

# ILA2E EtherCAT

## Lexium Integrated Drive Product manual

V2.02, 03.2012



## Important information

This manual is part of the product.

Carefully read this manual and observe all instructions.

Keep this manual for future reference.

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

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

Some products are not available in all countries.

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

Subject to technical modifications without notice.

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

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

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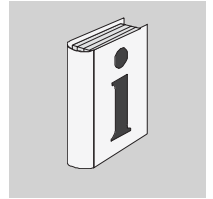
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## About this manual



	<p>This manual is valid for ILA2E standard products. Chapter "1 Introduction" lists the type code for this product. The type code allows you to identify whether your product is a standard product or a customized version.</p>
<i>Source manuals</i>	<p>The latest versions of the manuals can be downloaded from the Internet at:</p> <p><a href="http://www.schneider-electric.com">http://www.schneider-electric.com</a></p>
<i>Source CAD data</i>	<p>For easier engineering, CAD data (EPLAN macros or drawings) are available for download from the Internet at:</p> <p><a href="http://www.schneider-electric.com">http://www.schneider-electric.com</a></p>
<i>Corrections and suggestions</i>	<p>We always try to further optimize our manuals. We welcome your suggestions and corrections.</p> <p>Please get in touch with us by e-mail:  <a href="mailto:techcomm@schneider-electric.com">techcomm@schneider-electric.com</a>.</p>
<i>Work steps</i>	<p>If work steps must be performed consecutively, this sequence of steps is represented as follows:</p> <ul style="list-style-type: none"> <li>■ Special prerequisites for the following work steps</li> <li>▶ Step 1</li> <li>◁ Specific response to this work step</li> <li>▶ Step 2</li> </ul> <p>If a response to a work step is indicated, this allows you to verify that the work step has been performed correctly.</p> <p>Unless otherwise stated, the individual steps must be performed in the specified sequence.</p>
<i>Making work easier</i>	<p>Information on making work easier is highlighted by this symbol:</p> <div style="text-align: center;">  </div> <p><i>Sections highlighted this way provide supplementary information on making work easier.</i></p>
<i>Parameters</i>	<p>In text sections, parameters are shown with the parameter name, for example <code>_IO_act</code>. The way parameters are represented in tables is explained in the chapter Parameters. The parameter list is sorted alphabetically by parameter name.</p>
<i>SI units</i>	<p>SI units are the original values. Converted units are shown in brackets behind the original value; they may be rounded.</p> <p>Example:          Minimum conductor cross section: 1.5 mm<sup>2</sup> (AWG 14)</p>
<i>Inverted signals</i>	<p>Inverted signals are represented by an overline, for example <math>\overline{STO\_A}</math> or <math>\overline{STO\_B}</math>.</p>
<i>Glossary</i>	<p>Explanations of special technical terms and abbreviations.</p>

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

## Further reading

Recommended literature for further reading:

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

*User associations* <http://www.ethercat.org>

# 1 Introduction

# 1

## 1.1 Device overview

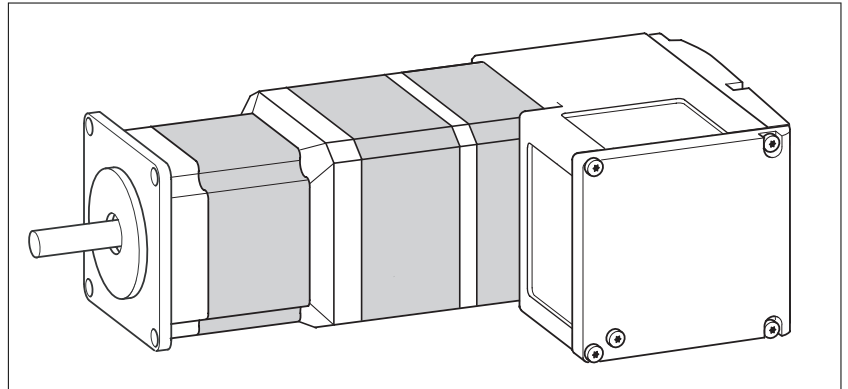


Figure 1: Device overview

The "Lexium Integrated Drive" consists of a servo motor and integrated drive. The product integrates interfaces, control electronics, a holding brake (optional) and the power stage.

*Supply of reference values*

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

*Integrated safety function "Safe Torque Off" STO*

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

*Drive profile*

The product supports the following drive profiles:

- PLCopen (vendor-specific)
- CANopen CiA 402

*TwinCAT support*

The following TwinCAT functions are supported:

- TwinCAT-Systeme PLC, NC PTP, NC I and CNC
- TwinCAT libraries using TcMc.lib or TcMc2.lib
- TwinCAT homing methods Plc CAM and Software Sync

1.2 Components and interfaces

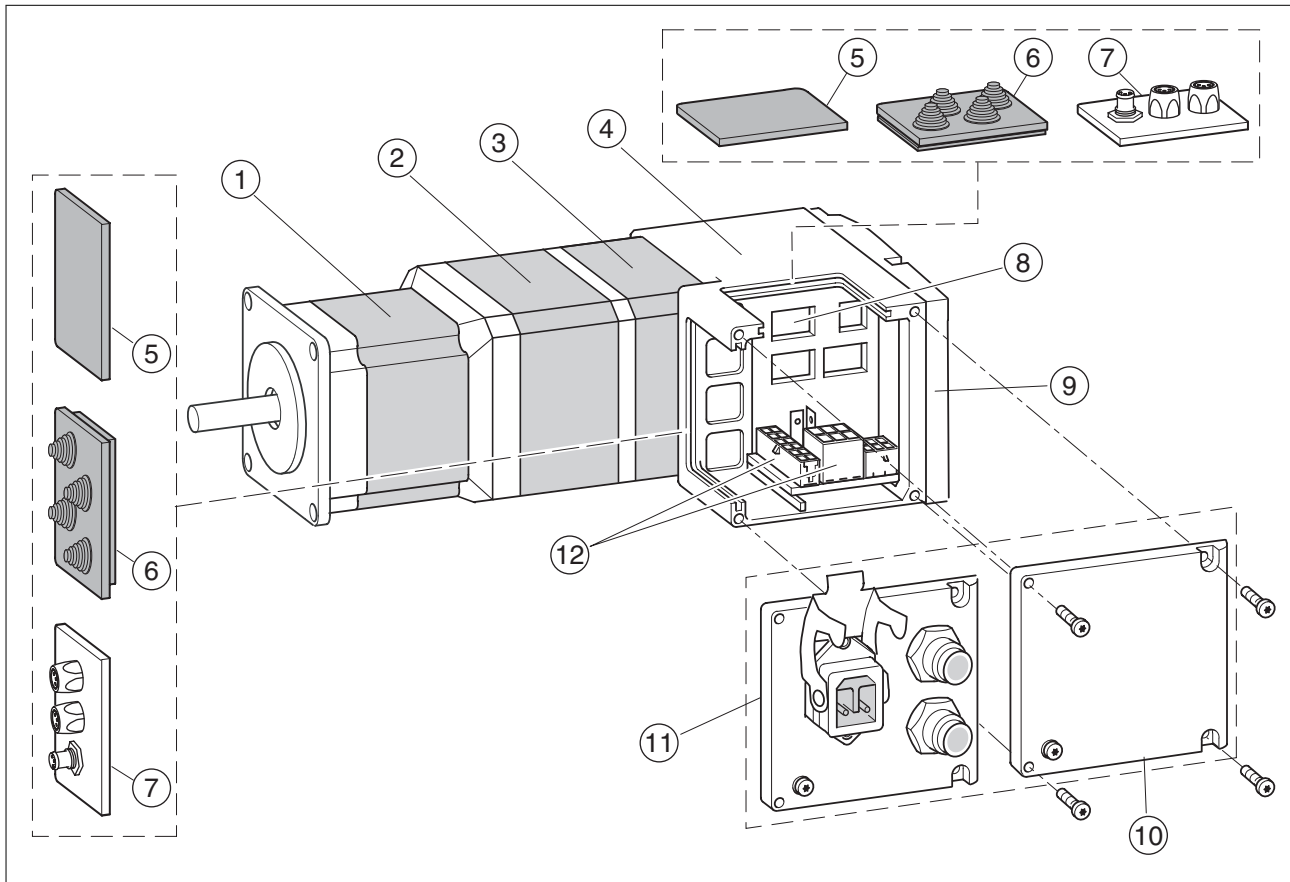


Figure 2: Components and interfaces

- (1) AC synchronous servo motor
- (2) Holding brake (optional)
- (3) Encoder
- (4) Electronics housing
- (5) Insert for sealing (accessory)
- (6) Insert with cable entry (accessory)
- (7) I/O insert with industrial connector (accessory)
- (8) Switches for settings
- (9) Cover of electronics housing, must not be removed
- (10) Cover of connector housing, to be removed for installation
- (11) Cover with industrial connector for VDC supply voltage and IN/OUT fieldbus connection (optional)
- (12) Electrical interfaces

### 1.2.1 Components

<i>Motor</i>	The motor is a brushless AC synchronous servo motor with 3-phase technology. The motor has a high power density due to the use of the latest magnetic materials and an optimized design.
<i>Electronics</i>	<p>The electronic system comprises control electronics and power stage. The product can be parameterized and controlled via the fieldbus interface.</p> <p>Four digital 24V signals are also available. Each of these signals can be used as an input or output.</p>
<i>Encoder</i>	<p>The standard product operates with a singleturn encoder. The singleturn encoder has an internal resolution of 32768 increments per revolution.</p> <p>Scaling of the product is set to 16384 user-defined units per revolution.</p> <p>The product can optionally be equipped with a multiturn encoder. The multiturn encoder covers a range of 4096 motor revolutions.</p>
<i>Holding brake</i>	The product can optionally be equipped with an integrated holding brake. The holding brake is controlled automatically.

## 1.2.2 Interfaces

*Supply voltage  $V_{DC}$*  The supply voltage  $V_{DC}$  supplies the control electronics and the power stage.

*Ethernet fieldbus interface* The product features an Ethernet fieldbus interface. This interface is used for controlling and commissioning the drive.

EtherCAT is an Ethernet-based fieldbus system. The technology is standardized as per the international standards IEC 61158 and IEC 61784 as well as ISO 15745-4.

EtherCAT is a real-time Ethernet system that lends itself for use in cycle-synchronous motion control applications.

EtherCAT® is a registered trademark and patented technology licenced by Beckhoff Automation GmbH, Germany.

*RS485 interface* An RS485 interface is provided in addition to the fieldbus interface. The RS485 interface is also used to commission the product.

You can also use the RS485 interface and the commissioning software to monitor the product 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:

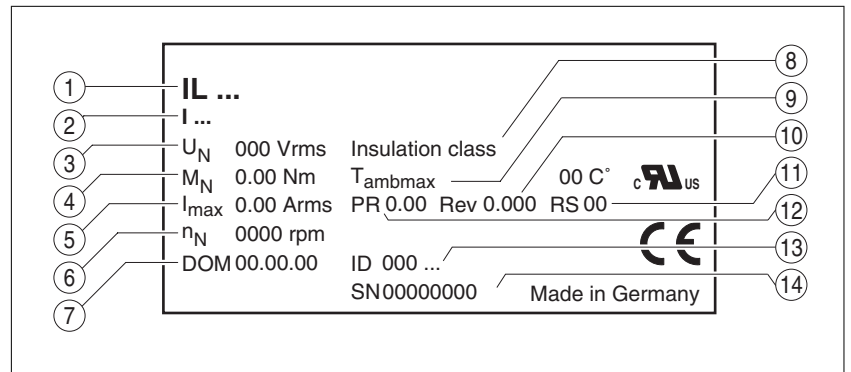


Figure 3: Nameplate

- (1) Type code
- (2) Type code (old designation)
- (3) Nominal voltage
- (4) Nominal torque
- (5) Maximum input current
- (6) Nominal speed of rotation
- (7) Date of manufacture
- (8) Thermal class
- (9) Maximum surrounding air temperature
- (10) Firmware version
- (11) Hardware version
- (12) Firmware number
- (13) Order no.
- (14) Serial number

1.4 Type code

	ILA	2	E	57	1	P	B	1	A	0	--
<b>Motor</b> ILA = Servo motor											
<b>Supply voltage</b> 2 = 24 ... 48 V <sub>dc</sub>											
<b>Communication interface</b> E = EtherCAT											
<b>Size</b> 57 = 57 mm											
<b>Length</b> 1 = 1 stack 2 = 2 stacks											
<b>Winding</b> P = Medium speed of rotation/medium torque T = High speed of rotation/low torque											
<b>Connection version</b> B = Printed circuit board connector C = Industrial connector											
<b>Position capture</b> 1 = Singleturn encoder 2 = Multiturn encoder <sup>1)</sup>											
<b>Holding brake</b> A = Without holding brake F = With holding brake <sup>2)</sup>											
<b>Gearbox</b> 0 = Without gearbox											
<b>Reserved</b>											

1) Not available in combination with the holding brake option.  
 2) Not available in combination with the servo multiturn encoder option.

*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--



## 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

<b>⚠ WARNING</b>
<p><b>UNEXPECTED MOVEMENT</b></p> <p>Drives may perform unexpected movements because of incorrect wiring, incorrect settings, incorrect data or other errors.</p> <p>Interference (EMC) may cause unpredictable responses in the system.</p> <ul style="list-style-type: none"> <li>• Carefully install the wiring in accordance with the EMC requirements.</li> <li>• Do not operate the product with unknown settings or data.</li> <li>• Perform a comprehensive commissioning test.</li> </ul> <p><b>Failure to follow these instructions can result in death or serious injury.</b></p>

<b>⚠ WARNING</b>
<p><b>LOSS OF CONTROL</b></p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Separate or redundant control paths must be provided for critical functions.</li> <li>• System control paths may include communication links. Consideration must be given to the implication of unanticipated transmission delays or failures of the link.</li> <li>• Observe all accident prevention regulations and local safety guidelines.<sup>1)</sup></li> <li>• Each implementation of the product must be individually and thoroughly tested for proper operation before being placed into service.</li> </ul> <p><b>Failure to follow these instructions can result in death or serious injury.</b></p>

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

<b>⚠ WARNING</b>
<p><b>UNEXPECTED BEHAVIOR AND DESTRUCTION OF SYSTEM COMPONENTS</b></p> <p>When you work on the wiring and when you unplug or plug in connectors, this may cause unexpected behavior and destruction of system components.</p> <ul style="list-style-type: none"> <li>• Switch the power supply off before working on the wiring.</li> </ul> <p><b>Failure to follow these instructions can result in death, serious injury or equipment damage.</b></p>

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### 2.5 Functional safety

Using the safety functions integrated in this product requires careful planning. See chapter "5.4 Safety function STO ("Safe Torque Off")", page 36 for additional information.

### 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: "Adjustable speed electrical power drive systems"
- IEC 61158: "Digital data communications for measurement and control – Fieldbus for use in industrial control systems"
- IEC 61784: "Industrial communication networks – Profiles"
- IEC 61508: "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 Ambient conditions

##### *Ambient conditions transportation and storage*

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

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

##### *Climatic environmental conditions operation*

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

Ambient temperature <sup>1)</sup>	[°C]	0 ... 40
Ambient temperature with current reduction of 2 [%] per Kelvin <sup>1)</sup>	[°C]	40 ... 55
Max. temperature of power stage <sup>2)</sup>	[°C]	105
Max. temperature of motor <sup>3)</sup>	[°C]	110

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

2) Can be read via parameter

3) Measured on the surface

The following relative humidity is permissible during operation:

Relative humidity	[%]	15 ... 85
-------------------	-----	-----------

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

Installation altitude without derating	[m]	<1000
--	-----	-------

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

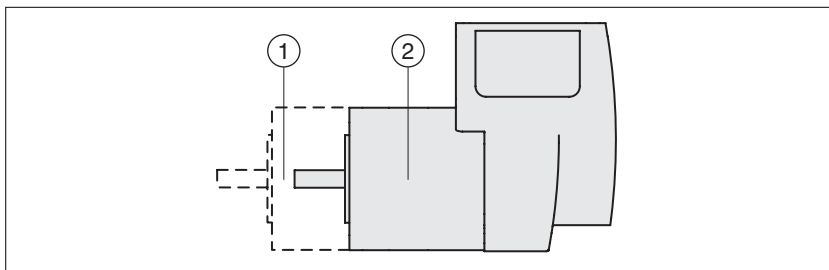


Figure 4: IP degree of protection

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.

*Degree of protection when the safety function is used*

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

*Vibration and shock*

Vibration, sinusoidal	Type test with 10 runs as per IEC 60068-2-6 0.15 [mm] (from 10 [Hz] ... 60 [Hz]) 20 [m/s <sup>2</sup> ] (from 60 [Hz] ... 500 [Hz])
Shock, semi-sinusoidal	Type test with 3 shocks in each direction as per IEC 60068-2-27 150 [m/s <sup>2</sup> ] (11 [ms])

*EMC*

Emission	IEC 61800-3: Category C2 IEC 61000-6-4 EN 55022: Class A
Immunity	IEC 61800-3: second environment

### 3.2 Mechanical data

#### 3.2.1 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

#### 3.2.2 Dimensions

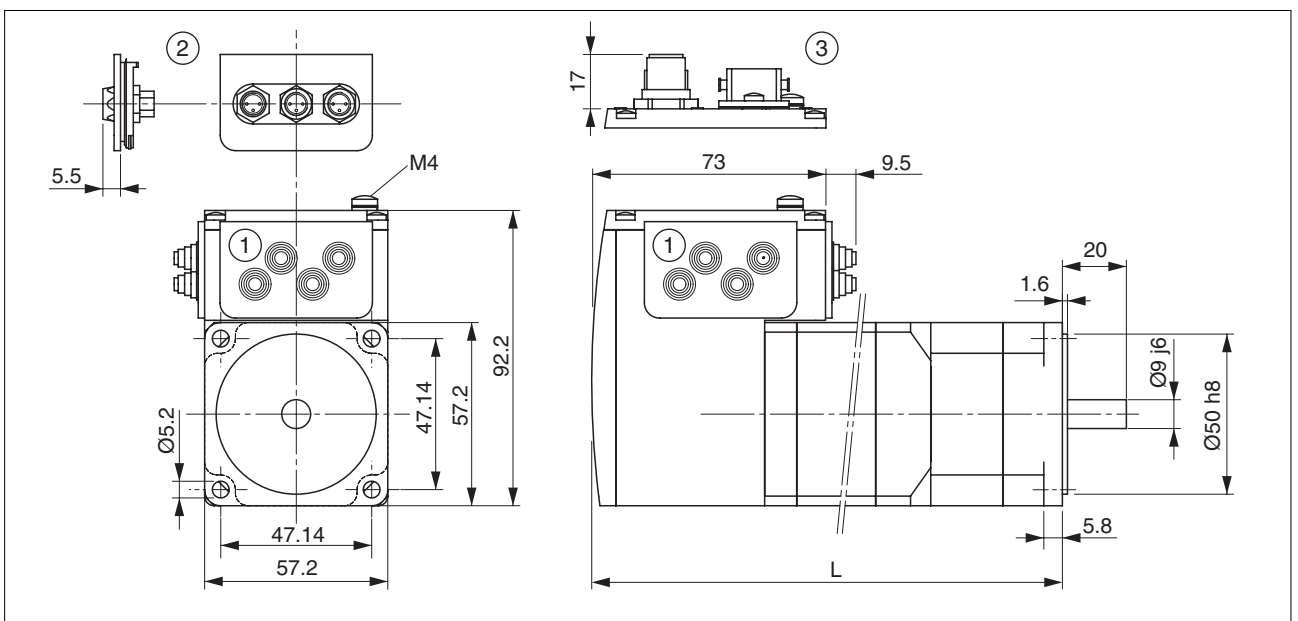


Figure 5: Dimensions

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

ILA••57...		1••1A0	1••2A0	1••1F0
Total length L	[mm]	145.3	179.3	190.8

ILA••57...		2••1A0	2••2A0	2••2F0
Total length L	[mm]	163.8	197.8	209.3

3.3 Electrical Data

Overview of printed circuit board connectors

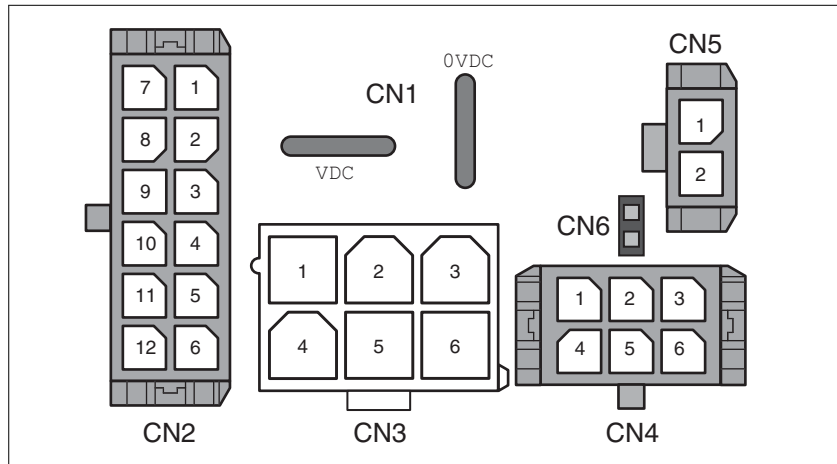


Figure 6: Overview of printed circuit board connectors

3.3.1 Supply voltage  $v_{DC}$  at CN1

		ILA2•571	ILA2•572
Nominal voltage <sup>1)</sup>	[V <sub>dc</sub> ]	24 / 48	24 / 48
Limit values <sup>1)</sup>	[V <sub>dc</sub> ]	18 ... 55.2	18 ... 55.2
Ripple at nominal voltage	[V <sub>pp</sub> ]	≤3.6	≤3.6
Max. continuous current input <sup>2)</sup>	[A]		
Winding type P		5	7
Winding type T		7.5	7.5
Peak input current	[A]		
Winding type P		7	8.5
Winding type T		11	9
Fuse to be connected upstream <sup>3)</sup>	[A]	≤16	≤16

- 1) If the product is to be used in compliance with UL 508C, note the information provided in chapter "3.4 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



3.3.2 Fieldbus at CN2

*EtherCAT signals* The EtherCAT signals comply with the IEEE 802.3 standard and are galvanically isolated.

Transmission protocol		EtherCAT
Transmission rate	[MBit]	100
Addressing methods		Position addressing Node addressing Logical addressing
Communication profile		CoE, EoE
Synchronization methods		DC synchronous (Distributed Clock, Jitter <1 μs) SM synchronous (SyncManager)
Communication cycle time	[ms]	0,25 ... 20 <sup>1)</sup>

1) Increments of 0.25 ms

3.3.3 Commissioning 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

3.3.4 24V signals at CN4

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

Logic 0 (U <sub>low</sub> )	[V]	-3 ... +4.5
Logic 1 (U <sub>high</sub> )	[V]	+15 ... +30
Input current (typical at 24 [V])	[mA]	2
Debounce time LIO1 ... LIO4	[ms]	1.25 ... 1.5
Debounce time LIO1 and LIO2 <sup>1)</sup>	[ms]	0.01
Jitter LIO1 and LIO2 <sup>1)</sup>	[μs]	<2

1) When the function "Fast Position Capture is used"

*Internal 24V signal supply and signal outputs*

The internal 24 V signal supply and the signal outputs are short-circuit protected and not galvanically isolated.

Nominal voltage	[V]	24
Voltage range	[V]	23 ... 25
Maximum current +24VDC_OUT	[mA]	200
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

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3.3.5 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 24 [V])	[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 disabling 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 Hard- ware Failure per Hour	[1/h]	5.223*10 <sup>-9</sup>
PL (ISO 13849-1) Performance Level		d (Category 3)
MTTF <sub>d</sub> (ISO 13849-1) Mean Time to Dangerous Failure		1995 years
DC (ISO 13849-1) Diagnostic Coverage	[%]	90

3.4 Conditions for UL 508C

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

Pollution degree

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.

### 3.5 Certifications

Product certifications:

Certified by	Assigned number
TÜV Nord	SAS-1728/08
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)

## 3.6 Declaration of conformity



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

**EC DECLARATION OF CONFORMITY**  
**YEAR 2010**

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

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

Designation:	Motors with integrated control electronics
Type:	ILA, ILE, ILS
Applied harmonized standards, especially:	EN ISO 13849-1:2008, 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**  
Postfach 11 80 · D-77901 Lahr  
Breslauer Str. 7 · D-77933 Lahr

Date/Signature: 12 October 2010

Name/Department: Wolfgang Brandstätter/Development

3.7 TÜV certificate for functional safety



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## 4 Basics

# 4

### 4.1 Functional safety

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

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

*Integrated safety function "Safe Torque Off" STO*

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

*IEC 61508 standard*

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

*SIL, Safety Integrity Level*

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

*PFH, Probability of a dangerous hardware failure per hour*

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

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

*HFT and SFF*

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

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

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

*Fault avoidance measures*

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

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## 5 Engineering

# 5

This chapter contains information on the application of the product that is vital in the engineering 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 "8.6.9 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.

The VDC power supply for this product is the DC bus.

*Reverse polarity protection* In the case of reverse polarity of the  $V_{DC}$  supply voltage, there is a short-circuit in the drive. 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.

Fuse to be connected upstream: circuit-breaker (type multi9 C60N by Schneider Electric, Cat.No.60112, rated current 15 A, trip characteristic C.) or blade fuse (FKS, max. 15 A) or fuse (5 x 20 mm, 10A slow-blow).

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

The motors regenerate energy during deceleration. The DC bus can absorb a limited amount of energy in the capacitors. Connecting additional capacitors to the DC bus increases the amount of energy that can be absorbed.

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.

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  $V_{DC}$  supply voltage to an unexpected level. Components not rated for this voltage may be destroyed or cause misoperation.

- Verify that all  $V_{DC}$  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.
- If necessary, use a braking resistor controller.

**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 Wiring concept

Note the following for wiring the product:

- Keep the voltage drop on the supply cables for the  $V_{DC}$  supply voltage to less than 1 V. The reference potential of some interfaces are connected to  $0V_{DC}$ . At higher potential differences, the communication and control signals may be disturbed.

Decentralized power supply units for  $V_{DC}$  close to the drives are recommended in the case of great distances. Connect  $0V_{DC}$  of the individual power supply units with the largest possible conductor cross section.

- Do not connect any other power supply in parallel with the internal 24V signal supply (+24 $V_{DC\_OUT}$ ). This may cause overloads of the internal 24V signal supply.
- Connect the reference potential of signal wires only in the case of interfaces with galvanic isolation.

In the case of interfaces without galvanic isolation, the reference potential is already connected via  $0V_{DC}$ . If  $0V_{DC}$  is interrupted, the current to the power stage would otherwise flow via these signal wires. This may damage these signal wires and the connected interfaces.

#### *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<sup>2</sup> (AWG 4) for equipotential bonding conductors up to a length of 200 m
- 20 mm<sup>2</sup> (AWG 4) for equipotential bonding conductors with a length of more than 200 m

## 5.4 Safety function STO ("Safe Torque Off")

See chapter 20 for information on using the IEC 61508 standard.

### 5.4.1 Definitions

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

### 5.4.2 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 safety relay module, it is also possible to implement category 1 stops.

<i>Function principle</i>	<p>The STO safety function is triggered via 2 redundant inputs. The circuits of the two inputs must be separate so that there are two channels.</p> <p>The switching process must be simultaneous for both inputs (offset &lt;1s). The power stage is disabled and an error message is generated. The motor can no longer generate torque and coasts down without braking. A restart is possible after resetting the error message with a "Fault Reset".</p> <p>The power stage is disabled and an error message is generated if only one of the two inputs is switched off or if the time offset is too great. This error message can only be reset by switching off the product.</p>
---------------------------	--

5.4.3 Requirements for using the safety function

<b>▲ WARNING</b>
<b>LOSS OF SAFETY FUNCTION</b>
Incorrect usage may cause a hazard due to the loss of the safety function.
<ul style="list-style-type: none"> <li>Observe the requirements for using the safety function.</li> </ul>
<b>Failure to follow these instructions can result in death or serious injury.</b>

<i>Category 0 stop</i>	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.
<i>Category 1 stop</i>	A controlled stop must be triggered with a category 1 stop. The controlled stop is not monitored by the drive system. In the case of power outage or an error, a controlled stop is impossible. Final shutoff of the motor is achieved by switching off the two inputs of the STO safety function. The shutoff is usually controlled by a standard EMERGENCY STOP safety relay module with a safe time delay.
<i>Behavior of holding brake</i>	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.
<i>Vertical axes, external forces</i>	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.
<i>Unintended restart</i>	To avoid unintended restart of the motor after restoration of power (for example, after power outage), the parameter <code>IO_AutoEnable</code> must be set to "off". Note that a master controller must not trigger an unintended restart.
<i>Degree of protection when the safety function is used</i>	You must ensure that conductive substances cannot get into the product (pollution degree 2). Conductive substances may cause the safety function to become inoperative.
<i>Protected cable installation</i>	<p>If short circuits and cross circuits can be expected in connection with safety-related signals and if they are not detected by upstream devices, protected cable installation as per ISO 13849-2 is required.</p> <p>In the case of an unprotected cable installation, the two signals (both channels) of a safety function may be connected to external voltage if a cable is damaged. If the two channels are connected to external voltage, the safety function is no longer operative.</p>

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*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]	$5.223 \cdot 10^{-9}$
PL (ISO 13849-1) Performance Level		d (Category 3)
MTTF <sub>d</sub> (ISO 13849-1) Mean Time to Dangerous Failure		1995 years
DC (ISO 13849-1) Diagnostic Coverage	[%]	90

*Hazard and risk analysis*

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

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

5.4.4 Application examples STO

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

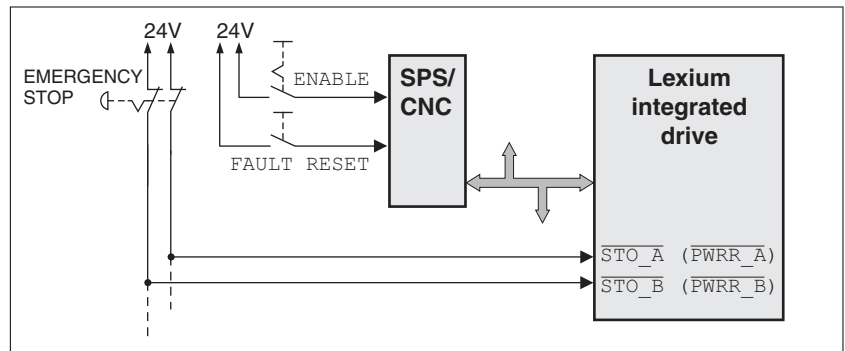


Figure 7: Example of category 0 stop

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

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

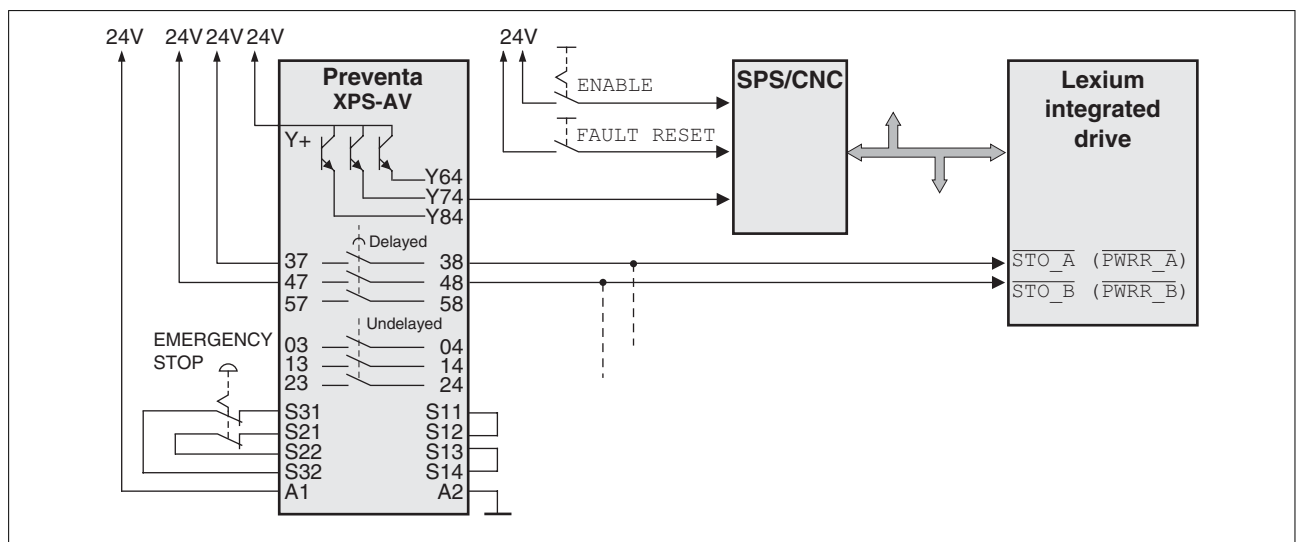


Figure 8: Example of category 1 stop

- 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 relay module. If the motor has not yet stopped when the delay time has elapsed, it coasts down in an uncontrolled way (uncontrolled stop).
- The specified minimum current and the permissible maximum current of the relay must be observed for the relay outputs of the EMERGENCY STOP safety relay module.

## 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
Data connection	Error response if the link becomes inoperative
Limit switch signals	Monitors for permissible movement range
I <sup>2</sup> t limitation	Power limitation in the case of overloads for the motor, the output current, the output power and the braking resistor.
Position deviation	Monitors for difference between actual position and reference position
Overvoltage and undervoltage	Monitors for overvoltage and undervoltage of the power stage supply and the DC bus
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 146.



6 Installation



**⚠ WARNING**

**LOSS OF CONTROL**

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

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

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

**⚠ CAUTION**

**RISK OF INJURY WHEN THE PRINTED CIRCUIT BOARD CONNECTORS ARE REMOVED**

- Before removing the connectors, you must unlocked them.
  - Supply voltage  $V_{DC}$ :  
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.**



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

### 6.1 Electromagnetic compatibility, EMC

<b>⚠ WARNING</b>
<b>SIGNAL AND DEVICE INTERFERENCE</b>
Signal interference can cause unexpected responses of the device.
<ul style="list-style-type: none"> <li>• Install the wiring in accordance with the EMC requirements.</li> <li>• Verify compliance with the EMC requirements.</li> </ul>
<b>Failure to follow these instructions can result in death, serious injury or equipment damage.</b>

*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:

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

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.

*Shield* The following cables must be shielded:

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

The following cables do not need to be shielded:

- Supply voltage  $\nabla$ DC
- 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<sup>2</sup> (AWG 4) for equipotential bonding conductors up to a length of 200 m
- 20 mm<sup>2</sup> (AWG 4) for equipotential bonding conductors with a length of more than 200 m

## 6.2 Mechanical installation

### WARNING

#### HOT SURFACES

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

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

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

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

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

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

**▲ WARNING**

**LOSS OF BRAKING FORCE DUE TO WEAR OR HIGH TEMPERATURE**

Applying the holding brake while the motor is running will cause excessive wear and loss of the braking force. Heat decreases the braking force.

- Do not use the holding brake as a service brake.
- Note that "EMERGENCY STOPS" may also cause wear
- At operating temperatures of more than 80°C (176°F), do not exceed a maximum of 50% of the specified holding torque when using the brake.

**Failure to follow these instructions can result in death, serious 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 use damaged products.
- 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 safety functions to become inoperative.

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

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

#### **⚠ WARNING**

##### **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 Overview of the connections

*Overview of printed circuit board connectors*

The following figure shows the pin assignment of the interfaces with the connector housing cover open.

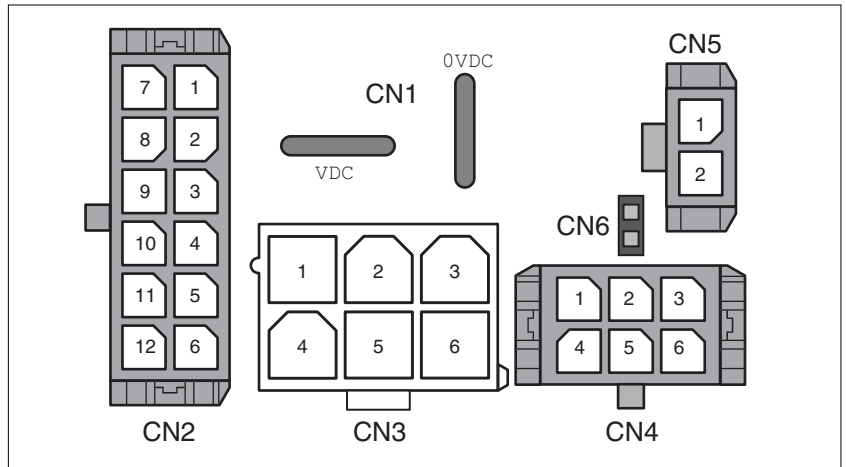


Figure 9: Overview of the connections

Connection	Assignment
CN1	Supply voltage $\nabla$ DVC
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.  
 For connection via cable entries see page 48.  
 For connection via industrial connectors see page 51.

## 6.3.2 Connection via cable entry

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

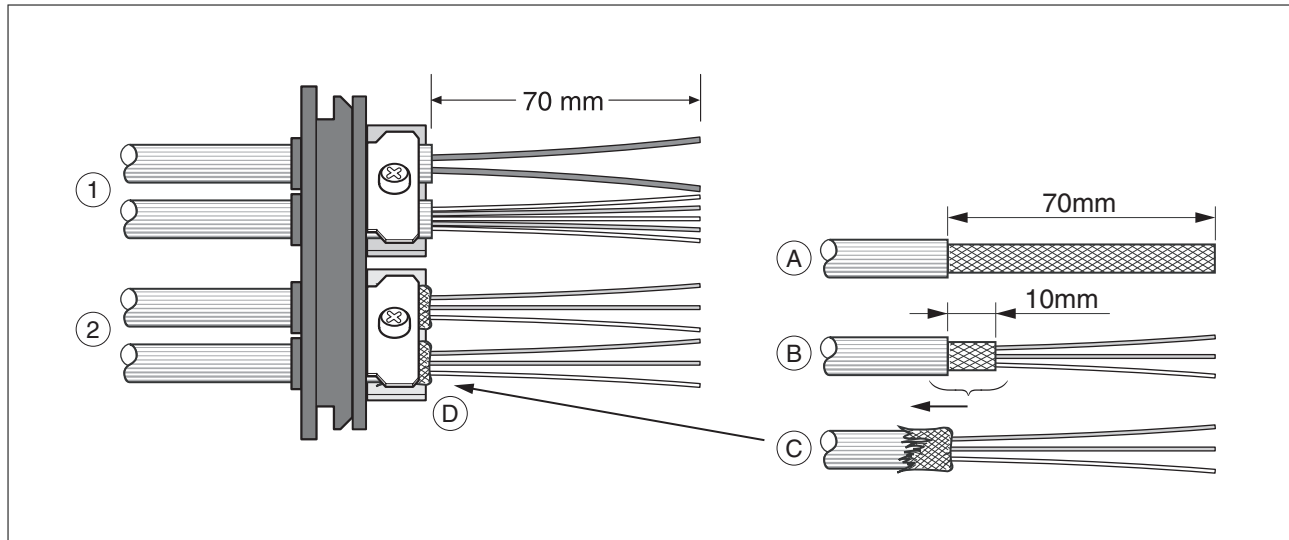
*Preparing and fastening cables*

Figure 10: 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 the cables; length 70 mm.
- ▶ (B) Shorten the shield to a length of 10 mm.
- ▶ (C) Slide the shield braiding back over the cable jacket.
- ▶ (D) Loosen the strain relief.
- ▶ Push the cables through 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 [mm <sup>2</sup> ]	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.

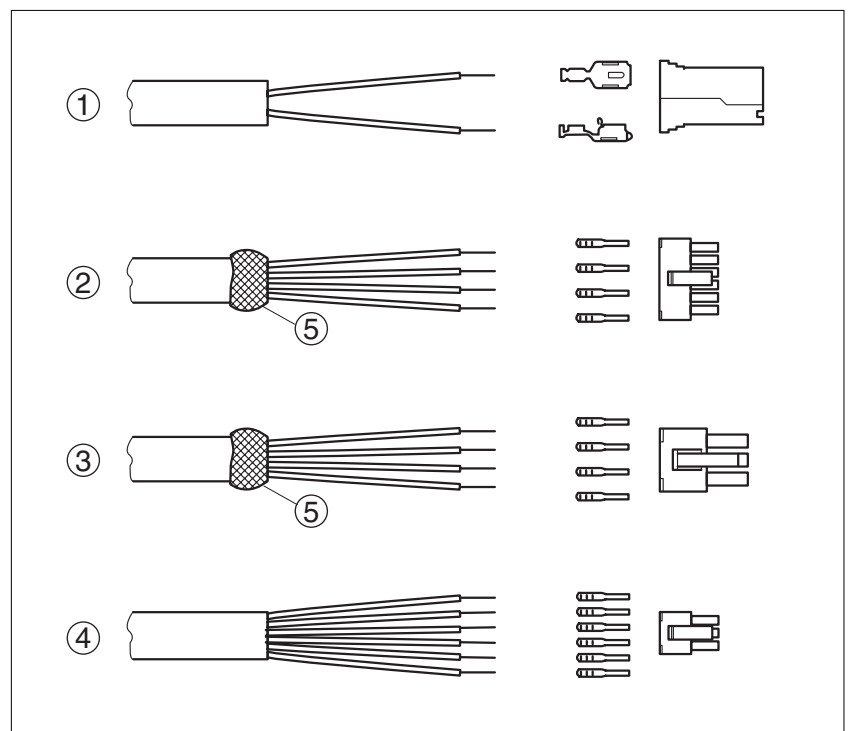


Figure 11: Connectors, cable lugs and crimp contacts

- (1) CN1 supply voltage  $V_{DC}$
- (2) CN2 fieldbus
- (3) CN3 commissioning
- (4) CN4 24V signals
- (5) Shield wire with EMC shield foil

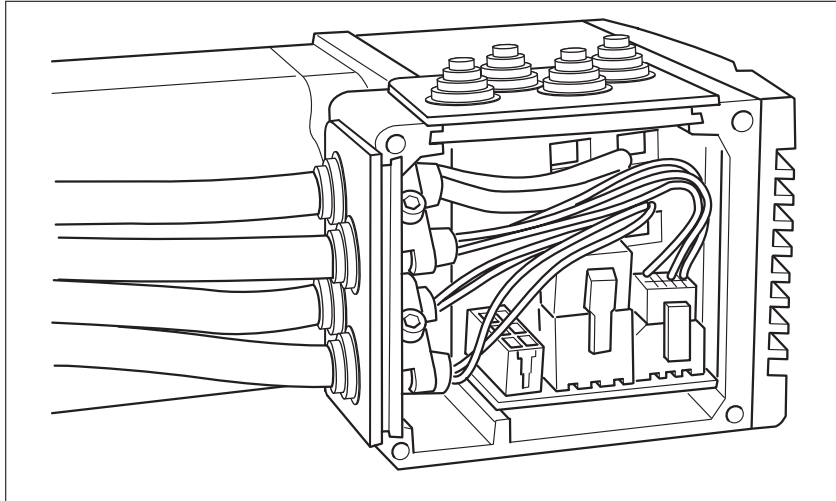
*Mounting the cable entry*

Figure 12: 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.

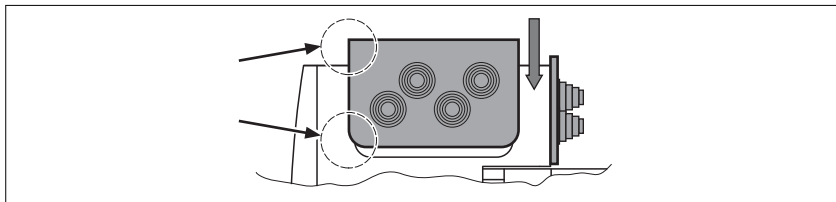
For a description of the parameter switches, see the chapters describing the connections.

- ▶ Connect the plugs of the assembled cables to the matching sockets. The connectors must snap 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.

Maximum tightening torque in Nm (lb·in): 1.1 (9.74)

If screws are lost use M3x12 only.

### 6.3.3 Connection via industrial connectors

Interface	Connector used
Supply voltage $V_{DC}$	Hirschmann STASEI 200
Ethernet fieldbus	Circular connector M12, 4-pin, D-coded
Digital signal inputs and signal outputs	Circular connector M8, 3-pin
Safety function STO	Circular connector M8, 4-pin

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

See chapter "12 Accessories and spare parts" for information on pre-assembled cables, connector kits and recommended suppliers.

6.3.4 Connection of  $\nu$ DC supply voltage**⚠ DANGER****ELECTRIC SHOCK CAUSED BY INCORRECT POWER SUPPLY UNIT**

The  $\nu$ DC 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  $\nu$ DC supply voltage to an unexpected level. Components not rated for this voltage may be destroyed or cause misoperation.

- Verify that all  $\nu$ DC 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.
- If necessary, use a braking resistor controller.

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

**CAUTION****DAMAGE TO CONTACTS**

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

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

**Failure to follow these instructions can result in equipment damage.**

<b>⚠ WARNING</b>
<b>DAMAGE TO SYSTEM COMPONENTS AND LOSS OF CONTROL</b>
<p>Interruptions of the negative connection of the controller supply voltage can cause excessively high voltages at the signal connections.</p> <ul style="list-style-type: none"> <li>• Do not interrupt the negative connection between the power supply unit and load with a fuse or switch.</li> <li>• Verify correct connection before switching on.</li> <li>• Do not connect the controller supply voltage or change its wiring while the supply voltage is present.</li> </ul> <p><b>Failure to follow these instructions can result in death, serious injury or equipment damage.</b></p>

*Cable specifications*

Two different crimp contacts are available for different conductor cross sections, see chapter "6.3.2 Connection via cable entry".

Minimum conductor cross section	[mm <sup>2</sup> ]	0.75 (AWG 18)
Maximum connection cross section	[mm <sup>2</sup> ]	4.0 (AWG 12)
Stripping length	[mm]	5 ... 6

Crimp contact 1607736-6	[mm <sup>2</sup> ]	
Minimum connection cross section		0.75 (AWG 18)
Maximum connection cross section		1.5 (AWG 16)
Crimp contact 341001-6	[mm <sup>2</sup> ]	
Minimum connection cross section		2.5 (AWG 12)
Maximum connection cross section		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 Wiring concept".
- ▶ 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

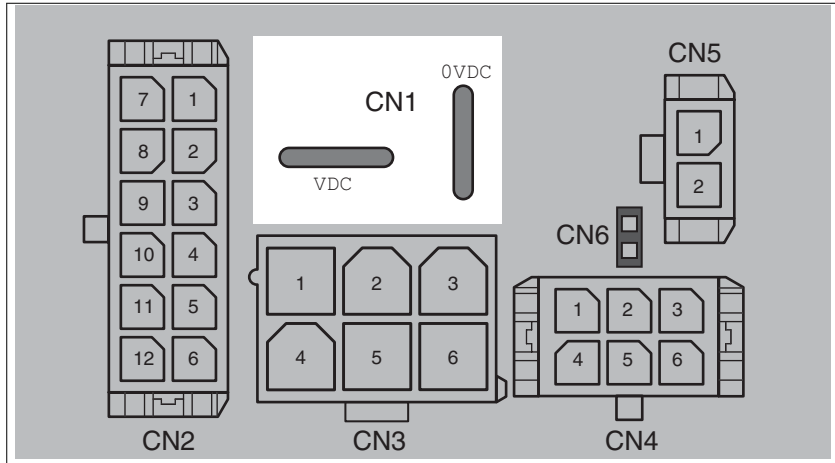


Figure 13: Pin assignment supply voltage

Signal	Meaning	Number <sup>1)</sup>
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 "6.3.2 Connection via cable entry".

Pin assignment industrial connector

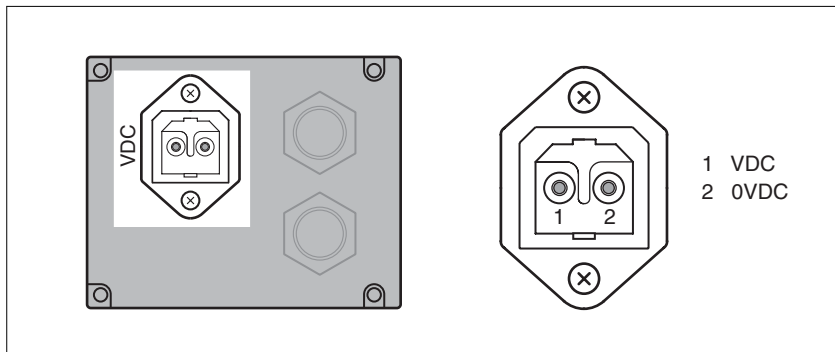


Figure 14: Pin assignment supply voltage

Pin	Signal	Meaning	Number <sup>1)</sup>
1	VDC	Supply voltage	1
2	0VDC	Reference potential to VDC	2

1) Information relates to pre-assembled cables

6.3.5 Connection Ethernet fieldbus interface

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

The fieldbus is connected by means of printed circuit board connectors or industrial connectors.

*Topology*

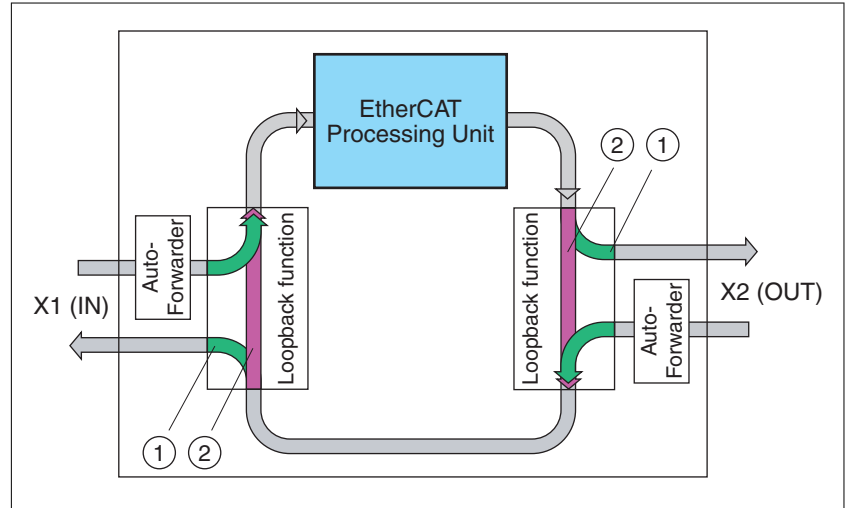


Figure 15: Topology

- (1) Port open
- (2) Port closed

*Cable specifications*

- ▶ Use equipotential bonding conductors, see page 35.
- ▶ Use pre-assembled cables to reduce the risk of wiring errors.
- ▶ Verify that wiring, cables and connected interfaces meet the PELV requirements.

Category:	Cat 5e
Shield:	Required, both ends grounded
Twisted Pair:	Required
PELV:	Required
Cable composition:	8 * 0.25 mm <sup>2</sup> (8 * AWG 22)
Maximum cable length:	100 m
Special features:	No crossover cable

Pin assignment printed circuit board connector

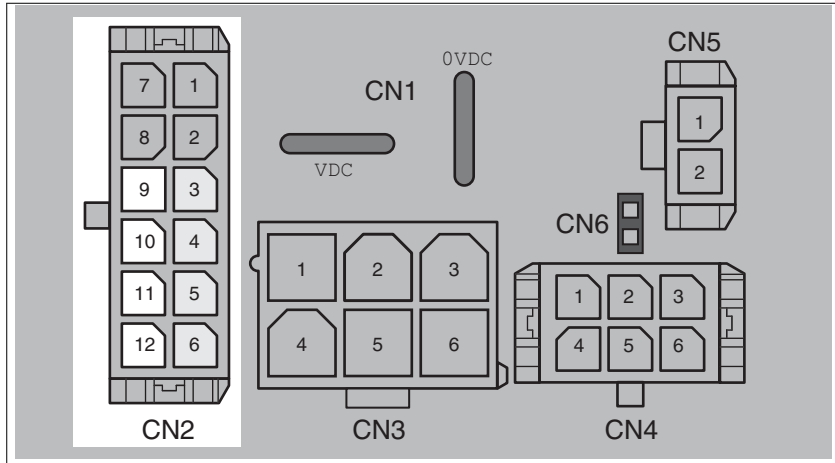


Figure 16: Pin assignment printed circuit board connector

Pin assignment connection IN:

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

Pin assignment connection OUT:

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



Pin assignment industrial connector

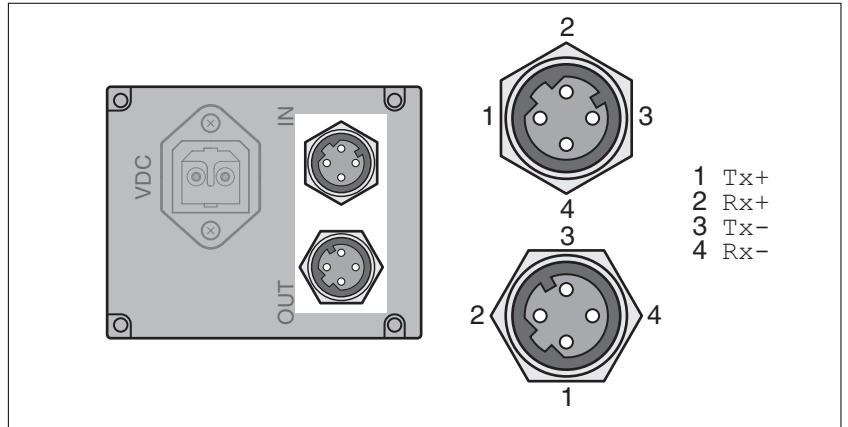


Figure 17: Pin assignment industrial connector

Pin assignment connection IN:

Pin	Signal	Meaning
1	Tx+	Fieldbus Tx+ (internally connected to CN2.9)
2	Rx+	Fieldbus Rx+ (internally connected to CN2.11)
3	Tx-	Fieldbus Tx- (internally connected to CN2.10)
4	Rx-	Fieldbus Rx- (internally connected to CN2.12)

Pin assignment connection OUT:

Pin	Signal	Meaning
1	Tx+	Fieldbus Tx+ (internally connected to CN2.3)
2	Rx+	Fieldbus Rx+ (internally connected to CN2.5)
3	Tx-	Fieldbus Tx- (internally connected to CN2.4)
4	Rx-	Fieldbus Rx- (internally connected to CN2.6)

6.3.6 RS485 interface connection

*Function* An RS485 interface is provided in addition to the fieldbus interface. The RS485 interface is also used to commission the drive.

You can also use the RS485 interface and 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*

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

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

- ▶ Use equipotential bonding conductors, see page 35.
- ▶ 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

*Pin assignment printed circuit board connector*

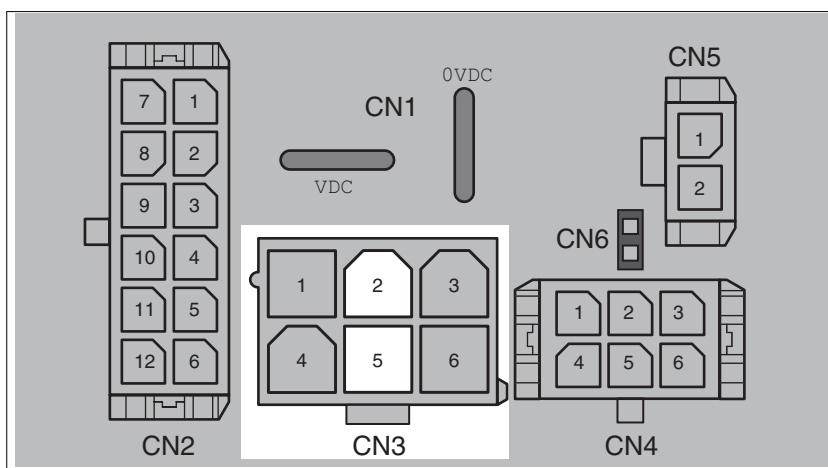


Figure 18: Pin assignment printed circuit board connector

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

6.3.7 24V signal interface connection

*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*

Minimum conductor cross section	[mm <sup>2</sup> ]	0.2 (AWG 24)
Maximum connection cross section	[mm <sup>2</sup> ]	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 signal functions can be assigned to the digital signal inputs and digital signal outputs. For a detailed description, see chapter "8.6.9 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

**⚠ WARNING**

**LOSS OF CONTROL**

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

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

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

During movements the two limit switches are monitored via the input signals LIMP and LIMN. When a limit switch is reached, the drive stops. Triggering of the limit switch is signaled.

Pin assignment printed circuit board connector

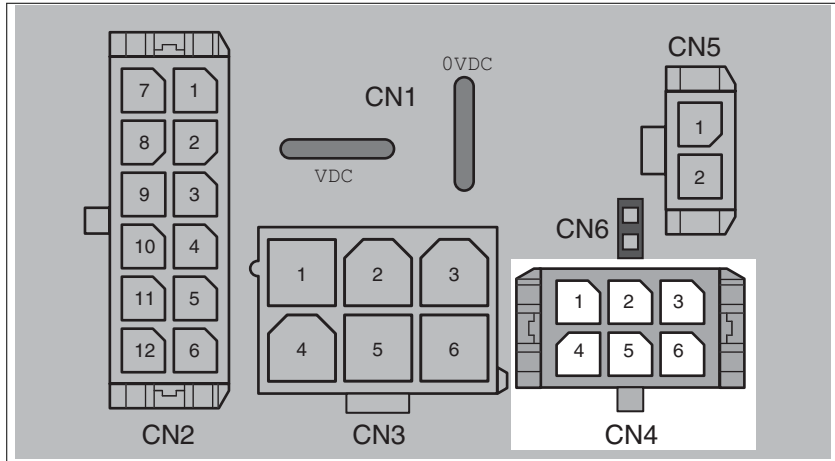


Figure 19: Pin assignment printed circuit board connector

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

6.3.8 Connection of STO safety function

<b>▲ WARNING</b>
<p><b>LOSS OF SAFETY FUNCTION</b></p> <p>Incorrect usage may cause a hazard due to the loss of the safety function.</p> <ul style="list-style-type: none"> <li>• Observe the requirements for using the safety function.</li> </ul> <p><b>Failure to follow these instructions can result in death or serious injury.</b></p>

*Requirements* For information and requirements relating to the STO safety function, see page 36.

*Cable specifications*

- Shielded cable corresponding to the requirements for protected cable installation

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

- ▶ Use equipotential bonding conductors, see page 35.
- ▶ 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

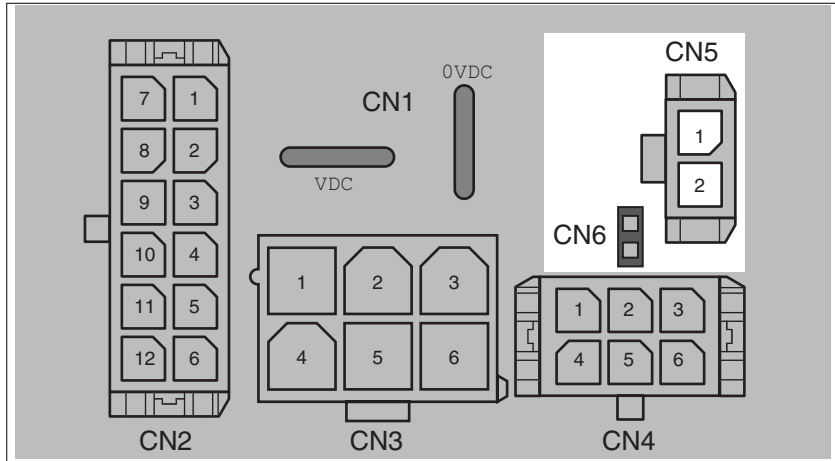
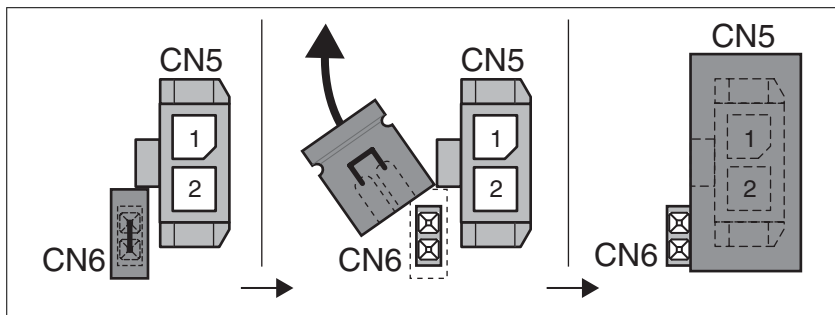


Figure 20: Pin assignment of safety function

Pin	Signal	Meaning
CN5.1	STO_A ( $\overline{PWRR\_A}$ )	Safety function STO "Safe Torque Off" (IEC/EN 61800-5-2)
CN5.2	STO_B ( $\overline{PWRR\_B}$ )	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.

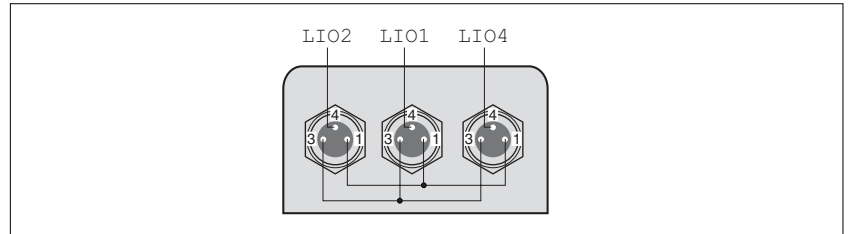


Figure 21: Pin assignment

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.

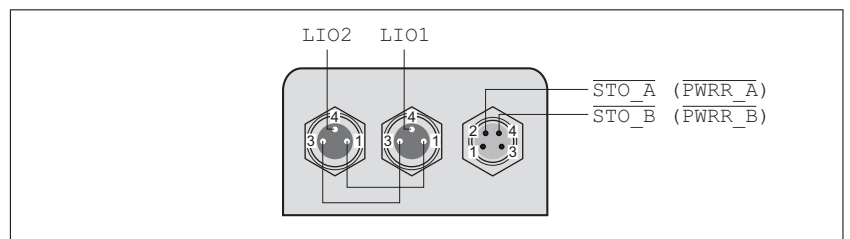


Figure 22: Pin assignment

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.

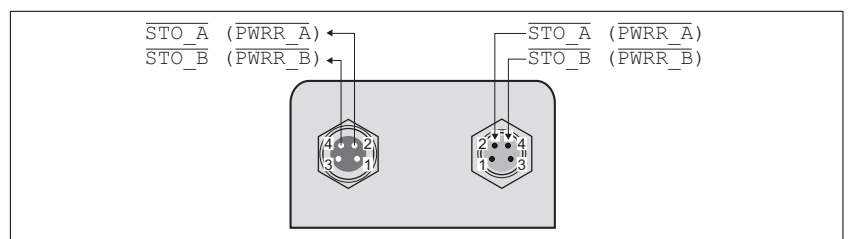


Figure 23: Pin assignment

### 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.

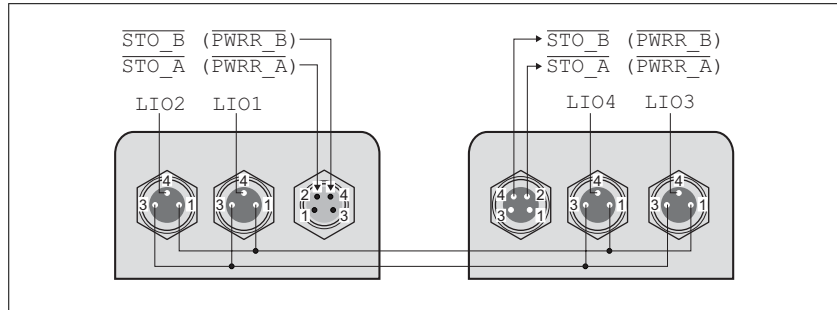


Figure 24: Pin assignment

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.*

### **⚠ 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 motor.
- 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**

Unsuitable settings or unsuitable data may trigger unexpected movements, trigger signals, damage parts 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****ROTATING PARTS**

Rotating parts may cause injuries and may catch clothing or hair. Loose parts or parts that are out of balance may be catapulted away.

- Verify correct mounting and installation of all rotating parts.
- Use a suitable cover.

**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.**

**⚠ WARNING****HOT SURFACES**

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

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

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

## 7.1 Overview

This chapter describes the commissioning procedure for the drive.

*Required components*

The following is required for commissioning:

- Commissioning software Lexium CT  
<http://www.schneider-electric.com>
- ESI file (EtherCAT Slave Information, file format XML)
- Fieldbus converter for the commissioning software for connection via the commissioning interface



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

*To be done*

- ▶ Carry out the steps below in the specified order.

To be done ...	Page
"6.5 Checking wiring"	64
"7.3 Add the product as an NC axis in "TwinCAT"."	69

- ▶ Carry out the following steps using the commissioning software.

To be done ...	Page
"7.4.1 Lexium CT commissioning software"	77
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## 7.2 Drive profile and ESI file

*Drive profile* The product supports the following drive profiles:

- PLCopen (vendor-specific)
- CANopen CiA 402

*ESI file* An ESI file (EtherCAT Slave Information, XML file format) is available for the product.

The ESI file can be downloaded at:

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

The ESI file must be integrated into the system of the master controller.

*Use* A separate ESI file is available for each drive profile.

Depending on the ESI file used, the drive profile PLCopen (vendor-specific) or the drive profile CANopen CiA 402 is active.

ESI file for drive profile	Suitable for
PLCopen (vendor-specific)	Operating mode: Jog Speed Control Profile Position Profile Velocity Homing  TwinCAT system: PLC
CANopen CiA 402	Operating mode: Cyclic Synchronous Position Jog Speed Control Profile Position Profile Velocity Homing  TwinCAT system: PLC NC PTP NC I CNC

NOTE: If both ESI files are installed in TwinCAT, the ESI file for the drive profile CANopen CiA 402 is active.

## 7.3 Add the product as an NC axis in "TwinCAT".

The product is added to the fieldbus using the Beckhoff TwinCAT software.

### 7.3.1 Adding the product using the drive profile PLCopen

A separate library and manual are available for the drive profile "PLCopen".

The library and the manual can be downloaded at:

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

### 7.3.2 Adding the product using the drive profile CANopen CiA 402

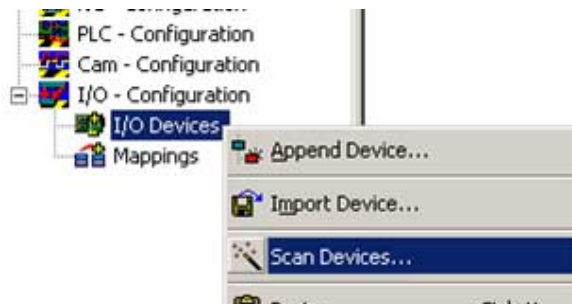
*Availability* The drive profile CANopen CiA 402 is available as of firmware version V1.010.

*TwinCAT support* The following TwinCAT functions are supported:

- TwinCAT-Systeme PLC, NC PTP, NC I and CNC
- TwinCAT libraries using TcMc.lib or TcMc2.lib
- TwinCAT homing methods Plc CAM and Software Sync

#### 7.3.2.1 Adding the product to TwinCAT

Scan the EtherCAT network to automatically add the product the TwinCAT.



- The ESI file must have been added to TwinCAT.
- ▶ Scan the network.
- ▶ Add the product to the NC configuration.
- ◀ The found product is added to the NC configuration.

## 7.3.2.2 Process data

A predefined RxPDO and predefined TxPDO are available.

The predefined PDO mapping is suitable for the operating mode Cyclic Synchronous Position.

*Structure RxPDO 1600<sub>h</sub>*

Index	Parameter name (DS402 name)
6040:0 <sub>h</sub>	DCOMcontrol (Control word)
6060:0 <sub>h</sub>	DCOMopmode (Mode of operation)
607A:0 <sub>h</sub>	PPp_target (Target position)
3008:11 <sub>h</sub>	IO_LO_set

*Structure TxPDO 1A00<sub>h</sub>*

Index	Parameter name (DS402 name)
6041:0 <sub>h</sub>	_DCOMstatus (Status word)
6061:0 <sub>h</sub>	_DCOMopmd_act (Mode of operation display)
6064:0 <sub>h</sub>	_p_act (Position actual value)
3008:15 <sub>h</sub>	_IO_LIO_act
603F:0 <sub>h</sub>	_StopFault (Error code)

*Adapting the PDO mapping*

The predefined PDO mapping can be adapted as required.

A maximum of 15 parameters are possible for the RxPDO and a maximum of 19 parameters are possible for the TxPDO.

## 7.3.2.3 Setting monitoring of the position deviation

Monitoring of the position deviation must be deactivated for the operating mode Cyclic Synchronous Position since the position deviation is monitored in the product.



General   Settings   Parameter   Dynamics   Online   Functions   Coupling   Compensation				
	Parameter	Value	Type	Unit
+	Velocities:			
+	Dynamics:			
+	Limit Switches:			
-	Monitoring:			
	Position Lag Monitoring	FALSE	B	
	Maximum Position Lag Value	5.0	F	mm
	Maximum Position Lag Filter Time	0.02	F	s

- ▶ If you use the operating mode Cyclic Synchronous Position, set "Position Lag Monitoring" to "FALSE".

7.3.2.4 Setting the scaling factor

The scaling factor must be set.

Formula:

Scaling factor = 1 / (position scaling in the product / mechanical system)

Example:

Mechanical system:

1 revolution corresponds to 10 mm

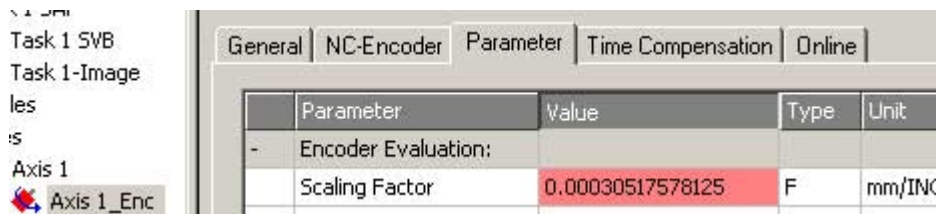
Position scaling in the product:

1 revolution corresponds to 32768 INC

Calculation:

$1 / (32768 \text{ INC} / 10 \text{ mm}) = 0.00030517578125 \text{ mm/INC}$

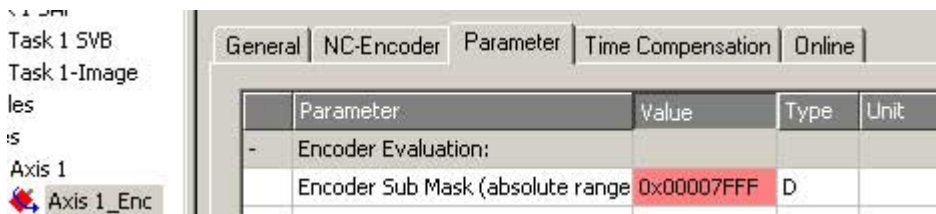
NOTE: Position scaling in the product is adapted by the list of startup parameters; it must not be changed, see chapter "7.3.2.6 List of the startup parameters".



- ▶ Set "Scaling Factor" to 0.00030517578125 (example).

7.3.2.5 Setting homing

For the TwinCAT homing method Software Sync, you must adjust the setting "Encoder Sub Mask (absolute range maximum value)".



- ▶ Set "Encoder Sub Mask (absolute range maximum value)" to 0x00007FFF.

## 7.3.2.6 List of the startup parameters

The list of the startup parameters comprises parameters of the product. These parameters are adjusted so that the product can be added to "TwinCAT" as an NC axis.

The following parameters are contained in the list of start-up parameters:

- ScalePOSdenom
- ScalePOSnum
- LIM\_QStopReact
- IOsigLimFreeMode
- DCOMopmode

*Setting position scaling* The parameter for position scaling is set to the following value:

Parameter name	Value that is written
ScalePOSdenom	32768 The value must not be changed.
ScalePOSnum	1 The value must not be changed.

These values are required for the operating mode Cyclic Synchronous Position; they must not be changed.

See also chapter "8.6.2 Scaling".

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
POSscaleDenom	Position scaling: Denominator Refer to numerator (POSscaleNum) for a description.  A new scaling is activated when the numerator value is supplied.  Setting can only be changed if power stage is disabled.	usr 1 16384 2147483647	INT32 INT32 R/W per. -	CANopen 3006:7 <sub>h</sub> Modbus 1550
POSscaleNum	Position scaling: Numerator Specification of the scaling factor:  Motor revolutions [U] ----- User-defined units [usr]  A new scaling is activated when the numerator value is supplied.  User-defined limit values may be reduced due to the calculation of an internal factor.  Setting can only be changed if power stage is disabled.  Changed settings become active immediately.	revolution 1 1 2147483647	INT32 INT32 R/W per. -	CANopen 3006:8 <sub>h</sub> Modbus 1552



Setting the response to "Quick Stop"

The parameter for the response to a "Quick Stop" is set to the following value:

Parameter name	Value that is written
LIM_QStopReact	-2

See also chapter "8.6.4 Quick Stop".

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
LIM_QStopReact	<p>Quick Stop option code</p> <p><b>-2 / Torque ramp (Fault):</b> Use torque ramp and transit to operating state 9 Fault</p> <p><b>6 / Deceleration ramp (Quick Stop):</b> Use torque ramp and remain in operating state 7 Quick Stop</p> <p><b>7 / Torque ramp (Quick Stop):</b> Use deceleration ramp and remain in operating state 7 Quick Stop</p> <p>Setting of deceleration ramp with parameter RAMPquickstop. Setting of torque ramp with parameter LIM_I_maxQSTP.</p> <p>The deceleration ramp is only available for operating modes with profile generator. The torque ramp is used in the operating modes without profile generator.</p> <p>Changed settings become active immediately.</p>	- -2 7 7	INT16 INT16 R/W per. -	CANopen 605A:0h Modbus 1584

Setting the response to a limit switch error

The parameter for the response to a limit switch error is set to the following value:

Parameter name	Value that is written
IOsigLimFreeMode	2 The value must not be changed.

See also chapter "8.6.1.2 Positioning range".

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOsigLimFreeMode	<p>Special movement away from limit switches</p> <p><b>0 / Off:</b> Off</p> <p><b>1 / Mode 1:</b> Limit switch error can be reset and active limit switch during enabling of power stage does not trigger an error</p> <p>Processing is only possible in the cyclic synchronous operating modes.</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the power stage is enabled.</p>	- 0 0 2	UINT16 UINT16 R/W per. -	CANopen 3006:6h Modbus 1548

*Setting the operating mode* The parameter for the operating mode is set to the following value:

Parameter name	Value that is written
DCOMopmode	8

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
DCOMopmode	Operating mode <b>-1 / Jog:</b> Jog <b>0 / Reserved:</b> Reserved <b>1 / Profile Position:</b> Profile Position <b>3 / Profile Velocity:</b> Profile Velocity <b>6 / Homing:</b> Homing <b>8 / Cyclic Synchronous Position:</b> Cyclic Synchronous Position  Changed settings become active immediately.	- -6 - 8	INT8 INT16 R/W - -	CANopen 6060:0h Modbus 6918

### 7.3.3 Setting EtherCAT "Identification"

The following possibilities are available for an EtherCAT "Identification":

- Selection of a value via rotary switch (factory setting in ESI file)  
Slave-Register (ADO): 0FFE<sub>h</sub>  
Available with firmware version  $\geq$ V1.020.
- Selection of a value via the TwinCAT system manager (also known as Station-Alias)  
Slave-Register (ADO): 12<sub>h</sub>

*Setting via rotary switch* An "Identification" value can be set via the rotary switches.

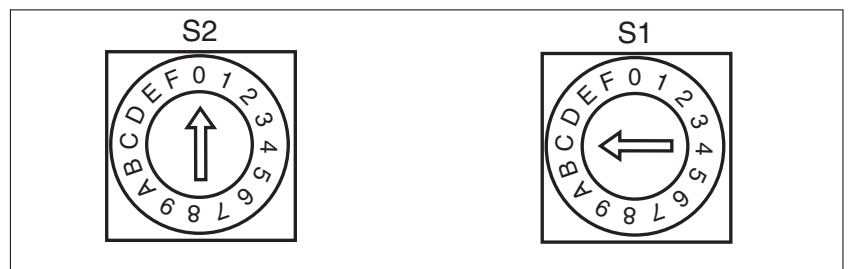


Figure 25: EtherCAT "Identification" via the rotary switches

- (S1) Determines the ones digit
- (S2) Determines the sixteens digit

Example:

Switch setting: S2 = 0<sub>h</sub>, S1 = C<sub>h</sub>

Value: 0C<sub>h</sub>

The value set via the rotary switches is stored in the Slave-Register (ADO) 0FFE<sub>h</sub>

*Setting via TwinCAT system manager*

Instead of using the rotary switches, you can set an "Identification" value via the TwinCAT system manager.

The value set via the TwinCAT system manager is stored in the Slave-Register (ADO) 12<sub>h</sub>.

The device must be switched off and on again after the value has been changed.

## 7.4 Commissioning procedure

### WARNING

#### UNINTENDED BEHAVIOR

Unsuitable settings or unsuitable data may trigger unexpected movements, trigger signals, damage parts and disable monitoring functions.

- Do not operate the drive system with unknown settings or data.
- Verify that the stored data and settings are correct.
- When commissioning, carefully run tests for all operating states and potential error situations.
- Verify the functions after replacing the product and also after making changes to the settings or data.
- Only start the system if there are no persons or obstructions in the hazardous area.

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

### WARNING

#### UNINTENDED BEHAVIOR CAUSED BY ACCESS CONTROL

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

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

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

### 7.4.1 Lexium CT commissioning software

	The commissioning software has a graphic user interface and is used for commissioning, diagnostics and testing settings.
<i>Source of commissioning software</i>	The latest version of the commissioning software is available for download from the internet. <a href="http://www.schneider-electric.com">http://www.schneider-electric.com</a>
<i>Functions of the commissioning software</i>	The functions of the commissioning software include: <ul style="list-style-type: none"><li>• Scan various fieldbuses for devices</li><li>• Extensive information on connected devices</li><li>• Display and change device parameters</li><li>• Archive and duplicate device parameters</li><li>• Manual positioning of the motor</li><li>• Test input signals and output signals</li><li>• Record, evaluate and archive motion and signals</li><li>• Error diagnostics</li><li>• Optimize control performance (servo motors only)</li></ul>
<i>System requirements</i>	The minimum hardware requirements for installation and operation of the commissioning software are: <ul style="list-style-type: none"><li>• PC with operating system Windows 2000, Windows XP Professional or Windows Vista</li><li>• Approx. 200 [MB] of hard disk space</li><li>• 512 [MB RAM]</li><li>• Graphics card and monitor with a resolution of at least 1024x768 pixels</li><li>• Free serial interface (RS232) or free USB interface</li><li>• Local administrator rights</li><li>• Acrobat Reader 5.0 or later</li><li>• Internet connection (for initial installation and updates)</li></ul>
<i>Online help</i>	The commissioning software offers help functions, which can be accessed via "? Help Topics" or by pressing the F1 key.

*Converter* A converter is required to connect the product to a PC. The connection can be made via the commissioning interface or the fieldbus interface.

The commissioning interface differs from the fieldbus interface as follows:

- Commissioning interface
  - A converter to RS485 (PC to device) is required.
  - The master must be disconnected from the device during the access.
- Fieldbus interface
  - Access is possible directly via the controller, provided an industrial PC is used on which the runtime system runs.
  - Access is also possible via the Beckhoff switch terminal. This device is connected directly to the EtherCAT bus and features a network connector for direct connection of a PC with a network card.
  - The EtherCAT bus must be activated.
  - The device must have obtained an IP address from the master.

An EtherCAT master must control the EtherCAT communication since Modbus TCP is tunneled through EtherCAT. The drive must at least be in the state Pre-Operational (see chapter "10.2.2 EtherCAT state machine") for communication via Modbus TCP.

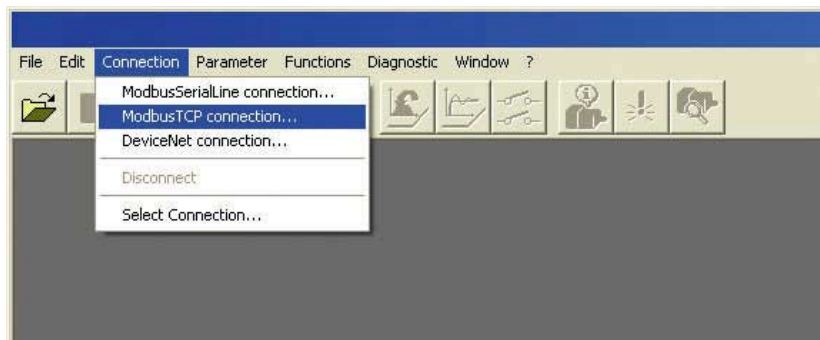


Figure 26: Lexium CT, Selecting a Modbus TCP connection

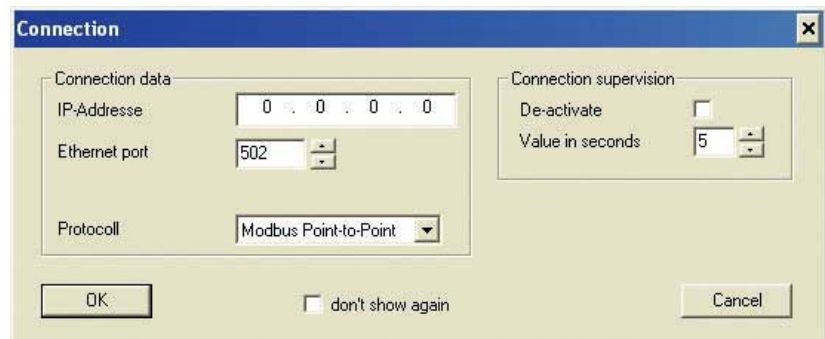


Figure 27: Lexium CT, entering the connection data

- ▶ Enter the IP address of the product in the field **IP Address**.
- ▶ Enter the value **502** in the field **Ethernet Port**.

## 7.4.2 Setting basic parameters and limit values



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

### *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	<p>Current limitation</p> <p>The value must not exceed the maximum permissible current of the motor or the power stage.</p> <p>Default: M_I_max</p> <p>In increments of 0.01 A<sub>pk</sub>.</p> <p>Changed settings become active immediately.</p>	A <sub>pk</sub> 0.00 - 299.99	UINT16 UINT16 R/W per. -	CANopen 3012:1 <sub>h</sub> Modbus 4610
LIM_I_maxQSTP	<p>Current limitation for Quick Stop</p> <p>Maximum current during deceleration via torque ramp due to an error of error classes 1 or 2 and when a software stop is triggered.</p> <p>Maximum and default settings depend on the motor and the power stage (settings M_I_max and PA_I_max).</p> <p>In increments of 0.01 A<sub>pk</sub>.</p> <p>Changed settings become active immediately.</p>	A <sub>pk</sub> - - -	UINT16 UINT16 R/W per. -	CANopen 3011:5 <sub>h</sub> Modbus 4362
LIM_I_maxHalt	<p>Current limitation for Halt</p> <p>Maximum current during deceleration after Halt or when an operating mode is terminated.</p> <p>Maximum and default settings depend on the motor and the power stage (settings M_I_max and PA_I_max).</p> <p>In increments of 0.01 A<sub>pk</sub>.</p> <p>Changed settings become active immediately.</p>	A <sub>pk</sub> - - -	UINT16 UINT16 R/W per. -	CANopen 3011:6 <sub>h</sub> Modbus 4364

*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	<p>Speed limitation</p> <p>The set value must not exceed the maximum motor speed.</p> <p>Default: maximum motor speed (see M_n_max)</p> <p>Changed settings become active immediately.</p>	min <sup>-1</sup> 0 - 13200	UINT16 UINT16 R/W per. -	CANopen 3012:2 <sub>h</sub> Modbus 4612



*Limitation of reference velocity* For operating modes that are executed with the profile generator (ramps), the reference velocity can be limited with the parameter RAMPn\_max.

- ▶ Use the parameter RAMPn\_max to set the maximum reference velocity.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
RAMPn_max	<p>Maximum velocity of profile generator</p> <p>The parameter is active in the following operating modes:</p> <ul style="list-style-type: none"> <li>- Profile Position</li> <li>- Profile Velocity</li> <li>- Homing</li> <li>- Jog</li> </ul> <p>If a greater reference velocity is set in one of these operating modes, it is automatically limited to RAMPn_max. This way, commissioning at limited velocity is easier to perform.</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the motor moves.</p>	<p>min<sup>-1</sup></p> <p>60</p> <p>13200</p> <p>13200</p>	<p>UINT32</p> <p>UINT16</p> <p>R/W</p> <p>per.</p> <p>-</p>	<p>CANopen 607F:0<sub>h</sub></p> <p>Modbus 1554</p>

## 7.4.3 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 "8.6.9 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 field-bus
<code>_IO_LIO_act</code>	Status of digital inputs/outputs Coding of the individual signals: Bit 0: LIO1 Bit 1: LIO2 ...	- - 0 -	UINT16 UINT16 R/- - -	CANopen 3008:15h Modbus 2090

## 7.4.4 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.
- You must release the limit switches before you can use them.
- Verify the correct function of the limit switches.

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

- You must have configured the functions "Negative limit switch (LIMN)" and "Positive limit switch (LIMP)", see chapter "8.6.9 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 and verify the response.

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.*

### 7.4.5 Testing the safety function STO

- Operation with STO* If you want to use the STO safety function, carry out the following steps:
- Supply voltage switched off.
  - ▶ Verify that the signal wires at 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 signal wires must not be electrically connected.
  - Supply voltage switched on.
  - ▶ Verify that the `IO_AutoEnable` parameter is set to "off" to avoid unexpected restart.
  - ▶ 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.
  - △ The power stage is disabled and error message 1300 is generated. (NOTE: Error message 1301 indicates a wiring error.)
  - ▶ Check the behavior of the drive when errors are present.
  - ▶ Document all tests of the safety function in your acceptance protocol.
- Operation without STO* If you do not want to use the STO safety function:
- ▶ Check whether the jumper CN6 is connected.

7.4.6 Releasing the holding brake manually

The drive automatically controls the integrated holding brake. However, during commissioning it may be necessary to release the holding brake manually.

The power supply must be on to release the holding brake manually.

<b>▲ WARNING</b>
<p><b>UNEXPECTED MOVEMENT</b></p> <p>Releasing the holding brake may cause an unexpected movement in the system, for example if vertical axes are used.</p> <ul style="list-style-type: none"> <li>• Take appropriate measures to avoid damage caused by falling or lowering loads.</li> <li>• Only run the test if there are no persons or obstacles in the hazardous area.</li> </ul> <p><b>Failure to follow these instructions can result in death, serious injury or equipment damage.</b></p>

*Power stage disabled* The holding brake can be released with the parameter `BRK_release` and the commissioning software when the power stage is not enabled.

The power stage cannot be enabled with a manually released holding brake.

*Power stage enabled* When the power stage is enabled, automatic holding brake control is active. If the holding brake is manually released an error message is generated.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
<code>BRK_release</code>	<p>Processing of holding brake</p> <p><b>0 / Close:</b> Automatic processing <b>1 / Open:</b> Manual release of brake</p> <p>The brake output can only be activated in the operating states Switch On Disabled or Ready To Switch On.</p> <p>If the power stage is enabled, the value is automatically set to 0.</p> <p>Changed settings become active immediately.</p>	<p>-</p> <p>0</p> <p>0</p> <p>1</p>	<p>UINT16</p> <p>UINT16</p> <p>R/W</p> <p>-</p> <p>-</p>	<p>CANopen 3008:A<sub>n</sub></p> <p>Modbus 2068</p>

### 7.4.7 Checking the direction of movement

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

Use the commissioning software for the following activities.

- ▶ Start the operating mode Jog.
- ▶ Start a movement with positive direction of movement.
- ◁ The motor shaft rotates with positive direction of movement.
- ▶ Start a movement with negative direction of movement.
- ◁ The motor shaft rotates with negative direction of movement.
  
- ▶ If the arrow and direction of movement do not match, correct this with the `POSdirOfRotat` parameter, see chapter "8.6.10 Changing the direction of movement".

### 7.4.8 Setting parameters for encoder



*This commissioning step is only required if you use an absolute encoder.*

#### *Setting an absolute position*

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

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

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
<code>_p_absENCusr</code>	<p>Motor position with reference to encoder range</p> <p>The value range is determined by the encoder type.</p> <p>In the case of singleturn encoders, the value refers to one motor revolution, in the case of multiturn encoders to the entire encoder range (for example 4096 revolutions).</p> <p>NOTE: The position is not valid until the absolute motor position has been determined.</p> <p>In the case of invalid absolute motor position:</p> <p><code>_WarnLatched</code> <code>_WarnActive</code> Bit 13=1: Absolute motor position not yet captured</p>	usr - 0 -	UINT32 UINT32 R/- - -	CANopen 301E:F <sub>h</sub> Modbus 7710
<code>ENC_pabsusr</code>	<p>Adjustment of absolute position of encoder</p> <p>The value range depends on the encoder type.</p> <p>Singleturn encoder: 0 ... <code>max_pos_usr/rev.</code> - 1 Multiturn encoder: 0 ... (<code>4096 * max_pos_usr/rev.</code>) - 1</p> <p><code>max_pos_usr/rev.</code>: maximum user position for one motor turn. This value is 16384 with the default scaling.</p> <p>NOTE: * If processing is to be performed with inversion of the direction of rotation, this must be set before the motor encoder position is adjusted. * After the write access, a wait time of at least 1 second is required before the drive is switched off. * Changing this value also changes the position of the virtual index pulse and the index pulse for the ESIM function.</p> <p>Changed settings become active the next time the product is switched on.</p>	usr -2147483648 - 2147483647	INT32 INT32 R/W - -	CANopen 3005:16 <sub>h</sub> Modbus 1324

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

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



*Multiturn encoder*

In the case of a multiturn encoder, the mechanical working range of the motor can be shifted to the continuous range of the encoder by setting a new absolute position.

If the motor is moved counterclockwise from the absolute position 0, there is an underrun of the absolute position of the multiturn encoder. However, the internal actual position keeps counting forward and delivers a negative position value. After switching off and on, the internal actual position would no longer be the negative position value, but the absolute position of the encoder.

This situation represents a discontinuous position in the movement range. The absolute position in the encoder must be set in such a way that the mechanical limits are within the continuous range of the encoder.

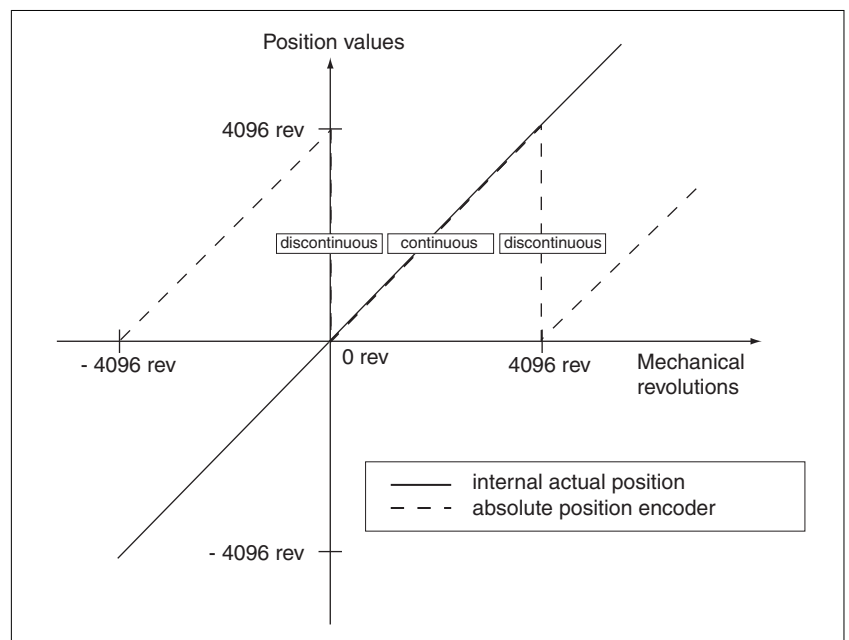


Figure 28: Position values of multiturn encoder

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

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

### 7.4.9 Web server

The product features an integrated web server. This means that the product can be configured without the commissioning software via a Web browser.

The drive must at least be in the state Pre-Operational (see chapter "10.2.2 EtherCAT state machine") for communication via the Web server.

#### *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 to the product.
- ▶ Open the **Maintenance** menu and select 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.

#### *User interface*

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



Figure 29: User interface

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

*Web server functions*

General access:

- Diagnostics
- Display manual

Password-protected access:

- Display parameters
- Change parameters

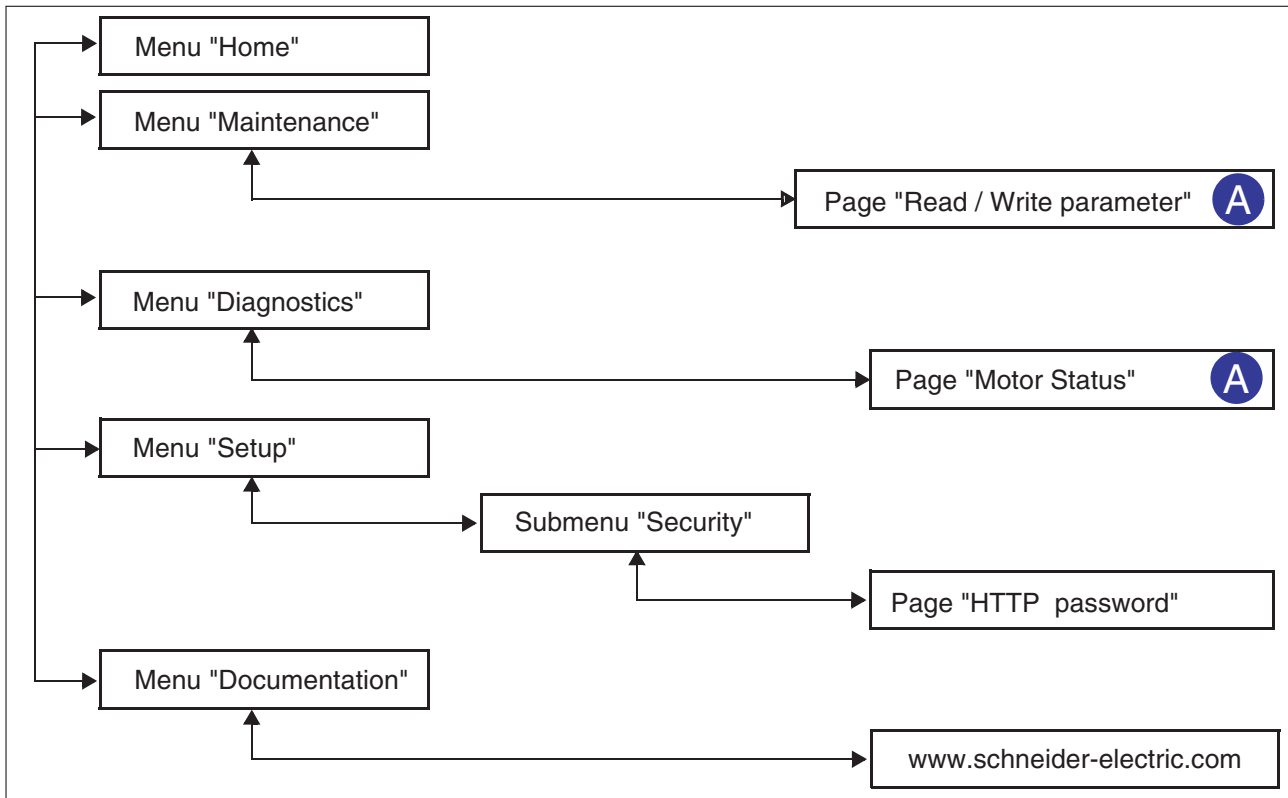


Figure 30: Web server page structure

Menu	Page	Function
HOME	English	Start page
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 <b>Restore Factory Defaults</b> .
DOCUMENTATION	References	Link to the website <a href="http://www.schneider-electric-motion.com">http://www.schneider-electric-motion.com</a>

## 7.5 Controller optimization with step response

### 7.5.1 Controller structure

The controller structure of the controller corresponds to the classical cascaded closed positioning loop with current controller, velocity controller and position controller. In addition, the reference value of the velocity controller can be smoothed via a filter.

The controllers are tuned one after the other from the "inside" to the "outside" in the following sequence: current controller, velocity controller, position controller. The superimposed control loop remains off.

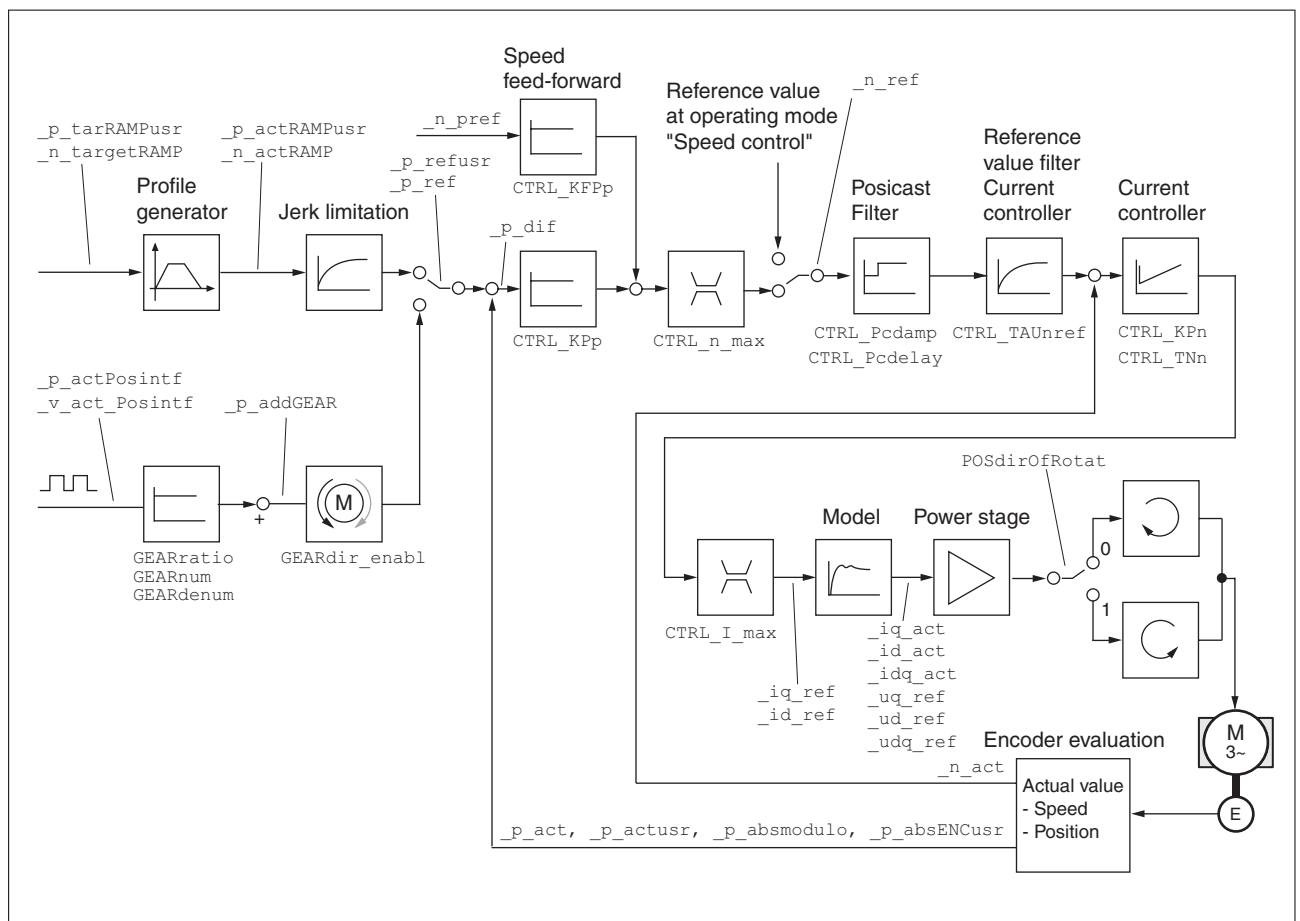


Figure 31: Controller structure

- Current controller* The current controller determines the torque of the motor. The current controller is automatically optimally tuned with the stored motor data.
- Velocity controller* The velocity controller maintains the required motor velocity by varying the output motor torque depending on the load situation. The velocity controller has a decisive influence on the dynamic response of the drive. The dynamics of the velocity controller depend on:
- Moment of inertia of the drive and the controlled system
  - Torque of the motor
  - Stiffness and elasticity of the elements in the flow of forces
  - Backlash of the drive elements
  - Friction

*Position controller* The position controller reduces the difference between the reference position and the actual position of the motor (position deviation) to a minimum. When the motor is at a standstill, the position deviation is close to zero in the case of a well-tuned position controller. When the motor is running, a position deviation results that depends on the speed of rotation.

In the operating modes Profile Position, Profile Velocity, Homing and Jog, the reference position for the closed positioning loop is generated by the internal motion profile generator.

An optimized velocity control loop is a prerequisite for good amplification of the position controller.

## 7.5.2 Optimization

The drive optimization function matches the device to the application conditions. The following options are available:

- Selecting control loops. Superimposed control loops are automatically deactivated.
- Defining reference value signals: signal type, amplitude, frequency and starting point
- Testing control performance with the signal generator.
- Recording the control performance on screen and evaluating it with the commissioning software.

### *Setting reference value signals*

- ▶ Start controller optimization with the commissioning software using the sequence of menus and commands "Functions - Recording/Tuning...".
- ▶ Display the "Tune" tab.
- ▶ Set the following values for the reference value signal:
  - Amplitude: 100 min<sup>-1</sup>
  - Period: 100 ms
  - Signal: Positive step
  - Number of repetitions: 1
- ▶ Also note additional settings in the menu "Display - Specific Displays".



*Only the signal types "Step" and "Square" allow you to determine the entire dynamic behavior of a control loop. The manual shows signal paths for the signal type "Step".*

### *Entering controller values*

The optimization steps described on the following pages require you to enter control loop parameters and test their effect by triggering a step function.

A step function is triggered as soon as you start recording in the commissioning software.

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

7.5.3 Optimizing the velocity controller

Optimum settings of complex mechanical control systems require hands-on experience with controller tuning . This includes the ability to calculate control loop parameters and to apply identification procedures.

Less complex mechanical systems can often be successfully optimized by means of experimental adjustment using the aperiodic limit method. The following parameters are used for this:

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL_KPn	Velocity controller P gain The default value is calculated on the basis of the motor parameters. In increments of 0.0001 A/min <sup>-1</sup> . Changed settings become active immediately.	A/min <sup>-1</sup> 0.0001 - 1.2700	UINT16 UINT16 R/W per. -	CANopen 3012:3h Modbus 4614
CTRL_TNn	Velocity controller integral action time In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 - 327.67	UINT16 UINT16 R/W per. -	CANopen 3012:4h Modbus 4616

Check and optimize the calculated values in a second step, as described on page 98.

*Determining the mechanical system of the system*

To assess and optimize the transient response behavior of your system, group its mechanical system into one of the following two categories.

- System with rigid mechanical system
- System with a less rigid mechanical system

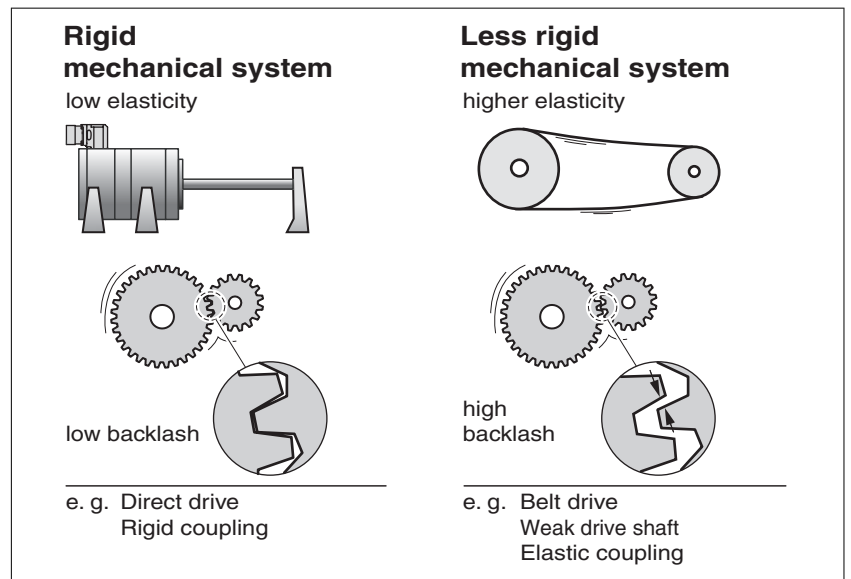


Figure 32: Rigid and less rigid mechanical systems

- ▶ Couple the motor and the mechanical system

- ▶ If you use limit switches, verify the function of the limit switches after installation of the motor.

### Switching off the reference value filter of the velocity controller

The reference value filter of the velocity controller allows you to improve the transient response at optimized velocity control. The reference value filter must be switched off for the first setup of the velocity controller.

- ▶ Deactivate the reference value filter of the velocity controller. Set the parameter `CTRL_TAUnref` to the lower limit value "0".

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
CTRL_TAUnref	Filter time constant of reference velocity value filter In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 0.00 327.67	UINT16 UINT16 R/W per. -	CANopen 3012:9h Modbus 4626



*The procedure for optimization of the settings is only a suggestion. It is responsibility of the user to decide whether the method is suitable for the actual application.*

### Determining controller parameter values for rigid mechanical systems

In the case of a rigid mechanical system, adjusting the control performance on the basis of the table is possible if:

- the moment of inertia of the load and of the motor are known and
- the moment of inertia of the load and of the motor are constant

The P gain `CTRL_KPn` and the integral action time `CTRL_TNn` depend on:

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

- ▶ Determine the controller parameter values using Table 1:

$J_L$ [kgcm <sup>2</sup> ]	$J_L = J_M$		$J_L = 5 * J_M$		$J_L = 10 * J_M$	
	KPn	TNn	KPn	TNn	KPn	TNn
1	0.0125	8	0.008	12	0.007	16
2	0.0250	8	0.015	12	0.014	16
5	0.0625	8	0.038	12	0.034	16
10	0.125	8	0.075	12	0.069	16
20	0.25	8	0.15	12	0.138	16

Table 1: Determining controller values



*Determining controller parameter values for rigid mechanical systems*

For optimization purposes, determine the P gain of the velocity controller at which the controller adjusts velocity `_n_act` as quickly as possible without overshooting.

- ▶ Set the integral action time `CTRL_TNn` to infinite.  
`CTRL_TNn = 327.67 ms.`

If a load torque acts on the motor when the motor is at a standstill, the integral action time must not exceed a value that causes uncontrolled change of the motor position.



*If the motor is subject to loads when it is at a standstill, setting the integral action time to "infinite" may cause position deviations. Reduce the integral action time if the deviation is unacceptable in your application. However, reducing the integral action time can adversely affect optimization results.*

**▲ WARNING**

**UNEXPECTED MOVEMENT**

The step function moves the motor at constant velocity until the specified time has expired.

- Verify that the selected values for velocity and time do not exceed the available distance.
- If possible, use limit switches.
- Verify that a functioning button for emergency stop is within reach.
- Verify that the system is free and ready for the movement before starting the function.

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

- ▶ Initiate a step function.
- ▶ After the first test, check the maximum amplitude for the reference value for the current `_Iq_ref`.

Set the amplitude of the reference value just high enough so the reference value for the current `_Iq_ref` remains below the maximum value `CTRL_I_max`. On the other hand, the value selected should not be too low, otherwise friction effects of the mechanical system will determine the performance of the control loop.

- ▶ Trigger another step function if you had to modify `_n_ref` and check the amplitude of `_Iq_ref`.
- ▶ Increase or decrease the P gain in small increments until `_n_act` is obtained as fast as possible. The following diagram shows the required transient response on the left. Overshooting - as shown on the right - is reduced by reducing `CTRL_KPn`.

Differences between `_n_ref` and `_n_act` result from setting `CTRL_TNn` to "Infinite".

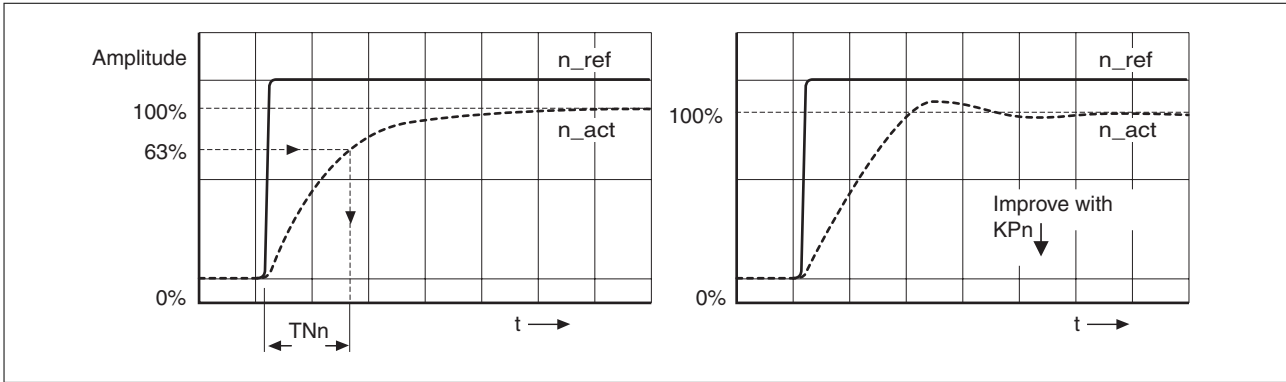


Figure 33: Determining "TNn" for the aperiodic limit



*In the case of drive systems in which oscillations occur before the aperiodic limit is reached, the P gain "KPn" must be reduced until oscillations can no longer be detected. This occurs frequently in the case of linear axes with a toothed belt drive.*

*Graphic determination of the 63% value*

Graphically determine the point at which the actual velocity  $\_n\_act$  reaches 63% of the final value. The integral action time  $CTRL\_TNn$  then results as a value on the time axis. The commissioning software supports you with the evaluation:

### 7.5.4 Checking and optimizing default settings

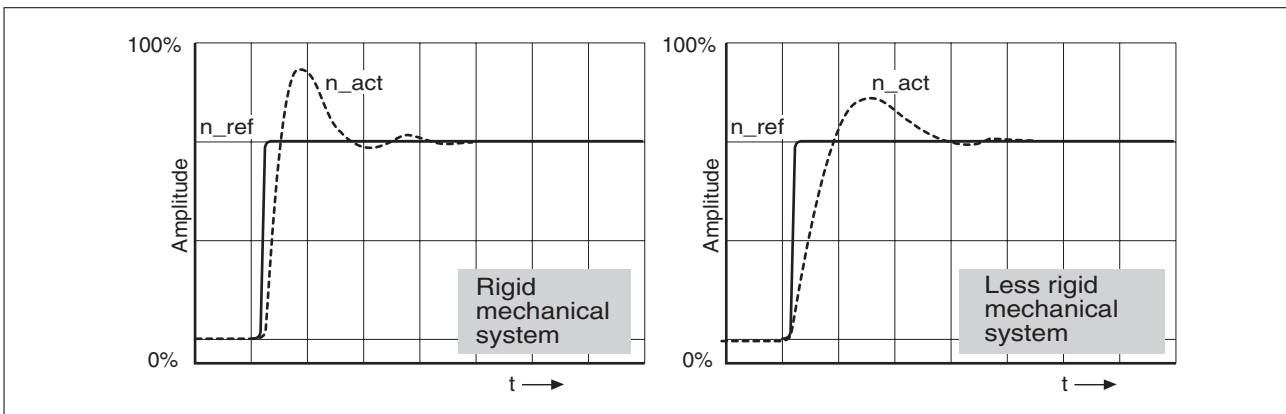


Figure 34: Step responses with good control performance

The controller is properly set when the step response is approximately identical to the signal shown. Good control performance is characterized by

- Fast transient response
- Overshooting up to a maximum of 40%, 20% is recommended.

If the control performance does not correspond to the curve shown, change  $CTRL\_KPn$  in increments of about 10% and then trigger another step function:

- If the control is too slow: Use a higher  $CTRL\_KPn$  value.
- If the control tends to oscillate: Use a lower  $CTRL\_KPn$  value.

Oscillation ringing is characterized by continuous acceleration and deceleration of the motor.

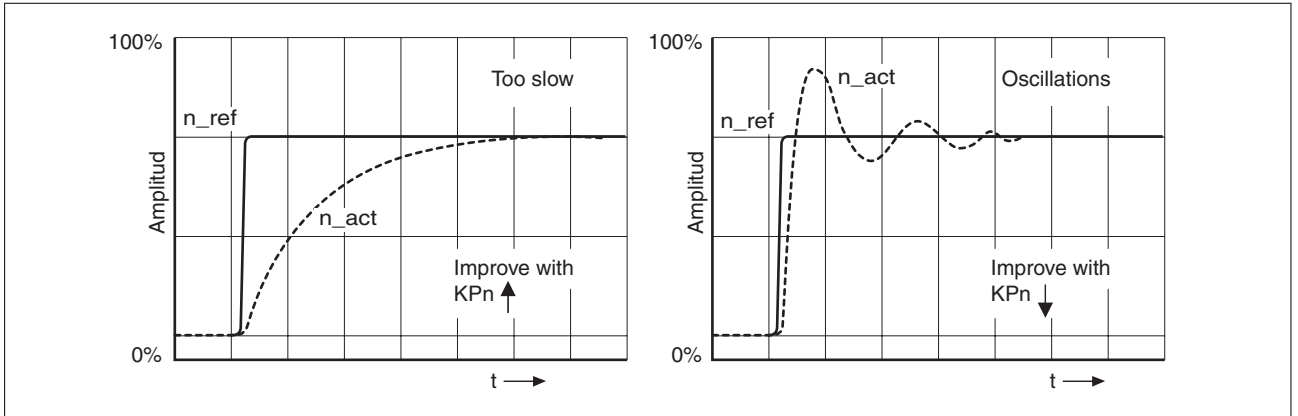


Figure 35: Optimizing inadequate velocity controller settings



*If the controller performance remains unsatisfactory in spite of optimization, contact your local sales representative.*

## 7.5.5 Optimizing the position controller

An optimized subordinate velocity controller is a prerequisite for optimization of the position controller.

When tuning the position controller, you must optimize the P gain `CTRL_KPp` in two limits:

- `CTRL_KPp` too high: Overshooting of the mechanical system, instability of the closed-loop control
- `CTRL_KPp` too low: High position deviation

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
<code>CTRL_KPp</code>	Position controller P gain The default value is calculated. In increments of 0.1 1/s. Changed settings become active immediately.	1/s 2.0 - 114.3	UINT16 UINT16 R/W per. -	CANopen 3012:6h Modbus 4620

**⚠ WARNING**

**UNEXPECTED MOVEMENT**

The step function moves the motor at constant velocity until the specified time has expired.

- Verify that the selected values for velocity and time do not exceed the available distance.
- If possible, use limit switches.
- Verify that a functioning button for emergency stop is within reach.
- Verify that the system is free and ready for the movement before starting the function.

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

*Setting the reference value signal*

- ▶ Select Position Controller as the reference value in the commissioning software.
- ▶ Set the reference value signal:
  - Signal type: "Step"
  - Set the amplitude to approx. 1/10 motor revolution.

The amplitude is entered in user-defined units. With the default scaling, the resolution is 16384 usr per motor revolution.

*Selecting the recording signals*

- ▶ Select the values in the box General Recording Parameters:
  - Reference position of position controller  $\_p\_refusr$  ( $\_p\_ref$ )
  - Actual position of position controller  $\_p\_actusr$  ( $\_p\_act$ )
  - Actual velocity  $\_n\_act$
  - Actual motor current  $\_Iq\_ref$

Controller values for the position controller can be changed in the same parameter group that you already used for the velocity controller.

*Optimizing the position controller value*

- ▶ Trigger a step function with the default controller values.
- ▶ After the first test, check the values achieved for  $\_n\_act$  and  $\_Iq\_ref$  for current and velocity control. The values must not reach the current and velocity limitation ranges.

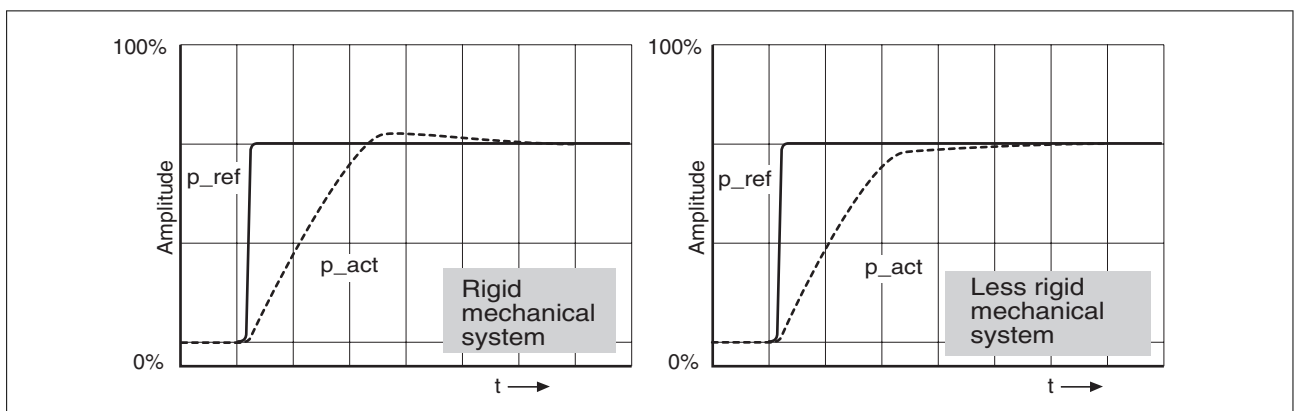


Figure 36: Step responses of a position controller with good control performance

The p gain setting  $CTRL\_Kp_p$  is optimal if the reference value is reached rapidly and with little or no overshooting.

If the control performance does not correspond to the curve shown, change the P gain  $CTRL\_Kp_p$  in increments of approximately 10% and trigger another step function.

- If the control tends to oscillate: Use a lower  $CTRL\_Kp_p$  value.
- If the actual value is too slow reaching the reference value: Use a higher  $CTRL\_Kp_p$  value.

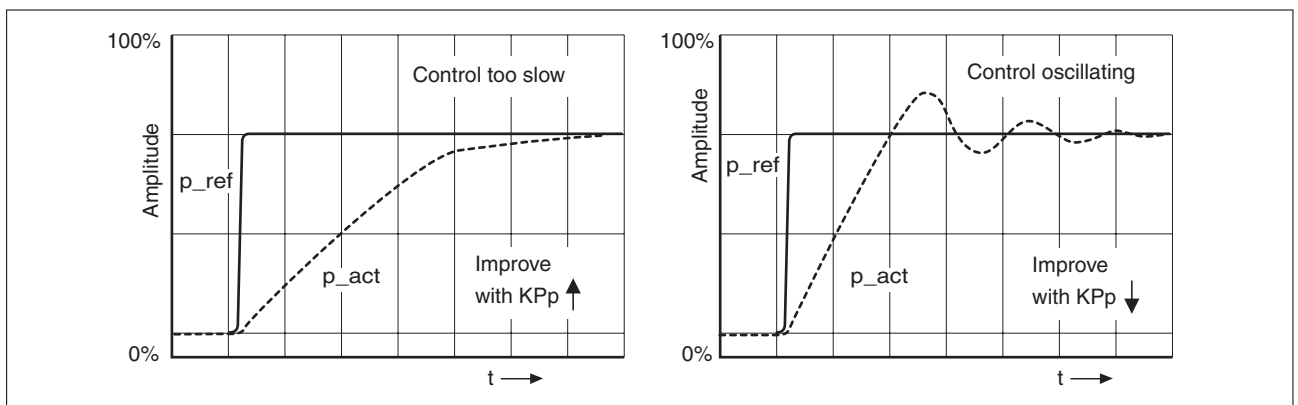


Figure 37: Optimizing inadequate position controller settings

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# 8 Operation



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

<b>⚠ WARNING</b>
<b>UNINTENDED BEHAVIOR</b>
<p>Unsuitable settings or unsuitable data may trigger unexpected movements, trigger signals, damage parts and disable monitoring functions.</p> <ul style="list-style-type: none"> <li>• Do not operate the drive system with unknown settings or data.</li> <li>• Verify that the stored data and settings are correct.</li> <li>• When commissioning, carefully run tests for all operating states and potential error situations.</li> <li>• Verify the functions after replacing the product and also after making changes to the settings or data.</li> <li>• Only start the system if there are no persons or obstructions in the hazardous area.</li> </ul> <p><b>Failure to follow these instructions can result in death, serious injury or equipment damage.</b></p>

## 8.1 Overview of operating modes

The table below provides an overview of the operating modes.

Operating mode	Page
"8.5.1 Operating mode Cyclic Synchronous Position"	116
"8.5.2 Operating mode Jog"	117
"8.5.3 Operating mode Speed Control"	122
"8.5.5 Operating mode Profile Position"	126
"8.5.4 Operating mode Profile Velocity"	123
"8.5.6 Operating mode Homing"	132

This chapter describes how to use the drive profile CANopen CiA 402.

## 8.2 Access channels

### ⚠ WARNING

#### UNINTENDED BEHAVIOR CAUSED BY ACCESS CONTROL

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

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

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

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

Exclusive access can be assigned to an access channel. With exclusive access, the device can only be controlled via this access channel.

The device has the following access channels:

- Ethernet fieldbus
- Commissioning software
- Signal inputs
- Web server

### 8.2.1 Access channel Ethernet fieldbus

Use the parameter `AccessLock` to assign exclusive access 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
<code>AccessLock</code>	<p>Locking other access channels</p> <p>0: Release other access channels 1: Lock other access channels</p> <p>The fieldbus can lock active access to the device via the following access channels with this parameter:</p> <ul style="list-style-type: none"> <li>- Input signals</li> <li>- Commissioning software</li> </ul> <p>Processing of the input signal HALT cannot be locked.</p> <p>Changed settings become active immediately.</p>	- 0 - 1	UINT16 UINT16 R/W -	CANopen 3001:1E <sub>n</sub> Modbus 316



### 8.2.2 Access channel commissioning software

Use the "Access" control to assign exclusive access to the commissioning software. In this case, the product can no longer be controlled via another access channel.

### 8.2.3 Access channel signal input

You can control the device using the functions of the signal inputs LIO1 ... LIO4. Control is not possible while another access channel has exclusive access.

The following signal inputs are effective even if another access channel has exclusive access.

- The digital signal inputs of the STO safety function.
- The digital signal inputs with the functions "Halt", "Positive limit switch (LIMP)", "Negative limit switch (LIMN)" and "Reference switch (REF)".

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 internally monitored and influenced by monitoring functions

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

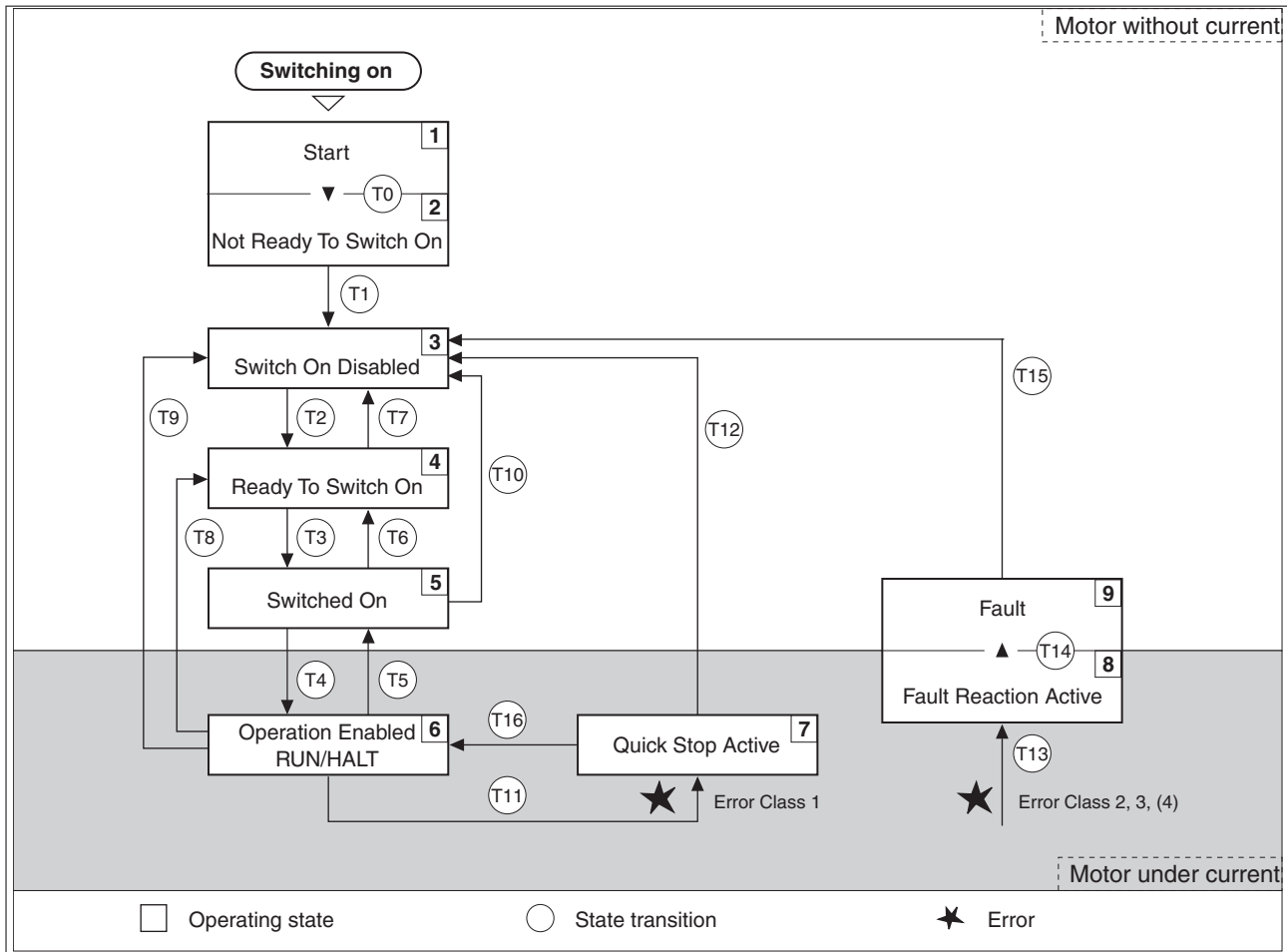


Figure 38: State diagram

*Operating states*

Operating state	Description
<b>1</b> Start	Controller supply voltage switched on Electronics are initialized
<b>2</b> Not Ready To Switch On	The power stage is not ready to switch on
<b>3</b> Switch On Disabled	Impossible to enable the power stage
<b>4</b> Ready To Switch On	The power stage is ready to switch on.
<b>5</b> Switched On	Power stage is switched on
<b>6</b> Operation Enabled	Power stage is enabled Selected operating mode is active
<b>7</b> Quick Stop Active	"Quick Stop" is being executed
<b>8</b> Fault Reaction Active	Error response is active
<b>9</b> Fault	Error response terminated Power stage is disabled

*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	Response
2	Movement is stopped with "Quick Stop" Holding brake is applied Power stage is disabled
3, 4 or Safety function STO	Power stage is immediately disabled

An error can be triggered by a temperature sensor, for example. The product cancels the current movement and triggers an error response. 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 an error of class 1 (operating state **7**), a "Fault Reset" causes a direct transition to operating state **6**.

*State transitions*

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

Transition	Operating state	Condition / event <sup>1)</sup>	Response
T0	1-> 2	<ul style="list-style-type: none"> <li>Device electronics successfully initialized</li> </ul>	
T1	2-> 3	<ul style="list-style-type: none"> <li>Parameter successfully initialized</li> </ul>	
T2	3 -> 4	<ul style="list-style-type: none"> <li>No undervoltage</li> <li>Encoder successfully checked</li> <li>Actual velocity: &lt;1000 min<sup>-1</sup></li> <li>STO signals = +24V (or jumper CN6 plugged in)</li> </ul>	
T3	4 -> 5	<ul style="list-style-type: none"> <li>Request for enabling the power stage</li> <li>Fieldbus command: Switch On or Enable Operation</li> </ul>	
T4	5 -> 6	<ul style="list-style-type: none"> <li>Automatic transition</li> <li>Fieldbus command: Enable Operation</li> </ul>	Power stage is enabled User-defined parameters are checked Holding brake is released (if available)
T5	6 -> 5	<ul style="list-style-type: none"> <li>Fieldbus command: Disable Operation</li> </ul>	Movement is canceled with "Halt". Holding brake is applied Power stage is disabled
T6	5 -> 4	<ul style="list-style-type: none"> <li>Fieldbus command: Shutdown</li> </ul>	
T7	4 -> 3	<ul style="list-style-type: none"> <li>Undervoltage</li> <li>STO signals = 0V</li> <li>Actual velocity: &gt;1000 min<sup>-1</sup> (for example by external driving force)</li> <li>Fieldbus command: Disable Voltage</li> </ul>	-
T8	6 -> 4	<ul style="list-style-type: none"> <li>Fieldbus command: Shutdown</li> </ul>	Power stage is immediately disabled.
T9	6 -> 3	<ul style="list-style-type: none"> <li>Request for disabling the power stage</li> <li>Fieldbus command: Disable Voltage</li> </ul>	Power stage is immediately disabled.
T10	5 -> 3	<ul style="list-style-type: none"> <li>Request for disabling the power stage</li> <li>Fieldbus command: Disable Voltage</li> </ul>	
T11	6 -> 7	<ul style="list-style-type: none"> <li>Error of error class 1</li> <li>Fieldbus command: Quick Stop</li> </ul>	Movement is canceled with "Quick Stop".
T12	7 -> 3	<ul style="list-style-type: none"> <li>Request for disabling the power stage</li> <li>Fieldbus command: Disable Voltage</li> </ul>	Power stage is disabled immediately, even if "Quick Stop" is still active.
T13	x -> 8	<ul style="list-style-type: none"> <li>Error of error classes 2, 3 or 4</li> </ul>	Error response is carried out, see "Error Response"
T14	8 -> 9	<ul style="list-style-type: none"> <li>Error response terminated (error class 2)</li> <li>Error of error classes 3 or 4</li> </ul>	
T15	9 -> 3	<ul style="list-style-type: none"> <li>Function: "Fault Reset"</li> </ul>	Error is reset (cause of error must have been corrected).
T16	7 -> 6	<ul style="list-style-type: none"> <li>Function: "Fault Reset"</li> <li>Fieldbus command: Enable Operation <sup>2)</sup></li> </ul>	

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

2) Possible only if operating state was triggered via the fieldbus

### 8.3.2 Indicating the operating states

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

*Via signal outputs*

Indication of the operating states via the signal outputs must be configured, see chapter "8.6.9 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 Enabled	1	1
7 Quick Stop Active	0	0
8 Fault Reaction Active	0	0
9 Fault	0	0

*Via fieldbus*

The operating state is indicated via the signal inputs, the fieldbus or the commissioning software.

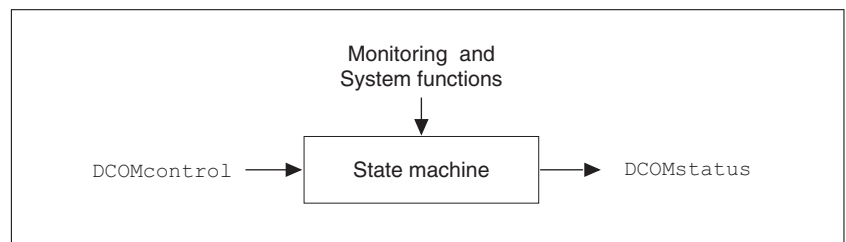


Figure 39: Changing and monitoring the operating state via parameters

*Status information*

The parameter `DCOMstatus` provides global information on the operating state of the device and the processing status.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
DCOMstatus	Drivecom status word Refer to chapter Operation, State Machine for bit coding information. Bit 0-3,5,6: Status bits Bit 4: Voltage enabled Bit 7: Warning Bit 8: HALT request active Bit 9: Remote Bit 10: Target reached Bit 11: Reserved Bit 12: Operating mode specific Bit 13: x_err Bit 14: x_end Bit 15: ref_ok	- - 0 -	UINT16 UINT16 R/- - -	CANopen 6041:0h Modbus 6916

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*Bits 0, 1, 2, 3, 5 and 6* Bits 0, 1, 2, 3, 5 and 6 of the `DCOMstatus` parameter provide information on the operating state.

Operating state	Bit 6 Switch On Disabled	Bit 5 Quick Stop	Bit 3 Fault	Bit 2 Operation Enabled	Bit 1 Switch On	Bit 0 Ready To Switch On
2 Not Ready To Switch On	0	X	0	0	0	0
3 Switch On Disabled	1	X	0	0	0	0
4 Ready To Switch On	0	1	0	0	0	1
5 Switched On	0	1	0	0	1	1
6 Operation Enabled	0	1	0	1	1	1
7 Quick Stop Active	0	0	0	1	1	1
8 Fault Reaction Active	0	X	1	1	1	1
9 Fault	0	X	1	0	0	0

*Bit 4, Voltage enabled* Bit 4=1 indicates whether the DC bus voltage is correct. If the voltage is missing or is too low, the device does not transition from operating state 3 to operating state 4.

*Bit 7, Warning* Bit 7 is 1 if parameter `_WarnActive` contains a warning message. Operation is not interrupted. The bit remains set as long as a warning message is contained in parameter `_WarnActive`. The bit remains set for at least 100ms, even if a warning message is active for a shorter time. The bit is reset immediately in the case of a "Fault Reset".

*Bit 8, Halt request active* Bit 8=1 indicates that a "Halt" is active.

*Bit 9, Remote* If bit 9 is set, the device carries out commands via the fieldbus. If Bit 9 is reset, the device is controlled via a different interface. In such a case, it is still possible to read or write parameters via the fieldbus.

*Bit 10, target reached* Bit 10 only becomes "1", if the operating mode is terminated successfully and the motor has come to a standstill. Bit 10 has the value "0" as long as the motor is running, if the operating mode is interrupted by a "Halt" or canceled because of an error.

*Bit 11* Reserved.

*Bit 12* Bit 12 is used for monitoring the current operating mode. Details can be found in the chapters on the individual operating modes.

*Bit 13, x\_err* Bit 13 only becomes "1" in the case of an error which needs to be remedied prior to further processing. The device responds corresponding to the error class.

*Bit 14, x\_end* Bit 14 changes to "0" if an operating mode is started. When processing is terminated or interrupted, for example by a "Halt", bit 14 toggles back to "1" once the motor has come to a standstill. The signal change of bit 14 to "1" is suppressed if one process is followed immediately by a new process in a different operating mode.

*Bit 15, ref\_ok* Bit 15 is "1" if the motor or the axis has a valid reference point, for example as a result of a reference movement. A valid reference point remains valid even if the power stage is disabled.

8.3.3 Changing operating states

You can switch the operating state via the commissioning software or the fieldbus.

*Via signal inputs* The operating state is changed either via the commissioning software, the signal inputs or automatically.

Input signal	State transitions	State transition to
ENABLE 0 -> 1	T3, T4	6 Operation Enabled
ENABLE 1 -> 0	T5, T6	4 Ready To Switch On
FAULT_RESET 0 -> 1	T15 T16	4 Ready To Switch On 6 Operation Enabled

*Via fieldbus* The operating states are either set via the commissioning software or the parameter DCOMcontrol. Bits 0 to 3 and bit 7 are relevant for state transitions.

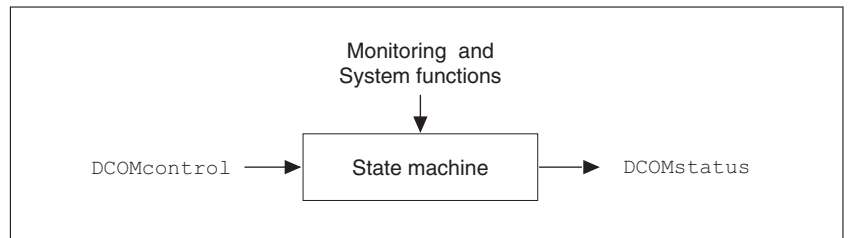


Figure 40: Changing and monitoring the operating state via parameters

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
DCOMcontrol	Drivecom control word Refer to chapter Operation, Operating States, for bit coding information. Bit 0: Switch on Bit 1: Enable Voltage Bit 2: Quick Stop Bit 3: Enable Operation Bit 4..6: Operating mode specific Bit 7: Fault Reset Bit 8: Halt Bit 9..15: Reserved (must be 0) Changed settings become active immediately.	- - 0 -	UINT16 UINT16 R/W - -	CANopen 6040:0h Modbus 6914

Bits 0 to 3 and 7

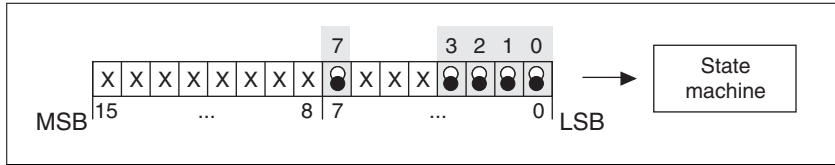


Figure 41: Changing the operating state

Fieldbus command	State transitions	State transition to	Bit 7, Fault Reset	Bit 3, Enable operation	Bit 2, Quick Stop	Bit 1, Enable Voltage	Bit 0, Switch On
Shutdown	T2, T6, T8	4 Ready To Switch On	X	X	1	1	0
Switch On	T3	5 Switched On	X	X	1	1	1
Disable Voltage	T7, T9, T10, T12	3 Switch On Disabled	X	X	X	0	X
Quick Stop	T7, T10T11	3 Switch On Disabled 7 Quick Stop Active	X	X	0	1	X
Disable Operation	T5	5 Switched On	X	0	1	1	1
Enable Operation	T4, T16	6 Operation Enabled	X	1	1	1	1
Fault Reset	T15	3 Switch On Disabled	0->1	X	X	X	X

The bit states in the fields marked with "X" have no meaning for the corresponding state transition.

**Bits 4 to 6** Bits 4 to 6 are used for the operating mode-specific settings. Details can be found in the descriptions of the individual operating modes in this chapter.

**Bit 8, Halt** A "Halt" can be triggered with bit 8=1.

**Bits 9 to 15** Reserved.



## 8.4 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 "Operation Enabled".

*Restarting a canceled operating mode*

If an operating mode is to be continued after cancellation due to a state transition, the master must change the corresponding reference value. If it does not do so, the value is not taken over by the drive and the operating mode not started.

This applies to the operating modes that do not have an explicit start bit in the control word `DCOMcontrol`:

- Profile Velocity: `PVn_target`
- Jog: `JOGactivate`
- Speed Control: `SPEEDreference`

## 8.4.1 Starting the operating mode

*Via fieldbus* An operating mode is started using the parameter `DCOMopmode`.

The following table shows the sequence of parameters for starting an operating mode using the example of the operating mode Jog.

	Parameters	Meaning
1	JOGactivate	Activation of jog
2	DCOMopmode	Starting the operating mode (-3)

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
JOGactivate	Activation of operating mode Jog Bit 0: positive direction of rotation Bit 1: negative direction of rotation Bit 2: 0=slow 1=fast  Changed settings become active immediately.	- 0 0 7	UINT16 UINT16 R/W - -	CANopen 301B:9h Modbus 6930
DCOMopmode	Operating mode <b>-1 / Jog:</b> Jog <b>0 / Reserved:</b> Reserved <b>1 / Profile Position:</b> Profile Position <b>3 / Profile Velocity:</b> Profile Velocity <b>6 / Homing:</b> Homing <b>8 / Cyclic Synchronous Position:</b> Cyclic Synchronous Position  Changed settings become active immediately.	- -6 - 8	INT8 INT16 R/W - -	CANopen 6060:0h Modbus 6918

In the operating modes Profile Position and Homing, the device receives the request for starting the selected operating mode via bit 4 in the parameter `DCOMcontrol`.

In the other operating modes, bits 4 to 6 have operating mode-specific assignments.

8.4.2 Changing the operating mode

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

2 parameters are available for indicating the current operating mode and for changing the operating modes.

- Parameter for indication: `_DCOMopmd_act`
- Parameter for change: `DCOMopmode`

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
<code>_DCOMopmd_act</code>	Active operating mode <b>-1 / Jog:</b> Jog <b>0 / Reserved:</b> Reserved <b>1 / Profile Position:</b> Profile Position <b>3 / Profile Velocity:</b> Profile Velocity <b>6 / Homing:</b> Homing	- -6 - 6	INT8 INT16 R/- -	CANopen 6061:0h Modbus 6920
<code>DCOMopmode</code>	Operating mode <b>-1 / Jog:</b> Jog <b>0 / Reserved:</b> Reserved <b>1 / Profile Position:</b> Profile Position <b>3 / Profile Velocity:</b> Profile Velocity <b>6 / Homing:</b> Homing <b>8 / Cyclic Synchronous Position:</b> Cyclic Synchronous Position Changed settings become active immediately.	- -6 - 8	INT8 INT16 R/W -	CANopen 6060:0h Modbus 6918

8.5 Operating modes

The settings for the operating mode must be made in TwinCAT, see chapter "7.3 Add the product as an NC axis in "TwinCAT".".

8.5.1 Operating mode Cyclic Synchronous Position

The drive synchronously follows the position values transmitted on a cyclic basis. The transmitted values are linearly interpolated (internally).

The motion profile is generated by the master controller, in the case of TwinCAT via the NC axis with the blocks of the TcMc.lib library.

The possible applications for this operating mode are described in the manual of the master controller.

*Availability* Available with firmware version  $\geq V1.010$ .

*Starting the operating mode* The operating mode is set in the parameter `DCOMopmode`.

A transition to the operating state **6** Operation Enabled starts the set operating mode.

The parameter `PPp_targetusr` provides the target value.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PPp_targetusr	Target position for operating mode Profile Position  Min./max values depend on: - Scaling factor - Software limit switches (if they are activated)  Changed settings become active immediately.	usr - 0 -	INT32 INT32 R/W - -	CANopen 607A:0h Modbus 6940

*Control word* In the operating mode, the operating mode-specific bits in the control word have no significance.

*Status word* Information on the current movement is available via bits 10 and 12 ... 15 in the parameter `DCOMstatus`.

Parameter value	Meaning
Bit 10: Reserved	Not relevant for this operating mode
Bit 12:	0: Target position ignored 1: Target position shall be used as input to position control loop
Bit 13:	0: No following error 1: Following error
Bit 14: x_end	0: Operating mode started 1: Operating mode terminated
Bit 15: ref_ok	1: Drive has valid reference point

*Terminating the operating mode* The operating mode is terminated when a different operating mode is selected or when the operating state **6** Operation Enabled is left.

### 8.5.2 Operating mode Jog

*Overview of operating mode Jog*

In the operating mode Jog, the motor moves by one jog unit or at constant speed of rotation during continuous movements. The distance of the jog unit, the values for the speed of rotation and the waiting time prior to continuous movement can be set.

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

If movements in positive and negative directions are requested at the same time, there is no motor movement.

*Starting the operating mode*

In the case of fieldbus control mode, the operating mode must be set using the parameter `DCOMopmode`.

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 movement until the start signal is canceled.

The illustration below shows an overview of control via signal inputs.

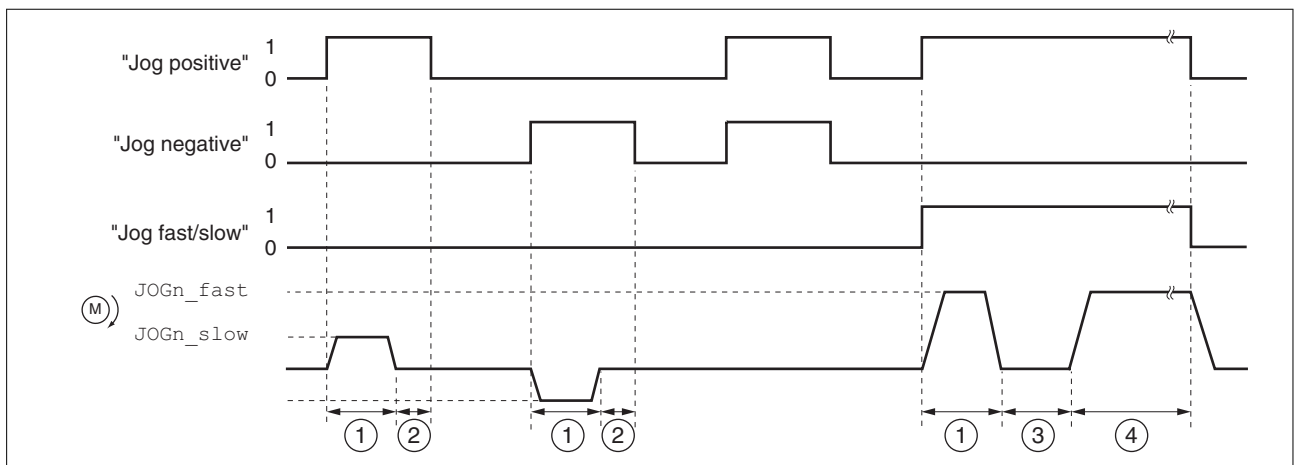


Figure 42: Jog, slow and fast

- (1) Distance unit
- (2)  $t < \text{waiting time}$
- (3)  $t > \text{waiting time}$
- (4) Continuous movement

The illustration below shows an overview of control via the fieldbus.

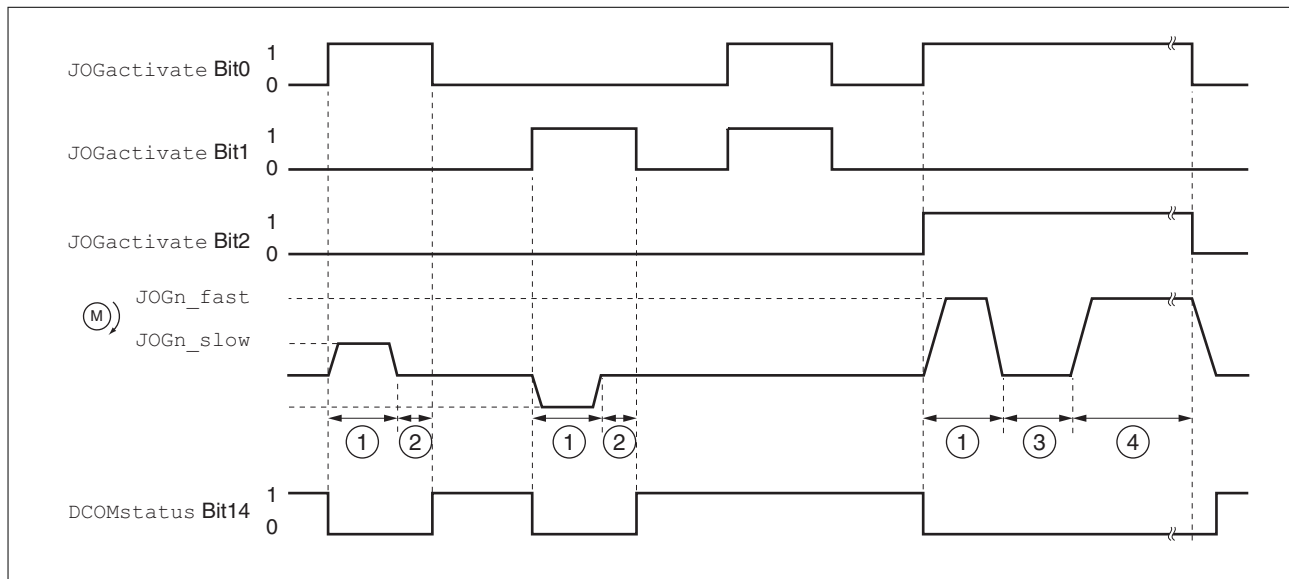


Figure 43: Jog, slow and fast

- (1) Distance unit
- (2)  $t < \text{waiting time}$
- (3)  $t > \text{waiting time}$
- (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 operating mode Jog Bit 0: positive direction of rotation Bit 1: negative direction of rotation Bit 2: 0=slow 1=fast Changed settings become active immediately.	- 0 0 7	UINT16 UINT16 R/W - -	CANopen 301B:9h Modbus 6930
JOGn_slow	Speed for slow jog The adjustable value is internally limited to the current parameter setting in RAMPn_max. Changed settings become active immediately.	min <sup>-1</sup> 1 60 13200	UINT16 UINT16 R/W per. -	CANopen 3029:4h Modbus 10504
JOGn_fast	Speed for fast jog The adjustable value is internally limited to the current parameter setting in RAMPn_max. Changed settings become active immediately.	min <sup>-1</sup> 1 180 13200	UINT16 UINT16 R/W per. -	CANopen 3029:5h Modbus 10506
JOGstepusr	Jog distance prior to continuous movement 0: Direct activation of continuous movement >0: Positioning distance per jog cycle Changed settings become active the next time the motor moves.	usr 0 20 2147483647	INT32 INT32 R/W per. -	CANopen 3029:7h Modbus 10510
JOGtime	Wait time prior to continuous movement This time is only effective if you have set a jog distance not equal to 0, otherwise the drive immediately starts a continuous movement. Changed settings become active the next time the motor moves.	ms 1 500 32767	UINT16 UINT16 R/W per. -	CANopen 3029:8h Modbus 10512

*Status messages* The drive provides information concerning the movements via bits 10 and 12 to 15 in the parameter DCOMstatus.

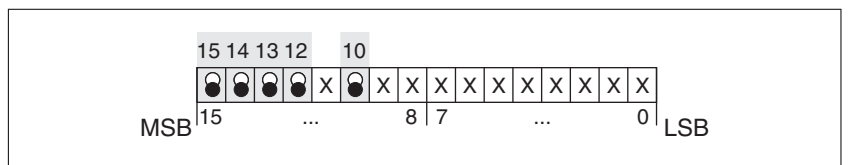


Figure 44: Status messages for the operating mode

Parameter value	Meaning
Bit 10: Target reached	Not relevant for this operating mode
Bit 12: Operating mode-dependent	Reserved
Bit 13: x_err	1: Error
Bit 14: x_end	1: Operating mode terminated, motor at a standstill
Bit 15: ref_ok	1: Drive has valid reference point

*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* Jog can also be assigned to digital inputs. It is possible to assign Jog positive, Jog negative and Jog slow/fast to one input each.

For further settings and functions for the operating mode, see page 146.



8.5.2.1 Example of a movement via DS402 objects

*Adapting the list of the startup parameters*

Index	Parameter name (DS402 name)	Value
3006:7 <sub>h</sub>	ScalePOSdenom	16384
3006:8 <sub>h</sub>	ScalePOSnum	1
605A:0 <sub>h</sub>	LIM_QStopReact (Quick stop option code)	6
3006:6 <sub>h</sub>	IOsigLimFreeMode	0
6060:0 <sub>h</sub>	DCOMopmode (Mode of operation)	-1

*Adapting the mapping for RxPDO*

Index	Parameter name (DS402 name)
6040:0 <sub>h</sub>	DCOMcontrol (Control word)
301B:9 <sub>h</sub>	JOGactivate
6060:0 <sub>h</sub>	DCOMopmode (Mode of operation)

*Adapting the mapping for TxPDO*

Index	Parameter name (DS402 name)
6041:0 <sub>h</sub>	_DCOMstatus (Status word)
6060:0 <sub>h</sub>	_DCOMopmd_act (Mode of operation display)

*Example*

Meaning	Index	Parameter name (DS402 name)	Value
SDO: Set the velocity for slow movement (for example, 100 min <sup>-1</sup> )	3029:4 <sub>h</sub>	JOGn_slow	64 <sub>h</sub>
SDO: Set the velocity for fast movement (for example, 300 min <sup>-1</sup> )	3029:5 <sub>h</sub>	JOGn_fast	012C <sub>h</sub>
RxPDO: Enable power stage	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	00 <sub>h</sub>
	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	06 <sub>h</sub>
	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	0F <sub>h</sub>
TxPDO: Check whether power stage has been enabled	6041:0 <sub>h</sub>	_DCOMstatus (Status word)	4637 <sub>h</sub>
RxPDO: Set the operating mode	6060:0 <sub>h</sub>	DCOMopmode (Mode of operation)	FF <sub>h</sub>
TxPDO: Check whether operating mode has been set	6061:0 <sub>h</sub>	_DCOMopmd_act (Mode of operation display)	FF <sub>h</sub>
RxPDO: Start movement (for example, slow movement in positive direction)	301B:9 <sub>h</sub>	JOGactivate	01 <sub>h</sub>
TxPDO: Get the state via status parameters	6041:0 <sub>h</sub>	_DCOMstatus (Status word)	0237 <sub>h</sub>
RxPDO: Terminate movement	301B:9 <sub>h</sub>	JOGactivate	00 <sub>h</sub>

8.5.3 Operating mode Speed Control

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

Transitions between two velocities follow the adjusted control loop parameters.

*Starting the operating mode* In the case of fieldbus control mode, the operating mode must be set using the parameter `DCOMopmode`. Writing the parameter value `SPEEDreference` causes the operating mode to start. The parameter `SPEEDn_target` specifies the reference value.

*Setting limit values* See chapter "7.4.2 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
<code>SPEEDreference</code>	Reference value source for operating mode Speed Control  <b>0 / None:</b> None <b>2 / Parameter 'SPEEDn_target':</b> Reference value via parameter <code>SPEEDn_target</code>  Changed settings become active immediately.	- 0 0 2	UINT16 UINT16 R/W - -	CANopen 301B:11h Modbus 6946
<code>SPEEDn_target</code>	Reference velocity in operating mode Speed Control  The internal maximum speed is limited to the current setting in <code>CTRL_n_max</code> .  Changed settings become active immediately.	min <sup>-1</sup> -30000 0 30000	INT16 INT16 R/W - -	CANopen 3021:4h Modbus 8456

*Status messages* The drive provides information concerning the movements via bits 10 and 12 to 15 in the parameter `DCOMstatus`.

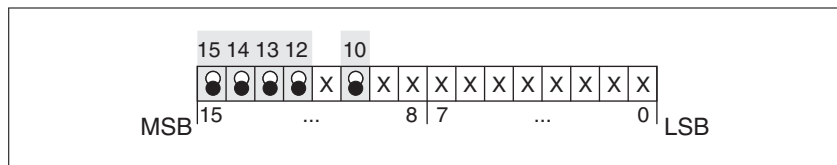


Figure 45: Status messages for the operating mode

Parameter value	Meaning
Bit 10: Target reached	Not relevant for this operating mode
Bit 12: Operating mode-dependent	Reserved
Bit 13: <code>x_err</code>	1: Error
Bit 14: <code>x_end</code>	1: Operating mode terminated, motor at a standstill
Bit 15: <code>ref_ok</code>	1: Drive has valid reference point

*Terminating the operating mode* Processing is terminated by:

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

8.5.4 Operating mode Profile Velocity

In the operating mode Profile Velocity, a movement is made with a desired target velocity. You can set a motion profile with values for acceleration and deceleration ramps.

Starting the operating mode

After the operating mode, the operating state and the parameter values have been set, the operating mode can be started by applying the target velocity set in the parameter *PVn\_target*.

Status messages

The drive provides information concerning the movements via bits 10 and 12 to 15 in the parameter *DCOMstatus*.

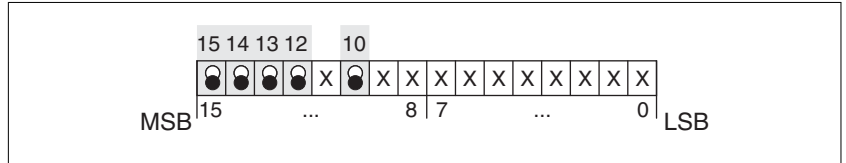


Figure 46: Status messages for the operating mode

Parameter value	Meaning
Bit 10: Target reached	0: Target velocity not reached 1: Target velocity reached (also in the case of motor standstill via "Halt")
Bit 12: speed=0	0: Motor shaft moves 1: Motor at a standstill
Bit 13: x_err	1: Error
Bit 14: x_end	1: Operating mode terminated
Bit 15: ref_ok	1: Drive has valid reference point

Operating mode terminated

The operating mode is terminated by a motor standstill caused by "Halt", by an error or when the reference value is 0.

8.5.4.1 Parameterization

Overview

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

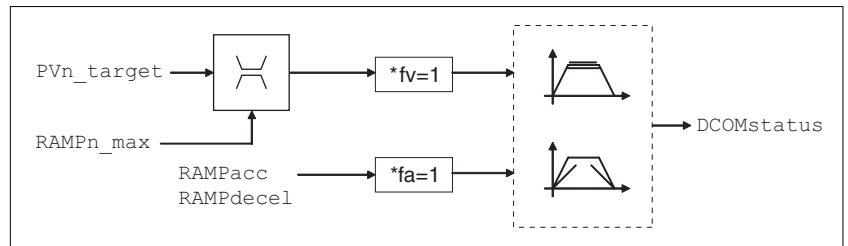


Figure 47: Operating mode Profile Velocity, function principle of adjustable parameters

Reference velocity

The target velocity is assigned via the parameter *PVn\_target* and can be changed during the movement. The operating mode is not limited by the movement 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	<p>Target velocity for operating mode Profile Velocity</p> <p>The maximum value is limited to the current setting in CTRL_n_max.</p> <p>The adjusted value is internally limited to the current parameter value in RAMPn_max.</p> <p>Changed settings become active immediately.</p>	min <sup>-1</sup> - 0 -	INT32 INT32 R/W - -	CANopen 60FF:0h Modbus 6938

*Actual velocity* The actual velocity can be determined with 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 velocity of motor	min <sup>-1</sup> - 0 -	INT32 INT16 R/- - -	CANopen 606C:0h Modbus 7696
_n_actRAMP	Actual velocity of profile generator	min <sup>-1</sup> - 0 -	INT32 INT32 R/- - -	CANopen 606B:0h Modbus 7948

8.5.4.2 Example of a movement via DS402 objects

*Adapting the list of the startup parameters*

Index	Parameter name (DS402 name)	Value
3006:7 <sub>h</sub>	ScalePOSdenom	16384
3006:8 <sub>h</sub>	ScalePOSnum	1
605A:0 <sub>h</sub>	LIM_QStopReact (Quick stop option code)	6
3006:6 <sub>h</sub>	IOsigLimFreeMode	0
6060:0 <sub>h</sub>	DCOMopmode (Mode of operation)	3

*Adapting the mapping for RxPDO*

Index	Parameter name (DS402 name)
6040:0 <sub>h</sub>	DCOMcontrol (Control word)
60FF:0 <sub>h</sub>	PVn_target (Target velocity)
6083:0 <sub>h</sub>	RAMPacc (Profile acceleration)
6084:0 <sub>h</sub>	RAMPdecel (Profile deceleration)
6060:0 <sub>h</sub>	DCOMopmode (Mode of operation)

*Adapting the mapping for TxPDO*

Index	Parameter name (DS402 name)
6041:0 <sub>h</sub>	_DCOMstatus (Status word)
6060:0 <sub>h</sub>	_DCOMopmd_act (Mode of operation display)

*Example*

Meaning	Index	Parameter name (DS402 name)	Value
RxPDO: Set acceleration (for example, 100 min <sup>-1</sup> /s)	6083:0 <sub>h</sub>	RAMPacc (Profile acceleration)	64 <sub>h</sub>
RxPDO: Set deceleration (for example, 300 min <sup>-1</sup> /s)	6084:0 <sub>h</sub>	RAMPdecel (Profile deceleration)	012C <sub>h</sub>
RxPDO: Enable power stage	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	00 <sub>h</sub>
	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	06 <sub>h</sub>
	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	0F <sub>h</sub>
TxPDO: Check whether power stage has been enabled	6041:0 <sub>h</sub>	_DCOMstatus (Status word)	4637 <sub>h</sub>
RxPDO: Set the operating mode	6060:0 <sub>h</sub>	DCOMopmode (Mode of operation)	03 <sub>h</sub>
TxPDO: Check whether operating mode has been set	6061:0 <sub>h</sub>	_DCOMopmd_act (Mode of operation display)	03 <sub>h</sub>
RxPDO: Start movement by setting a target velocity (for example, 600 min <sup>-1</sup> )	60FF:0 <sub>h</sub>	PVn_target (Target velocity)	0258 <sub>h</sub>
TxPDO: Check whether target velocity has been reached	6041:0 <sub>h</sub>	_DCOMstatus (Status word)	0637 <sub>h</sub>
RxPDO: Terminate movement (with Quick Stop)	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	0B <sub>h</sub>
RxPDO: Reset Quick Stop	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	0F <sub>h</sub>

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8.5.5 Operating mode Profile Position

In the operating mode Profile Position, 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 velocity.

*Relative and absolute movements*

In the case of absolute positioning, the movement distance is specified absolutely with reference to the zero point of the axis. A zero point must be defined with the operating mode Homing prior to the first absolute movement.

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

Absolute movement or relative movement is set with bit 6 via the parameter `DCOMcontrol`.

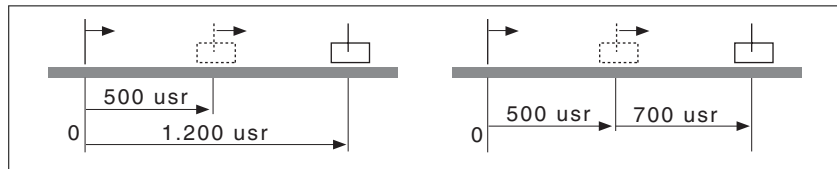


Figure 48: Absolute movement (left) and relative movement (right)

*Trigger movement*

Parameter value	Meaning
Bit 4: New target value	0->1: Start movement or prepare subsequent movement
Bit 5: Change setpoint immediately (only if New setpoint 0->1)	0: Activate new reference position when target position is reached 1: Activate new reference position immediately
Bit 6: Absolute / relative	0: Absolute movement 1: Relative movement

A new movement is started when the edge of bit 4 in the parameter `DCOMcontrol` rises.

The movement can be triggered in 2 ways depending on bit 5.

- Bit 5 = 0:  
Reference positions (PPp\_targetusr, PPn\_target, RAMPacc and RAMPdecel) that are supplied while a movement is active, are saved temporarily. The movement continues to the target position of the current movement. The new movement according to the reference position is executed only when the target position has been reached.  
If new reference positions are provided again, the temporarily saved reference positions are overwritten.
- Bit 5 = 1:  
Reference positions (PPp\_targetusr, PPn\_target, RAMPacc and RAMPdecel) that are supplied while a movement is active are immediately executed. The movement to the new target position starts immediately.

*Status messages* The drive provides information concerning the movements via bits 10 and 12 to 15 in the parameter DCOMstatus.

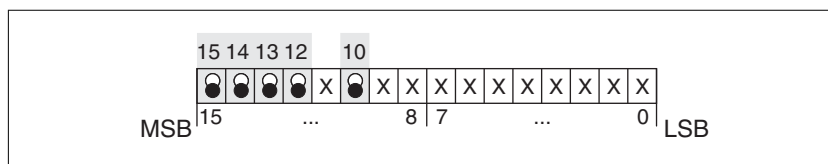


Figure 49: Status messages for the operating mode

Parameter value	Meaning
Bit 10: Target reached	0: Target position not reached (also in the case of "Halt" or error) 1: Target position reached
Bit 12: Target value acknowledge	0: New position possible 1: New target position accepted
Bit 13: x_err	1: Error
Bit 14: x_end	1: Operating mode terminated, motor at a standstill
Bit 15: ref_ok	1: Drive has valid reference point

*Positioning finished* Bit 14 indicates whether positioning has been finished. If the target position was reached, bit 10 changes to 1. If the positioning movement was canceled by "Halt" or by an error, bit 10 remains set to 0.

### 8.5.5.1 Parameterization

The Profile Position operating mode can be set and executed via parameters.

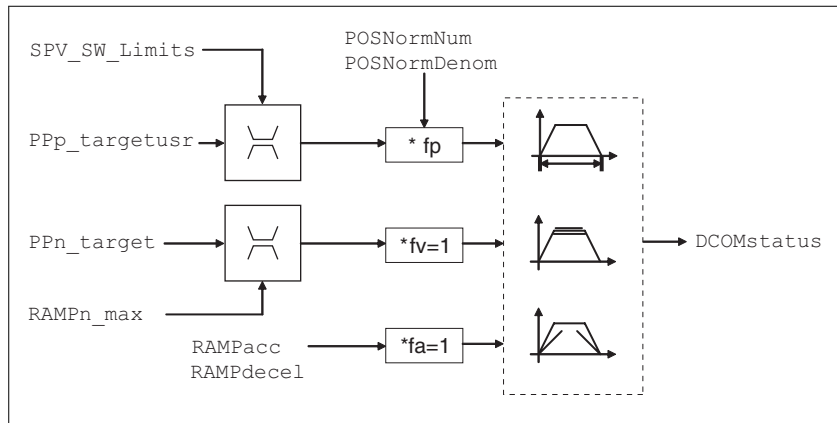


Figure 50: Operating mode Profile Position, function principle of adjustable parameters

*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. This depends on the setting in parameter  $PPoption$ .



Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
PPn_target	Target velocity for operating mode Profile Position The maximum value is limited to the current setting in CTRL_n_max. The adjusted value is internally limited to the current parameter value in RAMPn_max. Changed settings become active the next time the motor moves.	min <sup>-1</sup> 1 60 -	UINT32 UINT32 R/W -	CANopen 6081:0h Modbus 6942
PPoption	Options for operating mode profile position Determines the reference position for relative positioning: 0: Relative with reference to the previous target position of the motion profile generator 1: Not supported 2: Relative with reference to the actual position of the motor Changed settings become active the next time the motor moves.	- 0 0 2	UINT16 UINT16 R/W -	CANopen 60F2:0h Modbus 6960
AbsHomeRequest	Absolute positioning only after homing <b>0 / No:</b> No <b>1 / Yes:</b> Yes Changed settings become active immediately.	- 0 0 1	UINT16 UINT16 R/W per. -	CANopen 3006:16h Modbus 1580
PPp_targetusr	Target position for operating mode Profile Position Min./max values depend on: - Scaling factor - Software limit switches (if they are activated) Changed settings become active immediately.	usr - 0 -	INT32 INT32 R/W -	CANopen 607A:0h Modbus 6940

*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
<u>p_actusr</u>	Actual position in user-defined units	usr - 0 -	INT32 INT32 R/- -	CANopen 6064:0h Modbus 7706
<u>p_actRAMPusr</u>	Actual position of profile generator In user-defined units	usr - 0 -	INT32 INT32 R/- -	CANopen 301F:2h Modbus 7940

## 8.5.5.2 Example of a movement via DS402 objects

*Adapting the list of the startup parameters*

Index	Parameter name (DS402 name)	Value
3006:7h	ScalePOSdenom	16384
3006:8h	ScalePOSnum	1
605A:0h	LIM_QStopReact (Quick stop option code)	6
3006:6h	IOsigLimFreeMode	0
6060:0h	DCOMopmode (Mode of operation)	1

*Adapting the mapping for RxPDO*

Index	Parameter name (DS402 name)
6040:0h	DCOMcontrol (Control word)
607A:0h	PPp_targetusr (Target position)
6081:0h	PPn_target (Profile velocity)
6083:0h	RAMPacc (Profile acceleration)
6084:0h	RAMPdecel (Profile deceleration)
6060:0h	DCOMopmode (Mode of operation)

*Adapting the mapping for TxPDO*

Index	Parameter name (DS402 name)
6041:0h	_DCOMstatus (Status word)
6060:0h	_DCOMopmd_act (Mode of operation display)

*Example*

Meaning	Index	Parameter name (DS402 name)	Value
RxPDO: Set acceleration (for example, 100 min <sup>-1</sup> /s)	6083:0 <sub>h</sub>	RAMPacc (Profile acceleration)	64 <sub>h</sub>
RxPDO: Set deceleration (for example, 300 min <sup>-1</sup> /s)	6084:0 <sub>h</sub>	RAMPdecel (Profile deceleration)	012C <sub>h</sub>
RxPDO: Set target velocity (for example, 60 min <sup>-1</sup> )	6081:0 <sub>h</sub>	PPn_target (Profile velocity)	3C <sub>h</sub>
RxPDO: Enable power stage	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	00 <sub>h</sub>
	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	06 <sub>h</sub>
	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	0F <sub>h</sub>
TxPDO: Check whether power stage has been enabled	6041:0 <sub>h</sub>	_DCOMstatus (Status word)	4637 <sub>h</sub>
RxPDO: Set the operating mode	6060:0 <sub>h</sub>	DCOMopmode (Mode of operation)	01 <sub>h</sub>
TxPDO: Check whether operating mode has been set	6061:0 <sub>h</sub>	_DCOMopmd_act (Mode of operation display)	01 <sub>h</sub>
RxPDO: Set target position (for example, 10000_usr)	607A:0 <sub>h</sub>	PPp_targetusr (Target position)	2710 <sub>h</sub>
RxPDO: start relative movement	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	5F <sub>h</sub>
TxPDO: Check whether target position has been reached	6041:0 <sub>h</sub>	_DCOMstatus (Status word)	5637 <sub>h</sub>
RxPDO: Rest bit "New setpoint"	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	4F <sub>h</sub>
TxPDO: Check whether new target position has been accepted	6041:0 <sub>h</sub>	_DCOMstatus (Status word)	4637 <sub>h</sub>

### 8.5.6 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 the subsequent absolute movements as a reference point. It is possible to parameterize a shift of the zero point.

A reference movement must be completed successfully 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 have been 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 not required for a motor with a multiturn encoder because it provides a valid absolute position immediately after being 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  $\overline{\text{REF}}$  in negative direction of movement
- Movement to reference switch  $\overline{\text{REF}}$  in positive direction of movement

Reference movements are possible with or without index pulse.

- Reference movement without index pulse  
Movement from the switching point to a parameterizable distance from switching point
- Reference movement with index pulse  
Movement from the switching point 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.

*Starting homing* Homing is triggered via bit 4=1 in parameter `DCOMcontrol`.

*Status messages* The drive provides information concerning positioning via bits 10 and 12 to 15 in the parameter `DCOMstatus`.

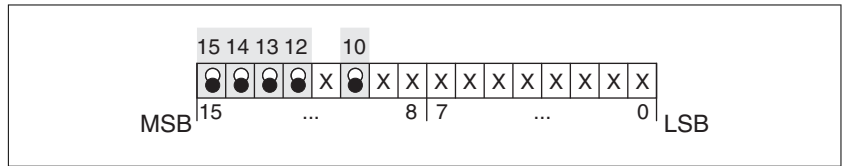


Figure 51: Status messages for the operating mode

Parameter value	Meaning
Bit 10: Target reached	0: Homing not completed 1: Homing completed (also in the case of cancellation via "Halt")
Bit 12: Homing attained	1: Homing successfully completed
Bit 13: x_err	1: Error
Bit 14: x_end	1: Homing completed, motor at standstill
Bit 15: ref_ok	1: Drive has valid reference point

## 8.5.6.1 Parameterization, general

*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	<p>Homing method</p> <p>1: LIMN with index pulse 2: LIMP with index pulse 7: REF+ with index pulse, inv., outside 8: REF+ with index pulse, inv., inside 9: REF+ with index pulse, not inv., inside 10: REF+ with index pulse, not inv., outside 11: REF- with index pulse, inv., outside 12: REF- with index pulse, inv., inside 13: REF- with index pulse, not inv., inside 14: REF- with index pulse, not inv., outside 17: LIMN 18: LIMP 23: REF+, inv., outside 24: REF+, inv., inside 25: REF+, not inv., inside 26: REF+, not inv., outside 27: REF-, inv., outside 28: REF-, inv., inside 29: REF-, not inv., inside 30: REF-, not inv., outside 33: Index pulse neg. direction 34: Index pulse pos. direction 35: Position setting</p> <p>Abbreviations: REF+: Search movement in pos. direction REF-: Search movement in neg. 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 Changed settings become active immediately.</p>	- 1 18 35	INT8 INT16 R/W - -	CANopen 6098:0 <sub>h</sub> Modbus 6936

Use the parameter `IOsigREF` to set the evaluation of the reference switch `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 `LIMP` and `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 for reference switch <b>1 / Normally Closed:</b> Normally closed NC <b>2 / Normally Open:</b> Normally open NO  The reference switch is only active while a reference movement to the reference switch is processed.  Setting can only be changed if power stage is disabled.  Changed settings become active the next time the power stage is enabled.	- 1 1 2	UINT16 UINT16 R/W per. -	CANopen 3006:E <sub>h</sub> Modbus 1564
IOsigLimN	Signal evaluation for negative limit switch <b>0 / Inactive:</b> Inactive <b>1 / Normally Closed:</b> Normally closed NC <b>2 / Normally Open:</b> Normally open NO  Setting can only be changed if power stage is disabled.  Changed settings become active the next time the power stage is enabled.	- 0 1 2	UINT16 UINT16 R/W per. -	CANopen 3006:F <sub>h</sub> Modbus 1566
IOsigLimP	Signal evaluation for positive limit switch <b>0 / Inactive:</b> Inactive <b>1 / Normally Closed:</b> Normally closed NC <b>2 / normally open:</b> Normally open NO  Setting can only be changed if power stage is disabled.  Changed settings become active the next time the power stage is enabled.	- 0 1 2	UINT16 UINT16 R/W per. -	CANopen 3006:10 <sub>h</sub> Modbus 1568

The parameters  $HM_n$  and  $HM_{n\_out}$  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
$HM_n$	Target velocity for searching the switch  The adjustable value is internally limited to the current parameter setting in $RAMP_n\_max$ .  Changed settings become active the next time the motor moves.	$min^{-1}$ 1 60 13200	UINT32 UINT16 R/W per. -	CANopen 6099:1 <sub>h</sub> Modbus 10248
$HM_{n\_out}$	Target velocity for moving away from switch  The adjustable value is internally limited to the current parameter setting in $RAMP_n\_max$ .  Changed settings become active the next time the motor moves.	$min^{-1}$ 1 6 3000	UINT32 UINT16 R/W per. -	CANopen 6099:2 <sub>h</sub> Modbus 10250

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

Parameter name	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. Changed settings become active the next time the motor moves.	usr -2147483648 0 2147483647	INT32 INT32 R/W per. -	CANopen 3028:B <sub>h</sub> Modbus 10262

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 point 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 point. If the defined switching point is not found within the distance defined here, the reference movement is canceled with an error. Changed settings become active the next time the motor moves.	usr 0 0 2147483647	INT32 INT32 R/W per. -	CANopen 3028:6 <sub>h</sub> Modbus 10252
HMsrchdisusr	Maximum search distance after overtravel of switch 0: Search distance monitoring disabled >0: Search distance The switch must be activated again within this search distance, otherwise the reference movement is canceled. Changed settings become active the next time the motor moves.	usr 0 0 2147483647	INT32 INT32 R/W per. -	CANopen 3028:D <sub>h</sub> Modbus 10266



8.5.6.2 Reference movement without index pulse

*Description* A reference movement without index pulse is set with the parameter  $HMmethod = 17$  to 30, see page 134.

The first movement is to the defined limit switch or reference switch. The next movement is to a defined distance from the switching point.

The parameter  $HMdisusr$  lets you set the distance to the switching point.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
$HMdisusr$	Distance from switching point The distance from the switching point is defined as the reference point.  The parameter is only effective during a reference movement without index pulse. Changed settings become active the next time the motor moves.	usr 1 200 2147483647	INT32 INT32 R/W per. -	CANopen 3028:7h Modbus 10254

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

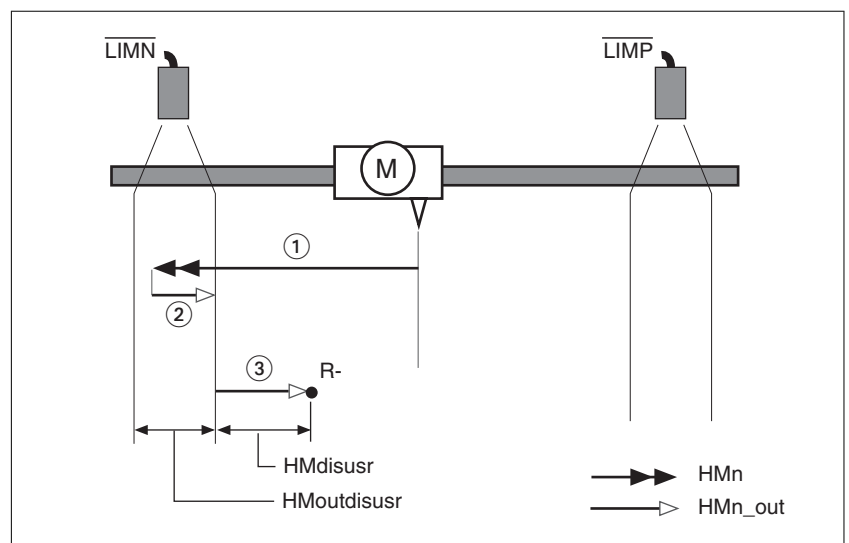


Figure 52: Reference movement to the negative limit switch

- (1) Movement to limit switch at search velocity
- (2) Movement to switching point at velocity for moving away from switch
- (3) Movement to distance from switching point at velocity 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 point ( $HM_{method} = 27$  to 30).

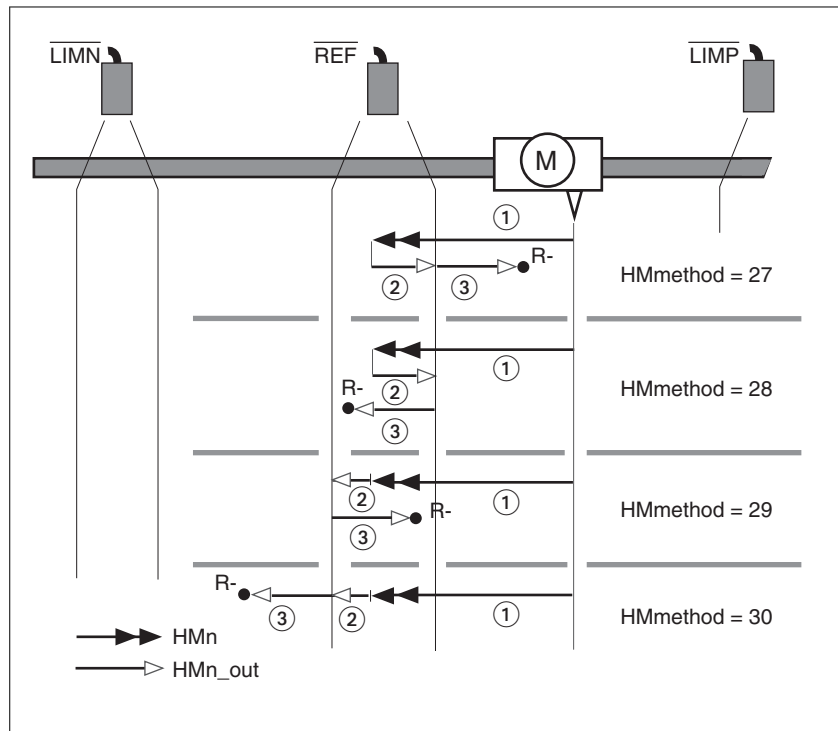


Figure 53: Reference movements to the reference switch

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

*Examples* The following illustration shows reference movements to the reference switch with distance from the switching point ( $HM_{method} = 27$ ). Various responses at different search velocities 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 switch range is passed (A2, B2).

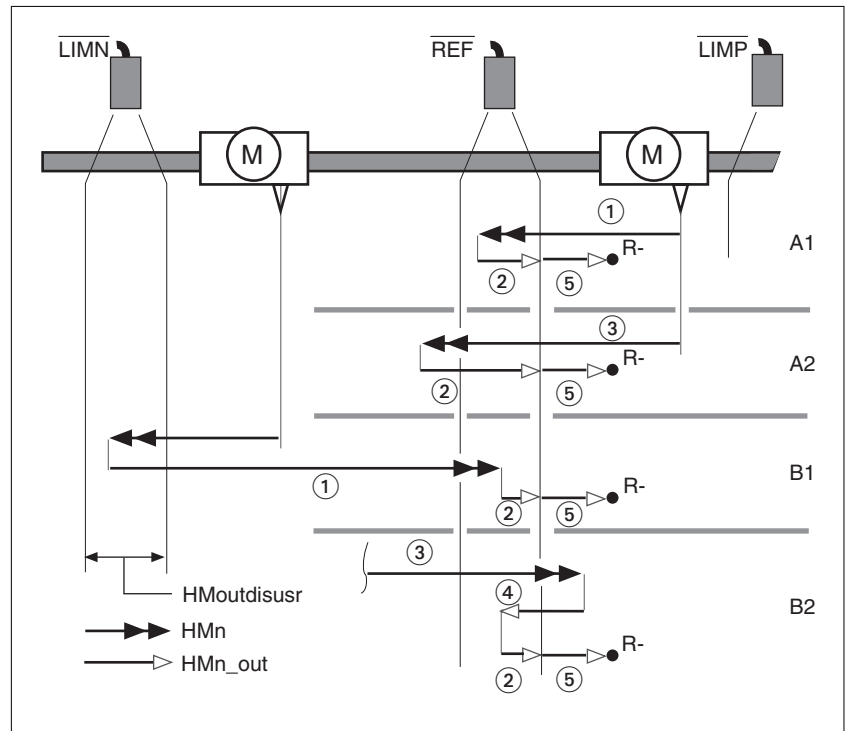


Figure 54: Reference movements to the reference switch

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

8.5.6.3 Reference movement with index pulse

*Description* A reference movement with index pulse is set with the parameter  $HMmethod = 1$  to 14, see page 134.

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 point and index pulse can be determined with the parameter  $HMdisREFtoIDX$ . The value must be  $>0.05$  for reproducible reference movements with index pulse. If the index pulse is too close to the switching point, the limit switch or reference switch can be moved mechanically.

Otherwise the position of the index pulse can be moved with the parameter  $ENC\_pabsusr$ , see Chapter "7.4.8 Setting parameters for encoder".

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
HMdisREFtoIDX	Distance from switching point to index pulse The value serves as a criterion for determining whether the reference movement with index pulse can be reproduced. In increments of 0.0001 revolution.	revolution - 0.0000 -	INT32 INT32 R/- - -	CANopen 3028:C <sub>h</sub> Modbus 10264

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

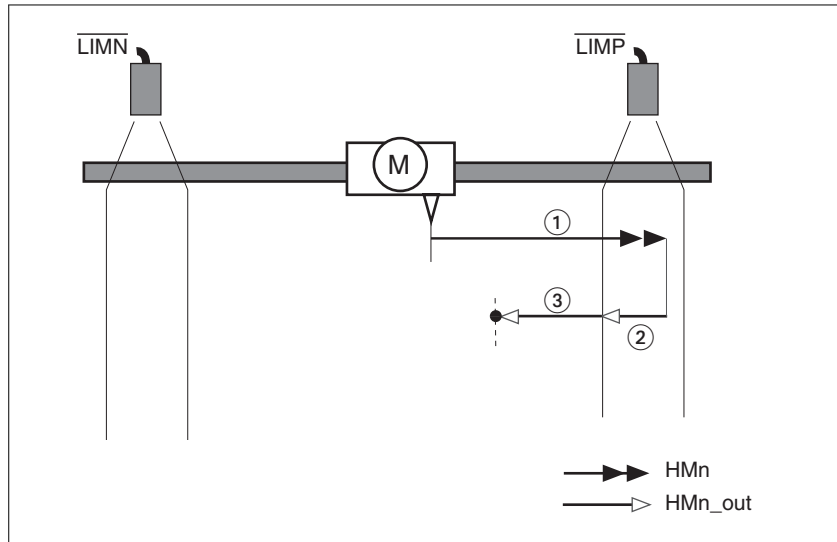


Figure 55: Reference movement to the positive limit switch

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

Reference movement to reference switch

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

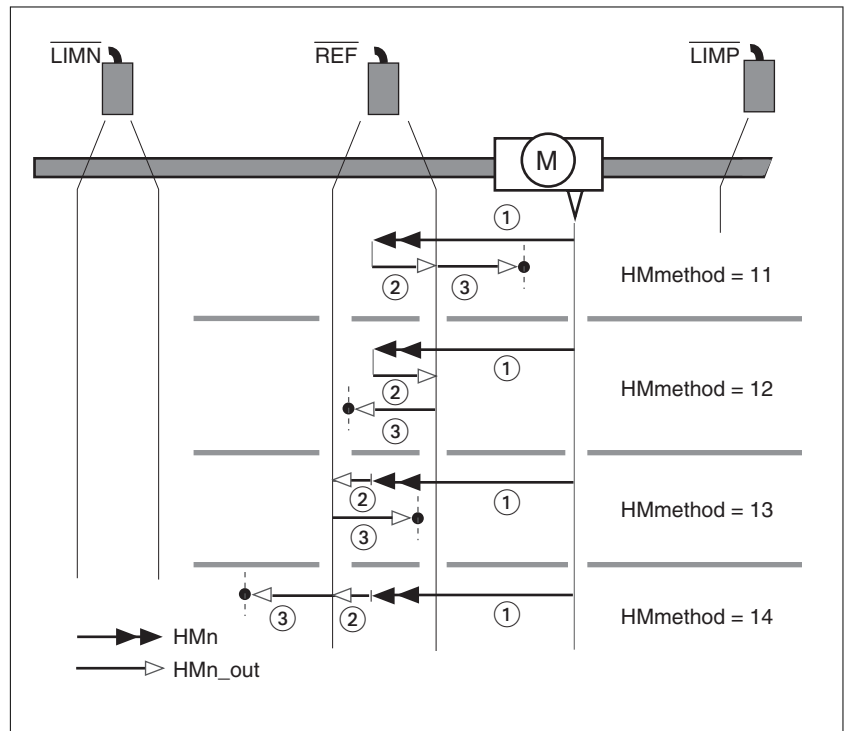


Figure 56: Reference movements to the reference switch

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

*Examples* The following illustration shows reference movements to the reference switch with movement to the first index pulse ( $HM_{method}=11$ ). Various responses at different search velocities 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 switch range is passed (A2, B2).

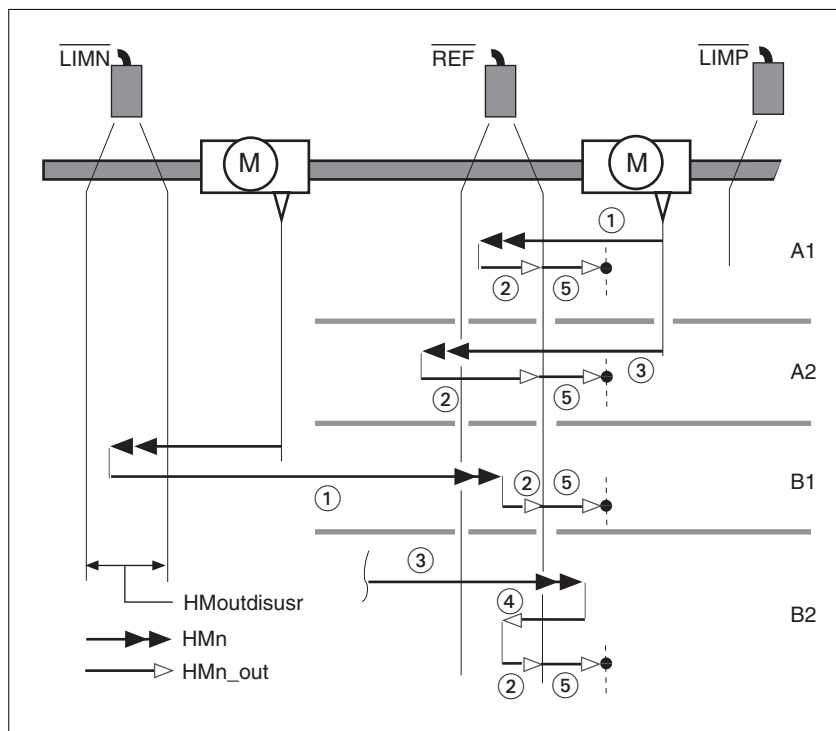


Figure 57: Reference movements to the reference switch

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

8.5.6.4 Reference movement to the index pulse

*Description* A movement is made from the current position to the index pulse.

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

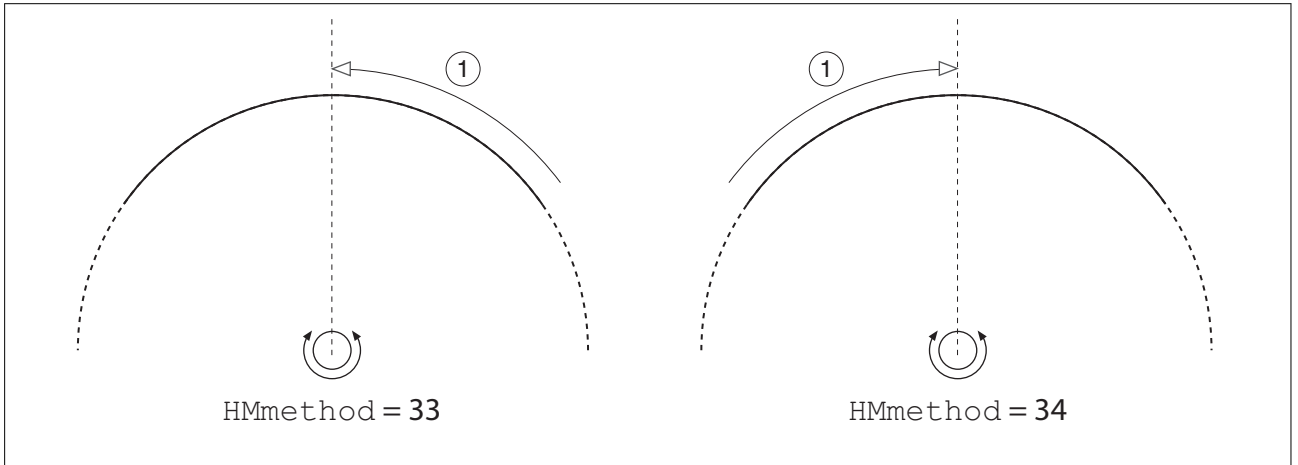


Figure 58: Reference movements to the index pulse

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

8.5.6.5 Homing by position setting

*Description* Homing by position setting is set with the parameter `HMmethod = 35`, see page 134.

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.

Position setting is only possible when the motor is at a standstill. Any active position deviation remains active and can still be compensated for 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
<code>HMp_setpusr</code>	Position for position setting Position setting position for homing method 35 Changed settings become active immediately.	usr - 0 -	INT32 INT32 R/W - -	CANopen 301B:16 <sub>n</sub> Modbus 6956

*Example* Position setting can be used to carry out a continuous motor movement without exceeding the movement limits.

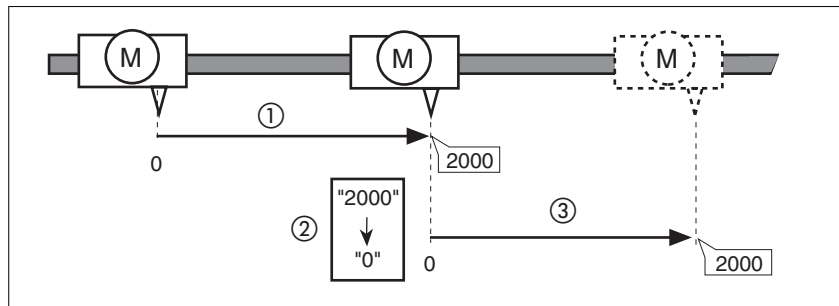


Figure 59: Movement by 4000 usr units with position setting

- (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 movement because the zero point is continuously adjusted.



8.5.6.6 Example of a movement via DS402 objects

*Adapting the list of the startup parameters*

Index	Parameter name (DS402 name)	Value
3006:7 <sub>h</sub>	ScalePOSdenom	16384
3006:8 <sub>h</sub>	ScalePOSnum	1
605A:0 <sub>h</sub>	LIM_QStopReact (Quick stop option code)	6
3006:6 <sub>h</sub>	IOsigLimFreeMode	0
6060:0 <sub>h</sub>	DCOMopmode (Mode of operation)	6

*Adapting the mapping for RxPDO*

Index	Parameter name (DS402 name)
6040:0 <sub>h</sub>	DCOMcontrol (Control word)
6060:0 <sub>h</sub>	DCOMopmode (Mode of operation)

*Adapting the mapping for TxPDO*

Index	Parameter name (DS402 name)
6041:0 <sub>h</sub>	_DCOMstatus (Status word)
6060:0 <sub>h</sub>	_DCOMopmd_act (Mode of operation display)

*Example*

Meaning	Index	Parameter name (DS402 name)	Value
SDO: Set homing method (for example 17)	6098:0 <sub>h</sub>	HMmethod (Homing method)	11 <sub>h</sub>
SDO: Set target velocity for searching the switch (for example, 100 min <sup>-1</sup> )	6099:1 <sub>h</sub>	HMn (Homing speed during search for switch)	64 <sub>h</sub>
SDO: Target velocity for moving away from switch (for example 6 min <sup>-1</sup> )	6099:2 <sub>h</sub>	HMn_out (Speed during search for zero)	6 <sub>h</sub>
RxPDO: Enable power stage	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	00 <sub>h</sub>
	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	06 <sub>h</sub>
	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	0F <sub>h</sub>
TxPDO: Check whether power stage has been enabled	6041:0 <sub>h</sub>	_DCOMstatus (Status word)	4637 <sub>h</sub>
RxPDO: Set the operating mode	6060:0 <sub>h</sub>	DCOMopmode (Mode of operation)	06 <sub>h</sub>
TxPDO: Check whether operating mode has been set	6061:0 <sub>h</sub>	_DCOMopmd_act (Mode of operation display)	06 <sub>h</sub>
RxPDO: Start Homing	6040:0 <sub>h</sub>	DCOMcontrol (Control word)	1F <sub>h</sub>
TxPDO: Check whether Homing has been successful	6041:0 <sub>h</sub>	_DCOMstatus (Status word)	D637 <sub>h</sub>

8.6 Functions

8.6.1 Monitoring functions

8.6.1.1 Status monitoring during operation

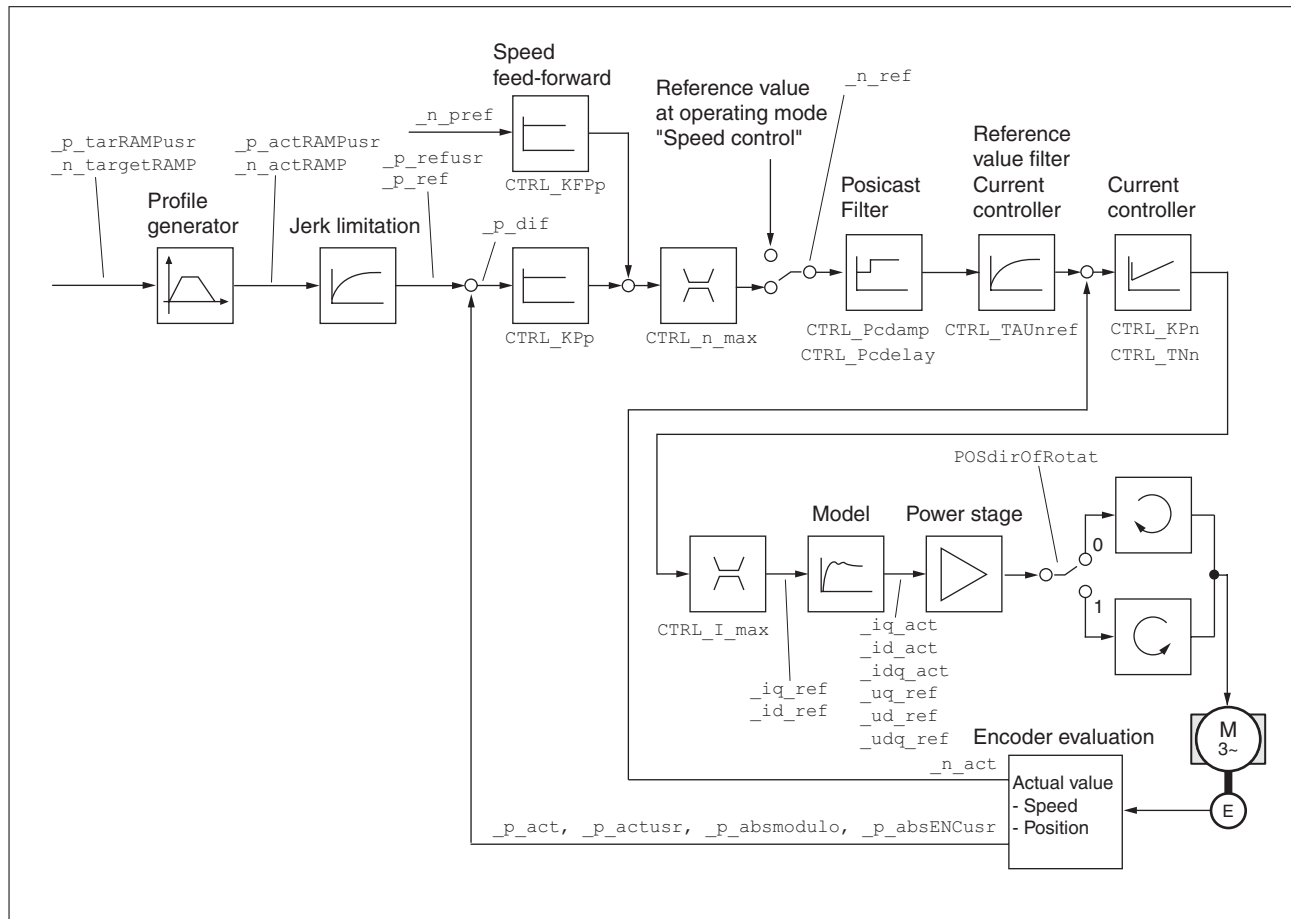


Figure 60: Status monitoring of the control loops

8.6.1.2 Positioning range

*Movement range* The motor can be moved to any point on the axis within the movement range by means of absolute movements.

The current position of the motor can be read with the parameter `_p_actusr`.

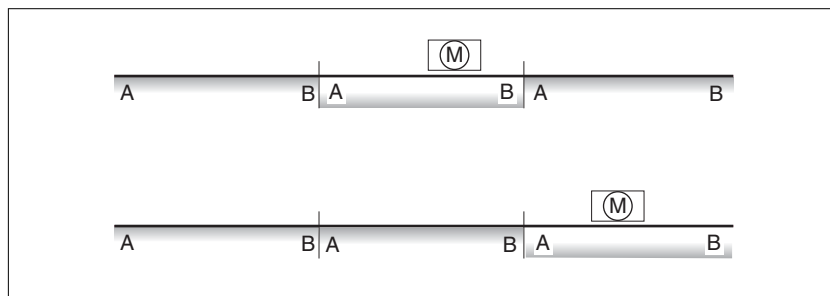


Figure 61: Movement range

With the default scaling, the movement limits are:

- (A) -1 073 741 824 usr
- (B) 1 073 741 823 usr

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

If a positioning limit is overtraveled, the reference point is lost.

In the case of relative movement 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 switch* 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 of the software limit switches 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 the limit switch position is reached.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
SPVswLimPusr	<p>Positive position limit for software limit switch</p> <p>If a user-defined value entered is outside of the permissible range, the limit switch limits are automatically set to the maximum user-defined value.</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the power stage is enabled.</p>	usr - 2147483647 -	INT32 INT32 R/W per. -	CANopen 607D:2h Modbus 1544
SPVswLimNusr	<p>Negative position limit for software limit switch</p> <p>Refer to description of parameter SPVswLimPusr.</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the power stage is enabled.</p>	usr - -2147483648 -	INT32 INT32 R/W per. -	CANopen 607D:1h Modbus 1546
SPV_SW_Limits	<p>Monitoring of software limit switches</p> <p><b>0 / None:</b> None  <b>1 / SWLIMP:</b> Activation of software limit switches positive direction  <b>2 / SWLIMN:</b> Activation of software limit switches negative direction  <b>3 / SWLIMP+SWLIMN:</b> Activation of software limit switches both directions</p> <p>Monitoring of software limit switches only works in case of successful homing (ref_ok = 1).</p> <p>Changed settings become active immediately.</p>	- 0 0 3	UINT16 UINT16 R/W per. -	CANopen 3006:3h Modbus 1542

*Limit switches***⚠ WARNING****LOSS OF CONTROL**

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

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

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

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  $\text{IOsigLimP}$  and  $\text{IOsigLimN}$  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 for negative limit switch <b>0 / Inactive:</b> Inactive <b>1 / Normally Closed:</b> Normally closed NC <b>2 / Normally Open:</b> Normally open NO Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 1 2	UINT16 UINT16 R/W per. -	CANopen 3006:F <sub>n</sub> Modbus 1566
IOsigLimP	Signal evaluation for positive limit switch <b>0 / Inactive:</b> Inactive <b>1 / Normally Closed:</b> Normally closed NC <b>2 / normally open:</b> Normally open NO Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 0 1 2	UINT16 UINT16 R/W per. -	CANopen 3006:10 <sub>n</sub> Modbus 1568
IOsigRef	Signal evaluation for reference switch <b>1 / Normally Closed:</b> Normally closed NC <b>2 / Normally Open:</b> Normally open NO The reference switch is only active while a reference movement to the reference switch is processed. Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 1 1 2	UINT16 UINT16 R/W per. -	CANopen 3006:E <sub>n</sub> Modbus 1564

*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 the motor and the power stage. The 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	Current power stage temperature	°C - 0 -	INT16 INT16 R/- -	CANopen 301C:10h Modbus 7200
PA_T_max	Maximum permissible temperature of power stage	°C - 0 -	INT16 INT16 R/- per. -	CANopen 3010:7h Modbus 4110
PA_T_warn	Temperature warning threshold of power stage	°C - 0 -	INT16 INT16 R/- per. -	CANopen 3010:6h Modbus 4108

*I<sup>2</sup>t monitoring* If the device operates with high peak currents, temperature monitoring with sensors can be too sluggish. I<sup>2</sup>t monitoring allows the controller to anticipate a rise in temperature and to reduce the current to the nominal value when the I<sup>2</sup>t 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 overload of motor	% - 0 -	INT16 INT16 R/- -	CANopen 301C:19h Modbus 7218
_I2t_mean_M	Current load of motor	% - 0 -	INT16 INT16 R/- -	CANopen 301C:1Ah Modbus 7220

*Following error* The drive monitors the so-called position deviation at 1 ms 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 the parameter `SPV_P_maxDiff` considerably greater than the maximum position deviation that may occur during operation. This way, a following error will only occur in the case of

errors, for example, in the case of excessively high external load torques.

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
<code>_p_DifPeak</code>	Value of the maximum tracking error of the position controller  The tracking error is the current position control deviation. See <code>SPV_p_maxDiff</code> for more information. A write access resets this value.  In increments of 0.0001 revolution.  Changed settings become active immediately.	revolution 0.0000 - 429496.7295	UINT32 UINT32 R/W -	CANopen 3011:F <sub>h</sub> Modbus 4382
<code>_p_dif</code>	Current deviation between reference and actual position  Corresponds to the current control deviation of the position controller.  In increments of 0.0001 revolution.	revolution -214748.3648 - 214748.3647	INT32 INT32 R/- -	CANopen 60F4:0 <sub>h</sub> Modbus 7716
<code>SPV_p_maxDiff</code>	Max. permissible tracking error of the position controller  The tracking error is the current position control deviation.  In increments of 0.0001 revolution.  Changed settings become active immediately.	revolution 0.0001 1.0000 200.0000	UINT32 UINT32 R/W per. -	CANopen 6065:0 <sub>h</sub> Modbus 4636

*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/- - -	CANopen 301C:7h Modbus 7182
_SigLatched	Saved status of monitoring signals  Signal state: 0: Not activated 1: Activated  Bit assignments: Bit 0: General error Bit 1: Limit switches (LIMP/LIMN/REF) Bit 2: Out of range (software limit switches, tuning) Bit 3: Quick Stop via fieldbus Bit 4: Inputs STO are 0 Bit 5: Reserved Bit 6: RS485 error Bit 7: CAN error Bit 8: Ethernet error Bit 9: Frequency of reference signal too high Bit 10: Error current operating mode Bit 11: Reserved Bit 12: Profibus error Bit 13: Reserved Bit 14: Undervoltage DC bus Bit 15: Overvoltage DC bus Bit 16: Mains phase missing Bit 17: Motor connection error Bit 18: Motor overcurrent/short circuit Bit 19: Motor encoder error Bit 20: Undervoltage 24VDC Bit 21: Overtemperature (power stage, motor) Bit 22: Following error Bit 23: Maximum velocity exceeded Bit 24: Inputs STO different Bit 25: Reserved Bit 26: Reserved Bit 27: Reserved Bit 28: Reserved Bit 29: EEPROM error Bit 30: System booting (hardware error or parameter error) Bit 31: System error (for example, watch-dog)  Monitoring functions are product-dependent.	- - 0 -	UINT32 UINT32 R/- - -	CANopen 301C:8h Modbus 7184
_WarnActive	Active warnings, bit-coded See _WarnLatched for more details on the bit codes.	- - 0 -	UINT16 UINT16 R/- - -	CANopen 301C:Bh Modbus 7190



Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_WarnLatched	<p>Saved warnings, bit-coded</p> <p>Saved warning bits are deleted in the case of a FaultReset. Bits 10, 11, 13 are deleted automatically.</p> <p>Signal state: 0: Not activated 1: Activated</p> <p>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<sup>2</sup>t) Bit 5: Motor overload (I<sup>2</sup>t) Bit 6: Braking resistor overload (I<sup>2</sup>t) Bit 7: CAN warning Bit 8: Motor encoder warning Bit 9: RS485 protocol warning Bit 10: STO_A (PWRR_A) and/or STO_B (PWRR_B) Bit 11: DC bus undervoltage/missing mains phase Bit 12: Profibus warning Bit 13: Position not yet valid (position capture still running) Bit 14: Ethernet warning Bit 15: Reserved</p> <p>Monitoring functions are product-dependent.</p>	- - 0 -	UINT16 UINT16 R/- - -	CANopen 301C:Ch Modbus 7192
_actionStatus	<p>Action word</p> <p>Signal state: 0: Not activated 1: Activated</p> <p>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: Motor is at standstill (_n_act &lt; 9) Bit 7: Motor movement in positive direction Bit 8: Motor movement in negative direction Bit 9: Reserved Bit 10: Reserved Bit 11: Profile generator idle (reference velocity is 0) Bit 12: Profile generator decelerates Bit 13: Profile generator accelerates Bit 14: Profile generator moves at constant speed Bit 15: Reserved</p>	- - 0 -	UINT16 UINT16 R/- - -	CANopen 301C:4h Modbus 7176
_StopFault	<p>Number of last error causing a stop</p> <p>Number of the most recent error.</p>	- - 0 -	UINT16 UINT16 R/- - -	CANopen 603F:0h Modbus 7178

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*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	<p>Error response to following error</p> <p><b>1 / Error Class 1:</b> Error class 1  <b>2 / Error Class 2:</b> Error class 2  <b>3 / Error Class 3:</b> Error class 3</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the power stage is enabled.</p>	- 1 3 3	UINT16 UINT16 R/W per. -	CANopen 3005:B <sub>h</sub> Modbus 1302

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.

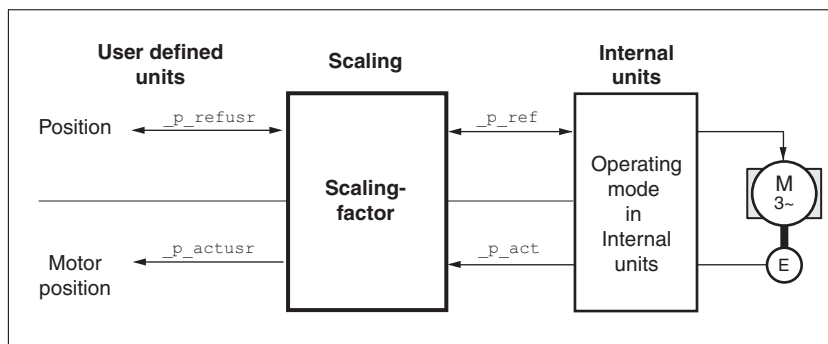


Figure 62: Scaling

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

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

Figure 63: 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	<p>Position scaling: Numerator</p> <p>Specification of the scaling factor:</p> <p>Motor revolutions [U]</p> <p>-----</p> <p>User-defined units [usr]</p> <p>A new scaling is activated when the numerator value is supplied.</p> <p>User-defined limit values may be reduced due to the calculation of an internal factor.</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active immediately.</p>	<p>revolution</p> <p>1</p> <p>1</p> <p>2147483647</p>	<p>INT32</p> <p>INT32</p> <p>R/W</p> <p>per.</p> <p>-</p>	<p>CANopen 3006:8<sub>h</sub></p> <p>Modbus 1552</p>
POSscaleDenom	<p>Position scaling: Denominator</p> <p>Refer to numerator (POSscaleNum) for a description.</p> <p>A new scaling is activated when the numerator value is supplied.</p> <p>Setting can only be changed if power stage is disabled.</p>	<p>usr</p> <p>1</p> <p>16384</p> <p>2147483647</p>	<p>INT32</p> <p>INT32</p> <p>R/W</p> <p>per.</p> <p>-</p>	<p>CANopen 3006:7<sub>h</sub></p> <p>Modbus 1550</p>



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

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

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

- Scaling corresponds to default scaling  
1 motor revolution = 16384 user-defined units  
=> Every second motor position can be approached.
- Scaling corresponds to motor resolution (minimum scaling)  
1 motor revolution = 32768 user-defined units  
=> Movements to every motor position are possible.
- Scaling is less than the default scaling  
1 motor revolution = 4096 user-defined units  
=> Movements to every fourth motor position are possible.

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

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

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

Figure 64: Calculation of the scaling factor, example 1

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

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

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

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

Figure 65: Calculation of the scaling factor, example 2

*Example 3* Setting positioning in 1/1000 rad  
 $1 \text{ rad} = 1 \text{ rev} / (2 * \pi)$   
 $\pi = 3.1416 \text{ (rounded)}$

User value = 1 usr

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

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

Figure 66: Calculation of the scaling factor, example 3

## 8.6.3 Motion profile

*Profile generator* Target position or target velocity are input values specified by the user. The profile generator uses these values to calculate a motion profile depending on the selected operating mode.

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

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

*Ramp shape* A linear ramp for the acceleration and deceleration phases is available as the ramp shape. The profile settings are valid for both directions of movement of the drive.

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

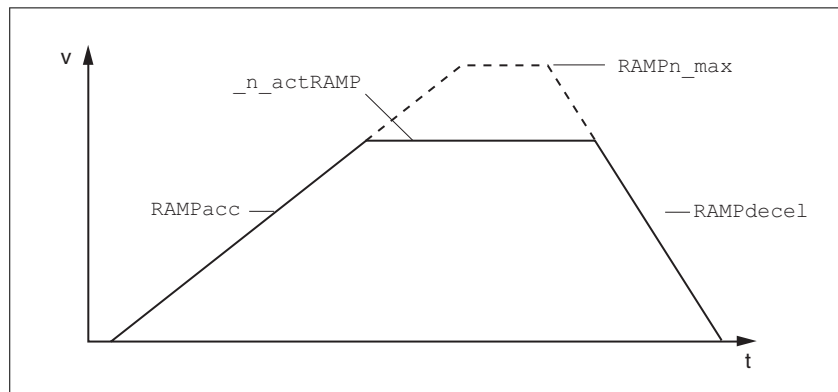


Figure 67: Acceleration and deceleration ramps

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 Changed settings become active the next time the motor moves.	min <sup>-1</sup> /s 1 600 3000000	UINT32 UINT32 R/W per. -	CANopen 6083:0h Modbus 1556
RAMPdecel	Deceleration of profile generator Changed settings become active the next time the motor moves.	min <sup>-1</sup> /s 750 750 3000000	UINT32 UINT32 R/W per. -	CANopen 6084:0h Modbus 1558
RAMPn_max	Maximum velocity of profile generator The parameter is active in the following operating modes: - Profile Position - Profile Velocity - Homing - Jog  If a greater reference velocity is set in one of these operating modes, it is automatically limited to RAMPn_max. This way, commissioning at limited velocity is easier to perform.  Setting can only be changed if power stage is disabled.  Changed settings become active the next time the motor moves.	min <sup>-1</sup> 60 13200 13200	UINT32 UINT16 R/W per. -	CANopen 607F:0h Modbus 1554

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

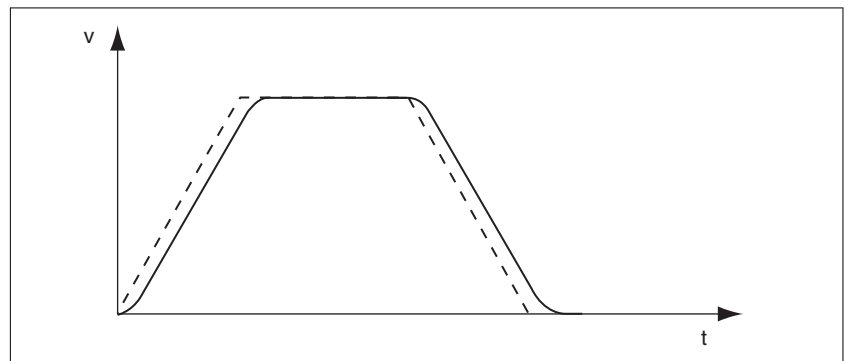


Figure 68: Speed curve with and without (dotted) jerk limitation

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	<p>Jerk limitation</p> <p><b>0 / Off:</b> Off  <b>1 / 1:</b> 1 ms  <b>2 / 2:</b> 2 ms  <b>4 / 4:</b> 4 ms  <b>8 / 8:</b> 8 ms  <b>16 / 16:</b> 16 ms  <b>32 / 32:</b> 32 ms  <b>64 / 64:</b> 64 ms  <b>128 / 128:</b> 128 ms</p> <p>Limits the acceleration change (jerk) of the reference position generation during the following transitions:  Standstill - acceleration  Acceleration - constant speed  Constant speed - deceleration  Deceleration - standstill</p> <p>Processing in the following operating modes:  - Profile Velocity  - Profile Position  - Jog  - Homing</p> <p>Adjustments can only be made if the operating mode is inactive (x_end=1).  Changed settings become active the next time the motor moves.</p>	ms 0 0 128	UINT16 UINT16 R/W per. -	CANopen 3006:D <sub>h</sub> Modbus 1562



### 8.6.4 Quick Stop

#### *Function principle*

A Quick Stop stops the motor. The current movement is stopped.

A Quick Stop can be triggered by an error of error classes 1 or 2 or via a fieldbus command.

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 set 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.

#### *Resetting a "Quick Stop"*

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

If a "Quick Stop" has been triggered by the positive or negative limit switch, moving back to the movement range is possible by means of the operating mode Jog.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
LIM_QStopReact	<p>Quick Stop option code</p> <p><b>-2 / Torque ramp (Fault):</b> Use torque ramp and transit to operating state 9 Fault</p> <p><b>6 / Deceleration ramp (Quick Stop):</b> Use torque ramp and remain in operating state 7 Quick Stop</p> <p><b>7 / Torque ramp (Quick Stop):</b> Use deceleration ramp and remain in operating state 7 Quick Stop</p> <p>Setting of deceleration ramp with parameter RAMPquickstop. Setting of torque ramp with parameter LIM_I_maxQSTP.</p> <p>The deceleration ramp is only available for operating modes with profile generator. The torque ramp is used in the operating modes without profile generator.</p> <p>Changed settings become active immediately.</p>	- -2 7 7	INT16 INT16 R/W per. -	CANopen 605A:0 <sub>h</sub> Modbus 1584
RAMPquickstop	<p>Deceleration ramp for Quick Stop</p> <p>Deceleration ramp for a software stop or an error with error class 1 or 2.</p> <p>Changed settings become active the next time the motor moves.</p>	min <sup>-1</sup> /s 200 6000 3000000	UINT32 UINT32 R/W per. -	CANopen 3006:12 <sub>h</sub> Modbus 1572
LIM_I_maxQSTP	<p>Current limitation for Quick Stop</p> <p>Maximum current during deceleration via torque ramp due to an error of error classes 1 or 2 and when a software stop is triggered.</p> <p>Maximum and default settings depend on the motor and the power stage (settings M_I_max and PA_I_max).</p> <p>In increments of 0.01 A<sub>pk</sub>.</p> <p>Changed settings become active immediately.</p>	A <sub>pk</sub> - - -	UINT16 UINT16 R/W per. -	CANopen 3011:5 <sub>h</sub> Modbus 4362

### 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 the "Halt" requests are cleared, the interrupted movement is resumed. If the "Halt" request is already cleared during deceleration, the drive continues to decelerate until the motor comes to a standstill. The interrupted movement is resumed after the standstill.
- 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 set 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	<p>Halt option code</p> <p><b>1 / Deceleration ramp:</b> Deceleration ramp <b>3 / Torque ramp:</b> Torque ramp</p> <p>Setting of deceleration ramp with parameter RAMPdecel. Setting of torque ramp with parameter LIM_I_maxHalt.</p> <p>The deceleration ramp is only available for operating modes with profile generator. The torque ramp is used in the operating modes without profile generator.</p> <p>Changed settings become active immediately.</p>	- 1 3 3	INT16 INT16 R/W per. -	CANopen 605D:0h Modbus 1582
RAMPdecel	<p>Deceleration of profile generator</p> <p>Changed settings become active the next time the motor moves.</p>	min <sup>-1</sup> /s 750 750 3000000	UINT32 UINT32 R/W per. -	CANopen 6084:0h Modbus 1558
LIM_I_maxHalt	<p>Current limitation for Halt</p> <p>Maximum current during deceleration after Halt or when an operating mode is terminated.</p> <p>Maximum and default settings depend on the motor and the power stage (settings M_I_max and PA_I_max).</p> <p>In increments of 0.01 A<sub>pk</sub>.</p> <p>Changed settings become active immediately.</p>	A <sub>pk</sub> - - -	UINT16 UINT16 R/W per. -	CANopen 3011:6h Modbus 4364

### 8.6.6 Fast position capture

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

*Settings* 2 independent capture inputs are available for the "Fast Position Capture" function.

- LIO1 (CAP1)
- LIO2 (CAP2)

One of two possible functions for capture can be selected for each capture input:

- Position capture with rising or falling edge at the capture input, adjustable with parameters `CAP1CONFIG` and `CAP2CONFIG`.
- One-time or continuous capture with multiple change of edge at the capture input with parameters `CAP1ACTIVATE` and `CAP2ACTIVATE`.

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

The CAP1 and CAP2 capture inputs have a time constant of  $t = 10 \mu\text{s}$ .

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

*Activating fast position capture* Activating one-time position capture

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

Activating continuous position capture

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

*Terminating position capture* In the case of one-time position capture, the "Fast Position Capture" function is terminated when the first signal edge is detected.

In the case continuous position capture or if no signal edge is detected, the capture can be stopped by writing the parameter `Cap1Activate`, value 0 or `Cap2Activate`, value 0.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
Cap1Activate	Capture input 1 start/stop <b>0 / Capture stop:</b> Cancel capture function <b>1 / Capture once:</b> Start one-time capture <b>2 / Capture continuous:</b> Start continuous capture  In the case of one-time capture, the function is terminated when the first value is captured. In the case of continuous capture, the function continues to run.  Changed settings become active immediately.	- 0 - 2	UINT16 UINT16 R/W - -	CANopen 300A:4h Modbus 2568
Cap1Config	Capture input 1 configuration <b>0 / 1-&gt;0:</b> Position capture at 1->0 change <b>1 / 0-&gt;1:</b> Position capture at 0->1 change  Changed settings become active immediately.	- 0 0 1	UINT16 UINT16 R/W - -	CANopen 300A:2h Modbus 2564
Cap1Count	Capture input 1 event counter  Counts the capture events. The counter is reset when capture unit 1 is activated.	- - 0 -	UINT16 UINT16 R/- - -	CANopen 300A:8h Modbus 2576
Cap1Pos	Capture input 1 captured position  Captured position at the time of the "capture signal". The captured position is re-calculated after "Position Setting" or "Homing".	usr - 0 -	INT32 INT32 R/- - -	CANopen 300A:6h Modbus 2572
Cap2Activate	Capture input 2 start/stop <b>0 / Capture stop:</b> Cancel capture function <b>1 / Capture once:</b> Start one-time capture <b>2 / Capture continuous:</b> Start continuous capture  In the case of one-time capture, the function is terminated when the first value is captured. In the case of continuous capture, the function continues to run.  Changed settings become active immediately.	- 0 - 2	UINT16 UINT16 R/W - -	CANopen 300A:5h Modbus 2570
Cap2Config	Capture input 2 configuration <b>0 / 1-&gt;0:</b> Position capture at 1->0 change <b>1 / 0-&gt;1:</b> Position capture at 0->1 change  Changed settings become active immediately.	- 0 0 1	UINT16 UINT16 R/W - -	CANopen 300A:3h Modbus 2566
Cap2Count	Capture input 2 event counter  Counts the capture events. The counter is reset when capture unit 2 is activated.	- - 0 -	UINT16 UINT16 R/- - -	CANopen 300A:9h Modbus 2578

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
Cap2Pos	Capture input 2 captured position Captured position at the time of the "capture signal". The captured position is re-calculated after "Position Setting" or "Homing".	usr - 0 -	INT32 INT32 R/- - -	CANopen 300A:7h Modbus 2574
CapStatus	Status of the capture inputs Read access: Bit 0: Position captured via input CAP1 Bit 1: Position captured via input CAP2	- - 0 -	UINT16 UINT16 R/- - -	CANopen 300A:1h Modbus 2562

## 8.6.7 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 movement for the period  $STANDpwinTime$ , the device signals the end of processing ( $x\_end = 0 \rightarrow 1$ ).

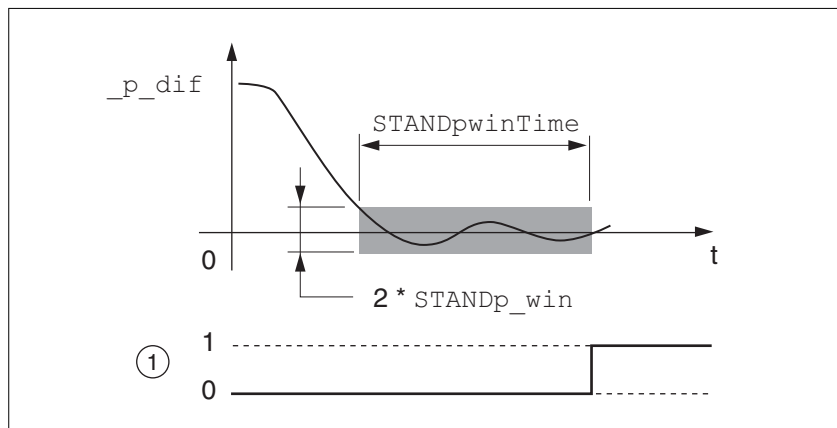


Figure 69: Standstill window

(1) Target position reached

The parameters  $STANDp\_win$  and  $STANDpwinTime$  specify 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'.  In increments of 0.0001 revolution.  Changed settings become active immediately.	revolution 0.0000 0.0010 3.2767	UINT32 UINT16 R/W per. -	CANopen 6067:0h Modbus 4370
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  Changed settings become active immediately.	ms 0 0 32767	UINT16 UINT16 R/W per. -	CANopen 6068:0h Modbus 4372
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.  Changed settings become active immediately.	ms 0 0 16000	UINT16 UINT16 R/W per. -	CANopen 3011:Bh Modbus 4374

8.6.8 Holding brake

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

The holding brake is not available with all product versions.

**⚠ WARNING**

**LOSS OF BRAKING FORCE DUE TO WEAR OR HIGH TEMPERATURE**

Applying the holding brake while the motor is running will cause excessive wear and loss of the braking force. Heat decreases the braking force.

- Do not use the holding brake as a service brake.
- Note that "EMERGENCY STOPS" may also cause wear
- At operating temperatures of more than 80°C (176°F), do not exceed a maximum of 50% of the specified holding torque when using the brake.

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

*Control* The integrated holding brake is controlled automatically.

*Releasing the holding brake* The holding brake is automatically released when the power stage is enabled. After a delay time the drive switches to operating state 6 "Operation Enable".

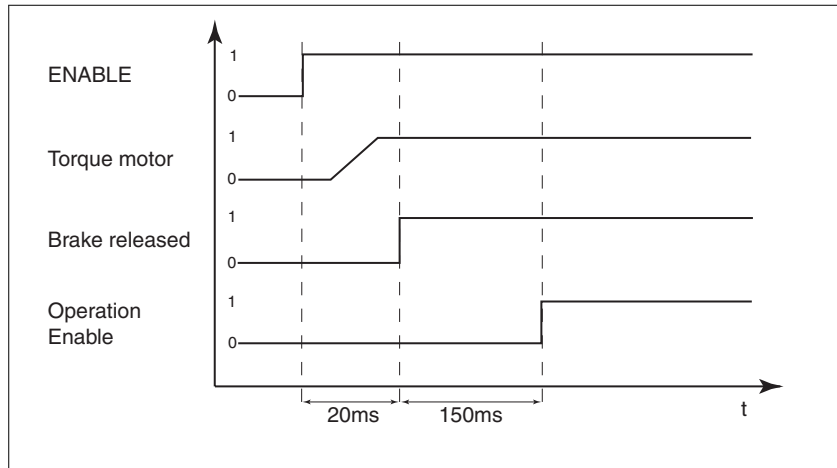


Figure 70: Releasing the holding brake

*Applying the holding brake*

When the power stage is disabled and in the event of an error of error class 2, the holding brake is automatically applied. However, the motor current is not disconnected until after a delay time. This allows the holding brake to be applied before the motor loses its torque.

In the event of an error of error classes 3 or 4, the holding brake is automatically applied and the motor current is immediately disconnected.

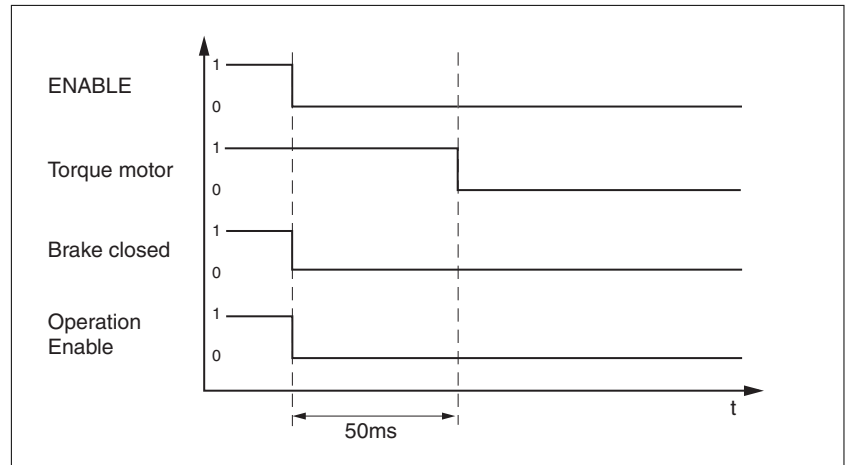


Figure 71: Applying the holding brake

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

8.6.9 Configurable inputs and outputs

<b>⚠ WARNING</b>
<b>UNINTENDED BEHAVIOR OF INPUTS AND OUTPUTS</b>
The functions of the inputs and outputs depend on the selected operating mode and the settings of the corresponding parameters.
<ul style="list-style-type: none"> <li>• Verify that the wiring is appropriate for the settings.</li> <li>• Only start the system if there are no persons or obstructions in the hazardous area.</li> <li>• When commissioning, carefully run tests for all operating states and potential fault situations.</li> </ul>
<b>Failure to follow these instructions can result in death, serious injury or equipment damage.</b>

*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 Coding of the individual signals: Bit 0: LIO1 Bit 1: LIO2 ...	- - 0 -	UINT16 UINT16 R/- -	CANopen 3008:15h Modbus 2090

8.6.9.1 Description of functions for signal inputs

- No function / free available* The function "No function / free available" has no device-internal functionality. The signal input can be read as required via the parameter `_IO_LIO_act`.
- Fault reset* An error message is reset with the function, see chapter "8.3 Operating states".
- Enable* The power stage is enabled with the function, see chapter "8.3 Operating states".
- Halt* The function triggers a "Halt", see chapter "8.6.5 Halt".
- Jog positive* The function performs a jog movement in positive direction of movement, see chapter "8.5.2 Operating mode Jog".
- Jog negative* The function performs a jog movement in negative direction of movement, see chapter "8.5.2 Operating mode Jog".
- Jog fast/slow* The function switches between slow and fast jog, see chapter "8.5.2 Operating mode Jog".
- Reference switch (REF)* The function defines the way the reference switch operates. See chapter "8.5.6 Operating mode Homing".
- Positiv limit switch (LIMP)* The function defines the way the positive limit switch operates. See chapter "8.5.6 Operating mode Homing" and chapter "8.6.1.2 Positioning range".
- Negative limit switch (LIMN)* The function defines the way the negative limit switch operates. See chapter "8.5.6 Operating mode Homing" and chapter "8.6.1.2 Positioning range".

8.6.9.2 Description of functions for signal outputs

- No function / free available* The function "No function / free available" lets you directly set an output via parameter `IO_LO_set`.
- No fault* The function indicates the operating state **9** Fault, see chapter "8.3.2 Indicating the operating states".
- Active* The function indicates the operating state "Operation Enabled", 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
<code>IO_LO_set</code>	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 -	CANopen 3008:11h Modbus 2082

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## 8.6.9.3 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	<p>Function Input/Output LIO1</p> <p><b>1 / Input Free available:</b> Available as required</p> <p><b>2 / Input Fault reset:</b> Reset fault (local control mode only)</p> <p><b>3 / Input Enable:</b> Enable (local control mode only)</p> <p><b>4 / Input Halt:</b> Halt</p> <p><b>9 / Input Jog positive:</b> Jog positive</p> <p><b>10 / Input Jog negative:</b> Jog negative</p> <p><b>11 / Input Jog fast/slow:</b> Jog fast/slow</p> <p><b>20 / Input Reference switch (REF):</b> Reference switch (REF)</p> <p><b>21 / Input Positive limit switch (LIMP):</b> Positive limit switch (LIMP)</p> <p><b>101 / Output Free available:</b> Available as required</p> <p><b>102 / Output No fault:</b> No fault</p> <p><b>103 / Output Active:</b> Ready</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the product is switched on.</p>	- - 0 -	UINT16 UINT16 R/W per. -	CANopen 3007:11 <sub>h</sub> Modbus 1826
IOfunct_LIO2	<p>Function Input/Output LIO2</p> <p><b>1 / Input Free available:</b> Available as required</p> <p><b>2 / Input Fault reset:</b> Reset fault (local control mode only)</p> <p><b>3 / Input Enable:</b> Enable (local control mode only)</p> <p><b>4 / Input Halt:</b> Halt</p> <p><b>9 / Input Jog positive:</b> Jog positive</p> <p><b>10 / Input Jog negative:</b> Jog negative</p> <p><b>11 / Input Jog fast/slow:</b> Jog fast/slow</p> <p><b>20 / Input Reference switch (REF):</b> Reference switch (REF)</p> <p><b>22 / Input Negative limit switch (LIMN):</b> Negative limit switch (LIMN)</p> <p><b>101 / Output Free available:</b> Available as required</p> <p><b>102 / Output No fault:</b> No fault</p> <p><b>103 / Output Active:</b> Ready</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the product is switched on.</p>	- - 0 -	UINT16 UINT16 R/W per. -	CANopen 3007:12 <sub>h</sub> Modbus 1828

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
IOfunct_LIO3	<p>Function Input/Output LIO3</p> <p><b>1 / Input Free available:</b> Available as required</p> <p><b>2 / Input Fault reset:</b> Reset fault (local control mode only)</p> <p><b>3 / Input Enable:</b> Enable (local control mode only)</p> <p><b>4 / Input Halt:</b> Halt</p> <p><b>9 / Input Jog positive:</b> Jog positive</p> <p><b>10 / Input Jog negative:</b> Jog negative</p> <p><b>11 / Input Jog fast/slow:</b> Jog fast/slow</p> <p><b>20 / Input Reference switch (REF):</b> Reference switch (REF)</p> <p><b>101 / Output Free available:</b> Available as required</p> <p><b>102 / Output No fault:</b> No fault</p> <p><b>103 / Output Active:</b> Ready</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the product is switched on.</p>	- - 0 -	UINT16 UINT16 R/W per. -	CANopen 3007:13 <sub>h</sub> Modbus 1830
IOfunct_LIO4	<p>Function Input/Output LIO4</p> <p><b>1 / Input Free available:</b> Available as required</p> <p><b>2 / Input Fault reset:</b> Reset fault (local control mode only)</p> <p><b>3 / Input Enable:</b> Enable (local control mode only)</p> <p><b>4 / Input Halt:</b> Halt</p> <p><b>9 / Input Jog positive:</b> Jog positive</p> <p><b>10 / Input Jog negative:</b> Jog negative</p> <p><b>11 / Input Jog fast/slow:</b> Jog fast/slow</p> <p><b>20 / Input Reference switch (REF):</b> Reference switch (REF)</p> <p><b>101 / Output Free available:</b> Available as required</p> <p><b>102 / Output No fault:</b> No fault</p> <p><b>103 / Output Active:</b> Ready</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the product is switched on.</p>	- - 0 -	UINT16 UINT16 R/W per. -	CANopen 3007:14 <sub>h</sub> Modbus 1832



8.6.10 Changing the direction of movement

If the expected direction of movement and the actual direction of movement are not identical, you can invert the direction of movement. Use the parameter `POSdirOfRotat` invert the direction of movement 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 movement to `LIMP`. Connect the limit switch that limits the working range for negative direction of movement to `LIMN`.

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
<code>POSdirOfRotat</code>	<p>Definition of direction of rotation</p> <p><b>0 / Clockwise:</b> Clockwise <b>1 / Counter Clockwise:</b> Counter-clockwise</p> <p>At positive reference values, the motor rotates clockwise (as you look at the end of the motor shaft at the flange).</p> <p>NOTE: The limit switch which is reached with a movement in positive direction must be connected to the positive limit switch input and vice versa.</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the product is switched on.</p>	- 0 0 1	UINT16 UINT16 R/W per. -	CANopen 3006:C <sub>n</sub> Modbus 1560

If the direction of movement of the motor must be reversed, the parameter values can be used unchanged.

Inverting the direction of movement changes the absolute position of the motor `_p_absworkusr` read from the encoder as well as the actual position `_p_actusr` determined by the device.

Therefore, set the direction of movement during commissioning to the direction that will be used for later operation of this motor.

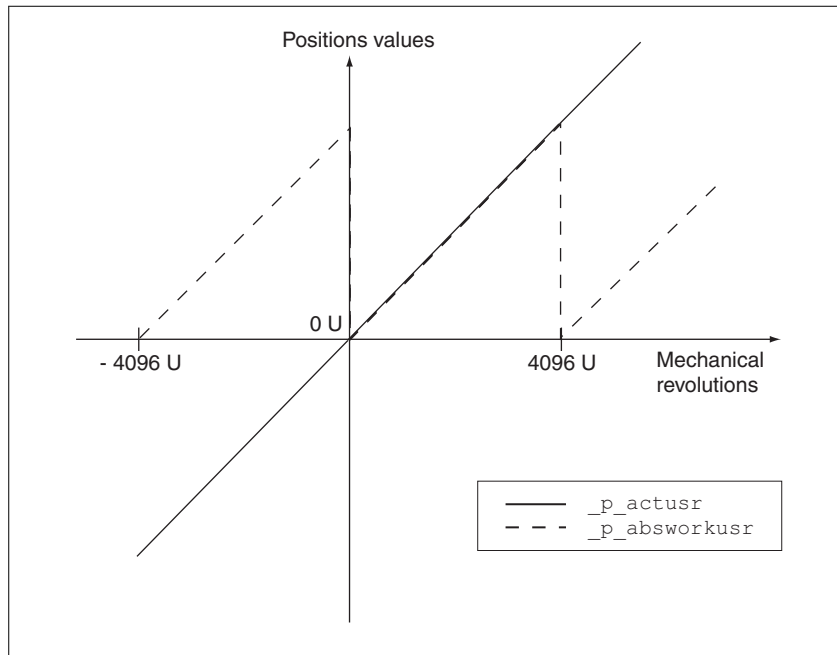


Figure 72: Position values without inversion of the direction of movement

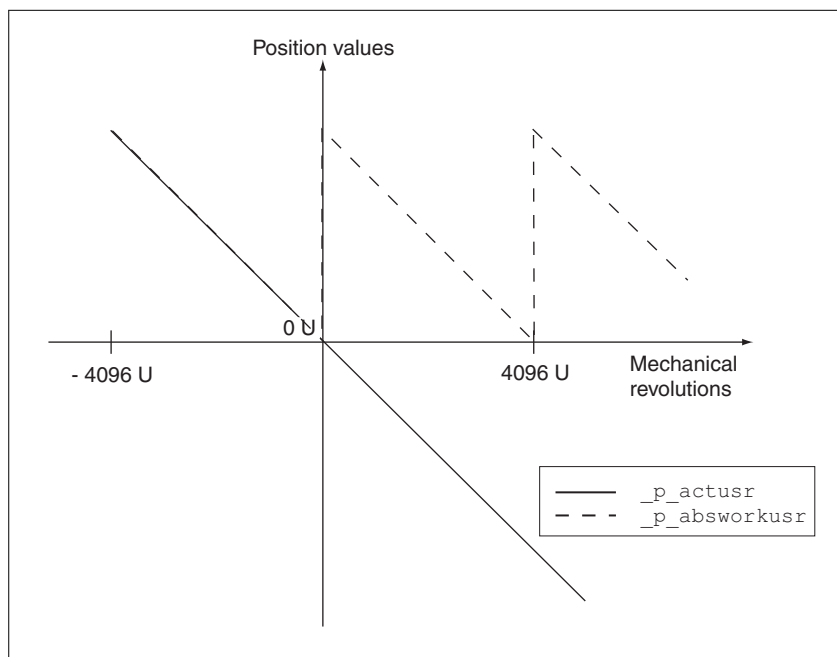


Figure 73: Position values with inversion of the direction of movement

8.6.11 Restoring default values



The 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.

8.6.11.1 Resetting user-defined parameters

Parameter `PARuserReset` is used to reset the 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
<code>PARuserReset</code>	<p>Reset user parameters</p> <p>Bit 0 = 1: Set persistent parameters to default values.</p> <p>All parameters are reset with the exception of:</p> <ul style="list-style-type: none"> <li>- Communication parameters</li> <li>- Definition of the direction of rotation</li> <li>- Signal selection position interface</li> <li>- I/O functions</li> </ul> <p>NOTE: The new settings are not saved to the EEPROM.</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the power stage is enabled.</p>	- 0 - 7	UINT16 UINT16 R/W - -	CANopen 3004:8 <sub>n</sub> Modbus 1040

8.6.11.2 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 from the fieldbus prior to restoring the factory settings.



# 9 Examples



## 9.1 General information

The examples show some typical applications of the product. The examples are intended to provide an overview; they are not exhaustive wiring plans.

Using the safety functions integrated in this product requires careful planning. See chapter "5.4 Safety function STO ("Safe Torque Off")", page 36 for additional information.

## 9.2 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.

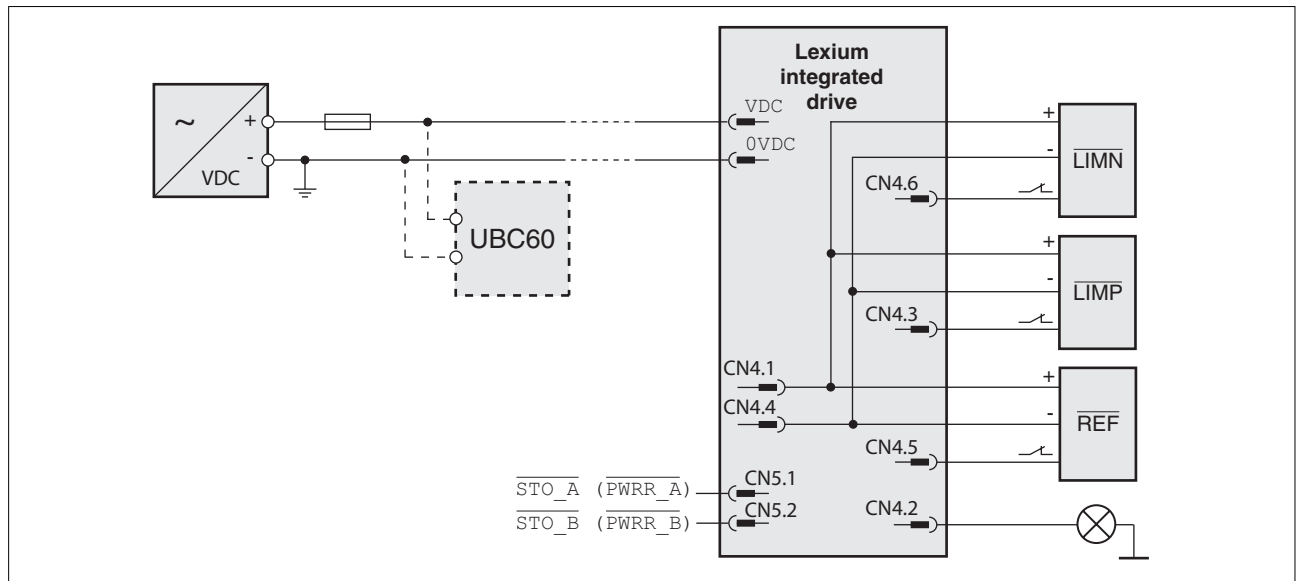


Figure 74: Wiring example

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



## 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 (with LED flash code or error number)
- Previous and concomitant circumstances
- Your own assumptions concerning the cause of the error

Also include this information if you return the product for inspection or repair.

### 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 "10.3.3 Table of warnings and errors by range" 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, limit 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 `DCOMstatus`
- Error number is written to parameter `StopFault`

*Synchronous errors* Synchronous errors occur as direct errors in response to a fieldbus command. They comprise, for instance:

- 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

10.2.1 State diagram

See chapter 106 for a detailed description of the state diagram of the drive..

10.2.2 EtherCAT state machine

According the IEC 61800-7-304, the following EtherCAT states have been defined for an EtherCAT network:

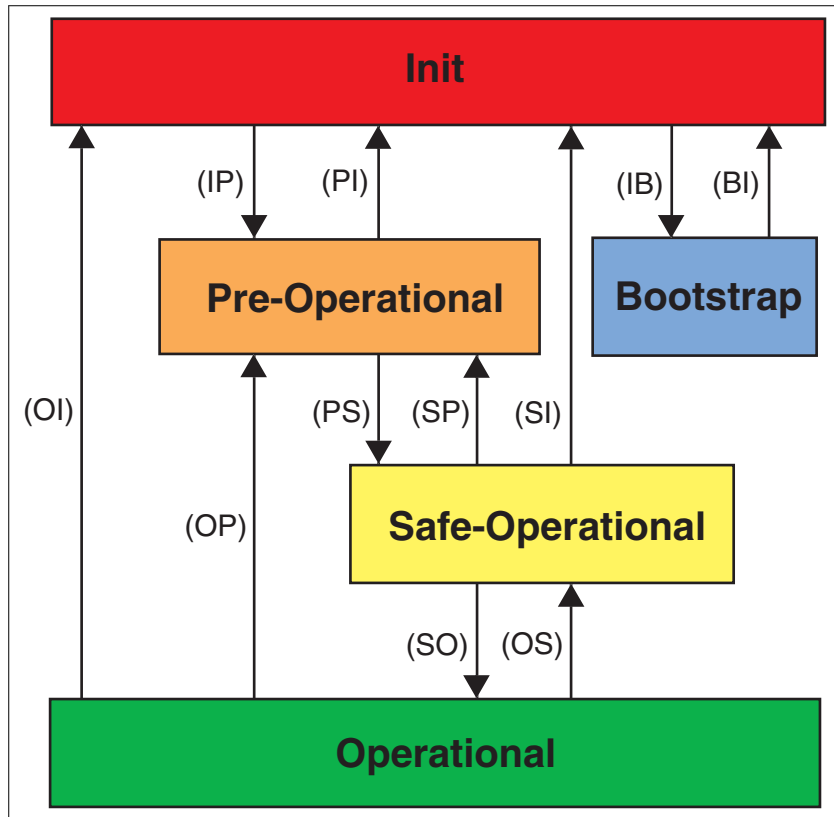


Figure 75: EtherCAT state machine

**States** The state **Init** defines the foundation of the communication relationship between the master and the slaves at the application layer. Direct communication between the master and the slave is impossible at the application layer. The master uses the Init state to initialize a set of configuration registers of the EtherCAT slave controllers. If the slaves support mailbox services, the Sync Manager is also configured in this state.

In the **Pre-Operational** state, the mailbox is active. Both master and slave use the mailbox and the corresponding protocol to interchange application-specific initialization data and parameters. In this state, process data communication is not possible.

If the drive does not receive a valid mapping for the process data from the EtherCAT master, it remains in this state.

In the **Safe-Operational** state, the slave application provides current input data such as limit switch data. Output data of the master are ignored in this state. This state is not a safety function.

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In the state **Operational**, the slave applications deliver current input data and the drive processes the current output data from the master, such as target positions.

*State transitions* The following state transitions are defined, see also Figure 75:

State transition	Local management service
IP	Start Mailbox Communication
PI	Stop Mailbox Communication
PS	Start Input Update
SP	Stop Input Update
SO	Start Output Update
OS	Stop Output Update
OP	Stop Output Update and Stop Input Update
SI	Stop Input Update, Stop Mailbox Communication
OI	Stop Input Update, Stop Input Update, Stop Mailbox Communication
IB	Start Bootstrap Mode
BI	Restart Device

### 10.2.3 Error detection via the state machine

Errors can be indicated via an Emergency message.

The Emergency message contains:

- CANopen error code
- Device-specific error code
- Vendor-specific error code

EtherCAT provides a certain degree of error detection for the implemented Sync Managers. For example, problems such as address problems, length errors and incorrect settings can be detected as errors.

10.2.4 Status LEDs

10.2.4.1 Device LEDs

The product has a green and a red LED on the printed circuit board. Both LEDs indicate the operating states and errors.

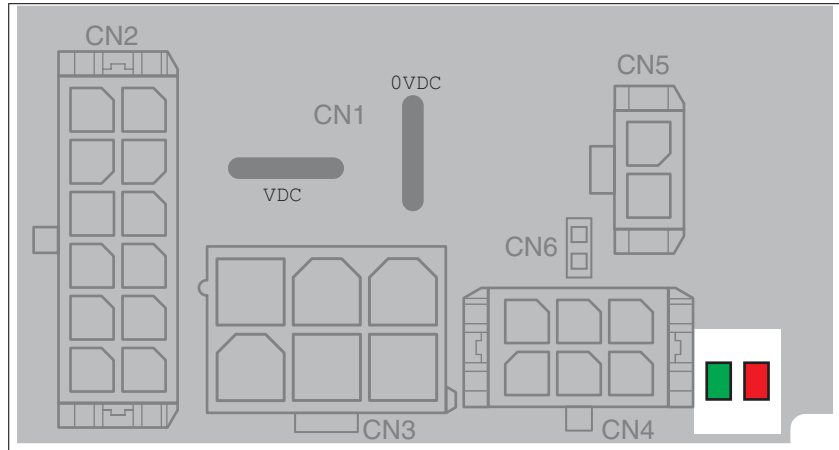


Figure 76: Device LEDs

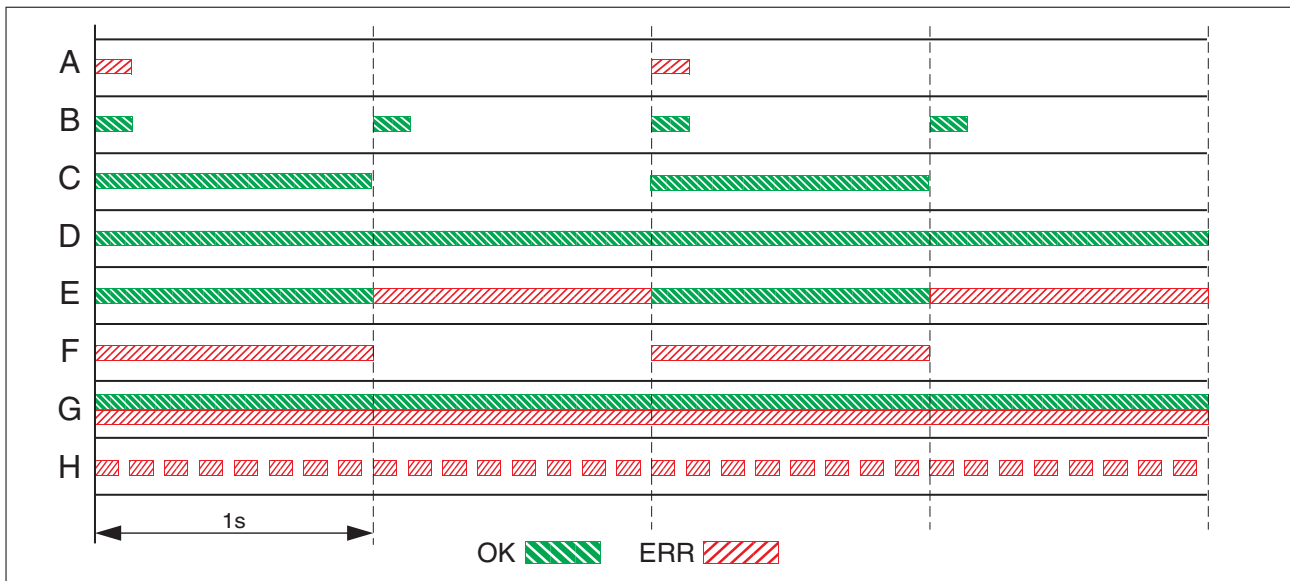


Figure 77: Indicator functions of the LED

- (A) 1 Start and 2 Not Ready To Switch On
- (B) 3 Switch On Disabled
- (C) 4 Ready To Switch On and 5 Switched On
- (D) 6 Operation Enabled
- (E) 7 Quick Stop Active and 8 Fault Reaction Active
- (F) 9 Fault
- (G) Firmware not available
- (H) Internal error

10.2.4.2 EtherCAT LEDs

2 LEDs indicate the Ethernet connection and the EtherCAT status.

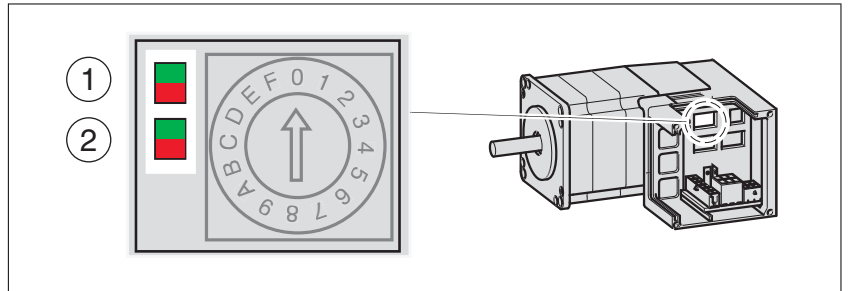


Figure 78: Overview of the LEDs at the module

- (1) Green: Link/Activity IN  
Red: Link/Activity OUT
- (2) Green: Network RUN  
Red: Network ERROR

*Link/Activity*

Status	Meaning
Off	No link
On	Link, no activity
Flickering	Link, activity




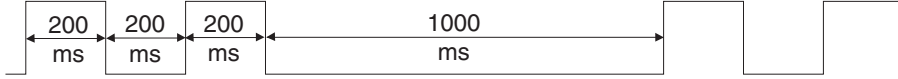
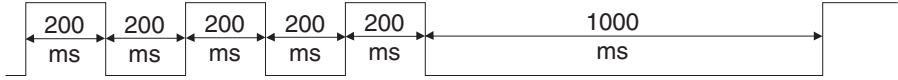
*Network RUN*

Status	Meaning
Off	EtherCAT state INIT
Blinking	EtherCAT state PRE-OPERATIONAL
Single flash	EtherCAT state SAFE-OPERATIONAL
On	EtherCAT state OPERATIONAL

*Network ERROR*

Status	Meaning
Double flash	Watchdog timeout
Single flash	Local error (such as synchronization error)
Blinking	Invalid configuration
Off	No error

*Meaning of the flashing signals* The table below summarizes the meaning of the flashing signals of the EtherCAT LEDs.

Status	Meaning
Flickering	
Blinking	
Single flash	
Double flash	
Triple flash	

10.2.5 Diagnostics via Web server

See chapter "7.4.9 Web server" for information on the web server.

10.2.6 Error indication using the commissioning software

- You need a PC with the commissioning software and a working connection to the product, see chapter "6.3.6 RS485 interface connection", page 58.
- ▶ 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 and switch it on again.

10.2.7 Error indication via the fieldbus

*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 number of the triggering error is stored.

The parameter `_StopFault` is contained in the TxPDO of the process data.

*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
<code>FLT_del_err</code>	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. Changed settings become active immediately.	- 0 - 1	UINT16 UINT16 R/W - -	CANopen 303B:4 <sub>h</sub> Modbus 15112
<code>FLT_MemReset</code>	Reset error memory read pointer 1: Set error memory read pointer to oldest error entry. Changed settings become active immediately.	- 0 - 1	UINT16 UINT16 R/W - -	CANopen 303B:5 <sub>h</sub> Modbus 15114

The error memory can only be read sequentially. The parameter `FLT_MemReset` must be used to reset the read pointer. Then the first error entry can be read. The read pointer is automatically 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/- - -	CANopen 303C:1h Modbus 15362
FLT_class	Error class  Value 0: Warning (no response) Value 1: Error (Quick Stop -> state 7) Value 2: Error (Quick Stop -> state 8, 9) Value 3: Fatal error (state 9, can be acknowledged) Value 4: Fatal error (state 9, cannot be acknowledged)	- 0 - 4	UINT16 UINT16 R/- - -	CANopen 303C:2h Modbus 15364
FLT_Time	Error time  With reference to operating hours counter	s 0 - 536870911	UINT32 UINT32 R/- - -	CANopen 303C:3h Modbus 15366
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/- - -	CANopen 303C:4h Modbus 15368

10.2.8 Response in the case of invalid communication objects

The parameter `EthErrBehv` allows you to define the error response to an attempt to write invalid communication objects.

A parameter value of 0 is the factory setting. Invalid write requests are ignored. There is no error response.

If the parameter value is 1, the product performs 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  <b>0 / Warning:</b> Warning (no error response) <b>1 / ErrorClass1:</b> Error class 1 (Quick Stop)  Sets the error class for incorrect realtime Ethernet data  Changed settings become active immediately.	- 0 0 1	UINT16 UINT16 R/W per. -	CANopen 3019:6h Modbus 6412

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## 10.3 Troubleshooting

### 10.3.1 Fieldbus communication

	<p>A properly operating fieldbus is essential for evaluating status and error messages.</p>
<i>Checking connections</i>	<p>If the product cannot be addressed via the fieldbus, first check the connections.</p> <p>Check the following connections:</p> <ul style="list-style-type: none"><li>▶ System power supply</li><li>▶ Supply connections</li><li>▶ Fieldbus cables and wiring</li><li>▶ Fieldbus connection</li></ul> <p>Also verify correct wiring of the limit switches (if installed) and the terminating resistors.</p>
<i>Fieldbus function test</i>	<p>If the connections are correct, check the settings for the fieldbus addresses. After correct configuration of the transmission data, test fieldbus mode.</p> <ul style="list-style-type: none"><li>▶ In addition to the master, activate a bus monitor that, as a passive device, displays messages.</li><li>▶ Switch the supply voltage off and on.</li><li>▶ Observe the network messages that are generated briefly after the supply voltage is switched on. A bus monitor can be used to record the elapsed time between messages and the relevant information in the messages.</li></ul>
<i>Addressing, parameterization</i>	<p>If it is impossible to connect to a device, check the following:</p> <ul style="list-style-type: none"><li>▶ Addressing Each network device must have a unique address.</li><li>▶ Parameterization "Vendor ID" and "Product Code" must match the values stored in the EDS file.</li></ul>

### 10.3.2 Troubleshooting of errors sorted by error bit

The parameters `_WarnLatched` and `_SigLatched` contain information on warnings and errors.

The error bits of the warnings can be read using the parameter `_WarnLatched`.

The error bits of the errors can be read using the parameter `_SigLatched`.



Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_WarnLatched	<p>Saved warnings, bit-coded</p> <p>Saved warning bits are deleted in the case of a FaultReset. Bits 10, 11, 13 are deleted automatically.</p> <p>Signal state: 0: Not activated 1: Activated</p> <p>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 (<math>I^2t</math>) Bit 5: Motor overload (<math>I^2t</math>) Bit 6: Braking resistor overload (<math>I^2t</math>) 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</p> <p>Monitoring functions are product-dependent.</p>	- - 0 -	UINT16 UINT16 R/- - -	CANopen 301C:C <sub>h</sub> Modbus 7192

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_SigLatched	<p>Saved status of monitoring signals</p> <p>Signal state: 0: Not activated 1: Activated</p> <p>Bit assignments: Bit 0: General error Bit 1: Limit switches (LIMP/LIMN/REF) Bit 2: Out of range (software limit switches, tuning) Bit 3: Quick Stop via fieldbus Bit 4: Inputs STO are 0 Bit 5: Reserved Bit 6: RS485 error Bit 7: CAN error Bit 8: Ethernet error Bit 9: Frequency of reference signal too high Bit 10: Error current operating mode Bit 11: Reserved Bit 12: Profibus error Bit 13: Reserved Bit 14: Undervoltage DC bus Bit 15: Overvoltage DC bus Bit 16: Mains phase missing Bit 17: Motor connection error Bit 18: Motor overcurrent/short circuit Bit 19: Motor encoder error Bit 20: Undervoltage 24VDC Bit 21: Overtemperature (power stage, motor) Bit 22: Following error Bit 23: Maximum velocity exceeded Bit 24: Inputs STO different Bit 25: Reserved Bit 26: Reserved Bit 27: Reserved Bit 28: Reserved Bit 29: EEPROM error Bit 30: System booting (hardware error or parameter error) Bit 31: System error (for example, watch-dog)</p> <p>Monitoring functions are product-dependent.</p>	- - 0 -	UINT32 UINT32 R/- - -	CANopen 301C:8h Modbus 7184

### 10.3.3 Table of warnings and errors by range

The table below summarizes the error numbers classified by range.

Error number	Range
E 1xxx	General
E 2xxx	Overcurrent
E 3xxx	Voltage
E 4xxx	Temperature
E 5xxx	Hardware
E 6xxx	Software
E 7xxx	Interface, wiring
E 8xxx	Fieldbus
E Axxx	Motor movement
E Bxxx	Communication

*Error number not listed* If the error number is not listed in the table below, the firmware version may be newer than the version of the manual or there may be a system error.

- ▶ Verify that you use the correct manual ("About this manual")
- ▶ Verify that the wiring is EMC-compliant ("6.1 Electromagnetic compatibility, EMC")
- ▶ Contact technical support ("13.1 Service address")

*List of error numbers* The table below provides an overview of the error numbers.

Error number	Class	Bit	Description, cause and correctives
E 1100	-	-	Parameter out of permissible range The value entered was outside of the permissible value range for this parameter. The entered value must be within the permissible value range.
E 1101	-	-	Parameter does not exist Error signaled by parameter management: Parameter (index) does not exist. Select a different parameter (index).
E 1102	-	-	Parameter does not exist Error signaled by parameter management: Parameter (subindex) does not exist. Select a different parameter (subindex).
E 1103	-	-	Parameter write not permissible (READ only) Write access to read only parameter. Write only to parameters that are not read-only.
E 1104	-	-	Write access denied (no access authorization) Parameter only accessible at expert level. The write access level expert is required.
E 1106	-	-	Command not allowed while power stage is active Command not allowed while the power stage is enabled (operating state Operation Enabled or Quick Stop Active). Disable the power stage and repeat the command.
E 1107	-	-	Access via other interface blocked Access occupied by another channel (for example: Commissioning software is active and fieldbus access was tried at the same time). Check the channel that blocks the access.
E 110B	3	30	Configuration error (additional info=Modbus register address) Error detected during parameter check (for example, reference velocity value for operating mode Profile Position is greater than maximum allowed velocity of drive). Value in additional error information shows the Modbus register address of the parameter where the initialization error was detected.
E 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 chapter Parameters for the parameter that requires 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 (STO_A, STO_B) The safety function STO was activated in the operating state Operation Enabled. Check the wiring of the inputs of the STO safety function and reset the error.
E 1301	4	24	STO_A and STO_B different level The levels of the inputs STO_A and STO_B were different for more than 1 second. The drive has to be switched off and the reason fixed (for example, check whether EMERGENCY STOP is active) before it is switched on.

Error number	Class	Bit	Description, cause and correctives
E 1312	-	-	Limit switch or reference switch signal not defined for signal input function Reference movements require limit switches. These limit switches are not assigned to inputs. Assign the signal input functions Positive Limit Switch, Negative Limit Switch and Reference Switch.
E 2300	3	18	Power stage overcurrent Motor short circuit and disabling of the power stage. Motor phases are inverted. Check the motor power connection.
E 3200	3	15	DC bus overvoltage Excessive regeneration during braking. Check deceleration ramp, check rating of drive and braking resistor.
E 3201	3	14	DC bus undervoltage (shutdown threshold) Power supply loss, poor power supply. Check mains supply.
E 3202	2	14	DC bus undervoltage (Quick Stop threshold) Power supply loss, poor power supply. Check mains supply.
E 4100	3	21	Power stage overtemperature Transistors overtemperature: Ambient temperature is too high, fan is inoperative, dust. Check the fan, improve the heat dissipation in the cabinet.
E 4101	0	1	Warning power stage overtemperature Transistors overtemperature: Ambient temperature is too high, fan is inoperative, dust. Check the fan, improve the heat dissipation in the cabinet.
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: Position evaluation error Position evaluation problem detected by encoder. Contact technical support or replace the motor.
E 7329	0	8	Motor encoder: 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.
E 7500	0	9	RS485/Modbus: overrun error EMC; cabling problem. Check cables.

Error number	Class	Bit	Description, cause and correctives
E 7501	0	9	RS485/Modbus: framing error EMC; cabling problem. Check cables.
E 7502	0	9	RS485/Modbus: parity error EMC; cabling problem. Check cables.
E 7503	0	9	RS485/Modbus: receive error EMC; cabling problem. Check cables.
E A069	3	10	Configuration error: The function Halt has been assigned to a digital input. When any of the Cyclic operating modes is used, the function Halt may not be assigned to a digital input. Check the configuration of the digital inputs.
E A06A	3	10	Configuration error: software limit switches are activated When any of the Cyclic operating modes is used, the software limit switches of the drive may not be activated. Check the configuration of the parameter SPV_SW_Limits.
E A300	-	-	Braking procedure after HALT request still active HALT was removed too soon. New command was sent before motor standstill was reached after a HALT request. Wait for complete stop before removing HALT signal. Wait until motor has come to a complete standstill.
E A301	-	-	Drive in operating state Quick Stop Active Error with error class 1 occurred. Drive stopped with Quick Stop command.
E A302	1	1	Stop by positive limit switch The positive limit switch was activated because movement range was exceeded, misoperation of limit switch or signal disturbance. Check application. Check limit switch function and connection.
E A303	1	1	Stop by negative limit switch The negative limit switch was activated because movement range was exceeded, misoperation of limit switch or signal disturbance. Check application. Check limit switch function and connection.
E A305	-	-	Power stage cannot be enabled in the current operating state Fieldbus: An attempt was made to enable the power stage in the operating state Not Ready To Switch On. Refer to the state diagram.
E A306	1	3	Stop by user-initiated software stop Drive is in operating state Quick Stop Active due to a software stop request. The activation of a new operating mode is not possible, the error code is sent as the response to the activation command. Clear break condition with command Fault Reset.

Error number	Class	Bit	Description, cause and correctives
E A307	-	-	Stop by internal software stop In the operating mode Homing and Jog, the movement is internally interrupted by an internal software stop. The activation of a new operating mode is not possible, the error code is sent as the response to the activation command. Clear break condition with command Fault Reset.
E A308	-	-	Drive is in operating state Fault or Fault Reaction Active Error with error class 2 or higher occurred. Check error code (HMI or commissioning software), remove error condition and clear error with command Fault Reset.
E A309	-	-	Drive not in operating state Operation Enabled A command was sent that requires the drive to be in the operating state Operation Enabled (for example, a command to change the operating mode). Set drive to operating state Operation Enabled and repeat the command.
E A310	-	-	Power stage not enabled Command cannot be used because the power stage is not enabled (operating state Operation Enabled or Quick Stop Active). Set drive to an operating state in which the power stage is enabled, refer to the state diagram.
E A313	-	-	Position overtraveled, reference point is therefore no longer defined (ref_ok=0) The movement range limits were exceeded which resulted in a loss of the reference point. An absolute movement cannot be made before a new reference point is defined. Define a new reference point by means of the operating mode Homing.
E A314	-	-	No reference point Command needs a defined reference point (ref_ok=1). Define a new reference point by means of the operating mode Homing.
E A315	-	-	Homing active Command cannot be used while the operating mode Homing is active. Wait until reference movement is finished.
E A317	-	-	Motor is not at a standstill Command sent which is not allowed when the motor is not at a standstill. For example: - Change of software limit switches - Change of handling of monitoring signals - Setting of reference point - Teach in of data set Wait until the motor has come to a standstill (x_end = 1).
E A318	-	-	Operating mode active (x_end=0) Activation of a new operating mode is not possible while the current operating mode is still active. Wait until the command in the operating mode has finished (x_end=1) or terminate current operating mode with HALT command.
E A319	1	2	Manual tuning/Autotuning: Movement out of permissible range The movement exceeds the parameterized maximum permissible movement range. Check permissible movement range value and time interval.
E A31A	-	-	Manual tuning/Autotuning: Amplitude/offset too high Amplitude plus offset for tuning exceed internal velocity or current limitation. Choose lower amplitude and offset values.

Error number	Class	Bit	Description, cause and correctives
E A31B	-	-	HALT requested Command not allowed while a HALT is requested. Clear HALT request and repeat command.
E A31C	-	-	Invalid position setting with software limit switch Value for negative (positive) software limit switch is greater (less) than value for positive (negative) software limit switch. Set correct position values.
E A31D	-	-	Velocity range overflow (CTRL_n_max) The velocity was set to a value greater than the maximum permissible velocity in parameter CTRL_n_max. Increase the value of parameter CTRL_n_max or reduce the velocity value.
E A31E	1	2	Stop by positive software limit switch Impossible to execute command because positive software limit switch was overtraveled. Return to the permissible range.
E A31F	1	2	Stop by negative software limit switch Impossible to execute command because negative software limit switch was overtraveled. Return to the permissible range.
E A320	par.	22	Following error External load or acceleration are too high. Reduce external load or acceleration. Use a differently rated drive, if necessary. Error response can be adjusted via parameter Flt_pDiff.
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 memory. Possible sub error codes: E A325, E A326, E A327, E A328 or E A329.
E A325	1	10	Limit switch to be approached not enabled Homing to positive limit switch or negative limit switch is disabled. Enable limit switch via 'IOsigLimP' or 'IOsigLimN'.
E A326	1	10	Reference switch not found between positive limit switch and negative limit switch Reference switch inoperative or not correctly connected. Check the function and wiring of the reference switch.
E A327	1	10	Reference movement to reference switch without reversal of direction results in activation of limit switch Search of reference switch without reversal of direction in positive (negative) direction with positive limit switch (negative limit switch) activated. Check the function and wiring of the positive limit switch (negative limit switch).
E A328	1	10	Reference movement to reference switch without reversal of direction results overtravel of limit switch or reference switch Search of reference switch without reversal of direction with limit switch or reference switch overtraveled. Reduce velocity for reference movement (parameter HMn) or increase deceleration (parameter RAMPdecel). Check the function and wiring of positive limit switch, negative limit switch and reference switch.



Error number	Class	Bit	Description, cause and correctives
E A329	1	10	More than one signal positive limit switch/negative limit switch/reference switch signal active Reference switch or limit switch not connected correctly or supply voltage for switches too low. Check the wiring and 24VDC supply voltage.
E A32A	1	10	Positive limit switch triggered with negative direction of movement Start reference movement with negative direction (for example reference movement to negative limit switch) and activate the positive limit switch (switch in opposite direction of movement). Check correct connection and function of limit switch. Activate a jog movement with negative movement (target limit switch must be connected to the negative limit switch).
E A32B	1	10	Negative limit switch triggered with positive direction of movement Start reference movement with positive direction (for example reference movement to positive limit switch) and activate the negative limit switch (switch in opposite direction of movement). Check correct connection and function of limit switch. Activate a jog movement with positive movement (target limit switch must be connected to the positive limit switch).
E A32C	1	10	Reference switch error (switch signal briefly enabled or switch overtraveled) Switch signal disturbance. Motor subjected to vibration or shock when stopped after activation of the switch signal. Check supply voltage, cabling and function of switch. Check motor reaction after stopping and optimize controller settings.
E A32D	1	10	Positive limit switch 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	Negative limit switch 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 index pulse and the switching point is insufficient. Increase the distance between the index pulse and the switching point. If possible, the distance between the index pulse and the switching point should be a half motor revolution.
E A332	1	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 memory.

Error number	Class	Bit	Description, cause and correctives
E A334	2	0	Timeout Standstill Window monitoring Position deviation after movement greater than standstill window. This may have been caused by an external load. Check load. Check settings for standstill window (parameters STANDp_win, STANDpwinTime and STANDpwinTout). Optimize controller settings.
E A337	0	10	Operating mode cannot be continued Continuation of interrupted movement in operating mode Profile Position is impossible because another operating mode had been active in the meantime. In the operating mode Motion Sequence, 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 B100	0	9	RS485/Modbus: unknown service Unsupported Modbus service was received. Check application on the Modbus master.
E B101	2	8	Cyclic communication: Deviation of synchronization signal 2 cycle times have passed, but no synchronization signal has been received. Analyze the trace of the communication.
E B102	2	8	Cyclic communication: Incorrect cycle time. The drive does not support the measured cycle time. Change the cycle time in the PLC master to a cycle time supported by the drive.
E B103	2	8	Cyclic communication: One signal was not received, the next signal received was incorrect. One synchronization signal was not received and one of the following synchronization signals was incorrect. Analyze the trace of the communication.
E B104	2	8	Cyclic communication: Synchronization signal missing 100ms have passed without a synchronization signal having been received. Analyze the communication.
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 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 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 B600	4	8	Ethernet: Initialization error

Error number	Class	Bit	Description, cause and correctives
E B601	1	8	Ethernet: Realtime data error
E B602	0	14	Ethernet: Realtime data warning
E B603	2	8	Ethernet: Protocol-specific error Can be caused by a connection timeout or a loss of the Ethernet link. Check cabling, network devices and PLC connection.
E B604	0	14	Ethernet: Protocol-specific warning
E B605	2	8	Unknown Ethernet error
E B607	0	14	Ethernet: Another request is currently being processed.
E B608	2	8	Ethernet: Realtime Hot-Reset - An NMT Reset was sent while the power stage was enabled - A Modbus TCP channel was reset while the power stage was enabled
E B609	2	8	Ethernet: Realtime Hot-Stop
E B60A	0	14	Ethernet: Timeout in internal communication
E B60B	0	14	Ethernet: Error in internal communication
E B60C	4	8	Ethernet Module Incompatible The firmware of the drive is not compatible with the communication firmware of the Ethernet module.



# 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**

Unsuitable parameter values may trigger unexpected movements, trigger signals, damage parts and disable 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 error situations.

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

### 11.1 Representation of the parameters

The way parameters are shown provides information required for unique identification, the default values and the properties of a parameter.

Structure of the parameter representation:

Parameter name	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 <b>1 / Selection value1:</b> Explanation 1 <b>2 / Selection value2:</b> Explanation 2 Further description and details	A <sub>pk</sub> 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	Minimum 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 .
- Parameter address* Each parameter has a unique parameter address. The parameter address is used to access the parameter via the fieldbus.

### 11.1.1 Decimal numbers for fieldbus

*Entering values* Please note that parameter values are entered via the fieldbus without a decimal point. All decimal places must be entered.

Input examples:

Value	Commissioning software	Fieldbus
20	20	20
5.0	5.0	50
23.57	23.57	2357
1.000	1.000	1000

## 11.2 Object dictionary

### 11.2.1 Communication profile range

The object dictionary is subdivided into the following ranges:

Index (hex)	Range in the object dictionary
0000 <sub>h</sub> ..0FFF <sub>h</sub>	Data Type Area
1000 <sub>h</sub> ..1FFF <sub>h</sub>	CoE Communication Area
2000 <sub>h</sub> ..5FFF <sub>h</sub>	Manufacturer-Specific Area
6000 <sub>h</sub> ..9FFF <sub>h</sub>	Profile Area
A000 <sub>h</sub> ..FFFF <sub>h</sub>	Reserved Area

The communication profile range in the index range from 1000<sub>h</sub>..1FFF<sub>h</sub> contains the communication-specific parameters for the EtherCAT network. The entries are identical for the devices.

- "Category" indicates whether the object is **mandatory** (M), **optional** (O) or **conditional** (C). This depends on the number and size of the objects.
- "Access" indicates whether the object is "Read Only" (R/-) or "Read/Write" (R/W) for the slave.

Index	Sub-index	Name	Default value	Access	Value or description
1000 <sub>h</sub>		Device type	-	R/-	
1008 <sub>h</sub>		Manufacturer device name	-	R/-	Vendor device name
1009 <sub>h</sub>		Manufacture. Hardware-version	-	R/-	Vendor hardware version
100A <sub>h</sub>		Manufacture. Software-Version	-	R/-	Vendor firmware version
1018 <sub>h</sub>		Identity Object	-	R/-	
	0	Number of Entries	4	R/-	4
	1	Vendor Id	080005A <sub>h</sub>	R/-	Vendor ID assigned by EtherCAT organization
	2	Product Code	-	R/-	Product code
	3	Revision number	-	R/-	Revision number
	4	Serial number	-	R/-	Serial number
1100 <sub>h</sub>	0	EtherCAT Address	-	R/-	EtherCAT site address assigned by master
1110 <sub>h</sub>	0	MAC Address	-	R/W	Virtual MAC address for the EoE interface
1111 <sub>h</sub>		Virtual IP Address info	-	R/W	
	0	Number of Entries	-		1 ... 5
	1	IP Address	-	R/W	IP address for the EoE interface
	2	Subnet Mask	-	R/W	Subnet mask for the EoE interface
	3	Default Gateway	-	R/W	Default gateway for the EoE interface
	4	DNS Server	-	R/W	DNS server for the EoE interface
1600 <sub>h</sub> ... 17FF <sub>h</sub>		Receive PDO Mapping	-	R/-	Receive PDO mapping
	0	Number of mapped objects in the PDO	-	R/- or R/W in variable mapping	Number of mapped objects
	1 ... 254	PDO mapping for the output object to be mapped	-	R/- or R/W in variable mapping	Receive data
1A00 <sub>h</sub> ... 1BFF <sub>h</sub>		Transmit PDO Mapping	-		Transmit PDO mapping
	0	Number of mapped objects in the PDO	-	R/- or R/W in variable mapping	Number of mapped objects
	1 ... 254	PDO mapping for the input object to be mapped	-	R/- or R/W in variable mapping	Transmit data
1C00 <sub>h</sub>		Sync Manager Communication Type	-		Sync Manager communication type
	0	Number of used sync Manger	-		Number of Sync Managers used
	1	Communication Type Sync Manager 0	-	R/-	Receive mailbox (master to slave)
	2	Communication Type Sync Manager 1	-	R/-	Send mailbox (slave to master)
	3	Communication Type Sync Manager 2	-	R/-	Output of process data (master to slave)
	4	Communication Type Sync Manager 3	-	R/-	Input of process data (slave to master)



Index	Sub-index	Name	Default value	Access	Value or description
	5 ... 32	Communication Type	-	R/-	
1C10 <sub>h</sub>		Sync Manager 0 PDO assignment	-		PDO assignment of Sync Manager 0
	0	Number of assigned PDOs	-	R/-	Number of assigned PDOs
1C11 <sub>h</sub>		Sync Manager 1PDO Assignment	-		PDO assignment of Sync Manager 1
	0	Number of assigned PDOs	-	R/-	Number of assigned PDOs
1C12 <sub>h</sub>		Sync Manager 2 PDO assignment	-		PDO assignment of Sync Manager 2
	0	Number of assigned PDOs	-	R/-	Number of assigned PDOs
	1 ... 254	PDO Mapping object index of assigned RxPDO	-	R/W	Index of the PDO mapping object of the assigned receive PDO
1C13 <sub>h</sub>		Sync Manager 3 PDO Assignment	-		PDO assignment of Sync Manager 3
	0	Number of assigned PDOs	-	R/-	Number of assigned PDOs
	1 ... 254	PDO Mapping object index of assigned TxPDO	-	R/W	Index of the PDO mapping object of the assigned transmit PDO

11.3 List of parameters

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
_acc_pref	Acceleration of reference value for profile generator Sign according to the changed speed value:  Increased speed: Positive sign Reduced speed: Negative sign	min <sup>-1</sup> /s - 0 -	INT32 INT32 R/- - -	CANopen 301F:9 <sub>h</sub> Modbus 7954
_AccessInfo	Current access channel for action objects  Low byte : Value 0: Used by channel in high byte Value 1: Exclusively used by channel in high byte  High byte: Current assignment of access channel Value 0: reserved Value 1: IO Value 2: HMI Value 3: Modbus RS485 Value 4: CANopen Value 5: CANopen via second SDO channel Value 6: Profibus Value 7: DeviceNet Value 8: reserved Value 9: Ethernet Values 10 ... 15: Modbus TCP	- - 0 -	UINT16 UINT16 R/- - -	CANopen 3001:C <sub>h</sub> Modbus 280
_actionStatus	Action word (153)  Signal state: 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: Motor is at standstill ( $\_n\_act < 9$ ) Bit 7: Motor movement in positive direction Bit 8: Motor movement in negative direction Bit 9: Reserved Bit 10: Reserved Bit 11: Profile generator idle (reference velocity 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/- - -	CANopen 301C:4 <sub>h</sub> Modbus 7176
_DCOMopmd_act	Active operating mode (115)  <b>-1 / Jog:</b> Jog <b>0 / Reserved:</b> Reserved <b>1 / Profile Position:</b> Profile Position <b>3 / Profile Velocity:</b> Profile Velocity <b>6 / Homing:</b> Homing	- -6 - 6	INT8 INT16 R/- - -	CANopen 6061:0 <sub>h</sub> Modbus 6920

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Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
_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 00001122h.	- - 0 -	UINT32 UINT32 R/- -	CANopen 301A:8h Modbus 6672
_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 33445566h.	- - 0 -	UINT32 UINT32 R/- -	CANopen 301A:9h Modbus 6674
_I2t_act_M	Current overload of motor (150)	% - 0 -	INT16 INT16 R/- -	CANopen 301C:19h Modbus 7218
_I2t_mean_M	Current load of motor (150)	% - 0 -	INT16 INT16 R/- -	CANopen 301C:1Ah Modbus 7220
_Id_act	Actual motor current d-component In increments of 0.01 A <sub>pk</sub> .	A <sub>pk</sub> - 0.00 -	INT16 INT16 R/- -	CANopen 301E:2h Modbus 7684
_Id_ref	Reference motor current (d component, field weakening) In increments of 0.01 A <sub>pk</sub> .	A <sub>pk</sub> - 0.00 -	INT16 INT16 R/- -	CANopen 301E:11h Modbus 7714
_Idq_act	Total motor current (vector sum d-components and q-components) In increments of 0.01 A <sub>pk</sub> .	A <sub>pk</sub> - 0.00 -	INT16 INT16 R/- -	CANopen 301E:3h Modbus 7686
_IO_LIO_act	Status of digital inputs/outputs (82) Coding of the individual signals: Bit 0: LIO1 Bit 1: LIO2 ...	- - 0 -	UINT16 UINT16 R/- -	CANopen 3008:15h Modbus 2090
_IO_STO_con	Connection of STO inputs <b>0 / Not Available:</b> Inputs not available <b>1 / Not Connected:</b> Inputs available, but not connected (jumpered) <b>3 / Connected:</b> Inputs available and connected (safety function STO active) Inputs STO_A (PWRR_A) and STO_B (PWRR_B)	- 0 - 3	UINT16 UINT16 R/- -	CANopen 3008:14h Modbus 2088

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Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
_Iq_act	Actual motor current q-component In increments of 0.01 A <sub>pk</sub> .	A <sub>pk</sub> - 0.00 -	INT16 INT16 R/- - -	CANopen 301E:1 <sub>h</sub> Modbus 7682
_Iq_ref	Reference motor current (q component, generating torque) In increments of 0.01 A <sub>pk</sub> .	A <sub>pk</sub> - 0.00 -	INT16 INT16 R/- - -	CANopen 301E:10 <sub>h</sub> Modbus 7712
_LastWarning	Number of last warning 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/- - -	CANopen 301C:9 <sub>h</sub> Modbus 7186
_n_act	Actual velocity of motor (124)	min <sup>-1</sup> - 0 -	INT32 INT16 R/- - -	CANopen 606C:0 <sub>h</sub> Modbus 7696
_n_actRAMP	Actual velocity of profile generator (124)	min <sup>-1</sup> - 0 -	INT32 INT32 R/- - -	CANopen 606B:0 <sub>h</sub> Modbus 7948
_n_pref	Velocity of reference value for profile generator	min <sup>-1</sup> - 0 -	INT32 INT32 R/- - -	CANopen 301F:7 <sub>h</sub> Modbus 7950
_n_ref	Reference speed of rotation	min <sup>-1</sup> - 0 -	INT16 INT16 R/- - -	CANopen 301E:7 <sub>h</sub> Modbus 7694
_n_targetRAMP	Target velocity of profile generator	min <sup>-1</sup> - 0 -	INT32 INT32 R/- - -	CANopen 301F:5 <sub>h</sub> Modbus 7946
_OpHours	Operating hours counter	s - 0 -	UINT32 UINT32 R/- - -	CANopen 301C:A <sub>h</sub> Modbus 7188

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
_p_absENCusr	Motor position with reference to encoder range (88)  The value range is determined by the encoder type. In the case of singleturn encoders, the value refers to one motor revolution, in the case of multiturn encoders to the entire encoder range (for example 4096 revolutions).  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	usr - 0 -	UINT32 UINT32 R/- - -	CANopen 301E:F <sub>h</sub> Modbus 7710
_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/- - -	CANopen 301E:E <sub>h</sub> Modbus 7708
_p_act	Actual position in internal units	inc - 0 -	INT32 INT32 R/- - -	CANopen 6063:0 <sub>h</sub> Modbus 7700
_p_actRAMPusr	Actual position of profile generator (129) In user-defined units	usr - 0 -	INT32 INT32 R/- - -	CANopen 301F:2 <sub>h</sub> Modbus 7940
_p_actusr	Actual position in user-defined units (129)	usr - 0 -	INT32 INT32 R/- - -	CANopen 6064:0 <sub>h</sub> Modbus 7706
_p_dif	Current deviation between reference and actual position (151)  Corresponds to the current control deviation of the position controller.  In increments of 0.0001 revolution.	revolution -214748.3648 - 214748.3647	INT32 INT32 R/- - -	CANopen 60F4:0 <sub>h</sub> Modbus 7716

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Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
_p_DifPeak	Value of the maximum tracking error of the position controller (151) The tracking error is the current position control deviation. See SPV_p_maxDiff for more information. A write access resets this value. In increments of 0.0001 revolution. Changed settings become active immediately.	revolution 0.0000 - 429496.7295	UINT32 UINT32 R/W - -	CANopen 3011:F <sub>h</sub> Modbus 4382
_p_ref	Reference position in internal units Value corresponds to the reference position of the position controller.	Inc - 0 -	INT32 INT32 R/- -	CANopen 301E:9 <sub>h</sub> Modbus 7698
_p_refusr	Reference position in user-defined units Value corresponds to the reference position of the position controller.	usr - 0 -	INT32 INT32 R/- -	CANopen 301E:C <sub>h</sub> Modbus 7704
_p_tarRAMPusr	Target position of profile generator Absolute position value of the profile generator, calculated on the basis of the relative and absolute position values received.	usr - 0 -	INT32 INT32 R/- -	CANopen 301F:1 <sub>h</sub> Modbus 7938
_PARchecksum	Read parameter checksum Changed settings become active immediately.	- 0 - 65535	UINT16 UINT16 R/- -	CANopen 3004:F <sub>h</sub> Modbus 1054
_prgNoCOM	Communication module program number Example: PR840.1 The value is entered as a decimal value: 8401	- - 0.0 -	UINT16 UINT16 R/- -	CANopen 301A:A <sub>h</sub> Modbus 6676
_prgNoDEV	Firmware program number Example: PR840.1 The value is provided as a decimal value: 8401	- - 0.0 -	UINT16 UINT16 R/- -	CANopen 3001:1 <sub>h</sub> Modbus 258
_prgVerCOM	Communication module firmware version Example: V4.201 The value is entered as a decimal value: 4201	- - 0.000 -	UINT16 UINT16 R/- -	CANopen 301A:B <sub>h</sub> Modbus 6678
_prgVerDEV	Firmware version number Example: V4.201 The value is provided as a decimal value: 4201	- - 0.000 -	UINT16 UINT16 R/- -	CANopen 3001:2 <sub>h</sub> Modbus 260
_serialNoDEV	Device serial number Serial number: Unique number for identification of the product Setting can only be changed if power stage is disabled.	- 0 - 4294967295	UINT32 UINT32 R/- per. -	CANopen 3001:17 <sub>h</sub> Modbus 302

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Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
_SigActive	Current status of monitoring signals (152) See _SigLatched for more details on the bit codes.	- - 0 -	UINT32 UINT32 R/- -	CANopen 301C:7 <sub>h</sub> Modbus 7182
_SigLatched	<p>Saved status of monitoring signals (152)</p> <p>Signal state: 0: Not activated 1: Activated</p> <p>Bit assignments: Bit 0: General error Bit 1: Limit switches (LIMP/LIMN/REF) Bit 2: Out of range (software limit switches, tuning) Bit 3: Quick Stop via fieldbus Bit 4: Inputs STO are 0 Bit 5: Reserved Bit 6: RS485 error Bit 7: CAN error Bit 8: Ethernet error Bit 9: Frequency of reference signal too high Bit 10: Error current operating mode Bit 11: Reserved Bit 12: Profibus error Bit 13: Reserved Bit 14: Undervoltage DC bus Bit 15: Overvoltage DC bus Bit 16: Mains phase missing Bit 17: Motor connection error Bit 18: Motor overcurrent/short circuit Bit 19: Motor encoder error Bit 20: Undervoltage 24VDC Bit 21: Overtemperature (power stage, motor) Bit 22: Following error Bit 23: Maximum velocity exceeded Bit 24: Inputs STO different Bit 25: Reserved Bit 26: Reserved Bit 27: Reserved Bit 28: Reserved Bit 29: EEPROM error Bit 30: System booting (hardware error or parameter error) Bit 31: System error (for example, watch-dog)</p> <p>Monitoring functions are product-dependent.</p>	- - 0 -	UINT32 UINT32 R/- -	CANopen 301C:8 <sub>h</sub> Modbus 7184
_StopFault	Number of last error causing a stop (153) Number of the most recent error.	- - 0 -	UINT16 UINT16 R/- -	CANopen 603F:0 <sub>h</sub> Modbus 7178
_Temp_act_PA	Current power stage temperature (150)	°C - 0 -	INT16 INT16 R/- -	CANopen 301C:10 <sub>h</sub> Modbus 7200

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Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
_Ud_ref	Reference motor voltage d-component In increments of 0.1 V.	V - 0.0 -	INT16 INT16 R/- - -	CANopen 301E:5h Modbus 7690
_UDC_act	Voltage at DC bus Supply voltage VDC. In increments of 0.1 V.	V - 0.0 -	UINT16 UINT16 R/- - -	CANopen 301C:Fh Modbus 7198
_Udq_ref	Total motor voltage (vector sum d-components and q-components) Square root of ( _Uq_ref <sup>2</sup> + _Ud_ref <sup>2</sup> ). In increments of 0.1 V.	V - 0.0 -	INT16 INT16 R/- - -	CANopen 301E:6h Modbus 7692
_Uq_ref	Reference motor voltage q-component In increments of 0.1 V.	V - 0.0 -	INT16 INT16 R/- - -	CANopen 301E:4h Modbus 7688
_UserAppMem1	User application memory 1 This memory area can be used to save user-specific values persistently in the drive. The values can be reset to the factory settings.	- - 0 -	UINT32 UINT32 R/W per. -	CANopen 3001:1Fh Modbus 318
_UserAppMem2	User application memory 2 This memory area can be used to save user-specific values persistently in the drive. The values can be reset to the factory settings.	- - 0 -	UINT32 UINT32 R/W per. -	CANopen 3001:20h Modbus 320
_UserAppMem3	User application memory 3 This memory area can be used to save user-specific values persistently in the drive. The values can be reset to the factory settings.	- - 0 -	UINT32 UINT32 R/W per. -	CANopen 3001:21h Modbus 322
_UserAppMem4	User application memory 4 This memory area can be used to save user-specific values persistently in the drive. The values can be reset to the factory settings.	- - 0 -	UINT32 UINT32 R/W per. -	CANopen 3001:22h Modbus 324
_VoltUtil	Degree of utilization of DC bus voltage With a value of 100%, the drive operates at the voltage limit.	% - 0 -	INT16 INT16 R/- - -	CANopen 301E:13h Modbus 7718
_WarnActive	Active warnings, bit-coded (152) See _WarnLatched for more details on the bit codes.	- - 0 -	UINT16 UINT16 R/- - -	CANopen 301C:Bh Modbus 7190



Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
_WarnLatched	<p>Saved warnings, bit-coded (153)</p> <p>Saved warning bits are deleted in the case of a FaultReset. Bits 10, 11, 13 are deleted automatically.</p> <p>Signal state: 0: Not activated 1: Activated</p> <p>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<sup>2</sup>t) Bit 5: Motor overload (I<sup>2</sup>t) Bit 6: Braking resistor overload (I<sup>2</sup>t) Bit 7: CAN warning Bit 8: Motor encoder warning Bit 9: RS485 protocol warning Bit 10: STO_A (PWRR_A) and/or STO_B (PWRR_B) Bit 11: DC bus undervoltage/missing mains phase Bit 12: Profibus warning Bit 13: Position not yet valid (position capture still running) Bit 14: Ethernet warning Bit 15: Reserved</p> <p>Monitoring functions are product-dependent.</p>	- - 0 -	UINT16 UINT16 R/- -	CANopen 301C:C <sub>h</sub> Modbus 7192
AbsHomeRequest	<p>Absolute positioning only after homing (129)</p> <p><b>0 / No:</b> No <b>1 / Yes:</b> Yes</p> <p>Changed settings become active immediately.</p>	- 0 0 1	UINT16 UINT16 R/W per. -	CANopen 3006:16 <sub>h</sub> Modbus 1580
AccessLock	<p>Locking other access channels (104)</p> <p>0: Release other access channels 1: Lock other access channels</p> <p>The fieldbus can lock active access to the device via the following access channels with this parameter: - Input signals - Commissioning software</p> <p>Processing of the input signal HALT cannot be locked.</p> <p>Changed settings become active immediately.</p>	- 0 - 1	UINT16 UINT16 R/W - -	CANopen 3001:1E <sub>h</sub> Modbus 316

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Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
BRK_release	<p>Processing of holding brake (85)</p> <p><b>0 / Close:</b> Automatic processing <b>1 / Open:</b> Manual release of brake</p> <p>The brake output can only be activated in the operating states Switch On Disabled or Ready To Switch On.</p> <p>If the power stage is enabled, the value is automatically set to 0.</p> <p>Changed settings become active immediately.</p>	- 0 0 1	UINT16 UINT16 R/W - -	CANopen 3008:A <sub>h</sub> Modbus 2068
BRK_status	<p>Status of holding brake</p> <p>Value 0: Applied Value 1: Released Value 2: Not available</p> <p>Changed settings become active immediately.</p>	- 0 0 2	UINT16 UINT16 R/- - -	CANopen 3008:B <sub>h</sub> Modbus 2070
Cap1Activate	<p>Capture input 1 start/stop (166)</p> <p><b>0 / Capture stop:</b> Cancel capture function <b>1 / Capture once:</b> Start one-time capture <b>2 / Capture continuous:</b> Start continuous capture</p> <p>In the case of one-time capture, the function is terminated when the first value is captured.</p> <p>In the case of continuous capture, the function continues to run.</p> <p>Changed settings become active immediately.</p>	- 0 - 2	UINT16 UINT16 R/W - -	CANopen 300A:4 <sub>h</sub> Modbus 2568
Cap1Config	<p>Capture input 1 configuration (166)</p> <p><b>0 / 1-&gt;0:</b> Position capture at 1-&gt;0 change <b>1 / 0-&gt;1:</b> Position capture at 0-&gt;1 change</p> <p>Changed settings become active immediately.</p>	- 0 0 1	UINT16 UINT16 R/W - -	CANopen 300A:2 <sub>h</sub> Modbus 2564
Cap1Count	<p>Capture input 1 event counter (166)</p> <p>Counts the capture events. The counter is reset when capture unit 1 is activated.</p>	- - 0 -	UINT16 UINT16 R/- - -	CANopen 300A:8 <sub>h</sub> Modbus 2576
Cap1Pos	<p>Capture input 1 captured position (166)</p> <p>Captured position at the time of the "capture signal". The captured position is re-calculated after "Position Setting" or "Homing".</p>	usr - 0 -	INT32 INT32 R/- - -	CANopen 300A:6 <sub>h</sub> Modbus 2572

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
Cap2Activate	Capture input 2 start/stop (166) <b>0 / Capture stop:</b> Cancel capture function <b>1 / Capture once:</b> Start one-time capture <b>2 / Capture continuous:</b> Start continuous capture  In the case of one-time capture, the function is terminated when the first value is captured. In the case of continuous capture, the function continues to run.  Changed settings become active immediately.	- 0 - 2	UINT16 UINT16 R/W - -	CANopen 300A:5 <sub>h</sub> Modbus 2570
Cap2Config	Capture input 2 configuration (166) <b>0 / 1-&gt;0:</b> Position capture at 1->0 change <b>1 / 0-&gt;1:</b> Position capture at 0->1 change  Changed settings become active immediately.	- 0 0 0 1	UINT16 UINT16 R/W - -	CANopen 300A:3 <sub>h</sub> Modbus 2566
Cap2Count	Capture input 2 event counter (166)  Counts the capture events. The counter is reset when capture unit 2 is activated.	- - 0 -	UINT16 UINT16 R/- - -	CANopen 300A:9 <sub>h</sub> Modbus 2578
Cap2Pos	Capture input 2 captured position (167)  Captured position at the time of the "capture signal". The captured position is re-calculated after "Position Setting" or "Homing".	usr - 0 -	INT32 INT32 R/- - -	CANopen 300A:7 <sub>h</sub> Modbus 2574
CapStatus	Status of the capture inputs (167)  Read access: Bit 0: Position captured via input CAP1 Bit 1: Position captured via input CAP2	- - 0 -	UINT16 UINT16 R/- - -	CANopen 300A:1 <sub>h</sub> Modbus 2562
CTRL_I_max	Current limitation (80)  The value must not exceed the maximum permissible current of the motor or the power stage.  Default: M_I_max In increments of 0.01 A <sub>pk</sub> .  Changed settings become active immediately.	A <sub>pk</sub> 0.00 - 299.99	UINT16 UINT16 R/W per. -	CANopen 3012:1 <sub>h</sub> Modbus 4610
CTRL_KFPp	Velocity feed-forward position controller  Overshoot of up to 110% is possible.  In increments of 0.1 %.  Changed settings become active immediately.	% 0.0 100.0 110.0	UINT16 UINT16 R/W per. -	CANopen 3012:8 <sub>h</sub> Modbus 4624

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
CTRL_KPn	Velocity controller P gain (95) The default value is calculated on the basis of the motor parameters. In increments of 0.0001 A/min <sup>-1</sup> . Changed settings become active immediately.	A/min <sup>-1</sup> 0.0001 - 1.2700	UINT16 UINT16 R/W per. -	CANopen 3012:3 <sub>h</sub> Modbus 4614
CTRL_KPp	Position controller P gain (100) The default value is calculated. In increments of 0.1 1/s. Changed settings become active immediately.	1/s 2.0 - 114.3	UINT16 UINT16 R/W per. -	CANopen 3012:6 <sub>h</sub> Modbus 4620
CTRL_n_max	Speed limitation (80) The set value must not exceed the maximum motor speed.  Default: maximum motor speed (see M_n_max) Changed settings become active immediately.	min <sup>-1</sup> 0 - 13200	UINT16 UINT16 R/W per. -	CANopen 3012:2 <sub>h</sub> Modbus 4612
CTRL_Pcdamp	Posicast filter: Damping The filter is switched off at a value of 1000. In increments of 0.1 %. Changed settings become active immediately.	% 50.0 100.0 100.0	UINT16 UINT16 R/W per. expert	CANopen 3012:14 <sub>h</sub> Modbus 4648
CTRL_Pcdelay	Posicast filter: Time delay The filter is switched off at a value of 0. In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 0.00 25.00	UINT16 UINT16 R/W per. expert	CANopen 3012:15 <sub>h</sub> Modbus 4650
CTRL_TAUUnref	Filter time constant of reference velocity value filter (96) In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 0.00 327.67	UINT16 UINT16 R/W per. -	CANopen 3012:9 <sub>h</sub> Modbus 4626
CTRL_TNn	Velocity controller integral action time (95) In increments of 0.01 ms. Changed settings become active immediately.	ms 0.00 - 327.67	UINT16 UINT16 R/W per. -	CANopen 3012:4 <sub>h</sub> Modbus 4616

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via fieldbus
DCOMcompatib	<p>DriveCom state machine: state transition from 3 to 4</p> <p><b>0 / Automatic:</b> Automatic (state transition is performed automatically)</p> <p><b>1 / Drivecom-conform:</b> Standard-compliant (state transition must be controlled via the fieldbus)</p> <p>Determines the state transition between the states SwitchOnDisabled (3) and Ready-ToSwitchOn (4) for CANopen devices. If the device is not CANopen, this value is ignored!</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active immediately.</p>	- 0 0 1	UINT16 UINT16 R/W per. -	CANopen 301B:13h Modbus 6950
DCOMcontrol	<p>Drivecom control word (111)</p> <p>Refer to chapter Operation, Operating States, for bit coding information.</p> <p>Bit 0: Switch on Bit 1: Enable Voltage Bit 2: Quick Stop Bit 3: Enable Operation Bit 4..6: Operating mode specific Bit 7: Fault Reset Bit 8: Halt Bit 9..15: Reserved (must be 0)</p> <p>Changed settings become active immediately.</p>	- - 0 -	UINT16 UINT16 R/W - -	CANopen 6040:0h Modbus 6914
DCOMopmode	<p>Operating mode (74)</p> <p><b>-1 / Jog:</b> Jog <b>0 / Reserved:</b> Reserved <b>1 / Profile Position:</b> Profile Position <b>3 / Profile Velocity:</b> Profile Velocity <b>6 / Homing:</b> Homing <b>8 / Cyclic Synchronous Position:</b> Cyclic Synchronous Position</p> <p>Changed settings become active immediately.</p>	- -6 - 8	INT8 INT16 R/W - -	CANopen 6060:0h Modbus 6918
DCOMstatus	<p>Drivecom status word (109)</p> <p>Refer to chapter Operation, State Machine for bit coding information.</p> <p>Bit 0-3,5,6: Status bits Bit 4: Voltage enabled Bit 7: Warning Bit 8: HALT request active Bit 9: Remote Bit 10: Target reached Bit 11: Reserved Bit 12: Operating mode specific Bit 13: x_err Bit 14: x_end Bit 15: ref_ok</p>	- - 0 -	UINT16 UINT16 R/- - -	CANopen 6041:0h Modbus 6916

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Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
ENC_pabsusr	<p>Adjustment of absolute position of encoder (88)</p> <p>The value range depends on the encoder type.</p> <p>Singleturn encoder: 0 ... max_pos_usr/rev. - 1</p> <p>Multiturn encoder: 0 ... (4096 * max_pos_usr/rev.) -1</p> <p>max_pos_usr/rev.: maximum user position for one motor turn. This value is 16384 with the default scaling.</p> <p>NOTE: * If processing is to be performed with inversion of the direction of rotation, this must be set before the motor encoder position is adjusted. * After the write access, a wait time of at least 1 second is required before the drive is switched off. * Changing this value also changes the position of the virtual index pulse and the index pulse for the ESIM function.</p> <p>Changed settings become active the next time the product is switched on.</p>	usr -2147483648 - 2147483647	INT32 INT32 R/W - -	CANopen 3005:16 <sub>h</sub> Modbus 1324
EthCycleTime	<p>EtherCAT cycle time</p> <p>This parameter is implicitly set with the EtherCAT configuration and cannot be written via CoE. It corresponds to EtherCAT cycle time 1C32:02h. Unit: ns</p> <p>Changed settings become active immediately.</p>	- - 0 -	UINT32 UINT32 R/W - -	CANopen 3019:9 <sub>h</sub> Modbus 6418
EthErrBehv	<p>Error behavior for realtime Ethernet data (190)</p> <p><b>0 / Warning:</b> Warning (no error response) <b>1 / ErrorClass1:</b> Error class 1 (Quick Stop)</p> <p>Sets the error class for incorrect realtime Ethernet data</p> <p>Changed settings become active immediately.</p>	- 0 0 1	UINT16 UINT16 R/W per. -	CANopen 3019:6 <sub>h</sub> Modbus 6412
EthFdrAutosave	<p>Fast Device Replacement (FDR) Autosave</p> <p><b>0 / Disabled:</b> Disabled <b>1 / 1 minute:</b> 1 minute <b>2 / 5 minutes:</b> 5 minutes <b>3 / 15 minutes:</b> 15 minutes <b>4 / 30 minutes:</b> 30 minutes <b>5 / 60 minutes:</b> 60 minutes</p> <p>If FDR is enabled, the drive cyclically stores the configuration to the server in Autosave mode.</p>	- 0 0 5	UINT16 UINT16 R/W per. -	CANopen 301A:15 <sub>h</sub> Modbus 6698

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
EthFdrEnable	Fast Device Replacement (FDR) Enable <b>0 / Disabled:</b> Disabled <b>1 / Enabled:</b> 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. -	CANopen 301A:14 <sub>h</sub> Modbus 6696
EthGateway	Stored Ethernet network gateway Default is 192.168.100.254  Changed settings become active immediately.	- - 0 -	UINT32 UINT32 R/W per. -	CANopen 301A:3 <sub>h</sub> Modbus 6662
EthGatewayAct	Currently used Ethernet network gateway Default is 192.168.100.254	- - 0 -	UINT32 UINT32 R/- - -	CANopen 301A:6 <sub>h</sub> Modbus 6668
EthIpAddr	Stored IP address Default is 192.168.100.10  Changed settings become active immediately.	- - 0 -	UINT32 UINT32 R/W per. -	CANopen 301A:1 <sub>h</sub> Modbus 6658
EthIpAddrAct	Currently used IP address	- - 0 -	UINT32 UINT32 R/- - -	CANopen 301A:4 <sub>h</sub> Modbus 6664
EthIPConfInfo	IP configuration information <b>2000 / Device Name:</b> Device Name <b>2001 / Bootp:</b> Bootp <b>2002 / Stored:</b> Stored in EEPROM <b>2003 / Build from MAC:</b> Build from MAC <b>2004 / EtherNet/IP default:</b> EtherNet/IP default <b>2005 / Powerlink:</b> Powerlink <b>2006 / EtherCAT:</b> EtherCAT  The IP configuration can be set with the switches in the connector housing.	- 0 - 65535	UINT16 UINT16 R/- - -	CANopen 301A:13 <sub>h</sub> Modbus 6694
EthSubMask	Stored subnet mask Default is 255.255.255.0  Changed settings become active immediately.	- - 0 -	UINT32 UINT32 R/W per. -	CANopen 301A:2 <sub>h</sub> Modbus 6660
EthSubMaskAct	Currently used subnet mask Default is 255.255.255.0	- - 0 -	UINT32 UINT32 R/- - -	CANopen 301A:5 <sub>h</sub> Modbus 6666
EthSyncErr	EtherCAT synchronization error  This counter is incremented whenever no interrupt has been received from the Ethercat module during the cycle time.  Changed settings become active immediately.	- - 0 -	UINT16 UINT16 R/W - -	CANopen 3019:A <sub>h</sub> Modbus 6420

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Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
EthSyncType	EtherCAT synchronization type This parameter is implicitly set with the EtherCAT configuration and cannot be written via CoE. It corresponds to EtherCAT synchronization type 1C32:01h Value 0: Free run Value 1: Synchronous with SM 2 event Value 2: DC mode - Synchronous with SYNC0 event Changed settings become active immediately.	- 0 0 2	UINT32 UINT32 R/W - -	CANopen 3019:8h Modbus 6416
FLT_class	Error class (190) Value 0: Warning (no response) Value 1: Error (Quick Stop -> state 7) Value 2: Error (Quick Stop -> state 8, 9) Value 3: Fatal error (state 9, can be acknowledged) Value 4: Fatal error (state 9, cannot be acknowledged)	- 0 - 4	UINT16 UINT16 R/- - -	CANopen 303C:2h Modbus 15364
FLT_del_err	Clear error memory (189) 1: Delete all entries in the error memory  The clearing process is completed if a 0 is returned after a read access. Changed settings become active immediately.	- 0 - 1	UINT16 UINT16 R/W - -	CANopen 303B:4h Modbus 15112
FLT_err_num	Error number (190) 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/- - -	CANopen 303C:1h Modbus 15362
FLT_Idq	Motor current at error time In increments of 0.01 A.	A - 0.00 -	UINT16 UINT16 R/- - -	CANopen 303C:9h Modbus 15378
FLT_MemReset	Reset error memory read pointer (189) 1: Set error memory read pointer to oldest error entry. Changed settings become active immediately.	- 0 - 1	UINT16 UINT16 R/W - -	CANopen 303B:5h Modbus 15114
FLT_n	Motor velocity at error time	min <sup>-1</sup> - 0 -	INT16 INT16 R/- - -	CANopen 303C:8h Modbus 15376



Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
FLT_powerOn	Number of power on cycles	- 0 - 4294967295	UINT32 UINT32 R/- - -	CANopen 303B:2 <sub>h</sub> Modbus 15108
FLT_Qual	Error additional information (190) This entry contains additional information on the error, depending on the error number. Example: a parameter address	- 0 - 65535	UINT16 UINT16 R/- - -	CANopen 303C:4 <sub>h</sub> Modbus 15368
FLT_Temp_DEV	Temperature of device at error time	°C - 0 -	INT16 INT16 R/- - -	CANopen 303C:B <sub>h</sub> Modbus 15382
FLT_Temp_PA	Temperature of power stage at error time	°C - 0 -	INT16 INT16 R/- - -	CANopen 303C:A <sub>h</sub> Modbus 15380
FLT_Time	Error time (190) With reference to operating hours counter	s 0 - 536870911	UINT32 UINT32 R/- - -	CANopen 303C:3 <sub>h</sub> Modbus 15366
FLT_UDC	DC bus voltage at error time In increments of 0.1 V.	V - 0.0 -	UINT16 UINT16 R/- - -	CANopen 303C:7 <sub>h</sub> Modbus 15374
FLTAmpOnCyc	Number of cycles of enabling the power stage at error time  Number of cycles of enabling the power stage from the time the power supply (control voltage) was switched on to the time the error occurred.	- - 0 -	UINT16 UINT16 R/- - -	CANopen 303C:5 <sub>h</sub> Modbus 15370
FLTAmpOnTime	Time between enabling of power stage and occurrence of error	s - 0 -	UINT16 UINT16 R/- - -	CANopen 303C:6 <sub>h</sub> Modbus 15372
HMdisREFtoIDX	Distance from switching point to index pulse (140) The value serves as a criterion for determining whether the reference movement with index pulse can be reproduced. In increments of 0.0001 revolution.	revolution - 0.0000 -	INT32 INT32 R/- - -	CANopen 3028:C <sub>h</sub> Modbus 10264
HMdisusr	Distance from switching point (137) The distance from the switching point is defined as the reference point.  The parameter is only effective during a reference movement without index pulse. Changed settings become active the next time the motor moves.	usr 1 200 2147483647	INT32 INT32 R/W per. -	CANopen 3028:7 <sub>h</sub> Modbus 10254

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Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
HMmethod	<p>Homing method (134)</p> <p>1: LIMN with index pulse                      2: LIMP with index pulse                      7: REF+ with index pulse, inv., inside                      8: REF+ with index pulse, inv., outside                      9: REF+ with index pulse, not inv., inside                      10: REF+ with index pulse, not inv., outside                      11: REF- with index pulse, inv., outside                      12: REF- with index pulse, inv., inside                      13: REF- with index pulse, not inv., inside                      14: REF- with index pulse, not inv., outside                      17: LIMN                      18: LIMP                      23: REF+, inv., outside                      24: REF+, inv., inside                      25: REF+, not inv., inside                      26: REF+, not inv., outside                      27: REF-, inv., outside                      28: REF-, inv., inside                      29: REF-, not inv., inside                      30: REF-, not inv., outside                      33: Index pulse neg. direction                      34: Index pulse pos. direction                      35: Position setting</p> <p>Abbreviations:                      REF+: Search movement in pos. direction                      REF-: Search movement in neg. 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</p> <p>Changed settings become active immediately.</p>	- 1 18 35	INT8 INT16 R/W - -	CANopen 6098:0h Modbus 6936
HMn_out	<p>Target velocity for moving away from switch (135)</p> <p>The adjustable value is internally limited to the current parameter setting in RAMPn_max.</p> <p>Changed settings become active the next time the motor moves.</p>	min <sup>-1</sup> 1 6 3000	UINT32 UINT16 R/W per. -	CANopen 6099:2h Modbus 10250
HMn	<p>Target velocity for searching the switch (135)</p> <p>The adjustable value is internally limited to the current parameter setting in RAMPn_max.</p> <p>Changed settings become active the next time the motor moves.</p>	min <sup>-1</sup> 1 60 13200	UINT32 UINT16 R/W per. -	CANopen 6099:1h Modbus 10248

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
HMoutdisusr	<p>Maximum distance for search for switching point (136)</p> <p>0: Monitoring of distance inactive &gt;0: Maximum distance in user-defined units</p> <p>After detection of the switch, the drive starts to search for the defined switching point. If the defined switching point is not found within the distance defined here, the reference movement is canceled with an error.</p> <p>Changed settings become active the next time the motor moves.</p>	usr 0 0 2147483647	INT32 INT32 R/W per. -	CANopen 3028:6 <sub>h</sub> Modbus 10252
HMp_homeusr	<p>Position at reference point (136)</p> <p>After a successful reference movement, this position is automatically set at the reference point.</p> <p>Changed settings become active the next time the motor moves.</p>	usr -2147483648 0 2147483647	INT32 INT32 R/W per. -	CANopen 3028:B <sub>h</sub> Modbus 10262
HMp_setpusr	<p>Position for position setting (144)</p> <p>Position setting position for homing method 35</p> <p>Changed settings become active immediately.</p>	usr - 0 -	INT32 INT32 R/W - -	CANopen 301B:16 <sub>h</sub> Modbus 6956
HMrchdisusr	<p>Maximum search distance after overtravel of switch (136)</p> <p>0: Search distance monitoring disabled &gt;0: Search distance</p> <p>The switch must be activated again within this search distance, otherwise the reference movement is canceled.</p> <p>Changed settings become active the next time the motor moves.</p>	usr 0 0 2147483647	INT32 INT32 R/W per. -	CANopen 3028:D <sub>h</sub> Modbus 10266
IO_AutoEnable	<p>Enabling the power stage at PowerOn</p> <p><b>0 / Off:</b> Active Enable during power on does not activate the power stage. <b>1 / On:</b> Active Enable during power on activates the power stage. <b>2 / AutoOn:</b> Power stage is automatically activated at power on.</p> <p>Changed settings become active the next time the power stage is enabled.</p>	- 0 0 0 2	UINT16 UINT16 R/W per. -	CANopen 3005:6 <sub>h</sub> Modbus 1292
IO_LO_set	<p>Setting the digital outputs directly (173)</p> <p>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'.</p> <p>Coding of the individual signals: Bit 0: LO1_OUT Bit 1: LO2_OUT ...</p>	- - 0 -	UINT16 UINT16 R/W - -	CANopen 3008:11 <sub>h</sub> Modbus 2082

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Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
IOfunct_LIO1	<p>Function Input/Output LIO1 (175)</p> <p><b>1 / Input Free available:</b> Available as required</p> <p><b>2 / Input Fault reset:</b> Reset fault (local control mode only)</p> <p><b>3 / Input Enable:</b> Enable (local control mode only)</p> <p><b>4 / Input Halt:</b> Halt</p> <p><b>9 / Input Jog positive:</b> Jog positive</p> <p><b>10 / Input Jog negative:</b> Jog negative</p> <p><b>11 / Input Jog fast/slow:</b> Jog fast/slow</p> <p><b>20 / Input Reference switch (REF):</b> Reference switch (REF)</p> <p><b>21 / Input Positive limit switch (LIMP):</b> Positive limit switch (LIMP)</p> <p><b>101 / Output Free available:</b> Available as required</p> <p><b>102 / Output No fault:</b> No fault</p> <p><b>103 / Output Active:</b> Ready</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the product is switched on.</p>	- - 0 -	UINT16 UINT16 R/W per. -	CANopen 3007:11h Modbus 1826
IOfunct_LIO2	<p>Function Input/Output LIO2 (175)</p> <p><b>1 / Input Free available:</b> Available as required</p> <p><b>2 / Input Fault reset:</b> Reset fault (local control mode only)</p> <p><b>3 / Input Enable:</b> Enable (local control mode only)</p> <p><b>4 / Input Halt:</b> Halt</p> <p><b>9 / Input Jog positive:</b> Jog positive</p> <p><b>10 / Input Jog negative:</b> Jog negative</p> <p><b>11 / Input Jog fast/slow:</b> Jog fast/slow</p> <p><b>20 / Input Reference switch (REF):</b> Reference switch (REF)</p> <p><b>22 / Input Negative limit switch (LIMN):</b> Negative limit switch (LIMN)</p> <p><b>101 / Output Free available:</b> Available as required</p> <p><b>102 / Output No fault:</b> No fault</p> <p><b>103 / Output Active:</b> Ready</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the product is switched on.</p>	- - 0 -	UINT16 UINT16 R/W per. -	CANopen 3007:12h Modbus 1828

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
IOfunct_LIO3	<p>Function Input/Output LIO3 (176)</p> <p><b>1 / Input Free available:</b> Available as required</p> <p><b>2 / Input Fault reset:</b> Reset fault (local control mode only)</p> <p><b>3 / Input Enable:</b> Enable (local control mode only)</p> <p><b>4 / Input Halt:</b> Halt</p> <p><b>9 / Input Jog positive:</b> Jog positive</p> <p><b>10 / Input Jog negative:</b> Jog negative</p> <p><b>11 / Input Jog fast/slow:</b> Jog fast/slow</p> <p><b>20 / Input Reference switch (REF):</b> Reference switch (REF)</p> <p><b>101 / Output Free available:</b> Available as required</p> <p><b>102 / Output No fault:</b> No fault</p> <p><b>103 / Output Active:</b> Ready</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the product is switched on.</p>	- - 0 -	UINT16 UINT16 R/W per. -	CANopen 3007:13 <sub>h</sub> Modbus 1830
IOfunct_LIO4	<p>Function Input/Output LIO4 (176)</p> <p><b>1 / Input Free available:</b> Available as required</p> <p><b>2 / Input Fault reset:</b> Reset fault (local control mode only)</p> <p><b>3 / Input Enable:</b> Enable (local control mode only)</p> <p><b>4 / Input Halt:</b> Halt</p> <p><b>9 / Input Jog positive:</b> Jog positive</p> <p><b>10 / Input Jog negative:</b> Jog negative</p> <p><b>11 / Input Jog fast/slow:</b> Jog fast/slow</p> <p><b>20 / Input Reference switch (REF):</b> Reference switch (REF)</p> <p><b>101 / Output Free available:</b> Available as required</p> <p><b>102 / Output No fault:</b> No fault</p> <p><b>103 / Output Active:</b> Ready</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the product is switched on.</p>	- - 0 -	UINT16 UINT16 R/W per. -	CANopen 3007:14 <sub>h</sub> Modbus 1832
IOsigLimFreeMode	<p>Special movement away from limit switches (73)</p> <p><b>0 / Off:</b> Off</p> <p><b>1 / Mode 1:</b> Limit switch error can be reset</p> <p><b>2 / Mode 2:</b> Limit switch error can be reset and active limit switch during enabling of power stage does not trigger an error</p> <p>Processing is only possible in the cyclic synchronous operating modes.</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the power stage is enabled.</p>	- 0 0 2	UINT16 UINT16 R/W per. -	CANopen 3006:6 <sub>h</sub> Modbus 1548

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Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
IOsigLimN	Signal evaluation for negative limit switch (135) <b>0 / Inactive:</b> Inactive <b>1 / Normally Closed:</b> Normally closed NC <b>2 / Normally Open:</b> Normally open NO  Setting can only be changed if power stage is disabled.  Changed settings become active the next time the power stage is enabled.	- 0 1 2	UINT16 UINT16 R/W per. -	CANopen 3006:F <sub>h</sub> Modbus 1566
IOsigLimP	Signal evaluation for positive limit switch (135) <b>0 / Inactive:</b> Inactive <b>1 / Normally Closed:</b> Normally closed NC <b>2 / normally open:</b> Normally open NO  Setting can only be changed if power stage is disabled.  Changed settings become active the next time the power stage is enabled.	- 0 1 2	UINT16 UINT16 R/W per. -	CANopen 3006:10 <sub>h</sub> Modbus 1568
IOsigRef	Signal evaluation for reference switch (135) <b>1 / Normally Closed:</b> Normally closed NC <b>2 / Normally Open:</b> Normally open NO  The reference switch is only active while a reference movement to the reference switch is processed.  Setting can only be changed if power stage is disabled.  Changed settings become active the next time the power stage is enabled.	- 1 1 2	UINT16 UINT16 R/W per. -	CANopen 3006:E <sub>h</sub> Modbus 1564
JOGactivate	Activation of operating mode Jog (114) Bit 0: positive direction of rotation Bit 1: negative direction of rotation Bit 2: 0=slow 1=fast  Changed settings become active immediately.	- 0 0 7	UINT16 UINT16 R/W - -	CANopen 301B:9 <sub>h</sub> Modbus 6930
JOGn_fast	Speed for fast jog (119)  The adjustable value is internally limited to the current parameter setting in RAMPn_max.  Changed settings become active immediately.	min <sup>-1</sup> 1 180 13200	UINT16 UINT16 R/W per. -	CANopen 3029:5 <sub>h</sub> Modbus 10506
JOGn_slow	Speed for slow jog (119)  The adjustable value is internally limited to the current parameter setting in RAMPn_max.  Changed settings become active immediately.	min <sup>-1</sup> 1 60 13200	UINT16 UINT16 R/W per. -	CANopen 3029:4 <sub>h</sub> Modbus 10504

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
JOGstepusr	Jog distance prior to continuous movement (119) 0: Direct activation of continuous movement >0: Positioning distance per jog cycle Changed settings become active the next time the motor moves.	usr 0 20 2147483647	INT32 INT32 R/W per. -	CANopen 3029:7 <sub>h</sub> Modbus 10510
JOGtime	Wait time prior to continuous movement (119) This time is only effective if you have set a jog distance not equal to 0, otherwise the drive immediately starts a continuous movement. Changed settings become active the next time the motor moves.	ms 1 500 32767	UINT16 UINT16 R/W per. -	CANopen 3029:8 <sub>h</sub> Modbus 10512
LIM_HaltReaction	Halt option code (164) <b>1 / Deceleration ramp:</b> Deceleration ramp <b>3 / Torque ramp:</b> 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. Changed settings become active immediately.	- 1 3 3	INT16 INT16 R/W per. -	CANopen 605D:0 <sub>h</sub> Modbus 1582
LIM_I_maxHalt	Current limitation for Halt (80) Maximum current during deceleration 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 0.01 A <sub>pk</sub> . Changed settings become active immediately.	A <sub>pk</sub> - - -	UINT16 UINT16 R/W per. -	CANopen 3011:6 <sub>h</sub> Modbus 4364
LIM_I_maxQSTP	Current limitation for Quick Stop (80) Maximum current during deceleration 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 0.01 A <sub>pk</sub> . Changed settings become active immediately.	A <sub>pk</sub> - - -	UINT16 UINT16 R/W per. -	CANopen 3011:5 <sub>h</sub> Modbus 4362

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Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
LIM_QStopReact	<p>Quick Stop option code (73)</p> <p><b>-2 / Torque ramp (Fault):</b> Use torque ramp and transit to operating state 9 Fault</p> <p><b>6 / Deceleration ramp (Quick Stop):</b> Use torque ramp and remain in operating state 7 Quick Stop</p> <p><b>7 / Torque ramp (Quick Stop):</b> Use deceleration ramp and remain in operating state 7 Quick Stop</p> <p>Setting of deceleration ramp with parameter RAMPquickstop. Setting of torque ramp with parameter LIM_I_maxQSTP.</p> <p>The deceleration ramp is only available for operating modes with profile generator. The torque ramp is used in the operating modes without profile generator.</p> <p>Changed settings become active immediately.</p>	- -2 7 7	INT16 INT16 R/W per. -	CANopen 605A:0h Modbus 1584
M_I_0	Continuous stall current of motor In increments of 0.01 A <sub>pk</sub> .	A <sub>pk</sub> - - -	UINT16 UINT16 R/- -	CANopen 300D:13h Modbus 3366
M_I_max	Maximum current of motor In increments of 0.01 A <sub>pk</sub> .	A <sub>pk</sub> - - -	UINT16 UINT16 R/- -	CANopen 300D:6h Modbus 3340
M_I_nom	Nominal current of motor In increments of 0.01 A <sub>pk</sub> .	A <sub>pk</sub> - - -	UINT16 UINT16 R/- -	CANopen 300D:7h Modbus 3342
M_I2t	Maximum permissible time for M_I_max	ms - - -	UINT16 UINT16 R/- -	CANopen 300D:11h Modbus 3362
M_Jrot	Moment of inertia of motor In increments of 0.1 kg cm <sup>2</sup> .	kg cm <sup>2</sup> - - -	UINT16 UINT16 R/- -	CANopen 300D:C <sub>h</sub> Modbus 3352
M_kE	Voltage constant kE of motor Voltage constant in V <sub>pk</sub> at 1000 1/min	- - - -	UINT16 UINT16 R/- -	CANopen 300D:B <sub>h</sub> Modbus 3350
M_L_d	Inductance d component of motor In increments of 0.01 mH.	mH - - -	UINT16 UINT16 R/- -	CANopen 300D:F <sub>h</sub> Modbus 3358



Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
M_L_q	Inductance q component of motor In increments of 0.01 mH.	mH - - -	UINT16 UINT16 R/- - -	CANopen 300D:8h Modbus 3356
M_M_max	Maximum torque of motor	N cm - - -	UINT16 UINT16 R/- - -	CANopen 300D:9h Modbus 3346
M_M_nom	Nominal torque of motor	N cm - - -	UINT16 UINT16 R/- - -	CANopen 300D:8h Modbus 3344
M_n_max	Maximum permissible speed of rotation of motor	min <sup>-1</sup> - - -	UINT16 UINT16 R/- - -	CANopen 300D:4h Modbus 3336
M_n_nom	Nominal speed of rotation of motor	min <sup>-1</sup> - - -	UINT16 UINT16 R/- - -	CANopen 300D:5h Modbus 3338
M_Polepair	Number of pole pairs of motor	- - - -	UINT16 UINT16 R/- - -	CANopen 300D:14h Modbus 3368
M_R_UV	Motor connection resistance In increments of 0.01 Ω.	Ω - - -	UINT16 UINT16 R/- - -	CANopen 300D:Dh Modbus 3354
M_U_nom	Nominal voltage of motor In increments of 0.1 V.	V - - -	UINT16 UINT16 R/- - -	CANopen 300D:Ah Modbus 3348
MBadr	Modbus address Valid addresses: 1 to 247 Changed settings become active immediately.	- 1 1 247	UINT16 UINT16 R/W per. -	CANopen 3016:4h Modbus 5640
MBbaud	Modbus Baud rate <b>9600 / 9600</b> : 9600 Baud <b>19200 / 19200</b> : 19200 Baud <b>38400 / 38400</b> : 38400 Baud Changed settings become active the next time the product is switched on.	- 9600 19200 38400	UINT16 UINT16 R/W per. -	CANopen 3016:3h Modbus 5638

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
MBdword_order	<p>Modbus word order for double words (32 bit values)</p> <p><b>0 / HighLow:</b> HighWord-LowWord <b>1 / LowHigh:</b> LowWord-HighWord</p> <p>High word first or low word first</p> <p>High word first -&gt; Modicon Quantum Low word first -&gt; Premium, HMI (Schneider Electric)</p> <p>Changed settings become active immediately.</p>	- 0 0 1	UINT16 UINT16 R/W per. -	CANopen 3016:7h Modbus 5646
MBformat	<p>Modbus data format</p> <p><b>1 / 8Bit NoParity 1Stop:</b> 8 bits, no parity bit, 1 stop bit <b>2 / 8Bit EvenParity 1Stop:</b> 8 bits, even parity bit, 1 stop bit <b>3 / 8Bit OddParity 1Stop:</b> 8 bits, odd parity bit, 1 stop bit <b>4 / 8Bit NoParity 2Stop:</b> 8 bits, no parity bit, 2 stop bits</p> <p>Changed settings become active the next time the product is switched on.</p>	- 1 2 4	UINT16 UINT16 R/W per. -	CANopen 3016:5h Modbus 5642
MBnode_guard	<p>Modbus node guard</p> <p>Node guard 0: Inactive (default) &gt;0: Monitoring time</p> <p>Changed settings become active immediately.</p>	ms 0 0 10000	UINT16 UINT16 R/W - -	CANopen 3016:6h Modbus 5644
MBscan_guard	<p>ModbusTCP node guard for I/O scanning</p> <p>0: inactive (default) &gt;0: monitoring time in ms</p> <p>The drive starts monitoring when it receives the first I/O scanning message. After a node guarding error the drive starts monitoring again when it receives the next I/O scanning message.</p> <p>Changed settings become active immediately.</p>	ms 0 0 10000	UINT16 UINT16 R/W - -	CANopen 3019:7h Modbus 6414
MBTCPdword_order	<p>ModbusTCP word order for double words (32 bit values)</p> <p><b>0 / HighLow:</b> HighWord-LowWord <b>1 / LowHigh:</b> LowWord-HighWord</p> <p>High word first or low word first</p> <p>High word first -&gt; Modicon Quantum Low word first -&gt; Premium, HMI (Schneider Electric)</p> <p>Changed settings become active the next time the product is switched on.</p>	- 0 0 1	UINT16 UINT16 R/W per. -	CANopen 3019:5h Modbus 6410

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
MinTimeAckBitLow	<p>Minimum time for movement active acknowledge bit</p> <p>Value 0: Inactive. Acknowledge is generated by actual movement time. Value &gt;0: Minimum time for active movement acknowledge.</p> <p>If the movement time is less than the set time value, the time for the active movement acknowledge will be increased. If the movement time is greater than the set time value, the acknowledge bit for the active movement will be processed only by the movement time.</p> <p>Example: Actual movement time = 5 ms Value for minimum time = 20 ms Acknowledge bit for active movement will be set to Low for 20 ms.</p> <p>The minimum time setting is also active during processing of the homing movement and when a specific reference position value is set. In these two cases, the feedback information for 'ref_ok' or 'homing_attained' will also be processed using the set time.</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active immediately.</p>	- 0 0 16383	UINT16 UINT16 R/W per. -	CANopen 3006:24 <sub>h</sub> Modbus 1608
ModeError	<p>Error code for synchronous errors (ME flag)</p> <p>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.</p>	- - 0 -	UINT16 UINT16 R/- - -	CANopen 301B:19 <sub>h</sub> Modbus 6962
MT_dismax	<p>Max. permissible distance</p> <p>If the reference value is active and the maximum permissible distance is exceeded, an error of class 1 is generated.</p> <p>The value 0 switches off monitoring. In increments of 0.1 revolution. Changed settings become active the next time the motor moves.</p>	revolution 0.0 1.0 999.9	UINT16 UINT16 R/W - -	CANopen 302E:3 <sub>h</sub> Modbus 11782
PA_T_max	Maximum permissible temperature of power stage (150)	°C - 0 -	INT16 INT16 R/- per. -	CANopen 3010:7 <sub>h</sub> Modbus 4110
PA_T_warn	Temperature warning threshold of power stage (150)	°C - 0 -	INT16 INT16 R/- per. -	CANopen 3010:6 <sub>h</sub> Modbus 4108

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
PA_U_maxDC	Maximum permissible DC bus voltage In increments of 0.1 V.	V - - -	UINT16 UINT16 R/- per. -	CANopen 3010:3 <sub>h</sub> Modbus 4102
PA_U_minDC	DC bus voltage low threshold for switching off the drive In increments of 0.1 V.	V - - -	UINT16 UINT16 R/- per. -	CANopen 3010:4 <sub>h</sub> Modbus 4104
PA_U_minStopDC	DC bus voltage low threshold for Quick Stop If this threshold is reached, the drive performs a Quick Stop. In increments of 0.1 V.	V - - -	UINT16 UINT16 R/- per. -	CANopen 3010:A <sub>h</sub> Modbus 4116
PAR_CTRLreset	Reset controller parameters <b>0 / No:</b> No <b>1 / Yes:</b> Yes  The controller parameters of the velocity controller and the position controller are reset. The current controller is automatically adjusted under consideration of the connected motor.  Changed settings become active immediately.	- 0 - 1	UINT16 UINT16 R/W - -	CANopen 3004:7 <sub>h</sub> Modbus 1038
PAReprSave	Save parameter values to EEPROM Value 1: Save all persistent parameters  The currently set parameters are saved to the non-volatile memory (EEPROM). The saving process is complete when the parameter is read and 0 is returned.  Changed settings become active immediately.	- - - -	UINT16 UINT16 R/W - -	CANopen 3004:1 <sub>h</sub> Modbus 1026
PARfactorySet	Restore factory settings (default values) <b>0 / No:</b> No <b>1 / Yes:</b> 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.  Setting can only be changed if power stage is disabled.  Changed settings become active the next time the product is switched on.	- 0 - 3	R/W - -	

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
PARuserReset	<p>Reset user parameters (179)</p> <p>Bit 0 = 1: Set persistent parameters to default values.</p> <p>All parameters are reset with the exception of:</p> <ul style="list-style-type: none"> <li>- Communication parameters</li> <li>- Definition of the direction of rotation</li> <li>- Signal selection position interface</li> <li>- I/O functions</li> </ul> <p>NOTE: The new settings are not saved to the EEPROM.</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the power stage is enabled.</p>	- 0 - 7	UIN16 UIN16 R/W - -	CANopen 3004:8h Modbus 1040
PLCopenRxPar1	<p>PLCopen receive parameter data part 1</p> <p>Changed settings become active immediately.</p>	- - 0 -	UIN32 UIN32 R/W - -	CANopen 3019:1h Modbus 6402
PLCopenRxPar2	<p>PLCopen receive parameter data part 2</p> <p>Changed settings become active immediately.</p>	- - 0 -	UIN32 UIN32 R/W - -	CANopen 3019:2h Modbus 6404
PLCopenRxPro1	<p>PLCopen receive process data part 1</p>	- - 0 -	UIN32 UIN32 R/W - -	CANopen 301B:5h Modbus 6922
PLCopenRxPro2	<p>PLCopen receive process data part 2</p> <p>Changed settings become active immediately.</p>	- - 0 -	UIN32 UIN32 R/W - -	CANopen 301B:6h Modbus 6924
PLCopenTxPar1	<p>PLCopen transmit parameter data part 1</p> <p>Changed settings become active immediately.</p>	- - 0 -	UIN32 UIN32 R/- - -	CANopen 3019:3h Modbus 6406
PLCopenTxPar2	<p>PLCopen transmit parameter data part 2</p> <p>Changed settings become active immediately.</p>	- - 0 -	UIN32 UIN32 R/- - -	CANopen 3019:4h Modbus 6408
PLCopenTxPro1	<p>PLCopen transmit process data part 1</p> <p>Changed settings become active immediately.</p>	- - 0 -	UIN32 UIN32 R/- - -	CANopen 301B:7h Modbus 6926
PLCopenTxPro2	<p>PLCopen transmit process data part 2</p> <p>Changed settings become active immediately.</p>	- - 0 -	UIN32 UIN32 R/- - -	CANopen 301B:8h Modbus 6928

019844113634, V2.02, 03.2012

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
POSdirOfRotat	<p>Definition of direction of rotation (177)</p> <p><b>0 / Clockwise:</b> Clockwise <b>1 / Counter Clockwise:</b> Counter-clockwise</p> <p>At positive reference values, the motor rotates clockwise (as you look at the end of the motor shaft at the flange).</p> <p>NOTE: The limit switch which is reached with a movement in positive direction must be connected to the positive limit switch input and vice versa.</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the product is switched on.</p>	- 0 0 1	UINT16 UINT16 R/W per. -	CANopen 3006:C <sub>h</sub> Modbus 1560
POSScaleDenom	<p>Position scaling: Denominator (72)</p> <p>Refer to numerator (POSScaleNum) for a description.</p> <p>A new scaling is activated when the numerator value is supplied.</p> <p>Setting can only be changed if power stage is disabled.</p>	usr 1 16384 2147483647	INT32 INT32 R/W per. -	CANopen 3006:7 <sub>h</sub> Modbus 1550
POSScaleNum	<p>Position scaling: Numerator (72)</p> <p>Specification of the scaling factor:</p> <p>Motor revolutions [U] ----- User-defined units [usr]</p> <p>A new scaling is activated when the numerator value is supplied.</p> <p>User-defined limit values may be reduced due to the calculation of an internal factor.</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active immediately.</p>	revolution 1 1 2147483647	INT32 INT32 R/W per. -	CANopen 3006:8 <sub>h</sub> Modbus 1552
PPn_target	<p>Target velocity for operating mode Profile Position (129)</p> <p>The maximum value is limited to the current setting in CTRL_n_max.</p> <p>The adjusted value is internally limited to the current parameter value in RAMPn_max.</p> <p>Changed settings become active the next time the motor moves.</p>	min <sup>-1</sup> 1 60 -	UINT32 UINT32 R/W - -	CANopen 6081:0 <sub>h</sub> Modbus 6942

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
PPoption	Options for operating mode profile position (129) Determines the reference position for relative positioning: 0: Relative with reference to the previous target position of the motion profile generator 1: Not supported 2: Relative with reference to the actual position of the motor Changed settings become active the next time the motor moves.	- 0 0 2	UINT16 UINT16 R/W - -	CANopen 60F2:0h Modbus 6960
PPp_targetusr	Target position for operating mode Profile Position (116) Min./max values depend on: - Scaling factor - Software limit switches (if they are activated) Changed settings become active immediately.	usr - 0 -	INT32 INT32 R/W - -	CANopen 607A:0h Modbus 6940
ProfileType	Motion profile Value 0: Linear	- 0 0 0	INT16 INT16 R/W - -	CANopen 6086:0h Modbus 6954
PVn_target	Target velocity for operating mode Profile Velocity (124) The maximum value is limited to the current setting in CTRL_n_max.  The adjusted value is internally limited to the current parameter value in RAMPn_max. Changed settings become active immediately.	min <sup>-1</sup> - 0 -	INT32 INT32 R/W - -	CANopen 60FF:0h Modbus 6938

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
RAMP_TAUjerk	<p>Jerk limitation (160)</p> <p><b>0 / Off:</b> Off  <b>1 / 1:</b> 1 ms  <b>2 / 2:</b> 2 ms  <b>4 / 4:</b> 4 ms  <b>8 / 8:</b> 8 ms  <b>16 / 16:</b> 16 ms  <b>32 / 32:</b> 32 ms  <b>64 / 64:</b> 64 ms  <b>128 / 128:</b> 128 ms</p> <p>Limits the acceleration change (jerk) of the reference position generation during the following transitions:  Standstill - acceleration  Acceleration - constant speed  Constant speed - deceleration  Deceleration - standstill</p> <p>Processing in the following operating modes:  - Profile Velocity  - Profile Position  - Jog  - Homing</p> <p>Adjustments can only be made if the operating mode is inactive (x_end=1).  Changed settings become active the next time the motor moves.</p>	ms 0 0 128	UINT16 UINT16 R/W per. -	CANopen 3006:D <sub>h</sub> Modbus 1562
RAMPacc	<p>Acceleration of profile generator (159)</p> <p>Changed settings become active the next time the motor moves.</p>	min <sup>-1</sup> /s 1 600 3000000	UINT32 UINT32 R/W per. -	CANopen 6083:0 <sub>h</sub> Modbus 1556
RAMPdecel	<p>Deceleration of profile generator (159)</p> <p>Changed settings become active the next time the motor moves.</p>	min <sup>-1</sup> /s 750 750 3000000	UINT32 UINT32 R/W per. -	CANopen 6084:0 <sub>h</sub> Modbus 1558
RAMPn_max	<p>Maximum velocity of profile generator (81)</p> <p>The parameter is active in the following operating modes:  - Profile Position  - Profile Velocity  - Homing  - Jog</p> <p>If a greater reference velocity is set in one of these operating modes, it is automatically limited to RAMPn_max.  This way, commissioning at limited velocity is easier to perform.</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the motor moves.</p>	min <sup>-1</sup> 60 13200 13200	UINT32 UINT16 R/W per. -	CANopen 607F:0 <sub>h</sub> Modbus 1554



Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
RAMPquickstop	Deceleration ramp for Quick Stop (162) Deceleration ramp for a software stop or an error with error class 1 or 2. Changed settings become active the next time the motor moves.	min <sup>-1</sup> /s 200 6000 3000000	UINT32 UINT32 R/W per. -	CANopen 3006:12 <sub>h</sub> Modbus 1572
RAMPsym	Symmetrical ramp Acceleration and deceleration of the profile generator. The values are internally multiplied by 10 (example: 1 = 10 min <sup>-1</sup> /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 value cannot be represented as a 16 bit value, the value is set to 65535 (maximum UINT16 value). Changed settings become active the next time the motor moves.	usr - 0 -	UINT16 UINT16 R/W - -	CANopen 3006:1 <sub>h</sub> Modbus 1538
SPEEDn_target	Reference velocity in operating mode Speed Control (122) The internal maximum speed is limited to the current setting in CTRL_n_max. Changed settings become active immediately.	min <sup>-1</sup> -30000 0 30000	INT16 INT16 R/W - -	CANopen 3021:4 <sub>h</sub> Modbus 8456
SPEEDreference	Reference value source for operating mode Speed Control (122) <b>0 / None:</b> None <b>2 / Parameter 'SPEEDn_target':</b> Reference value via parameter SPEEDn_target Changed settings become active immediately.	- 0 0 2	UINT16 UINT16 R/W - -	CANopen 301B:11 <sub>h</sub> Modbus 6946
SPV_Flt_pDiff	Error response to following error (154) <b>1 / Error Class 1:</b> Error class 1 <b>2 / Error Class 2:</b> Error class 2 <b>3 / Error Class 3:</b> Error class 3 Setting can only be changed if power stage is disabled. Changed settings become active the next time the power stage is enabled.	- 1 3 3	UINT16 UINT16 R/W per. -	CANopen 3005:B <sub>h</sub> Modbus 1302

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
SPV_HW_Deactiv	<p>Temporary deactivation of hardware limit switches</p> <p><b>0:</b> No limit switch deactivated  <b>1:</b> Deactivate positive limit switch  <b>2:</b> Deactivate negative limit switch  <b>3:</b> Deactivate both limit switches</p> <p>With this parameter, a PLC can temporarily deactivate hardware limit switches. This is useful if a homing procedure controlled by a PLC is to use a limit switch as a reference switch without any error response of the drive.</p> <p>Changed settings become active immediately.</p> <p>Available with firmware version <math>\geq V1.010</math>.</p>	- 0 0 3	UINT16 UINT16 R/W - -	CANopen 3006:25 <sub>h</sub> Modbus 1610
SPV_p_maxDiff	<p>Max. permissible tracking error of the position controller (151)</p> <p>The tracking error is the current position control deviation.</p> <p>In increments of 0.0001 revolution.</p> <p>Changed settings become active immediately.</p>	revolution 0.0001 1.0000 200.0000	UINT32 UINT32 R/W per. -	CANopen 6065:0 <sub>h</sub> Modbus 4636
SPV_SW_Limits	<p>Monitoring of software limit switches (148)</p> <p><b>0 / None:</b> None  <b>1 / SWLIMP:</b> Activation of software limit switches positive direction  <b>2 / SWLIMN:</b> Activation of software limit switches negative direction  <b>3 / SWLIMP+SWLIMN:</b> Activation of software limit switches both directions</p> <p>Monitoring of software limit switches only works in case of successful homing (ref_ok = 1).</p> <p>Changed settings become active immediately.</p>	- 0 0 3	UINT16 UINT16 R/W per. -	CANopen 3006:3 <sub>h</sub> Modbus 1542
SPVswLimNusr	<p>Negative position limit for software limit switch (148)</p> <p>Refer to description of parameter SPVswLimPusr.</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the power stage is enabled.</p>	usr - -2147483648 -	INT32 INT32 R/W per. -	CANopen 607D:1 <sub>h</sub> Modbus 1546

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
SPVswLimPusr	<p>Positive position limit for software limit switch (148)</p> <p>If a user-defined value entered is outside of the permissible range, the limit switch limits are automatically set to the maximum user-defined value.</p> <p>Setting can only be changed if power stage is disabled.</p> <p>Changed settings become active the next time the power stage is enabled.</p>	<p>usr</p> <p>-</p> <p>2147483647</p> <p>-</p>	<p>INT32</p> <p>INT32</p> <p>R/W</p> <p>per.</p> <p>-</p>	<p>CANopen 607D:2<sub>h</sub></p> <p>Modbus 1544</p>
STANDp_win	<p>Standstill window, permissible control deviation (169)</p> <p>The control deviation for the standstill window time must be within this range for a standstill of the drive to be detected.</p> <p>Processing of the standstill window must be activated via the parameter 'STANDpwinTime.</p> <p>In increments of 0.0001 revolution.</p> <p>Changed settings become active immediately.</p>	<p>revolution</p> <p>0.0000</p> <p>0.0010</p> <p>3.2767</p>	<p>UINT32</p> <p>UINT16</p> <p>R/W</p> <p>per.</p> <p>-</p>	<p>CANopen 6067:0<sub>h</sub></p> <p>Modbus 4370</p>
STANDpwinTime	<p>Standstill window, time (169)</p> <p>0: Monitoring of standstill window deactivated</p> <p>&gt;0: Time in ms during which the control deviation must be in the standstill window</p> <p>Changed settings become active immediately.</p>	<p>ms</p> <p>0</p> <p>0</p> <p>32767</p>	<p>UINT16</p> <p>UINT16</p> <p>R/W</p> <p>per.</p> <p>-</p>	<p>CANopen 6068:0<sub>h</sub></p> <p>Modbus 4372</p>
STANDpwinTout	<p>Timeout time for standstill window monitoring (169)</p> <p>0 : Timeout monitoring deactivated</p> <p>&gt;0 : Timeout time in ms</p> <p>Standstill window processing values are set via STANDp_win and STANDpwinTime.</p> <p>Time monitoring starts when the target position (reference position of position controller) is reached or when the profile generator has finished processing.</p> <p>Changed settings become active immediately.</p>	<p>ms</p> <p>0</p> <p>0</p> <p>16000</p>	<p>UINT16</p> <p>UINT16</p> <p>R/W</p> <p>per.</p> <p>-</p>	<p>CANopen 3011:B<sub>h</sub></p> <p>Modbus 4374</p>

Parameter name	Description	Unit Minimum value Factory setting Maximum value	Data type R/W Persistent Expert	Parameter address via field-bus
SuppDriveModes	<p>Supported operating modes as per DSP402</p> <p>Coding:            Bit 0: Profile position            Bit 2: Profile velocity            Bit 5: Homing</p> <p>Bit 16: Jog            Bit 17: Electronic gear            Bit 18: Current control            Bit 19: Speed control            Bit 20: Position control            Bit 21: Manual tuning            Bit 22: Oscillator</p> <p>The availability of the individual bits is product-dependent.</p>	- - 0 -	UIN32 UIN32 R/- -	CANopen 6502:0h Modbus 6952

## 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 CAD data* For easier engineering, CAD data (EPLAN macros or drawings) are available for download from the Internet at:

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

Description	Order no.
Braking Resistor Controller UBC60	ACC3EA001
Installation kit	VW3L10111
Insert with cable entry (2 pieces)	VW3L10100N2
Insert with cable entry (10 pieces)	VW3L10100N10
Cable entry for commissioning	VW3L10222
Insert for sealing (10 pieces)	VW3L10000N10
Insert for sealing (20 pieces)	VW3L10000N20
Insert for sealing (50 pieces)	VW3L10000N50
Cable for commissioning interface, other cable end open 3 m	VW3L1R000R30
Cable for commissioning interface, other cable end RJ45 3 m	VW3L1T000R30
Insert kit for commissioning	VW3L1R000
Cable kit, power supply, EtherCAT, 3m	VW3L2E001R30
Cable kit, STO, 3 m	VW3L20010R30
Cable kit, STO, 5 m	VW3L20010R50
Cable kit, STO, 10 m	VW3L20010R100
Cable kit, STO, 15 m	VW3L20010R150
Cable kit, STO, 20 m	VW3L20010R200
Cable, power supply, 3 m	VW3L30001R30
Cable, power supply, 5 m	VW3L30001R50
Cable, power supply, 10 m	VW3L30001R100
Cable, power supply, 15 m	VW3L30001R150
Cable, power supply, 20 m	VW3L30001R200
Cable, STO, 3 m	VW3L30010R30
Cable, STO, 5 m	VW3L30010R50
Cable, STO, 10 m	VW3L30010R100
Cable, STO, 15 m	VW3L30010R150
Cable, STO, 20 m	VW3L30010R200
Connector kit, EtherCAT (2 pcs)	VW3L5E000
Connector kit, 2 x I/O	VW3L50200
Connector kit, 3 x I/O	VW3L50300
Connector, STO output	VW3L50010
Insert kit, 3 x I/O	VW3L40300
Insert kit, 2 x I/O, 1 x STO input	VW3L40210
Insert kit, 1 x STO input, 1 x STO output	VW3L40020
Insert kit, 4 x I/O, 1 x STO input, 1 x STO output	VW3L40420

*Cable* Supplier recommendations:

- Hans Turck GmbH & Co. KG  
[www.turck.com](http://www.turck.com)
- Franz Binder GmbH & Co. elektrische Bauelemente KG  
[www.binder-connector.de](http://www.binder-connector.de)
- PHOENIX CONTACT GmbH & Co. KG  
[www.phoenixcontact.com](http://www.phoenixcontact.com)
- Lumberg Automation  
[www.lumberg-automation.com](http://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 Gearbox

Description	Order no.
Planetary gear for Lexium Integrated Drive ILAxx571, ratio 3:1	GBX060003A571L
Planetary gear for Lexium Integrated Drive ILAxx571, ratio 5:1	GBX060005A571L
Planetary gear for Lexium Integrated Drive ILAxx571, ratio 8:1	GBX060008A571L
Planetary gear for Lexium Integrated Drive ILAxx571, ratio 16:1	GBX060016A571L
Planetary gear for Lexium Integrated Drive ILAxx571, ratio 40:1	GBX060040A571L
Planetary gear for Lexium Integrated Drive ILAxx572, ratio 3:1	GBX060003A572L
Planetary gear for Lexium Integrated Drive ILAxx572, ratio 5:1	GBX060005A572L
Planetary gear for Lexium Integrated Drive ILAxx572, ratio 8:1	GBX060008A572L
Planetary gear for Lexium Integrated Drive ILAxx572, ratio 16:1	GBX060016A572L
Planetary gear for Lexium Integrated Drive ILAxx572, ratio 40:1	GBX060040A572L





## 13 Service, maintenance and disposal

# 13

### **WARNING**

#### **DAMAGE TO SYSTEM COMPONENTS AND LOSS OF CONTROL**

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

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

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

### **CAUTION**

#### **RISK OF INJURY WHEN THE PRINTED CIRCUIT BOARD CONNECTORS ARE REMOVED**

- Before removing the connectors, you must unlock them.
  - Supply voltage  $V_{DC}$ :  
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.**



*The product may only be repaired by a Schneider Electric customer service center. No warranty or liability is accepted for repairs made by unauthorized persons.*

## 13.1 Service address

If you cannot resolve an error yourself please contact your sales office. Have the following details available:

- Nameplate (type, identification number, serial number, DOM, ...)
- Type of error (with LED flash code or error number)
- Previous and concomitant circumstances
- Your own assumptions concerning the cause of the error

Also include this information if you return the product for inspection or repair.



*If you have any questions please contact your sales office. Your sales office staff will be happy to give you the name of a customer service office in your area.*

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

## 13.2 Maintenance

Check the product for pollution or damage at regular intervals.

### 13.2.1 Lifetime STO safety function

The STO safety function is designed for a lifetime of 20 years. After this period, the data of the safety function are no longer valid. The expiry date is determined by adding 20 years to the DOM shown on the nameplate of the product.

- ▶ This date must be included in the maintenance plan of the system.

Do not use the safety function after this date.

*Example* The DOM on the nameplate of the product is shown in the format DD.MM.YY, for example 31.12.08. (31 December 2008). This means: Do not use the safety function after December 31, 2028.

### 13.3 Replacing devices

#### **WARNING**

##### **UNINTENDED BEHAVIOR**

Unsuitable settings or unsuitable data may trigger unexpected movements, trigger signals, damage parts 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 the parameter settings to your PC using the commissioning software, see chapter "7.4.1 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 "3.1 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 are met.  
Protect the product from dust and dirt.
- Disposal* The product consists of various materials that can be recycled. Dispose of the product in accordance with local regulations.

# 14 Glossary



## 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]  
 $5 \text{ m} / 0.9144 = 5.468 \text{ yd}$

### 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 <sup>-3</sup>	* 0.02834952	* 28.34952
slug	/ 0.03108095	/ 1.942559*10 <sup>-3</sup>	-	* 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	N
lb	-	* 16	* 453.55358	* 4.448222
oz	/ 16	-	* 28.349524	* 0.27801
p	/ 453.55358	/ 28.349524	-	* 9.807*10 <sup>-3</sup>
N	/ 4.448222	/ 0.27801	/ 9.807*10 <sup>-3</sup>	-

### 14.1.4 Power

	HP	W
HP	-	* 746
W	/ 746	-

019844113634, V2.02, 03.2012

14.1.5 Rotation

	min <sup>-1</sup> (RPM)	rad/s	deg./s
min <sup>-1</sup> (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 <sup>6</sup>
lb·ft	* 12	-	* 192	* 1.355822	* 0.138255	* 13.8255	* 13.558*10 <sup>6</sup>
oz·in	/ 16	/ 192	-	* 7.0616*10 <sup>-3</sup>	* 720.07*10 <sup>-6</sup>	* 72.007*10 <sup>-3</sup>	* 70615.5
Nm	/ 0.112985	/ 1.355822	/ 7.0616*10 <sup>-3</sup>	-	* 0.101972	* 10.1972	* 10*10 <sup>6</sup>
kp·m	/ 0.011521	/ 0.138255	/ 720.07*10 <sup>-6</sup>	/ 0.101972	-	* 100	* 98.066*10 <sup>6</sup>
kp·cm	/ 1.1521	/ 13.8255	/ 72.007*10 <sup>-3</sup>	/ 10.1972	/ 100	-	* 0.9806*10 <sup>6</sup>
dyne·cm	/ 1.129*10 <sup>6</sup>	/ 13.558*10 <sup>6</sup>	/ 70615.5	/ 10*10 <sup>6</sup>	/ 98.066*10 <sup>6</sup>	/ 0.9806*10 <sup>6</sup>	-

14.1.7 Moment of inertia

	lb·in <sup>2</sup>	lb·ft <sup>2</sup>	kg·m <sup>2</sup>	kg·cm <sup>2</sup>	kp·cm·s <sup>2</sup>	oz·in <sup>2</sup>
lb·in <sup>2</sup>	-	/ 144	/ 3417.16	/ 0.341716	/ 335.109	* 16
lb·ft <sup>2</sup>	* 144	-	* 0.04214	* 421.4	* 0.429711	* 2304
kg·m <sup>2</sup>	* 3417.16	/ 0.04214	-	* 10*10 <sup>3</sup>	* 10.1972	* 54674
kg·cm <sup>2</sup>	* 0.341716	/ 421.4	/ 10*10 <sup>3</sup>	-	/ 980.665	* 5.46
kp·cm·s <sup>2</sup>	* 335.109	/ 0.429711	/ 10.1972	* 980.665	-	* 5361.74
oz·in <sup>2</sup>	/ 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
mm <sup>2</sup>	42.4	33.6	26.7	21.2	16.8	13.3	10.5	8.4	6.6	5.3	4.2	3.3	2.6

AWG	14	15	16	17	18	19	20	21	22	23	24	25	26
mm <sup>2</sup>	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.

<i>ARP</i>	<b>A</b> ddress <b>R</b> esolution <b>P</b> rotocol, links the data link layer and the network layer in the OSI model.
<i>Actual position</i>	Current position of moving components in the drive system.
<i>Big Endian format</i>	Method of storing data; the highest-value byte of a data word is at the first position (big end first).
<i>cid</i>	<b>C</b> ommand <b>ID</b>
<i>Client</i>	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.
<i>CoE</i>	<b>C</b> ANopen <b>o</b> ver <b>E</b> therCAT
<i>DHCP server</i>	The task of the DHCP server is to assign an IP configuration (IP address, subnet mask, gateway, etc.) to other network devices. The network devices do not need to know the IP address of the DHCP server to obtain the configuration.
<i>DOM</i>	<b>D</b> ate <b>o</b> f <b>m</b> anufacturing: The nameplate of the product shows the date of manufacture in the format DD.MM.YY or in the format DD.MM.YYYY. Example: 31.12.09 corresponds to December 31, 2009 31.12.2009 corresponds to December 31, 2009
<i>Degree of protection</i>	The degree of protection is a standardized specification for electrical equipment that describes the protection against the ingress of foreign objects and water (for example: IP 20).
<i>Direction of rotation</i>	Rotation of the motor shaft in a positive or negative direction of rotation. Positive direction of rotation is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft.
<i>EDS</i>	<b>(E</b> lectronic <b>D</b> ata <b>S</b> heet); contains the specific properties of a product.
<i>EMC</i>	Electromagnetic compatibility
<i>Encoder</i>	Sensor that converts a measured distance or angle into an electrical signal. This signal is evaluated by the drive to determine the actual position of a shaft (rotor) or a driving unit.
<i>EoE</i>	<b>E</b> thernet <b>o</b> ver <b>E</b> therCAT
<i>Error</i>	Discrepancy between a detected (computed, measured or signaled) value or condition and the specified or theoretically correct value or condition.
<i>Error class</i>	Classification of errors into groups. The different error classes allow for specific responses to errors, for example by severity.
<i>FMMU</i>	<b>F</b> ieldbus <b>M</b> emory <b>M</b> anagement <b>U</b> nit, converts logical addresses into physical addresses. This way, the FMMU can logically address a data range that comprises several slaves.
<i>FTP</i>	<b>F</b> ile <b>T</b> ransfer <b>P</b> rotocol
<i>Factory setting</i>	Factory settings when the product is shipped

<i>Fatal error</i>	In the case of fatal error, the product is no longer able to control the motor so that the power stage must be immediately disabled.
<i>Fault</i>	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).
<i>Fault reset</i>	A function used to restore the drive to an operational state after a detected error is cleared by removing the cause of the error so that the error is no longer active.
<i>Gateway</i>	The gateway is a separate network station. The IP packets whose target address is not in the same subnet are sent to the gateway. If there is no gateway on the network, it is recommended to enter the IP address of the device.
<i>HTTP</i>	<b>H</b> yper <b>T</b> ext <b>T</b> ransfer <b>P</b> rotocol. Client-Server TCP//IP protocol used to transmit HTML documents on the internet and in intranets.
<i>I/O</i>	Inputs/outputs
<i>I<sup>2</sup>t monitoring</i>	Anticipatory temperature monitoring. The expected temperature rise of components is calculated in advance on the basis of the motor current. If a limit value is exceeded, the drive reduces the motor current.
<i>IP</i>	<b>I</b> nternet <b>P</b> rotocol (as opposed to Ethernet/IP where IP stands for Industrial Protocol)
<i>IP address</i>	The IP address consists of four bytes. The common notation is to separate the bytes by dots (example: 192.168.0.1). The first IP address of an IP network is the network address and must not be assigned to a device. The last address of an IP network is the broadcast address. It must not be assigned to a device.
<i>Inc</i>	Increments
<i>Index pulse</i>	Signal of an encoder to reference the rotor position in the motor. The encoder returns one index pulse per revolution.
<i>Internal units</i>	Resolution of the power stage at which the motor can be positioned. Internal units are specified in increments.
<i>LED</i>	Light Emitting Diode
<i>LSB</i>	<b>L</b> east <b>S</b> ignificant <b>B</b> it, least significant bit.
<i>Limit switch</i>	Switches that signal overtravel of the permissible range of travel.
<i>Little Endian format</i>	Method of storing data; the lowest-value byte of a data word is at the first position (little end first).
<i>MAC address</i>	Node address (MAC=Media Access Control), a hardware address for unique identification of a device in the network. The MAC address is assigned to the data link layer of the OSI model.
<i>MSB</i>	<b>M</b> ost <b>S</b> ignificant <b>B</b> it, most significant bit.
<i>Mailbox</i>	The mailbox is used for asynchronous, non-realtime data transmission.
<i>Master</i>	Active bus device that controls the data traffic on the network.
<i>OSI model</i>	Describes and categorizes specific components in a communication system.
<i>PDO</i>	<b>P</b> rocess <b>D</b> ata <b>O</b> bjects, process data objects



<i>PELV</i>	Protective Extra Low Voltage, low voltage with isolation. For more information: IEC 60364-4-41
<i>PLC</i>	Programmable logic controller
<i>Parameter</i>	Device data and values that can be read and set (to a certain extent) by the user.
<i>Persistent</i>	Indicates whether the value of the parameter remains in the memory after the device is switched off.
<i>Power stage</i>	The power stage controls the motor. The power stage generates current for controlling the motor on the basis of the positioning signals from the controller.
<i>Quick Stop</i>	The Quick Stop function can be used for fast deceleration of a movement in the case of an error or via a command.
<i>RCD</i>	RCD residual current device.
<i>rms</i>	"Root Mean Square" value of a voltage ( $V_{rms}$ ) or a current ( $A_{rms}$ )
<i>RO , RW</i>	Read Only = Parameter can only be read Read/Write = Parameter can be read and written
<i>RS485</i>	Fieldbus interface as per EIA-485 which enables serial data transmission with multiple devices.
<i>SCNM</i>	<b>S</b> lot <b>C</b> ommunication <b>N</b> etwork <b>M</b> anagement. SCNM is a polling mechanism
<i>SDO</i>	<b>S</b> ervice <b>D</b> ata <b>O</b> bjects, service data objects
<i>Scaling factor</i>	This factor is the ratio between an internal unit and a user-defined unit.
<i>Server</i>	First the transmitter, then the recipient of fieldbus messages in the client-server relationship; responds to the request of a client; the reference point is the server object dictionary
<i>Slave</i>	Passive bus device that receives control commands and provides data to the master.
<i>Slave address</i>	Communication between master and slave is only possible after the assignment of unique addresses.
<i>Subnet mask</i>	The subnet mask is used to distinguish between the network address and the network device address in the IP address.
<i>Switch terminal</i>	Switch provided by Beckhoff for decentralized connection of any type of Ethernet device (such as a PC) to the EtherCAT network.
<i>Sync Manager</i>	The Sync Manager control access to the memory of the application. Each channel specifies a suitable range of this memory.
<i>TCP</i>	<b>T</b> ransport <b>C</b> ontrol <b>P</b> rotocol
<i>UDP</i>	<b>U</b> ser <b>D</b> atagram <b>P</b> rotocol, supports application-to-application data exchange between computers. UDP is based on the underlying IP protocol.
<i>User-defined unit</i>	Unit whose reference to motor movement can be determined by the user via parameters.
<i>Warning</i>	If the term is used outside the context of safety instructions, a warning alerts to a potential problem that was detected by a monitoring function. A warning does not cause a transition of the operating state.



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