than standstill window, e.g. caused by an external load.
			Check load. Check settings for standstill window ('STANDp_win', 'STANDpwinTime' and 'STANDpwinTout'). Optimize controller settings.
E A337	0	10	Operating mode cannot be continued
			Continuation of interrupted movement in profile position mode is not possible because another mode had been active in the meantime. In Motion Sequence mode, continuation is impossible if a motion blend was interrupted.
E A33A	-	-	Reference point is not defined (ref_ok=0)
			No homing done and no motor with absolute encoder connected. Homing position lost because the working position range was left.
			Start homing. Use motor with multiturn encoder if no homing is to be done.
E A33B	3	22	Motor is blocked
			Brushless DC motor: Blocking detection with parameter SPV_t_block. Stepper motor: Stall detection with index pulse detected a deviation of magnetic field and rotor angle.
			Reduce acceleration/deceleration values. Reduce load. Increase current settings.
E B100	0	9	RS485/Modbus: unknown service
			Unsupported Modbus service was received.
			Check application on the Modbus master.

Error number	Class	Bit	Description, cause and correctives
E B200	0	9	RS485/Modbus: Protocol error Logical protocol error: wrong length or unsupported subfunction. Check application on the Modbus master.
E B201	2	6	RS485/Modbus: Nodeguard error Modbus is defined as command interface ('DEVcmdinterf'=Modbus): 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	9	RS485/Modbus: Nodeguard warning Modbus is not defined as command interface ('DEVcmdinterf '<>Modbus): connection monitoring parameter ('MBnode_guard') is <>0ms and a nodeguard event was detected. Check application on the Modbus master or change (set to 0ms or increase the parameter 'MBnode_guard' monitoring time).
E B600	4	8	Ethernet module: Initialization error
E B601	1	8	Ethernet module: Realtime data error
E B602	0	14	Ethernet module: Realtime data warning
E B603	2	8	Ethernet module: Protocol-specific error Can be caused by a connection timeout or a loss of Ethernet link when the power amplifier was activated. Check cabling, network devices and PLC connection.
E B604	0	14	Ethernet module: Protocol-specific warning
E B605	2	8	Unknown error of Ethernet module.
E B607	0	14	Ethernet module is currently processing another request.
E B608	2	8	Ethernet module: Realtime Hot-Reset - an NMT Reset was sent while the drive was enabled - a Modbus TCP channel was reset while the drive was enabled
E B609	2	8	Ethernet module: Realtime Hot-Stop
E B60A	0	14	Ethernet module: Timeout in internal communication
E B60B	0	14	Ethernet module: Error in internal communication

11 Parameters

11

This chapter provides an overview of the parameters which can be used for operating the product.

> ⚠ **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 of a parameter. In addition, information is provided on possible settings, defaults and parameter properties.

Entering values Please note that parameter values are entered via the fieldbus without a decimal point. All decimal places must be entered.

Input examples:

Value	Commissioning software	Fieldbus
20	20	20
5.0	5.0	50
23.57	23.57	2357
1.000	1.000	1000

11.1.1 Explanation of the parameter representation

Parameters are represented as shown below:

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
Example_Name	Brief description (cross-reference) Selection values **1 / Selection value1**: Explanation 1 **2 / Selection value2**: Explanation 2 Further description and details	A_{pk} 0.00 3.00 300.00	UINT32 R/W per. -	Fieldbus 1234

Parameter name	The parameter name uniquely identifies a parameter.
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 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 changing a value via commissioning software or fieldbus, the user must explicitly store the changed value in the persistent memory.

Parameter address   Each parameter has a unique parameter address. The parameter address is used to access the parameter via the fieldbus.

The address consists of:

- Class.Instance.Attribute

11.2 List of parameters

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_acc_pref	Acceleration of reference value generation Sign according to the changed speed value: Increased speed: pos. sign Reduced speed: neg. sign	min^{-1}/s - 0 -	INT32 INT32 R/- - -	Modbus 7954 CIP 131.1.9
_AccessInfo	Current access channel for action objects Low byte : 0 : Used by channel in high byte 1 : Exclusively used by channel in high byte High byte: Current assignment of access channel 0: reserved 1: IO 2: HMI 3: Modbus RS485 4: CANopen 5: CANopen via seconds SDO channel 6: Profibus 7: DeviceNet 8: reserved 9: Ethernet 10..15: Modbus TCP	- - 0 -	UINT16 UINT16 R/- - -	Modbus 280 CIP 101.1.12
_actionStatus	Action word (139) Signal status: 0: not activated 1: activated Bit 0: Warning Bit 1: Error class 1 Bit 2: Error class 2 Bit 3: Error class 3 Bit 4: Error class 4 Bit 5: Reserved Bit 6: Drive is at standstill (<9 [1/min]) Bit 7: Drive rotates clockwise Bit 8: Drive rotates counter-clockwise Bit 9: Reserved Bit 10: Reserved Bit 11: Profile generator idle (reference speed is 0) Bit 12: Profile generator decelerates Bit 13: Profile generator accelerates Bit 14: Profile generator moves at constant speed Bit 15: Reserved	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7176 CIP 128.1.4
_ethMacAdr1	Ethernet MAC address part1 Bytes 1-2 of the MAC address (XX:XX :__:__:__:__) XX are the bytes used Example: MAC address: 11:22:33:44:55:66 The value stored in this case is 0x00001122	- - 0 -	UINT32 UINT32 R/- - -	Modbus 6672 CIP 126.1.8

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_ethMacAdr2	Ethernet MAC address part2 Bytes 3-6 of the MAC address (__:__ :XX:XX:XX:XX) XX are the bytes used Example: MAC address: 11:22:33:44:55:66 The value stored in this case is 0x33445566	- - 0 -	UINT32 UINT32 R/- - -	Modbus 6674 CIP 126.1.9
_I2t_act_M	Current motor overload (137)	% - 0 -	INT16 INT16 R/- - -	Modbus 7218 CIP 128.1.25
_I2t_mean_M	Motor load (137)	% - 0 -	INT16 INT16 R/- - -	Modbus 7220 CIP 128.1.26
_Id_act	Actual motor current d-component In increments of 0.01Apk	A_{pk} - 0.00 -	INT16 INT16 R/- - -	Modbus 7684 CIP 130.1.2
_Id_ref	Reference motor current d-component (weakening the field) In increments of 0.01Apk	A_{pk} - 0.00 -	INT16 INT16 R/- - -	Modbus 7714 CIP 130.1.17
_Idq_act	Total motor current (vector sum d-compo- nents and q-components) In increments of 0.01Apk	A_{pk} - 0.00 -	INT16 INT16 R/- - -	Modbus 7686 CIP 130.1.3
_IO_LIO_act	Status of digital inputs/outputs (103) Coding of the individual signals: Bit 0: LIO1 Bit 1: LIO2 ...	- - 0 -	UINT16 UINT16 R/- - -	Modbus 2090 CIP 108.1.21
_IO_STO_con	Connection of STO inputs **0 / not available**: Inputs not available **1 / not connected**: Inputs available, but not connected (jumpered) **3 / connected**: Inputs available and con- nected (safety function STO active) Inputs STO_A (PWRR_A) and STO_B (PWRR_B)	- 0 - 3	UINT16 UINT16 R/- - -	Modbus 2088 CIP 108.1.20
_Iq_act	Actual motor current q-component In increments of 0.01Apk	A_{pk} - 0.00 -	INT16 INT16 R/- - -	Modbus 7682 CIP 130.1.1
_Iq_ref	Reference motor current q-component (gen- erating torque) In increments of 0.01Apk	A_{pk} - 0.00 -	INT16 INT16 R/- - -	Modbus 7712 CIP 130.1.16

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_LastWarning	Last warning as number 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	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7186 CIP 128.1.9
_n_act	Actual motor speed (120)	min⁻¹ - 0 -	INT16 INT16 R/- - -	Modbus 7696 CIP 130.1.8
_n_actRAMP	Actual speed of motion profile generator (120)	min⁻¹ - 0 -	INT32 INT32 R/- - -	Modbus 7948 CIP 131.1.6
_n_pref	Speed of reference value generation	min⁻¹ - 0 -	INT32 INT32 R/- - -	Modbus 7950 CIP 131.1.7
_n_ref	Reference speed of speed controller	min⁻¹ - 0 -	INT16 INT16 R/- - -	Modbus 7694 CIP 130.1.7
_n_targetRAMP	Reference speed of motion profile generator	min⁻¹ - 0 -	INT32 INT32 R/- - -	Modbus 7946 CIP 131.1.5
_OpHours	Operating hours counter	s - 0 -	UINT32 UINT32 R/- - -	Modbus 7188 CIP 128.1.10
_p_absmodulo	Absolute pos. with ref. to 1 motor revolution in internal units NOTE: The position is not valid until the absolute motor position has been determined. In the case of invalid absolute motor position: _WarnLatched _WarnActive Bit 13=1: Absolute motor position not yet captured	Inc - 0 -	UINT32 UINT32 R/- - -	Modbus 7708 CIP 130.1.14
_p_act	Actual position of motor in internal units	Inc - 0 -	INT32 INT32 R/- - -	Modbus 7700 CIP 130.1.10
_p_actRAMPusr	Actual position of motion profile generator (118) In user units	usr - 0 -	INT32 INT32 R/- - -	Modbus 7940 CIP 131.1.2

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_p_actusr	Actual motor position in user units (118)	usr - 0 -	INT32 INT32 R/- - -	Modbus 7706 CIP 130.1.13
_p_dif	Current deviation between reference and actual position (137) Corresponds to the current control deviation of the position controller.	revolution -214748.3648 - 214748.3647	INT32 INT32 R/- - -	Modbus 7716 CIP 130.1.18
_p_DifPeak	Value of the maximum tracking error of the position controller (137) The tracking error is the current position control deviation. See SPV_p_maxDiff for more information. A write access resets this value.	revolution 0.0000 - 429496.7295	UINT32 UINT32 R/W - -	Modbus 4382 CIP 117.1.15
_p_ref	Reference position in internal units Value corresponds to the reference position of the position controller.	Inc - 0 -	INT32 INT32 R/- - -	Modbus 7698 CIP 130.1.9
_p_refusr	Reference position in user units (132) Value corresponds to the reference position of the position controller.	usr - 0 -	INT32 INT32 R/- - -	Modbus 7704 CIP 130.1.12
_p_tarRAMPusr	Target position of motion profile generator Absolute position value of the profile generator, calculated on the basis of the relative and absolute position values received. In user units	usr - 0 -	INT32 INT32 R/- - -	Modbus 7938 CIP 131.1.1
_prgNoCOM	Communication module program number Example: PR840.1 The value is entered as a decimal value: 8401	- - 0.0 -	UINT16 UINT16 R/- - -	Modbus 6676 CIP 126.1.10
_prgNoDEV	Firmware program number Example: PR840.1 The value is entered as a decimal value: 8401	- - 0.0 -	UINT16 UINT16 R/- - -	Modbus 258 CIP 101.1.1
_prgVerCOM	Communication module firmware version Example: V4.201 The value is entered as a decimal value: 4201	- - 0.000 -	UINT16 UINT16 R/- - -	Modbus 6678 CIP 126.1.11
_prgVerDEV	Firmware version number Example: V4.201 The value is entered as a decimal value: 4201	- - 0.000 -	UINT16 UINT16 R/- - -	Modbus 260 CIP 101.1.2

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_serialNoDEV	Device serial number Serial number: unique number for identification of the product	- 0 - 4294967295	UINT32 UINT32 R/- per. -	Modbus 302 CIP 101.1.23
_SigActive	Current status of monitoring signals (138) See _SigLatched for more details on the bit codes.	- - 0 -	UINT32 UINT32 R/- - -	Modbus 7182 CIP 128.1.7
_SigLatched	Saved status of monitoring signals (138) Signal status: 0: Not activated 1: Activated Bit assignments: Bit 0: General fault Bit 1: Limit switches (LIMP/LIMN/REF) Bit 2: Out of range (SW limit switches, tuning) Bit 3: Quickstop via fieldbus Bit 4: Inputs STO are 0 Bit 5: Reserved Bit 6: RS485 fault Bit 7: CAN fault Bit 8: Ethernet fault Bit 9: Frequency of reference signal too high Bit 10: Fault current operating mode Bit 11: Reserved Bit 12: Profibus fault Bit 13: Reserved Bit 14: Undervoltage DC bus Bit 15: Overvoltage DC bus Bit 16: Mains phase missing Bit 17: Motor connection fault Bit 18: Motor overcurrent/short circuit Bit 19: Motor encoder fault Bit 20: Undervoltage 24VDC Bit 21: Overtemperature (power stage, motor) Bit 22: Tracking error Bit 23: Max. speed exceeded Bit 24: Inputs STO different Bit 25: Reserved Bit 26: Reserved Bit 27: Reserved Bit 28: Reserved Bit 29: EEPROM fault Bit 30: System booting (Hardware fault or parameter error) Bit 31: System error (e.g. watchdog) Monitoring functions are product-dependent.	- - 0 -	UINT32 UINT32 R/- - -	Modbus 7184 CIP 128.1.8
_StopFault	Error number of last stop fault (139)	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7178 CIP 128.1.5

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_Temp_act_PA	Power stage temperature (136)	°C - 0 -	INT16 INT16 R/- - -	Modbus 7200 CIP 128.1.16
_Ud_ref	Reference motor voltage d-component In increments of 0.1V	V - 0.0 -	INT16 INT16 R/- - -	Modbus 7690 CIP 130.1.5
_UDC_act	Voltage at DC bus Supply voltage VDC in 0.1 V increments	V - 0.0 -	UINT16 UINT16 R/- - -	Modbus 7198 CIP 128.1.15
_Udq_ref	Total motor voltage (vector sum d-components and q-components) Square root of (_Uq_ref^2 + _Ud_ref^2) In increments of 0.1V	V - 0.0 -	INT16 INT16 R/- - -	Modbus 7692 CIP 130.1.6
_Uq_ref	Reference motor voltage q-component In increments of 0.1V	V - 0.0 -	INT16 INT16 R/- - -	Modbus 7688 CIP 130.1.4
_VoltUtil	Degree of utilization of DC bus voltage With a value of 100%, the drive operates at the voltage limit.	% - 0 -	INT16 INT16 R/- - -	Modbus 7718 CIP 130.1.19
_WarnActive	Active warnings, bit-coded (138) See _WarnLatched for more details on the bit codes.	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7190 CIP 128.1.11

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_WarnLatched	Saved warnings, bit-coded (139) Saved warning bits are deleted in the case of a FaultReset. Bits 10, 11, 13 are deleted automatically. Signal status: 0: Not activated 1: Activated Bit assignments: Bit 0: General warning (see _LastWarning) Bit 1: Temperature of power stage high Bit 2: Temperature of motor high Bit 3: Reserved Bit 4: Power stage overload (I^2t) Bit 5: Motor overload (I^2t) Bit 6: Braking resistor overload (I^2t) Bit 7: CAN warning Bit 8: Motor encoder warning Bit 9: RS485 protocol warning Bit 10: STO_A (PWRR_A) and/or STO_B (PWRR_B) Bit 11: DC bus undervoltage/missing mains phase Bit 12: Profibus warning Bit 13: Position not yet valid (position capture still running) Bit 14: Ethernet warning Bit 15: Reserved Monitoring functions are product-dependent.	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7192 CIP 128.1.12
AbsHomeRequest	Absolute positioning only after homing (119) **0 / no**: No **1 / yes**: Yes	- 0 1 1	UINT16 UINT16 R/W per. -	Modbus 1580 CIP 106.1.22
AccessLock	Locking other access channels (109) 0: Release other access channels 1: Lock other access channels The fieldbus can lock active access to the device via the following access channels with this parameter: - Input signals - Commissioning software Processing of the input signal HALT cannot be locked.	- 0 - 1	UINT16 UINT16 R/W - -	Modbus 316 CIP 101.1.30
CTRL_I_max	Current limitation (102) The value must not exceed the maximum permissible current of the motor or the power stage. Default: M_I_max	A_{pk} 0.00 - 299.99	UINT16 UINT16 R/W per. -	Modbus 4610 CIP 118.1.1
CTRL_KFPp	Speed feed-forward control position controller Overshoot of up to 110% is possible.	% 0.0 100.0 110.0	UINT16 UINT16 R/W per. -	Modbus 4624 CIP 118.1.8

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL_KPn	Speed controller P-term The default value is calculated on the basis of the motor parameters.	A/min^{-1} 0.0001 - 1.2700	UINT16 UINT16 R/W per. -	Modbus 4614 CIP 118.1.3
CTRL_KPp	Position controller P-term The default value is calculated.	1/s 2.0 - 495.0	UINT16 UINT16 R/W per. -	Modbus 4620 CIP 118.1.6
CTRL_n_max	Speed limitation (102) The set value must not exceed the maximum motor speed. Default: maximum motor speed (see M_n_max)	min^{-1} 0 - 13200	UINT16 UINT16 R/W per. -	Modbus 4612 CIP 118.1.2
CTRL_Pcdamp	Damping Posicast filter speed The filter is switched off at a value of 1000.	% 50.0 100.0 100.0	UINT16 UINT16 R/W per. expert	Modbus 4648 CIP 118.1.20
CTRL_Pcdelay	Time delay Posicast filter speed The filter is switched off at a value of 0.	ms 0.00 0.00 25.00	UINT16 UINT16 R/W per. expert	Modbus 4650 CIP 118.1.21
CTRL_TAUnref	Filter time constant ref.value filter of the ref. speed value	ms 0.00 0.00 327.67	UINT16 UINT16 R/W per. -	Modbus 4626 CIP 118.1.9
CTRL_TNn	Speed controller setting time	ms 0.00 - 327.67	UINT16 UINT16 R/W per. -	Modbus 4616 CIP 118.1.4
EthErrBehv	Error behavior for realtime Ethernet data (164) **0 / Warning**: Warning (no error response) **1 / ErrorClass1**: Error class 1 (Quick Stop) Sets the error class for incorrect realtime Ethernet data	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 6412 CIP 125.1.6
EthFdrAutosave	Fast Device Replacement (FDR) Autosave **0 / disabled**: disabled **1 / 1 minute**: 1 minute **2 / 5 minute**: 5 minute **3 / 15 minute**: 15 minute **4 / 30 minute**: 30 minute **5 / 60 minute**: 60 minute If FDR is enabled, the drive cyclically stores the configuration to the server in Autosave mode.	- 0 0 5	UINT16 UINT16 R/W per. -	Modbus 6698 CIP 126.1.21

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
EthFdrEnable	Fast Device Replacement (FDR) Enable **0 / disabled**: disabled **1 / enabled**: enabled Global setting to enable the FDR. If the device name is configured and this parameter is enabled, the drive gets the configuration from the FDR server.	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 6696 CIP 126.1.20
EthGateway	Stored Ethernet network gateway Default is 192.168.100.254	- - 0 -	UINT32 UINT32 R/W per. -	Modbus 6662 CIP 126.1.3
EthGatewayAct	Currently used Ethernet network gateway Default is 192.168.100.254	- - 0 -	UINT32 UINT32 R/- - -	Modbus 6668 CIP 126.1.6
EthIpAddr	Stored IP address Default is 192.168.100.10	- - 0 -	UINT32 UINT32 R/W per. -	Modbus 6658 CIP 126.1.1
EthIpAddrAct	Currently used IP address	- - 0 -	UINT32 UINT32 R/- - -	Modbus 6664 CIP 126.1.4
EthIPConfInfo	IP configuration information **2000 / Device Name**: Device Name **2001 / Bootp**: Bootp **2002 / Stored**: Stored in EEPROM **2003 / Build from MAC**: Build from MAC **2004 / EtherNet/IP default**: EtherNet/IP default **2005 / Powerlink**: Powerlink **2006 / EtherCAT**: EtherCAT The IP configuration can be set with the switches in the connector housing.	- 0 - 65535	UINT16 UINT16 R/- - -	Modbus 6694 CIP 126.1.19
EthSubMask	Stored subnet mask Default is 255.255.255.0	- - 0 -	UINT32 UINT32 R/W per. -	Modbus 6660 CIP 126.1.2
EthSubMaskAct	Currently used subnet mask Default is 255.255.255.0	- - 0 -	UINT32 UINT32 R/- - -	Modbus 6666 CIP 126.1.5
FLT_class	Error class (163) 0: Warning (no response) 1: Error (Quick Stop -> state 7) 2: Error (Quick Stop -> state 8, 9) 3: Fatal error (state 9, can be acknowledged) 4: Fatal error (state 9, cannot be acknowledged)	- 0 - 4	UINT16 UINT16 R/- - -	Modbus 15364 CIP 160.1.2

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
FLT_del_err	Clear error memory (162) 1: Delete all entries in the error memory The clearing process is completed if a 0 is returned after a read access.	- 0 - 1	UINT16 UINT16 R/W - -	Modbus 15112 CIP 159.1.4
FLT_err_num	Error number (163) Reading this parameter copies the entire error entry (error class, time of occurrence of error, ...) to an intermediate memory from which all elements of the error can then be read. In addition, the read pointer of the error memory is automatically set to the next error entry.	- 0 - 65535	UINT16 UINT16 R/- - -	Modbus 15362 CIP 160.1.1
FLT_Idq	Motor current at error time In increments of10mA	A - 0.00 -	UINT16 UINT16 R/- - -	Modbus 15378 CIP 160.1.9
FLT_MemReset	Reset error memory read pointer (162) 1: Set error memory read pointer to oldest error entry.	- 0 - 1	UINT16 UINT16 R/W - -	Modbus 15114 CIP 159.1.5
FLT_n	Speed at error time	min^{-1} - 0 -	INT16 INT16 R/- - -	Modbus 15376 CIP 160.1.8
FLT_powerOn	Number of power on cycles	- 0 - 4294967295	UINT32 UINT32 R/- - -	Modbus 15108 CIP 159.1.2
FLT_Qual	Error additional information (163) This entry contains additional information on the error, depending on the error number. Example: a parameter address	- 0 - 65535	UINT16 UINT16 R/- - -	Modbus 15368 CIP 160.1.4
FLT_Temp_DEV	Temperature of device at error time	°C - 0 -	INT16 INT16 R/- - -	Modbus 15382 CIP 160.1.11
FLT_Temp_PA	Temperature of power stage at error time	°C - 0 -	INT16 INT16 R/- - -	Modbus 15380 CIP 160.1.10
FLT_Time	Error time (163) With reference to operating hours counter	s 0 - 536870911	UINT32 UINT32 R/- - -	Modbus 15366 CIP 160.1.3

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
FLT_UDC	DC bus voltage at error time In increments of 100mV	V - 0.0 -	UINT16 UINT16 R/- - -	Modbus 15374 CIP 160.1.7
FLTAmpOnCyc	ENABLE cycles up to the time of error Number of power on cycles from the time the power supply (control voltage) was switched on to the time the error occurred.	- - 0 -	UINT16 UINT16 R/- - -	Modbus 15370 CIP 160.1.5
FLTAmpOnTime	Time of error after ENABLE	s - 0 -	UINT16 UINT16 R/- - -	Modbus 15372 CIP 160.1.6
HMdisREFtoIDX	Distance from switching edge to index pulse (128) This read value delivers the difference between the index pulse position and the position at the switching edge of the limit or reference switch. It allows to check the distance between the index pulse and the switching edge and serves as a criterion for determining whether the reference movement with index pulse processing can be reproduced. In increments of 1/10000 revolutions	revolution - 0.0000 -	INT32 INT32 R/- - -	Modbus 10264 CIP 140.1.12
HMdisusr	Distance from switching edge to reference point (125) After the drive 'leaves' the switch, it is positioned into the working area by a defined distance. This target point is defined as the reference point. The parameter is only effective during reference movements without index pulse search.	usr 1 24 2147483647	INT32 INT32 R/W per. -	Modbus 10254 CIP 140.1.7

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMmethod	Homing method (122) **0 / deactivate**: Deactivated **1 / LIMN indexpuls**: LIMN with index pulse **2 / LIMP indexpuls**: LIMP with index pulse **7 / REFpos indexpuls**: REF+ with index pulse, inv., outside **8 / REFneg indexpuls**: REF+ with index pulse, inv., inside **9**: REF+ with index pulse, not inv., inside **10**: REF+ with index pulse, not inv., outside **11**: REF- with index pulse, inv., outside **12**: REF- with index pulse, inv., inside **13**: REF- with index pulse, not inv., inside **14**: REF- with index pulse, not inv., outside **17 / LIMN**: LIMN **18 / LIMP**: LIMP **23 / REFpos**: REF+, inv., outside **24**: REF+, inv., inside **25**: REF+, not inv., inside **26**: REF+, not inv., outside **27 / REFneg**: REF-, inv., outside **28**: REF-, inv., inside **29**: REF-, not inv., inside **30**: REF-, not inv., outside **33**: Index pulse neg. direction **34**: Index pulse pos. Direction Abbreviations: REF+: Search movement in pos. direction REF-: Search movement in pos. direction inv.: Invert direction in switch not inv.: Direction not inverted in switch outside: Index pulse / distance outside switch inside: Index pulse / distance inside switch	- 0 - 35	R/W - -	
HMn_out	Speed of rotation for moving away from switch (123) The adjustable value is internally limited to the current parameter setting in RAMPn_max.	min^{-1} 1 60 3000	UINT16 UINT16 R/W per. -	Modbus 10250 CIP 140.1.5
HMn	Speed of rotation for search of switch (123) The adjustable value is internally limited to the current parameter setting in RAMPn_max.	min^{-1} 1 600 13200	UINT16 UINT16 R/W per. -	Modbus 10248 CIP 140.1.4
HMoutdisusr	Maximum distance for search for switching edge (124) 0: Monitoring of distance inactive >0: Maximum distance in user-defined units After detection of the switch, the drive starts to search for the defined switching edge. If it is not found within the distance defined here, the reference movement is canceled with an error.	usr 0 0 2147483647	INT32 INT32 R/W per. -	Modbus 10252 CIP 140.1.6
HMp_homeusr	Position at reference point (123) After a successful reference movement, this position is automatically set at the reference point.	usr -2147483648 0 2147483647	INT32 INT32 R/W per. -	Modbus 10262 CIP 140.1.11

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMp_setpusr	Position setting to position setting position (132) Action object: write access triggers position setting. Only possible if the motor is at standstill. Position scaling is not considered.	usr -2147483648 - 2147483647	R/W - -	
HMsrchdisusr	Max. search distance after overrun of switch (124) 0: Search distance processing disabled >0: Search distance in user units The switch must be activated again within this search distance, otherwise the reference movement is canceled.	usr 0 0 2147483647	INT32 INT32 R/W per. -	Modbus 10266 CIP 140.1.13
IO_AutoEnable	Processing of power stage activation at PowerOn **0 / off**: Active Enable during power on does not activate the power stage. **1 / on**: Active Enable during power on activates the power stage. **2 / AutoOn**: Power stage is automatically activated at power on.	- 0 0 2	UINT16 UINT16 R/W per. -	Modbus 1292 CIP 105.1.6
IO_LO_set	Setting the digital outputs directly (152) 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: LO1_OUT Bit 1: LO2_OUT ...	- - 0 -	UINT16 UINT16 R/W - -	Modbus 2082 CIP 108.1.17
IOfunct_LIO1	Function Input/Output LIO1 (153) **1 / Input Free available**: Available as required **2 / Input Fault reset**: Reset fault (local control mode only) **3 / Input Enable**: Enable (local control mode only) **4 / Input Halt**: Halt **9 / Input Jog positive**: Jog right/positive **10 / Input Jog negative**: Jog left/negative **11 / Input Jog fast/slow**: Jog fast/slow **20 / Input Reference switch (REF)**: Reference switch (REF) **21 / Input Positive limit switch (LIMP)**: Positive limit switch (LIMP) **101 / Output Free available**: Available as required **102 / Output No fault**: No fault **103 / Output Active**: Ready	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1826 CIP 107.1.17

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOfunct_LIO2	Function Input/Output LIO2 (154) **1 / Input Free available**: Available as required **2 / Input Fault reset**: Reset fault (local control mode only) **3 / Input Enable**: Enable (local control mode only) **4 / Input Halt**: Halt **9 / Input Jog positive**: Jog right/positive **10 / Input Jog negative**: Jog left/negative **11 / Input Jog fast/slow**: Jog fast/slow **20 / Input Reference switch (REF)**: Reference switch (REF) **22 / Input Negative limit switch (LIMN)**: Negative limit switch (LIMN) **101 / Output Free available**: Available as required **102 / Output No fault**: No fault **103 / Output Active**: Ready	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1828 CIP 107.1.18
IOfunct_LIO3	Function Input/Output LIO3 (154) **1 / Input Free available**: Available as required **2 / Input Fault reset**: Reset fault (local control mode only) **3 / Input Enable**: Enable (local control mode only) **4 / Input Halt**: Halt **9 / Input Jog positive**: Jog right/positive **10 / Input Jog negative**: Jog left/negative **11 / Input Jog fast/slow**: Jog fast/slow **20 / Input Reference switch (REF)**: Reference switch (REF) **101 / Output Free available**: Available as required **102 / Output No fault**: No fault **103 / Output Active**: Ready	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1830 CIP 107.1.19
IOfunct_LIO4	Function Input/Output LIO4 (154) **1 / Input Free available**: Available as required **2 / Input Fault reset**: Reset fault (local control mode only) **3 / Input Enable**: Enable (local control mode only) **4 / Input Halt**: Halt **9 / Input Jog positive**: Jog right/positive **10 / Input Jog negative**: Jog left/negative **11 / Input Jog fast/slow**: Jog fast/slow **20 / Input Reference switch (REF)**: Reference switch (REF) **101 / Output Free available**: Available as required **102 / Output No fault**: No fault **103 / Output Active**: Ready	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1832 CIP 107.1.20
IOsigLimN	Signal evaluation LIMN (123) **0 / inactive**: Inactive **1 / normally closed**: Normally closed NC **2 / normally open**: Normally open NO	- 0 1 2	UINT16 UINT16 R/W per. -	Modbus 1566 CIP 106.1.15

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOsigLimP	Signal evaluation LIMP (123) **0 / inactive**: Inactive **1 / normally closed**: Normally closed NC **2 / normally open**: Normally open NO	- 0 1 2	UINT16 UINT16 R/W per. -	Modbus 1568 CIP 106.1.16
IOsigRef	Signal evaluation REF (122) **1 / normally closed**: Normally closed NC **2 / normally open**: Normally open NO The reference switch is only activated (to REF) while homing is processed.	- 1 1 2	UINT16 UINT16 R/W per. -	Modbus 1564 CIP 106.1.14
JOGactivate	Activation of jog (116) Bit0 : Positive direction of rotation Bit1 : Negative direction of rotation Bit2 : 0=slow 1=fast If both bits for the direction of rotation are activated at the same time, no movement is started. If a jog movement is running, the simultaneous activation of the bits for the direction of rotation has no effect.	- 0 0 7	R/W - -	
JOGn_fast	Speed for fast jog (116) The adjustable value is internally limited to the current parameter setting in RAMPn_max.	min^{-1} 1 180 13200	UINT16 UINT16 R/W per. -	Modbus 10506 CIP 141.1.5
JOGn_slow	Speed for slow jog (116) The adjustable value is internally limited to the current parameter setting in RAMPn_max.	min^{-1} 1 60 13200	UINT16 UINT16 R/W per. -	Modbus 10504 CIP 141.1.4
JOGstepusr	Jog distance prior to continuous run (116) 0: Direct activation of continuous run >0: Positioning distance per jog cycle	usr 0 1 2147483647	INT32 INT32 R/W per. -	Modbus 10510 CIP 141.1.7
JOGtime	Wait time prior to continuous run (116) This time is only effective if you have set a jog distance not equal to 0, otherwise the drive immediately starts a continuous run.	ms 1 500 32767	UINT16 UINT16 R/W per. -	Modbus 10512 CIP 141.1.8
LIM_HaltReaction	Type of deceleration for halt (148) **1 / Deceleration ramp**: Deceleration ramp **3 / Torque ramp**: Torque ramp Setting of deceleration ramp with parameter RAMPdecel. Setting of torque ramp with parameter LIM_I_maxHalt. The deceleration ramp is only available for operating modes with profile generator. The torque ramp is used in the operating modes without profile generator.	- 1 3 3	INT16 INT16 R/W per. -	Modbus 1582 CIP 106.1.23

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
LIM_I_maxHalt	Current limitation for Halt (102) Max. current during braking after Halt or when an operating mode is terminated. Maximum and default settings depend on the motor and the power stage (settings M_I_max and PA_I_max) In increments of 0.01Apk	A_{pk} - - -	UINT16 UINT16 R/W per. -	Modbus 4364 CIP 117.1.6
LIM_I_maxQSTP	Current limitation for Quick Stop (102) Max. current during braking via torque ramp due to an error of error classes 1 or 2 and when a software stop is triggered. Maximum and default settings depend on the motor and the power stage (settings M_I_max and PA_I_max) In increments of 0.01Apk	A_{pk} - - -	UINT16 UINT16 R/W per. -	Modbus 4362 CIP 117.1.5
LIM_QStopReact	Type of deceleration for Quick Stop (146) **6 / Deceleration ramp**: Deceleration ramp **7 / Torque ramp**: Torque ramp Setting of deceleration ramp with parameter RAMPquickstop. Setting of torque ramp with parameter LIM_I_maxQSTP. The deceleration ramp is only available for operating modes with profile generator. The torque ramp is used in the operating modes without profile generator.	- 6 7 7	INT16 INT16 R/W per. -	Modbus 1584 CIP 106.1.24
M_I_0	Continuous motor current at standstill In increments of 0.01Apk	A_{pk} - - -	UINT16 UINT16 R/- - -	Modbus 3366 CIP 113.1.19
M_I_max	Maximum motor current In increments of 0.01Apk	A_{pk} - - -	UINT16 UINT16 R/- - -	Modbus 3340 CIP 113.1.6
M_I_nom	Nominal motor current In increments of 0.01Apk	A_{pk} - - -	UINT16 UINT16 R/- - -	Modbus 3342 CIP 113.1.7
M_I2t	Maximum permissible time for M_I_max	ms - - -	UINT16 UINT16 R/- - -	Modbus 3362 CIP 113.1.17
M_Jrot	Mass moment of inertia of motor In increments of $0.1kgcm^2$	$kg\ cm^2$ - - -	UINT16 UINT16 R/- - -	Modbus 3352 CIP 113.1.12

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
M_kE	Motor EMF constant kE Voltage constant in Vpk at 1000 1/min	- - - -	UINT16 UINT16 R/- - -	Modbus 3350 CIP 113.1.11
M_L_d	Motor inductance d-direction In increments of 0.01 mH	mH - - -	UINT16 UINT16 R/- - -	Modbus 3358 CIP 113.1.15
M_L_q	Motor inductance q-direction In increments of 0.01 mH	mH - - -	UINT16 UINT16 R/- - -	Modbus 3356 CIP 113.1.14
M_M_max	Maximum motor torque	N cm - - -	UINT16 UINT16 R/- - -	Modbus 3346 CIP 113.1.9
M_M_nom	Nominal motor torque	N cm - - -	UINT16 UINT16 R/- - -	Modbus 3344 CIP 113.1.8
M_n_max	Maximum permissible motor speed	min^{-1} - - -	UINT16 UINT16 R/- - -	Modbus 3336 CIP 113.1.4
M_n_nom	Nominal motor speed	min^{-1} - - -	UINT16 UINT16 R/- - -	Modbus 3338 CIP 113.1.5
M_Polepair	Number of pole pairs of motor	- - - -	UINT16 UINT16 R/- - -	Modbus 3368 CIP 113.1.20
M_R_UV	Motor connection resistance In increments of 10mOhm	Ω - - -	UINT16 UINT16 R/- - -	Modbus 3354 CIP 113.1.13
M_U_nom	Nominal motor voltage Voltage in increments of 100mV	V - - -	UINT16 UINT16 R/- - -	Modbus 3348 CIP 113.1.10
MBadr	Modbus address Valid addresses: 1 to 247	- 1 1 247	UINT16 UINT16 R/W per. -	Modbus 5640 CIP 122.1.4

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
MBbaud	Modbus Baud rate **9600 / 9.6KB**: 9600 Baud **19200 / 19.2KB**: 19200 Baud **38400 / 38.4KB**: 38400 Baud NOTE: Changed settings do not become active until the unit is switched on the next time	- 9600 19200 38400	UINT16 UINT16 R/W per. -	Modbus 5638 CIP 122.1.3
MBdword_order	Modbus word sequence for double words (32 bit values) **0 / HighLow**: HighWord-LowWord **1 / LowHigh**: LowWord-HighWord High word first or low word first High word first -> Modicon Quantum Low word first -> Premium, HMI (Telemecanique)	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 5646 CIP 122.1.7
MBformat	Modbus data format **1 / 8Bit NoParity 1Stop**: 8 bits, no parity bit, 1 stop bit **2 / 8Bit EvenParity 1Stop**: 8 bits, even parity bit, 1 stop bit **3 / 8Bit OddParity 1Stop**: 8 bits, odd parity bit, 1 stop bit **4 / 8Bit NoParity 2Stop**: 8 bits, no parity bit, 2 stop bits NOTE: Changed settings do not become active until the unit is switched on the next time	- 1 2 4	UINT16 UINT16 R/W per. -	Modbus 5642 CIP 122.1.5
MBnode_guard	Modbus node guard Node guard 0: Inactive (default) >0: Monitoring time	ms 0 0 10000	UINT16 UINT16 R/W - -	Modbus 5644 CIP 122.1.6
MBTCPdword_order	ModbusTCP word sequence for double words (32 bit values) **0 / HighLow**: HighWord-LowWord **1 / LowHigh**: LowWord-HighWord High word first or low word first High word first -> Modicon Quantum Low word first -> Premium, HMI (Telemecanique)	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 6410 CIP 125.1.5
ModeError	Error code for synchronous errors (ME flag) Manufacturer-specific error code that caused the ModeError flag to be set. Usually, this is an error that was caused by the activation of an operating mode.	- - 0 -	UINT16 UINT16 R/- - -	Modbus 6962 CIP 127.1.25
MT_dismax	Max. permissible distance If the reference value is active and the maximum permissible distance is exceeded, an error of class 1 is generated. The value 0 switches off monitoring.	revolution 0.0 10.0 999.9	UINT16 UINT16 R/W - -	Modbus 11782 CIP 146.1.3

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PA_T_max	Maximum permissible power stage temperature (136)	°C - 0 -	INT16 INT16 R/- per. -	Modbus 4110 CIP 116.1.7
PA_T_warn	Temperature warning threshold of power stage (136)	°C - 0 -	INT16 INT16 R/- per. -	Modbus 4108 CIP 116.1.6
PA_U_maxDC	Maximum permissible DC bus voltage Voltage in increments of 100mV	V - - -	UINT16 UINT16 R/- per. -	Modbus 4102 CIP 116.1.3
PA_U_minDC	DC bus voltage low threshold for switching off the drive Voltage in increments of 100mV	V - - -	UINT16 UINT16 R/- per. -	Modbus 4104 CIP 116.1.4
PA_U_minStopDC	DC bus voltage low threshold for Quick Stop If this threshold is reached, the drive performs a Quick Stop. Voltage in increments of 100mV	V - - -	UINT16 UINT16 R/- per. -	Modbus 4116 CIP 116.1.10
PAR_CTRLreset	Reset controller parameters **0 / no**: No **1 / yes**: Yes The controller parameters of the speed controller and the position controller are reset. The current controller is automatically adjusted under consideration of the connected motor.	- 0 - 1	UINT16 UINT16 R/W - -	Modbus 1038 CIP 104.1.7
PAReeprSave	Save parameter values to EEPROM Bit 0 = 1: Save all persistent parameters The currently set parameters are saved to the non-volatile memory (EEPROM). The saving process is complete when the parameter is read and 0 is returned.	- - - -	UINT16 UINT16 R/W - -	Modbus 1026 CIP 104.1.1
PAReeprSaveDVN	Save parameter to EEPROM with DeviceNet When the configuration is downloaded with RSNetWorx, this parameter is transferred last. It saves the current parameter settings to the non-volatile memory (EEPROM). The parameter can be changed between two values and causes a download in case of a manual change in RSNetWorkx. Both values are saved.	- 0 0 1	UINT16 UINT16 R/W - -	Modbus 16218 CIP 163.1.45

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PARfactorySet	Restore factory settings (default values) **0 / No**: No **1 / Yes**: Yes All parameters are set to their default values, these are saved to the EEPROM. Restoring the factory settings is only possible via the commissioning software. The saving process is complete when the parameter is read and 0 is returned. NOTE: The default becomes active only when the unit is switched on the next time.	- 0 - 3	R/W - -	
PARuserReset	Reset user parameters (156) Bit 0 = 1: Set persistent parameters to default values. All parameters are reset with the exception of: - Communication parameters - Definition of the direction of rotation - Signal selection position interface - I/O functions NOTE: The new settings are not saved to the EEPROM!	- 0 - 7	UINT16 UINT16 R/W - -	Modbus 1040 CIP 104.1.8
POSdirOfRotat	Definition of direction of rotation (155) **0 / clockwise**: Clockwise **1 / counter clockwise**: Counter-clockwise Meaning: At positive speeds, the drive rotates clockwise (looking at the motor shaft at the flange). NOTE: If you use limit switches, you must interchange the limit switch connections after changing the settings. The limit switch which is reached with a jog movement in positive direction must be connected to the LIMP input and vice versa. NOTE: Changed settings do not become active until the unit is switched on the next time.	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 1560 CIP 106.1.12
POSscaleDenom	Denominator of position scaling (142) Refer to numerator (POSscaleNum) for a description. A new scaling is activated when the numerator value is supplied.	usr 1 12 2147483647	INT32 INT32 R/W per. -	Modbus 1550 CIP 106.1.7

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
POSscaleNum	Numerator of position scaling (142) Specification of the scaling factor: Motor revolutions [U] -- Change of user position [usr] A new scaling is activated when the numerator value is supplied. User limit values may be reduced due to the calculation of an internal factor.	revolution 1 1 2147483647	INT32 INT32 R/W per. -	Modbus 1552 CIP 106.1.8
PPn_target	Reference speed in operating mode profile position (119) The maximum value is limited to the current setting in CTRL_n_max. The adjustable value is internally limited to the current parameter setting in RAMPn_max.	min^{-1} 1 60 13200	R/W - -	
PPp_absusr	Target position absolute of operating mode profile position (119) Min./max values depend on: - Scaling factor - Software limit switches (if they are activated)	usr - 0 -	R/W - -	
PPp_relpactusr	Target position relative to current motor position (119) Min./max values depend on: - Position normalization factor - Software limit switches (if they are activated) In the case of active positioning in Profile Position mode, relative positioning refers to the current motor position. The absolute user position limits can only be overrun if the drive is at standstill when the movement starts (x_end=1). In this case, implicit position setting to position 0 is performed.	usr - 0 -	R/W - -	
PPp_relprefusr	Target position relative to the current target position (119) Min./max values depend on: - Position normalization factor - Software limit switches (if they are activated) In the case of active positioning in operating mode Profile Position, relative positioning refers to the target position of the current movement. The absolute user position limits can only be overrun if the drive is at standstill when the movement starts (x_end=1). In this case, implicit position setting to position 0 is performed.	usr - 0 -	R/W - -	

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PVn_target	Reference speed of operating mode profile velocity (120) The maximum value is limited to the current setting in CTRL_n_max. The adjustable value is internally limited to the current parameter setting in RAMPn_max.	min^{-1} -13200 - 13200	R/W - -	

RAMP_TAUjerk	Jerk limitation (145)
	
	0 / off: Off
	1 / 1: 1 ms
	2 / 2: 2 ms
	4 / 4: 4 ms
	8 / 8: 8 ms
	16 / 16: 16 ms
	32 / 32: 32 ms
	64 / 64: 64 ms
	128 / 128: 128 ms
	
	Limits the acceleration change (jerk) of the reference position generation during the positioning transitions:
	    Standstill - acceleration
	    Acceleration - constant speed
	    Constant speed - deceleration
	    Deceleration - standstill
	
	Processing in the following operating modes:
	- Profile velocity
	- Profile position
	- Jog
	- Homing
	
	Adjustments can only be made if the operating mode is inactive (x_end=1).
		ms
		0
		0
		128
			UINT16
			UINT16
			R/W
			per.
			-
				Modbus 1562
				CIP 106.1.13

RAMPacc	Acceleration of profile generator (144)	min^{-1}/s 1 600 3000000	UINT32 UINT32 R/W per. -	Modbus 1556 CIP 106.1.10
RAMPaccdec	Optimized ramp setting with one access Adjustment of acceleration and deceleration values with a single access High word: acceleration Low word: deceleration Values are entered in 10rpm/s Write access changes the values under RAMPacc and RAMPdecel. The limit values are checked on the basis of the values indicated for these parameters. If the currently set value cannot be represented as 16 bit value, the max, UINT16 value is written.	usr - 0 -	R/W - -	
RAMPdecel	Deceleration of profile generator (144)	min^{-1}/s 750 750 3000000	UINT32 UINT32 R/W per. -	Modbus 1558 CIP 106.1.11

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMPn_max	Limitation of ref. speed for op. modes with profile generation (144) The parameter is active in the following operating modes: - Profile position - Profile velocity - Homing - Jog If a greater reference speed is set in one of these operating modes, it is automatically limited to RAMPn_max. This way, commissioning at limited speed is easier to perform.	min^{-1} 60 13200 13200	UINT16 UINT16 R/W per. -	Modbus 1554 CIP 106.1.9
RAMPquickstop	Deceleration ramp for Quick Stop (146) Deceleration of the drive when a software stop is triggered or if an error of error class 1 has occurred.	min^{-1}/s 200 6000 3000000	UINT32 UINT32 R/W per. -	Modbus 1572 CIP 106.1.18
RAMPsym	Symmetrical ramp Acceleration and deceleration of the profile generator (16 bit value) in 10 (1/min)/s Write access changes the values under RAMPacc and RAMPdecel. The limit values are checked on the basis of the values indicated for these parameters. Read access returns the greater value from RAMPacc/RAMPdecel. If the currently set value cannot be represented as 16 bit value, the max, UINT16 value is written.	usr - 0 -	UINT16 UINT16 R/W - -	Modbus 1538 CIP 106.1.1
SPEEDn_target	Reference speed in operating mode speed control (117) The internal maximum speed is limited to the current setting in CTRL_n_max.	min^{-1} -30000 0 30000	INT16 INT16 R/W - -	Modbus 8456 CIP 133.1.4
SPEEDreference	Selection of ref. value source for operating mode speed control **0 / none**: None **1 / Analog Input**: Reference value via +/-10V interface ANA1 **2 / Parameter 'speedTarg'**: Reference value via parameter SPEEDn_target	- 0 0 2	UINT16 UINT16 R/W - -	Modbus 8450 CIP 133.1.1
SPV_Flt_pDiff	Error response to tracking error (140) **1 / ErrorClass1**: Error class 1 **2 / ErrorClass2**: Error class 2 **3 / ErrorClass3**: Error class 3	- 1 3 3	UINT16 UINT16 R/W per. -	Modbus 1302 CIP 105.1.11
SPV_p_maxDiff	Max. permissible tracking error of the position controller (137) The tracking error is the current position control deviation.	revolution 0.0001 1.0000 200.0000	UINT32 UINT32 R/W per. -	Modbus 4636 CIP 118.1.14

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
SPV_SW_Limits	Monitoring of software limit switches (135) **0 / none**: None (default) **1 / SWLIMP**: Activation of software limit switches positive direction **2 / SWLIMN**: Activation of software limit switches negative direction **3 / SWLIMP+SWLIMN**: Activation of software limit switches both directions Monitoring of software limit switches only works in case of successful homing (ref_ok = 1).	- 0 0 3	UINT16 UINT16 R/W per. -	Modbus 1542 CIP 106.1.3
SPV_t_block	Response time of blocking monitoring If, in spite of maximum current, the motor shaft does not move for the time set with this parameter, the monitoring system signal a blocking error. A value of 0 deactivated blocking monitoring.	ms 0 100 10000	UINT16 UINT16 R/W per. -	Modbus 1328 CIP 105.1.24
SPVswLimNusr	Negative position limit for software limit switch (134) Refer to description 'SPVswLimPusr'	usr - -2147483648 -	INT32 INT32 R/W per. -	Modbus 1546 CIP 106.1.5
SPVswLimPusr	Positive position limit for software limit switch (134) If a user value entered is outside of the permissible user range, the limit switch limits are automatically set to the max. user value.	usr - 2147483647 -	INT32 INT32 R/W per. -	Modbus 1544 CIP 106.1.4
STANDp_win	Standstill window, permissible control deviation (150) 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 'STANDpwinTime.	revolution 0.0000 0.0400 3.2767	UINT16 UINT16 R/W per. -	Modbus 4370 CIP 117.1.9
STANDpwinTime	Standstill window, time (150) 0: Monitoring of standstill window deactivated >0: Time in ms during which the control deviation must be in the standstill window	ms 0 0 32767	UINT16 UINT16 R/W per. -	Modbus 4372 CIP 117.1.10
STANDpwinTout	Timeout time for standstill window monitoring (150) 0 : Timeout monitoring deactivated >0 : Timeout time in ms Standstill window processing values are set via STANDp_win and STANDpwinTime. Time monitoring starts when the target position (reference position of position controller) is reached or when the profile generator has finished processing.	ms 0 0 16000	UINT16 UINT16 R/W per. -	Modbus 4374 CIP 117.1.11

12   Accessories and spare parts

12

12.1   Accessories

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

http://www.schneider-electric.com

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

http://www.schneider-electric.com

Description	Order no.
Cable kit, power supply, EtherNet/IP, 3m	VW3L2K001R30
Connector kit, EtherNet/IP	VW3L5K000

Cable   Supplier recommendations:

- Hans Turck GmbH & Co. KG
  www.turck.com

- Franz Binder GmbH & Co. elektrische Bauelemente KG
  www.binder-connector.de

- PHOENIX CONTACT GmbH & Co. KG
  www.phoenixcontact.com

- Lumberg Automation
  www.lumberg-automation.com

Tool   The tools required for cable assembly must be ordered directly from the manufacturer.

- Crimping tool for CN1: AMP 654174-1

- Crimping tool for CN2, CN4 and CN5: Molex 063819-0000

- Crimping tool for CN3: Molex 063819-1000

- Extraction tool for CN2, CN4 and CN5: Molex 11-03-0043

- Extraction tool for CN3: Molex 11-03-0044

12.2   Gearboxes

Description	Order no.
Planetary gear for Lexium Integrated Drive ILExx661, ratio 3:1	GBX040003E661L
Planetary gear for Lexium Integrated Drive ILExx661, ratio 5:1	GBX040005E661L
Planetary gear for Lexium Integrated Drive ILExx661, ratio 8:1	GBX040008E661L
Planetary gear for Lexium Integrated Drive ILExx661, ratio 16:1	GBX060016E661L
Planetary gear for Lexium Integrated Drive ILExx661, ratio 40:1	GBX060040E661L
Planetary gear for Lexium Integrated Drive ILExx662, ratio 3:1	GBX040003E662L
Planetary gear for Lexium Integrated Drive ILExx662, ratio 5:1	GBX040005E662L
Planetary gear for Lexium Integrated Drive ILExx662, ratio 8:1	GBX040008E662L
Planetary gear for Lexium Integrated Drive ILExx662, ratio 16:1	GBX060016E662L
Planetary gear for Lexium Integrated Drive ILExx662, ratio 40:1	GBX060040E662L

13   Service, maintenance and disposal

13

┌───┐
│   **⚠ WARNING**   │
├───┤
│ **DAMAGE TO SYSTEM COMPONENTS AND LOSS OF CONTROL**   │
│   │
│ Interruptions of the negative connection of the controller supply volt-│
│ age can cause excessively high voltages at the signal connections.│
│   │
│ • Do not interrupt the negative connection between the power sup-│
│   ply unit and load with a fuse or switch.   │
│   │
│ • Verify correct connection before switching on.   │
│   │
│ • Do not connect the controller supply voltage or change its wiring│
│   while the supply voltage is present.   │
│   │
│ **Failure to follow these instructions can result in death, serious**│
│ **injury or equipment damage.**   │
└───┘

┌───┐
│   **⚠ CAUTION**   │
├───┤
│ **RISK OF INJURY WHEN THE PRINTED CIRCUIT BOARD CONNEC-**   │
│ **TORS ARE REMOVED**   │
│   │
│ • Before removing the connectors, you must unlocked them.   │
│   │
│   – Supply voltage VDC: │
│   Unlock by pulling at the connector housing   │
│   │
│   – Others: │
│   Unlock by pressing the connector lock   │
│   │
│ • Only pull the connector housing (not the cable).   │
│   │
│ **Failure to follow these instructions can result in injury or equip-**│
│ **ment damage.**   │
└───┘

The product may only be repaired by a Schneider Electric customer service center. No warranty or liability is accepted for repairs made by unauthorized persons.

13.1   Service address

If you cannot resolve an error yourself please contact your sales office. Have the following details available:

- Nameplate (type, identification number, serial number, DOM, ...)
- Type of error (such as LED flash code or error number)
- Previous and concomitant circumstances
- Your own assumptions concerning the cause of the error

Also include this information if you return the product for inspection or repair.

If you have any questions please contact your sales office.
Your sales office staff will be happy to give you the name of
a customer service office in your area.

http://www.schneider-electric.com

13.2   Maintenance

Check the product for pollution or damage at regular intervals.

13.2.1 Lifetime STO safety function

The STO safety function is designed for a lifetime of 20 years. After this period, the data of the safety function are no longer valid. The expiry date is determined by adding 20 years to the DOM shown on the nameplate of the product.

▶ This date must be included in the maintenance plan of the system.

Do not use the safety function after this date.

Example   The DOM on the nameplate of the product is shown in the format DD.MM.YY, for example 31.12.08. (31 December 2008). This means: Do not use the safety function after December 31, 2028.

13.3 Replacing devices

⚠ WARNING

UNINTENDED BEHAVIOR

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

- Do NOT operate the drive system with unknown settings or data.
- Verify that the stored data and settings are correct.
- When commissioning, carefully run tests for all operating states and potential 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 your PC using the commissioning software, see chapter 7.2.2 "Lexium CT commissioning software".

▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).

▶ Label all connections and uninstall the product.

▶ Note the identification number and the serial number shown on the product nameplate for later identification.

▶ Install the new product as per chapter 6 "Installation".

▶ Commission the product as per chapter 7 "Commissioning".

13.4 Shipping, storage, disposal

Note the ambient conditions in chapter 3.2 "Ambient conditions".

Shipping   The product must be protected against shocks during transportation. If possible, use the original packaging for shipping.

Storage   The product may only be stored in spaces where the specified permissible ambient conditions for room temperature and humidity are met. Protect the product from dust and dirt.

Disposal   The product consists of various materials that can be recycled and must be disposed of separately. Dispose of the product in accordance with local regulations.

14 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

14.2   Terms and Abbreviations

See chapter 2.6 "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.

Assembly	Various attributes are combined in one single data packet. Client and server know the structure of the packets. See also Explicit Message.
Attribute	A single value of an object (in a network device) that can be read or written over the network. (see Class - Instance - Object - Attribute)
CIP	**C**ommon **I**ndustrial **P**rotocol, general specification for communication between fieldbus devices.
COS	**C**hange **O**f **S**tate: special I/O connection in which data is only transmitted when changes occur.
Class	DeviceNet and EtherNet/IP describes the behavior of a network node in so-called object classes. A class defines the behavior of (related) objects and consists of attributes and so-called services to work with these attributes (read/write) for example: class vehicles, object car, attribute fuel level, service fill (see Class - Instance - Object - Attribute)
Client	First transmitter, then recipient of fieldbus messages in the client-server relationship. Starts transmission with a transmission to the server; the reference point is the server object dictionary.
EDS	(**E**lectronic **D**ata **S**heet); contains the specific properties of a product.
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 (transition from operating state "Fault" to operating state "Operation Enabled").
Input	Direction of data flow from the network perspective: data packet/status message from device, see also Output
Instance	An actual object that is derived from a specific class. (see Class - Instance - Object - Attribute)
MAC ID	Node address (MAC=Media Access Control); a unique address in the entire network.
Master	Active bus device that controls the data traffic on the network.
ODVA	**O**pen **D**eviceNet **V**endor **A**ssociation. User organization for DeviceNet and EtherNet/IP standards

Object	An object is a member of a specific class. The object 'bicycle' is a member of the class 'vehicles'. The object 'car' is a member of the class 'vehicles'. (see Class - Instance - Object - Attribute)
Object dictionary	List of all parameters, values and functions available in the device. Each entry is uniquely referenced via index (16 bit) and subindex (8 bit).
Output	Direction of data flow from the network perspective: data packet/command to a device, see also Input
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.
Quick Stop	Function which can be used for fast deceleration of the motor via a command or in the event of an error.
Scanner	Bus device that, as a master unit, controls all data transmission via the bus. Corresponds to the master.
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 is not an error and does not cause a transition of the operating state.

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