

Technical Documentation



Product manual

Brushless DC drive

BLP14A

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Important information

The drive systems described here are products for general use that conform to the state of the art in technology and are designed to prevent any dangers. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or unbraked movements can never be totally excluded without additional safety equipment. For this reason personnel must never be in the danger zone of the drives unless additional suitable safety equipment prevents any personal danger. This applies to operation of the machine during production and also to all service and maintenance work on drives and the machine. The machine design must ensure personal safety. Suitable measures for prevention of property damage are also required.

See safety section for additional critical instructions.

Not all product variants are available in all countries.

Please consult the current catalog for information on the availability of product variants.

We reserve the right to make changes during the course of technical developments.

All details provided are technical data and not warranted quality.

In general, product names must be considered to be trademarks of the respective owners, even if not specifically identified as such.

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Writing conventions and symbols

Work steps If work steps must be carried out in sequence, they are shown as follows:

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

If a response to a work step is specified, this will inform you that the step has been carried out correctly.

Unless otherwise stated, the individual instruction steps must be carried in the given sequence.

Lists Lists can be sorted alphanumerically or by priority. Lists are structured as follows:

- Point 1
- Point 2
 - Subpoint to 2
 - Subpoint to 2
- Point 3

Making work easier Information on making work easier can be found at this symbol:



*This offers supplementary information on making work easier.
See the chapter on safety for an explanation of the safety instructions.*

Parameter display The parameters are displayed in the text with their parameter name, e.g. `POSDirOfRotat`. For an explanation of how parameters are displayed in tables, see Parameters. The parameter list is arranged alphabetically by parameter name.

1 Introduction

1.1 About this manual

This manual is valid for all BLP14A standard products. This chapter lists the type code for this product. The type code can be used to identify whether your product is a standard product or a customized model.

1.2 Unit overview

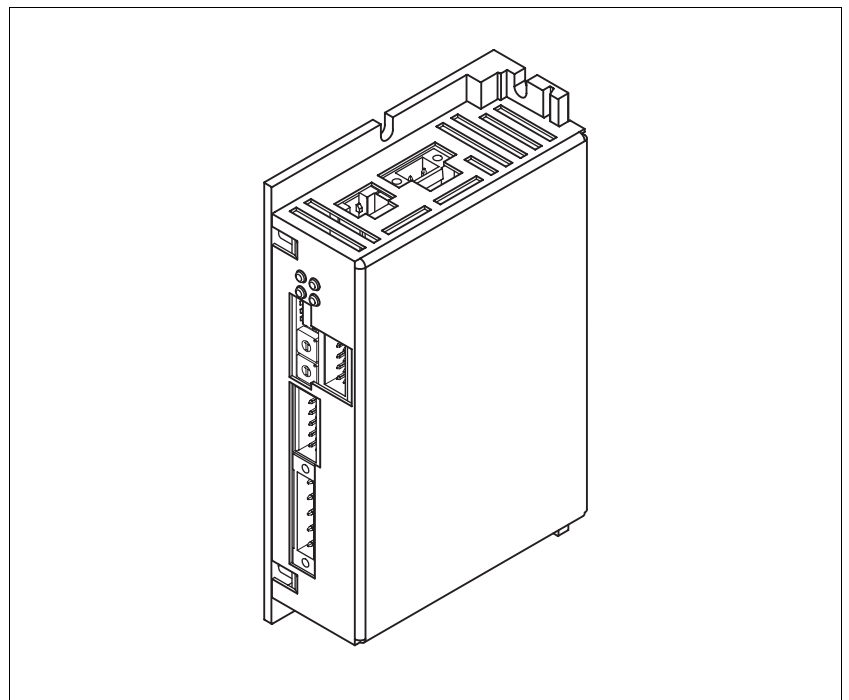


Figure 1.1 Unit overview

Drive system This drive is used to actuate a 3-phase EC motor.

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

Safety function The integrated STO (SIL2) safety function enables a stop of category 0 or 1 as per EN 60204-1 without external power contactors. It is not necessary to interrupt the supply voltage. This reduces the system costs and the response times.

1.3 Scope of supply

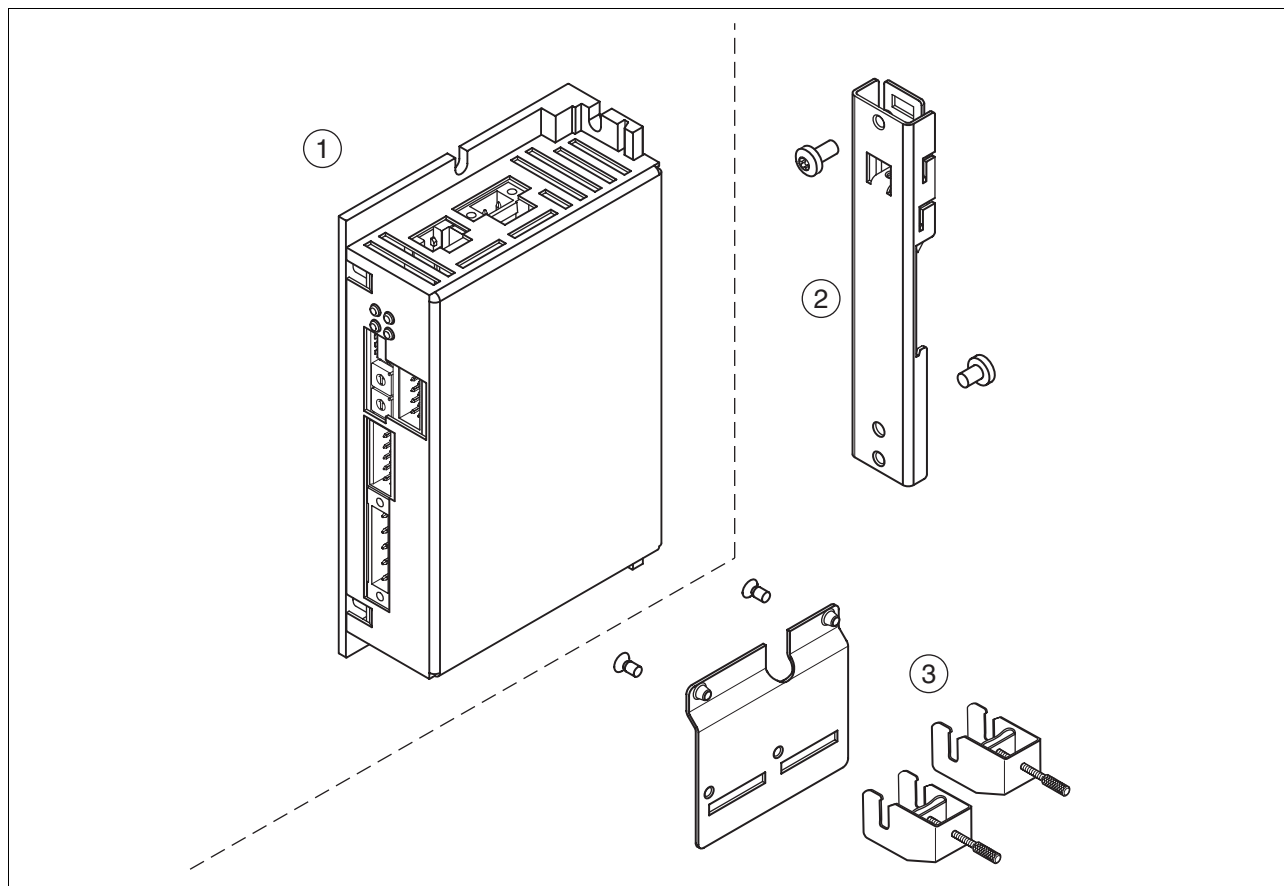


Figure 1.2 Scope of supply and accessories

- (1) BLP14A
- (2) DIN rail adapter with mounting screws (accessories)
- (3) EMC kit with mounting screws (accessories)

1.4 Components and interfaces

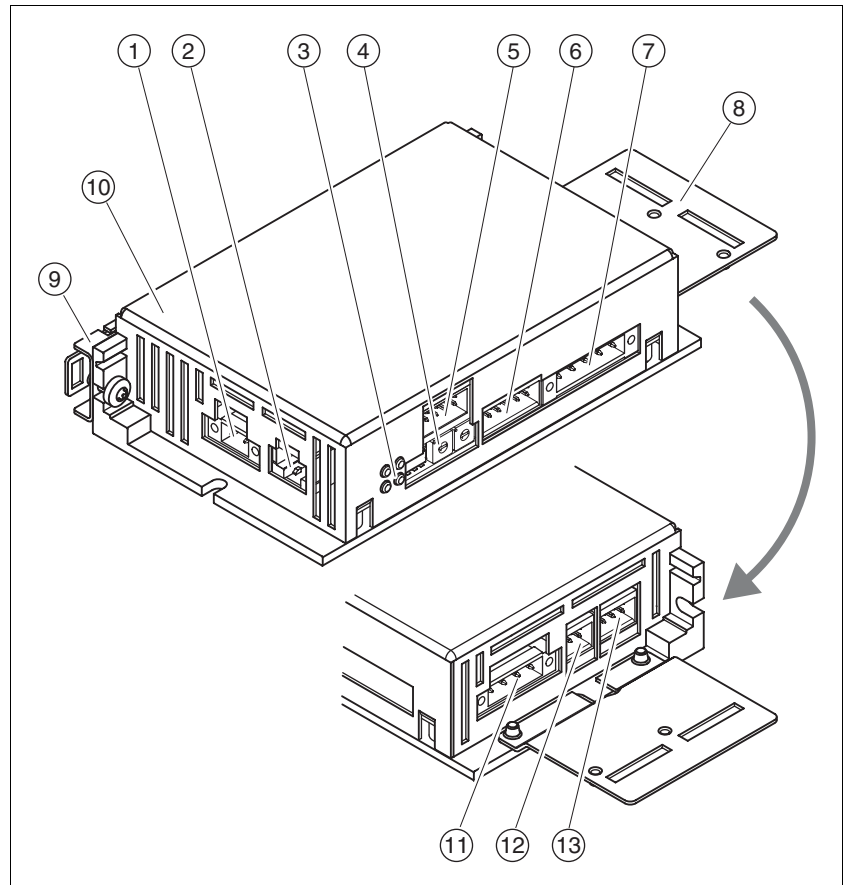


Figure 1.3 Components and interfaces

- (1) Connection of power supply (CN1)
- (2) Connection of commissioning point (CN2)
- (3) LEDs for status display
- (4) Switches for making settings
- (5) Connection: Expanded I/O signal interface (CN4) (optional)
- (6) Connection of I/O signal interface (CN3)
- (7) Connection fieldbus interface (CN5)
- (8) EMC mounting plate (accessories)
- (9) DIN rail adapter (accessories)
- (10) Name plate
- (11) Connection of motor (CN6)
- (12) Connection of hall sensors (CN7)
- (13) Connection of motor encoder (CN8)

1.5 Type code

	BLP1	•	•	D16	B4	••
Product designation BLP1 = Drive for EC motors (Brushless Positioning)						
Product design 4 = closed design						
Interface A = CANopen / analogt						
Peak current D16 = 16 A _{rms}						
Power supply B4 = 24 ... 48 V _{DC}						
Other options 00 = Standard 10 = I/O expansion xx = Customized model ¹⁾						

1) This documentation is for the standard model only, not customized models.

1.6 Documentation and literature references



- Source product manuals* The current product manuals are available for download from the Internet.
<http://www.berger-lahr.com/download>.
- CAN interest group* CiA - CAN in Automation
Am Weichselgarten 26
D-91058 Erlangen
<http://www.can-cia.org/>
- CANopen standards*
- CiA Draft Standard 301 (DS 301)
CANopen application layer and communication profile
V4.02, February 2002
 - CiA Draft Standard Proposal 402 (DSP 402)
Device profile for drives and motion control
V2.0, July 2002
 - ISO/DIS 11898: Controller Area Network (CAN) for high speed communication; 1993
 - EN 50325-4: Industrial communications subsystem based on ISO 11898 for controller device interfaces (CANopen); 2002
- Additional literature* We recommend the following literature for more in-depth information:
- Ellis, George: Control System Design Guide. Academic Press
 - Kuo, Benjamin; Golnaraghi, Farid: Automatic Control Systems. John Wiley & Sons

1.7 Directives and standards

<i>CE mark</i>	With the declaration of conformity and the CE mark on the product the manufacturer certifies that the product complies with the requirements of all relevant EC directives.
<i>EC Machine Directive</i>	<p>The drive systems described here are not machines as defined by the EC Machine Directive but components for installation in machines. They do not have moving parts designed for specific purposes. However, they can be components of a machine or system.</p> <p>The manufacturer must certify that the complete system conforms to the machine directive with the CE mark.</p>
<i>EC EMC Directive</i>	<p>The EC Electromagnetic Compatibility Directives applies to products that cause electromagnetic interference or whose operation may be adversely affected by electromagnetic interference.</p> <p>Conformity with the EMC Directive can only be expected of drive systems after correct installation in the machine. The information on ensuring electromagnetic compatibility given in the chapter on "Installation" must be followed to ensure that the drive system in the machine or system is EMC-compatible and that the product can legally be operated.</p>
<i>EC Low-Voltage Directive</i>	The EC Low Voltage Directive is not applicable, because the product is operated with direct voltage under 75 V _{DC} .
<i>Declaration of conformity</i>	The declaration of conformity certifies that the drive system complies with the specific EC directive.
<i>Standards for safe operation</i>	<p>IEC 60204-1: Electrical equipment of machines, General requirements</p> <p>IEC 60529: IP degrees of protection</p> <p>IEC 61508: Functional safety of safety - related electric, electronic and programmable electronic systems</p> <p>IEC 62061: Safety of machines - Functional safety of electrical, electronic and programmable controllers of machines</p> <p>ISO 13849-1: Safety of machines - safety-related components of controllers, Part 1: General design requirements</p>
<i>Standards for compliance with EMC limit values</i>	IEC 61800-3: Variable-speed electrical drives

1.8 Declaration of conformity

The following declaration of conformity is applicable when the product is used under the specified general conditions and with the cables listed in the accessories.

<u>EC Declaration of Conformity</u> <u>Year 2007</u>		
		BERGER LAHR GmbH & Co.KG Breslauer Str. 7 D-77933 Lahr
<input type="checkbox"/> according to EC Directive on Machinery 98/37/EEC <input checked="" type="checkbox"/> according to EC Directive EMC 2004/108/EC <input type="checkbox"/> according to EC Directive Low Voltage 2006/95/EC		
We declare that the products listed below meet the requirements of the mentioned EC Directives with respect to design, construction and version distributed by us. This declaration becomes invalid with any modification on the products not authorized by us.		
Designation:	Brushless DC Drive	
Type:	BLP14	
Product number:	006205000400x	
Applied harmonized standards, especially:	EN 61800-3:2004, second environment according to Berger Lahr EMC test conditions	
Applied national standards and technical specifications, especially:	Product documentation UL 508C	
<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div> <p>Company stamp:</p> <p>Berger Lahr GmbH & Co. KG Postfach 11 80 · D-77901 Lahr Breslauer Str. 7 · D-77933 Lahr</p> </div> <div style="text-align: right;">  </div> </div>		
Date/Signature:	5 November 2007	
Name/Department:	Wolfgang Brandstätter/Development	

1.9 TÜV certificate for functional safety



2 Safety

2.1 Qualification of personnel

Only technicians who are familiar with and understand the contents of this manual and the other relevant manuals are authorised to work on and with this drive system. The technicians must be able to detect potential dangers that may be caused by setting parameters, changing parameter values and generally by the mechanical, electrical and electronic equipment.

The technicians must have sufficient technical training, knowledge and experience to recognize and avoid dangers.

The technicians must be familiar with the relevant standards, regulations and safety regulations that must be observed when working on the drive system.

2.2 Intended use

The drive systems described here are products for general use that conform to the state of the art in technology and are designed to prevent any dangers. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or unbraked movements can never be totally excluded without additional safety equipment. For this reason personnel must never be in the danger zone of the drives unless additional suitable safety equipment prevents any personal danger. This applies to operation of the machine during production and also to all service and maintenance work on drives and the machine. The machine design must ensure personal safety. Suitable measures for prevention of property damage are also required.

With the system configuration described, the drive systems may only be used in industrial applications and only with a permanently installed connection.

In all cases the applicable safety regulations and the specified operating conditions, such as environmental conditions and specified technical data, must be observed.

The drive system must not be commissioned and operated until completion of installation in accordance with the EMC regulations and the specifications in this manual.

To prevent personal injury and damage to property damaged drive systems must not be installed or operated.

Modifications of the drive systems are not permitted and if made all no warranty and liability will be accepted.

The drive system must be operated only with the specified wiring and approved accessories. In general, use only original accessories and spare parts.

The drive systems must not be operated in an environment subject to explosion hazard (ex area).

2.3 Hazard categories

Safety notes and general information are indicated by hazard messages in the manual. In addition there are symbols and instructions affixed to the product that warn of possible hazards and help to operate the product safely.

Depending on the seriousness of the hazard, the messages are divided into three hazard categories.

DANGER

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

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.

2.4 General safety instructions

DANGER

Motor out of view

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

- Only start the system if there are no persons in the operating zone of the moving components and the system can be operated safely.

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

WARNING

Unexpected movement

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

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

- Install the wiring carefully in accordance with the EMC requirements.
- Disable the inputs $\overline{\text{STO_A}}$ and $\overline{\text{STO_B}}$ (status 0) to prevent unexpected movements before switching on and configuring the drive system.
- Do not operate a drive system with unknown settings or data.
- Carry out a comprehensive commissioning test.

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

WARNING

Loss of control

- Observe the accident prevention regulations. (For USA see also NEMA ICS1.1 and NEMA ICS7.1)
- The system manufacturer must take the potential error possibilities of the signals and the critical functions into account to ensure a safe status during and after errors. Examples are: Emergency stop, final position limitation, power failure and restart.
- The assessment of error possibilities must also include unexpected delays and the failure of signals or functions.
- Suitable redundant control paths must be in place for dangerous functions.
- Check that measures taken are effective.

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

⚠ CAUTION**Errors in control commands**

If a PLC is used as the master device, the exchange of data can lead to inconsistent transmission data as a result of fieldbus and PLC cycles not operating synchronously.

- Please observe the notes concerning the operation using PLC.

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

2.5 Safety functions

Using the safety functions integrated in this product requires careful planning. For more information see chapter 4.4 "Safety function STO ("Safe Torque Off")" on page 38.

2.6 Monitoring functions

The monitoring functions in the product protect the system and reduce the risks involved in a system malfunction. These monitoring functions are not sufficient for personal protection.

The following errors and limit values can be monitored:

Monitoring	Task	Protective function
Blocking error	Error message if the motor shaft remains stopped over a specified period even with maximum current	Functional safety
Data link	Error response in event of connection break	Functional safety and system protection
Limit switch signals	Monitoring of permissible area of travel	System protection
I ² t Limit	Power limitation in event of overloading	Device protection
Short circuit	Monitoring for short circuits between the motor phases	Device protection
Tracking error	Monitoring of variation between motor position and setpoint position	Functional safety
Overvoltage and undervoltage	Monitoring for overvoltage and undervoltage of the power supply	Functional safety and device protection
Overtemperature	Monitoring device for overtemperature	Device protection

For the description of the monitoring functions see 7.6.1 "Monitoring functions" from page 166.

3 Technical Data

This chapter contains information on the required environmental conditions and on the mechanical and electrical properties of the unit family and the accessories.

3.1 Environmental conditions

The ambient temperature is differentiated in the permissible operating temperature range and the permissible temperature range for transport and storage.

Ambient operating temperature The maximum permissible ambient air temperature during operation depends on the gap between the installed devices and the performance required. The relevant requirements in the chapter on installation are also very important.

Operating temperature ¹⁾	[°C]	0 ... +50
-------------------------------------	------	-----------

1) no icing

Ambient temperature for transport and storage The permissible air and ambient temperature during transport and storage must be dry and dust-free. The maximum oscillation and shock stress must be within the specified limits.

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

Pollution degree

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

Relative humidity

The following relative humidity is permissible during operation:

rel. air humidity	in accordance with IEC 60721-3-3, Class 3K3, 5% ... 85%, no condensation allowed
-------------------	---

Installation altitude

Installation height above mean sea level for 100% power	[m]	<1000
---	-----	-------

Installation height above mean sea level at a maximum ambient temperature of 40°C with a side clearance of >50mm	[m]	<2000
--	-----	-------

Oscillations and shocks

Oscillations, sinusoidal	As per IEC/EN 60068-2-6: 1.5 mm (from 3 Hz ... 13 Hz) 10 m/s ² (at 13Hz ... 150Hz)
Shocks, semi-sinusoidal	As per IEC/EN 60068-2-27: 150 m/s ² (over 11 ms)

EMC

Interference emission with shielded cables	IEC 61800-3: Class C2 EN 61000-6-4 EN 55022: Class A
Interference emission with unshielded cables	IEC 61800-3: Class C3 EN 61000-6-4 EN 55022: Class A
Noise immunity	IEC 61800-3: second environment

3.2 Mechanical data

3.2.1 Dimensions

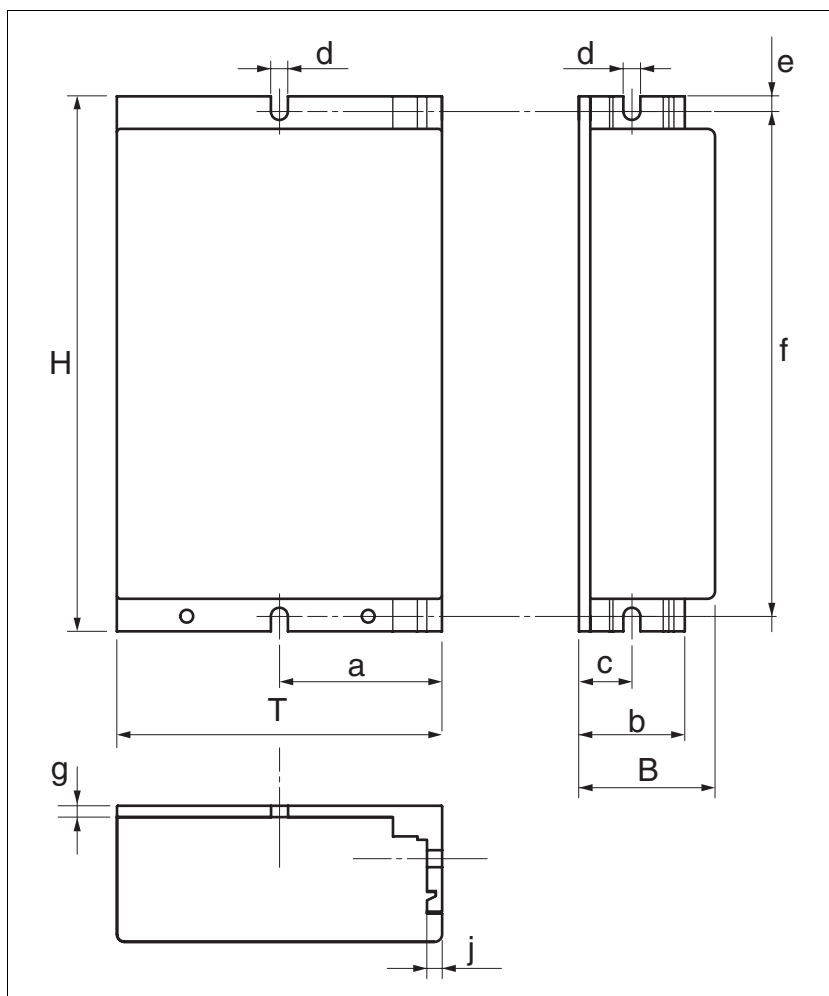


Figure 3.1 Dimensions

H	[mm]	141.5
B	[mm]	36
T	[mm]	86
a	[mm]	43
b	[mm]	28
c	[mm]	14
d	[mm]	4.5
e	[mm]	4
f	[mm]	133.5
g	[mm]	3
j	[mm]	4
Type of cooling	Free convection	
Weight	[kg]	0.38

3.2.2 Degree of protection

IP degree of protection

Degree of protection as per IEC 60529	IP20
---------------------------------------	------

Degree of protection when using STO

It is important to ensure that there are no conductive deposits on the product for the STO safety function (pollution degree 2). Protect the product appropriately against dust and spray.

3.3 Electrical Data

3.3.1 Overview of all connections

The following diagram displays an overview of all connections:

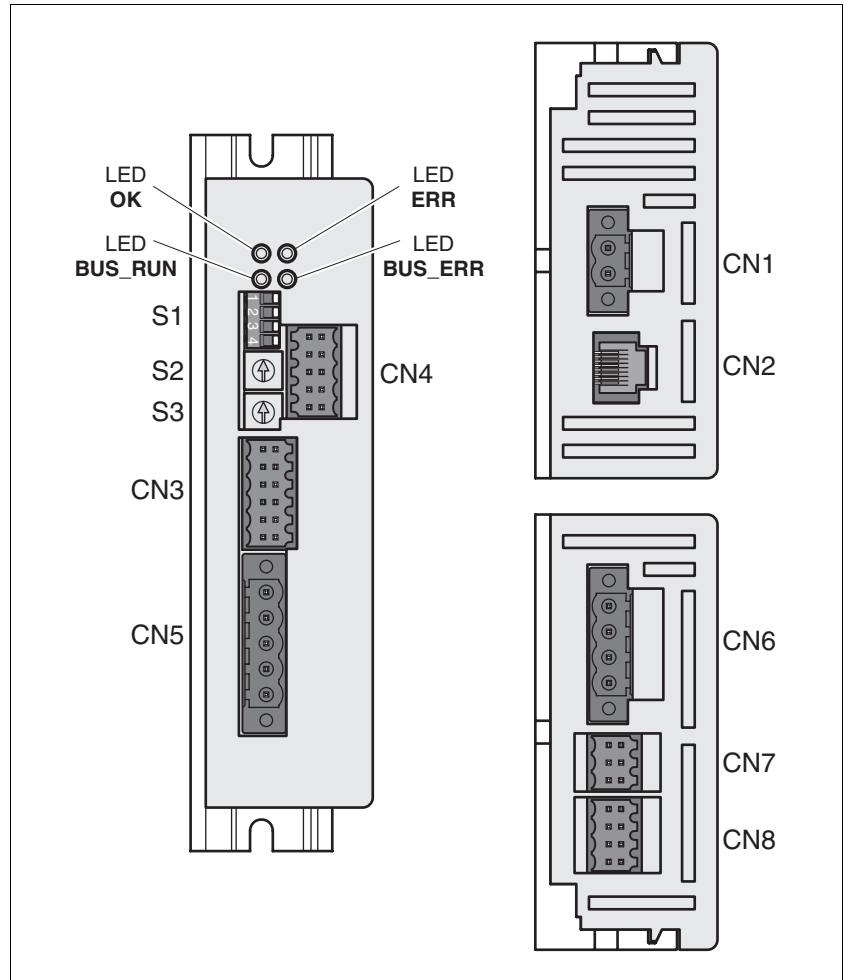


Figure 3.2 Overview of signal connections

Terminal	Configuration
CN1	Power supply
CN2	Commissioning interface
CN3	I/O signal interface
CN4	Expanded I/O signal interface (optional)
CN5	Fieldbus interface
CN6	Motor connection
CN7	Hall sensor interface
CN8	Motor encoder

3.3.2 Power supply V_{DC} at CN1**CAUTION****Destruction of contacts**

The connection for the controller supply voltage at the drive system does not have a inrush current limitation. If the voltage is switched on by switching contacts, the contacts may be destroyed or welded shut.

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

Failure to follow these instructions can result in equipment damage.

The power supply V_{DC} is also the controller supply.

Performance data

Nominal voltage V_{DC}	[V _{DC}]	24 ... 48 ¹⁾
Limit values V_{DC}	[V _{DC}]	19.2 ... 60
Residual ripple	[%]	<5
Current consumption	[A]	≤7
Current consumption short-term ²⁾	[A]	≤14
Input power at 24V _{DC}	[W]	≤150
Input power at 48V _{DC}	[W]	≤300
Input power at 24V _{DC} short-term ²⁾	[W]	≤300
Input power at 48V _{DC} short-term ²⁾	[W]	≤600
power loss	[W]	≤7
Internal capacitors	[μF]	1100
Fuse to be connected in series ³⁾	[A]	≤10

1) IMPORTANT: Please note the special requirements for the power supply parts. See 4.3 "External power supply units". (return)

2) maximum of 3s.

3) Note the section "Fuses" in this chapter.

Fuses

The current consumption may increase greatly for a short period with dynamic processes such as fast acceleration or brief load torque peaks. The high charging current may also trip a fuse.

Circuit breakers with thermal tripping are recommended.

For example, type 2-5700 from E-T-A (www.e-t-a.com).

Alternatively, circuit breakers with electronic tripping can be used.

For example, type ESS20 from E-T-A (www.e-t-a.com).

Select the nominal current of this circuit breaker depending on the wiring and the current consumption.

input current

Charging current of capacitor C=1100 μF

3.3.3 Commissioning interface at CN2

The commissioning interface uses the Modbus protocol with RS485 signal level.

RS485 signals The signals conform to the RS485 standard and are not electrically isolated.

transmission rate	[kbaud]	9.6 / 19.2 / 38.4
Transmission protocol		Modbus RTU

3.3.4 I/O signal interfaces at CN3 and CN4 (optional)

Signal inputs The signal inputs are electrically connected with 0VDC.

Logic 0 (V_{low})	[V]	-3 ... +5
Logic 1 (V_{high})	[V]	+15 ... +30
Input current (typically at 24V)	[mA]	3.5
Debouncing time	[ms]	1.25 ... 1.5

Analog inputs The analog inputs are electrically connected to 0VDC.

Differential input voltage range	[V _{DC}]	-10 ... +10
Zero voltage window	[mV]	50
Max. input voltage	[V _{DC}]	± 30
input resistance	[kΩ]	≥10
resolution	[Bit]	14
Sampling time	[ms]	0.25

signal outputs The signal outputs are electrically connected to 0VDC and are short-circuit protected.

IMPORTANT: To use the signal outputs at CN3 and CN4, an external power supply must be connected to CN3.

Voltage range	[V]	10 ... 30 ¹⁾
Max. switching current of the output L01_OUT ²⁾	[A]	1.5
Maximum switching current of the outputs L02_OUT, XLO1_OUT, XLO2_OUT	[mA]	200
Inductively chargeable	[mH]	1000
Voltage drop at 50 mA load	[V]	≤1

1) The value corresponds with the connected 24V signal supply

2) Der Ausgang kann zum Ansteuern einer Haltebremse parametrisiert werden. Eine Spannungsabsenkung findet nicht statt.

3.3.5 STO safety function at CN3

The signal inputs are electrically connected with 0VDC.

Logic 0 (V_{low})	[V]	-3 ... +5
Logic 1 (V_{high})	[V]	+15 ... +30
Input current range $\overline{STO_A}$ (typically at 24V)	[mA]	≤10
Input current range $\overline{STO_B}$ (typically at 24V)	[mA]	≤3
Debouncing time	[ms]	1 ... 5
Max. delay until detection of signal differences of $\overline{STO_A}$ and $\overline{STO_B}$ ¹⁾	[s]	<1
Response time (until shutdown of power amplifier)	[ms]	<50
Permitted test pulse width of upstream devices	[ms]	<1

1) Switching procedure must occur simultaneously for both inputs (time lag <1s)

*Data for maintenance schedule and
safety calculations*

Use the following data for your maintenance schedule and the safety calculations:

Service life corresponding to safety life cycle (IEC 61508)		20 years
SFF (Safe Failure Fraction) (IEC 61508)	[%]	49
HFT (Hardware Fail Tolerance) (IEC 61508) Type A subsystem		1
Safety integrity level IEC 61508 IEC 62061		SIL2 SILCL2
Performance level (ISO 13849-1)		d (Category 3)
Probability of failure (PFH) (IEC 61508)	[1/h]	$4.299 \cdot 10^{-9}$

3.3.6 Fieldbus interface at CN5

CAN bus signals

The CAN bus signals conform to the ISO 11898 standard and are not electrically isolated. The CN5.3 connection (\overline{SHLD}) is connected to the housing.

Transmission rate	[kbaud]	50 / 125 / 250 / 500 / 1000
Transmission protocol		CANopen as per CiA301
Device profile		CANopen as per CiA402

3.3.7 Motor connection at CN6

Max. motor phase current	[A _{rms}]	16
Continuous output current	[A _{rms}]	8
Phase count		3
Electrical motor time constant	[ms]	>0.8
Switching frequency of power amplifier	[kHz]	16

Approved motors You can use all motors from the 24/48V RECM motor series.

Third-party motors may also be connected. The third-party motors must comply with the technical specifications described here.

Even if motors are similar, different adjustment of the encoder may be a source of danger.

3.3.8 Interface for hall sensors at CN7

Supply voltage	[V _{DC}]	5 ±5%
Max. allowable current	[mA]	200
Short circuit proof		
internal Pull-Up resistor	[kΩ]	1
maximum commutation frequency	[Hz]	3000
maximum cable length	[m]	15

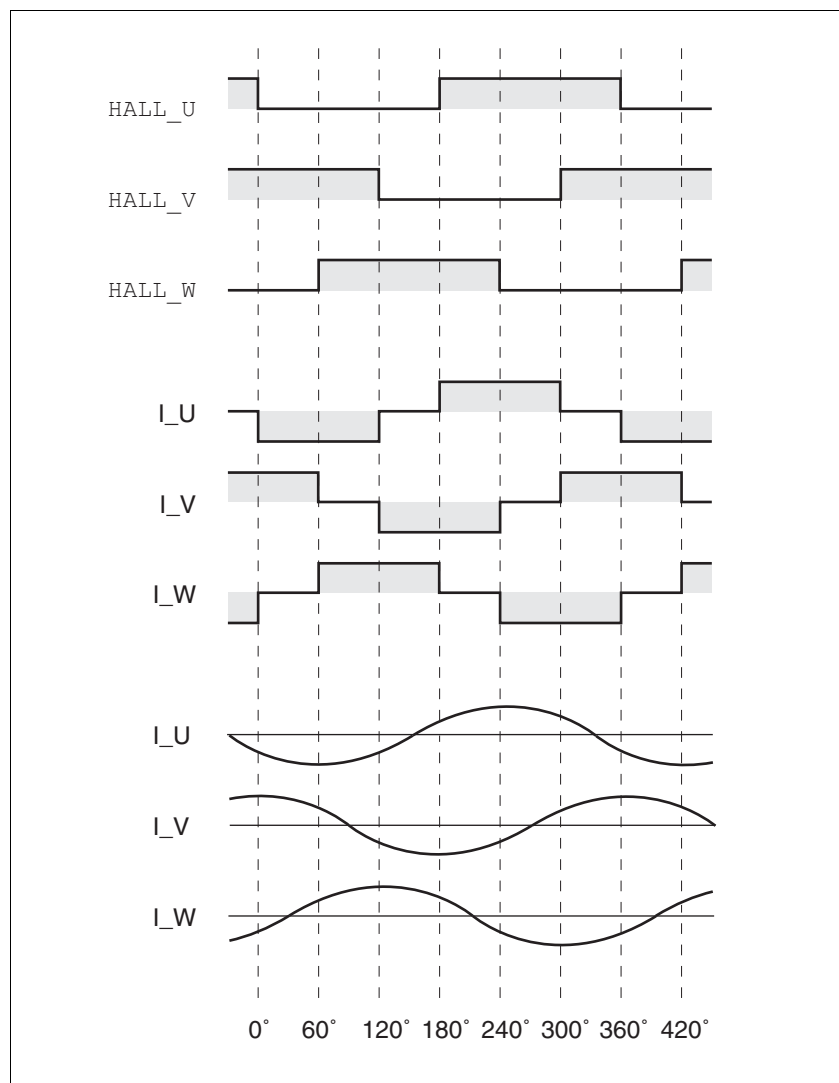


Figure 3.3 Switching behavior of the hall sensors

Hall sensors The rotor position is detected by 3 Hall sensors integrated in the motor. They are offset by 60° or 120° and send six different switching combinations per electrical revolution. The current is sent to the 3 windings according to the signals.

- Check the function as described in 6.4.6 "Check direction of rotation".

The layout of the Hall components as shown in Figure 3.3 is the prerequisite for trouble-free operation. If motors from other suppliers are used different allocations may be used. The allocation can be adjusted with the following parameters:

The `M_hallshift` is used to set an offset between the switch combinations of the hall sensors and the current feed of the motor phases.

The `M_hallpos` is used to set the position of the hall sensors.

3.3.9 Motor encoder at CN8

Motor encoder with A/B/I input signals

Output: ENC+5V_OUT		
Supply voltage	[V]	5 ±5%
Maximum output current	[mA]	100
short circuit proof		
Inputs: ENC_A, ENC_B, ENC_I		
Signal voltage	conforming to RS422	
frequency	[kHz]	≤400
	[inc/s]	≤1600000

When this sensor is connected, a sinusoidal run is also used as a current feed sample.

3.3.10 Technical Data accessories

3.3.11 Cable

Overview of cables required Note the dimensions shown when fabricating cables.

	max. length [m] (shielded)	max. length [m] (unshielded)	Stripped length [mm]	Rigid or flexible cross section [mm ²]
Power supply cable	30	30	10	0.5 ... 2.5
Modbus	10	2	-	0.14 ... 1.5
Signal interface	30	30	9	0.14 ... 1.5
CAN cable	see table 61	see table 61	7	0.5 ... 2.5
Motor cables	15	3	10	0.5 ... 2.5
Hall sensors cable	15	3	7	0.2 ... 1
Encoder cable	15	3	7	0.2 ... 1

3.3.12 Plug

Overview of required connectors The connectors are available as a connector set. See chapter 12 "Accessories and spare parts".

3.3.13 Other accessories

DIN rail adapter The 35mm DIN rail adapter is for a standard TH35 mounting rail in accordance with EN 60715. This accessory includes 2 fixing screws.

EMC kit The EMC kit simplifies the installation because the cable shields can be grounded EMC suitable. The Figure 5.1 "EMC measures" shows an example of the installation of the EMC plate. The delivery includes the EMC plate, 2 mounting screws and 2 cable shield grounding clamps.

4 Engineering

This chapter contains basic information on options for use of the product, which are essential for the engineering.

4.1 Specification of the control mode

<i>Control mode: local or fieldbus</i>	<p>The basic specification of whether the system should be controlled locally or over the fieldbus must be made when the product is started for the first time. This specification can only be modified by restoring the factory setting, see chapter 7.6.9.2 "Restore factory settings".</p> <p>The availability of operating modes of the product also depends on this setting.</p>
<i>Local control mode</i>	<p>With a local control mode the movement is preset with analog signals ($\pm 10V$).</p> <p>Limit switches and reference switches cannot be connected with the control mode.</p>
<i>Fieldbus control mode</i>	<p>In the fieldbus control mode all communications are made via fieldbus commands.</p>

4.2 Configurable inputs and outputs

This product has digital inputs and outputs that can be configured. The inputs and outputs have a defined standard assignment depending on the start-up operating mode. This assignment can be adapted to the requirements of the customer's installation. For more information see chapter 7.6.7 "Configurable inputs and outputs".

4.3 External power supply units

⚠ DANGER

Electric shock from incorrect power supply unit

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

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

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

4.3.1 Power supply

General The power supply unit must be designed to meet the power requirements of the drive. The power consumption can be found in the technical data.

The actual power requirement is often significantly lower, because the maximum possible motor torque is not required to ensure safe operation of a system.

When designing the system, note that during the motor acceleration phase the drive may use a higher current compared to constant movement.

Reverse polarity protection If the polarity of the VDC supply voltage is reversed, the drive shows a short circuit. The drive is short-circuit-resistant up to an effective short-circuit current of maximum 15A. If the power is supplied by a transformer power unit several hundred amperes may flow momentarily in the event of polarity reversal; the drive is designed for this and will not be damaged.

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

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

Motors will recover energy with delays. The DC bus can save a limited amount of energy in the capacitors. Connecting additional capacitors at the DC bus enables a higher energy input.

If the capacity of the capacitors is exceeded, the excess energy must be diverted via internal or external braking resistors. If the energy is not diverted, the overvoltage protector will shut off the power amplifier.

An overvoltage can be limited by switching a braking resistor with corresponding actuation. This converts the recovered energy to heat energy during deceleration or in braking mode.

A corresponding brake resistance controller can be found in 12 "Accessories and spare parts". The complete description can be found in the product manual of the brake resistor controller.

⚠ CAUTION**Loss of control by regeneration condition**

A regeneration condition during braking or external drive may increase the V_{DC} supply voltage by an unexpected degree. Parts that are not designed for this voltage may be destroyed or malfunction.

- Check that all consumers on V_{DC} are designed for the voltage occurring during a regeneration condition (for example limit switches).
- Use only power supply units that will not be damaged by a regeneration condition.
- Use a braking resistor actuator if necessary.

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

4.3.2 Signal power supply

General A separate power supply is required to supply the sensor technology and digital signal outputs (+24VDC).

A supply of the sensor technology and digital signal outputs (+24VDC) via power supply V_{DC} is not possible, because the voltage level at V_{DC} may become too high due to the recovery.

- Use a separate power supply to supply the sensor technology and digital signal outputs (+24VDC).

The chapter 8 "Examples" contains examples for wiring.

4.4 Safety function STO ("Safe Torque Off")

For some general information on the application of IEC 61508 see chapter 9.1 "Safety functions".

4.4.1 Definitions

<i>Safety function STO</i>	The safety function STO ("Safe Torque Off") shuts off the motor torque safely. The supply voltage does not have to be interrupted. There is no monitoring at standstill.
<i>Stop category 0 (EN60204-1)</i>	Standstill by immediate power shutdown to the machine drive elements (i. e. an uncontrolled stop).
<i>Stop category 1 (EN60204-1)</i>	A controlled stop in which the power to the machine drive elements are retained to effect the standstill. Power feed is only interrupted when everything has come to a standstill.

4.4.2 Function

	The STO safety function integrated into the product can be used to implement the "Emergency Stop" control function (EN 60204-1) for Category 0 Stop and Category 1 Stop. In addition, this safety function prevents the drive from unexpected restart.
<i>Mechanism of Action</i>	<p>The STO safety function can be triggered with the two redundant inputs $\overline{\text{STO_A}}$ and $\overline{\text{STO_B}}$. The circuits of the two inputs must be separated from each other to retain the two channels.</p> <p>The switching process must be simultaneous for both inputs (skew <1s). The power amplifier is disabled and an error message is generated. Then the motor cannot generate torque and runs down without braking. A restart is only possible after resetting the error message with a "Fault Reset".</p> <p>The power amplifier is also disabled and an error message is generated if only one of the two inputs is shut down. This error message can only be reset by switching off.</p>

4.4.3 Requirements for safe application

⚠ WARNING	
Loss of safety function	
Incorrect usage may cause a safety hazard by loss of the safety function.	
<ul style="list-style-type: none"> Observe the requirements for the safety function. 	
Failure to follow these instructions can result in death or serious injury.	

<i>Stop of category 0</i>	In a stop of category 0 the drive runs down uncontrolled. If access to the machine while it is running down is a hazard (result of hazard and risk analysis), suitable measures must be taken.
---------------------------	--

<i>Stop of category 1</i>	A controlled shutdown must be triggered with a category 1 stop. The controlled standstill is not monitored by the drive system and is not guaranteed if power fails or in the event of an error. The final shutdown is ensured by shutting down the $\overline{\text{STO_A}}$ and $\overline{\text{STO_B}}$ inputs. This is generally controlled by a standard EMERGENCY STOP module with safe time delay.
<i>Vertical axes, external forces</i>	If external forces act on the drive (vertical axis) and an unwanted movement, for example caused by gravity, could cause a hazard, the drive must not be operated without additional measures for drop protection corresponding to the required safety.
<i>Prevention of unexpected restart</i>	To prevent an unexpected restart after restoration of power (e.g. after power failure), the parameter <code>IO_AutoEnable</code> must be set to "off". Note that a higher level controller must not trigger a dangerous restart.
<i>Degree of protection when using STO</i>	It is important to ensure that there are no conductive deposits on the product for the STO safety function (pollution degree 2). Protect the product appropriately against dust and spray.
<i>Protected layout</i>	<p>If short circuits and cross connections can be expected on the wiring of the $\overline{\text{STO_A}}$ and $\overline{\text{STO_B}}$ signals and they are not detected by upstream devices, a protected wire layout is required.</p> <p>In the case of an unprotected layout the $\overline{\text{STO_A}}$ and $\overline{\text{STO_B}}$ signals may be connected to interference voltage if a cable is damaged. If both signals are connected to interference voltage the STO safety function will not operate.</p> <p>A protected layout can be achieved as follows:</p> <ul style="list-style-type: none"> • Layout of $\overline{\text{STO_A}}$ and $\overline{\text{STO_B}}$ signal lines in different cables. If there are additional wires in the cables they must only carry voltages corresponding to PELV. • Use of a shielded cable. The grounded shield protects the signals against interference voltage if the cable is damaged and trips the fuse. • Use of separate grounded shielding. If there are other wires in the cable, the $\overline{\text{STO_A}}$ and $\overline{\text{STO_B}}$ signals must be isolated from these wires by a separate grounded shield.
<i>Data for maintenance schedule and safety calculations</i>	Use the following data for your maintenance schedule and the safety calculations:

Service life corresponding to safety life cycle (IEC 61508)	20 years
SFF (Safe Failure Fraction) (IEC 61508)	[%] 49
HFT (Hardware Fail Tolerance) (IEC 61508) Type A subsystem	1
Safety integrity level IEC 61508 IEC 62061	SIL2 SILCL2
Performance level (ISO 13849-1)	d (Category 3)
Probability of failure (PFH) (IEC 61508)	[1/h] $4.299 \cdot 10^{-9}$

Hazard and risk analysis As a system manufacturer you must conduct a hazard and risk analysis (e.g. as per EN 1050) of the system. The results must be taken into account in the application of the STO safety function.

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

4.4.4 Application examples

Example: category 0 stop Circuit without EMERGENCY STOP module, category 0 stop.

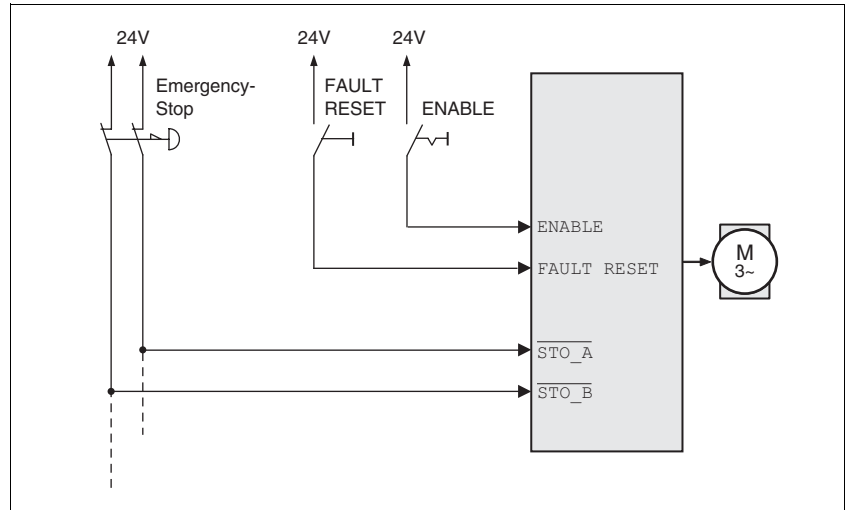


Figure 4.1 Example: category 0 stop

Please note:

- When the EMERGENCY STOP switch is tripped it initiates a stop of category 0

Example: category 1 stop Circuit with EMERGENCY STOP module, category 1 stop,

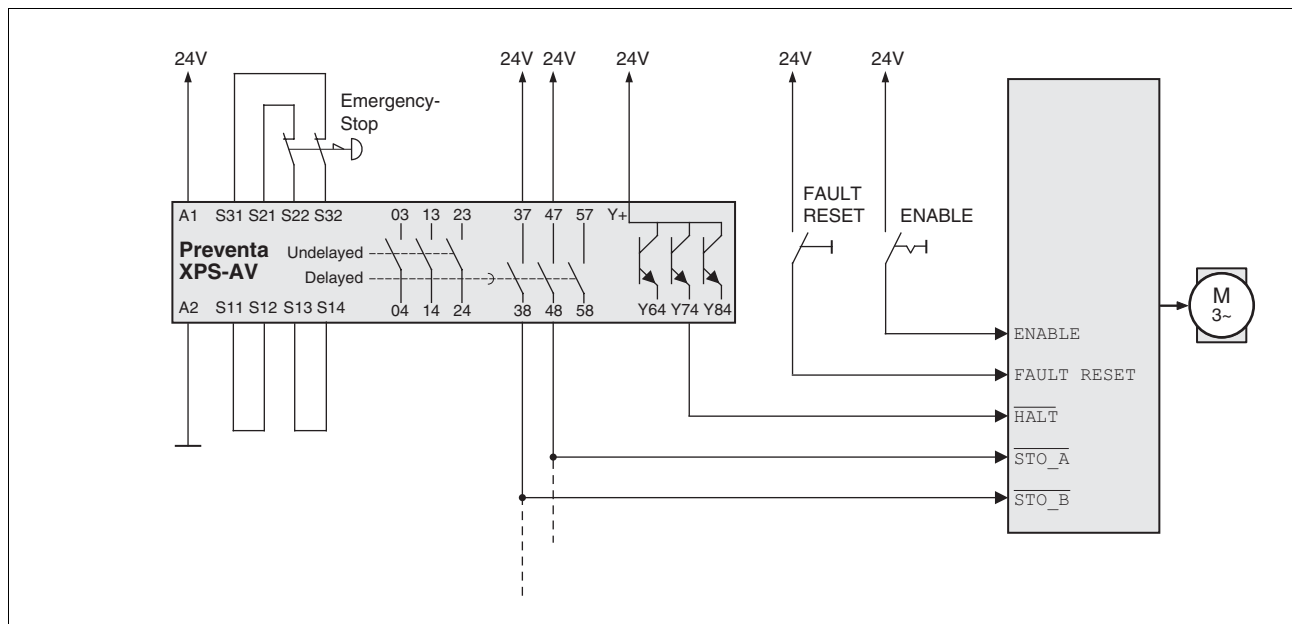


Figure 4.2 Example of category 1 stop with external Preventa XPS-AV EMERGENCY STOP module

Please note:

- A "Halt" is initiated without delay through the $\overline{\text{HALT}}$ input.
- The $\overline{\text{STO_A}}$ and $\overline{\text{STO_B}}$ inputs are shut down according to the delay time specified in the EMERGENCY STOP module. If the drive has not yet stopped at this time, it runs down without control (uncontrolled stop).
- The specified minimum current and the allowed maximum current of the relay must be maintained in the circuitry of the relay outputs at the EMERGENCY STOP module.

5 Installation

⚠ WARNING

Loss of control

- Observe the accident prevention regulations. (For USA see also NEMA ICS1.1 and NEMA ICS7.1)
- The system manufacturer must take the potential error possibilities of the signals and the critical functions into account to ensure a safe status during and after errors. Examples are: Emergency stop, final position limitation, power failure and restart.
- The assessment of error possibilities must also include unexpected delays and the failure of signals or functions.
- Suitable redundant control paths must be in place for dangerous functions.
- Check that measures taken are effective.

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



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

5.1 Electromagnetic compatibility, EMC

⚠ WARNING

Interference with signals and devices

Distorted signals can cause unpredictable device responses.

- Install the wiring in accordance with the EMC requirements.
- Check compliance with the EMC requirements, particularly in an environment subject to strong interference.

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

The drive and the system are subject to electromagnetic interference. If suitable precautions are not taken, the interference will affect the signals from the control wiring and system parts and adversely affect the operating safety of the system.

Before operation the electromagnetic compatibility of the system must be checked and assured. This drive system meets the EMC requirements according to the standard IEC 61800-3, if the described measures are taken into account during installation.

To maintain the limit values for the EMC interference resistance and interference radiation the drive must be grounded. It can be grounded from the motor flange or the electronics housing. This is generally done by bolting the motor to an electrically conductive and grounded machine component for sufficient grounding of the drive.

EMC measures	Consequence
Cable as short as possible. No ground loops.	Prevent capacitive and inductive fault interference
Earth shields on digital signal wires over a wide area at both ends or via conductive plug housing.	Preventing interference on signal wires, reduction of emissions
Connect large surface areas of cable shields, use cable clamps and tapes	Reduction of emissions.

Shielding

The following cables must be shielded:

- Fieldbus cable
- Cable for safety function STO
See the requirements in chapter 4.4.3 "Requirements for safe application".

The following cables can be left unshielded:

- Supply voltage V_{DC}
- 24 V signal interface

Equipotential bonding conductors

The shields are connected at both ends for fault protection. Potential differences can result in excessive currents on the shield and must be prevented by equipotential bonding conductor cables.

If lines with a length of more than 100m are permitted, the following applies: up to 200m length, a cross-sectional area of 16mm^2 will be sufficient, with greater lengths, a cross sectional area of 20mm^2 must be used.

5.2 Mechanical installation

⚠ CAUTION

Hot Surfaces

Depending on the operation the surface may heat up to more than 100°C (212°F).

- Prevent contact with the hot surfaces.
- Do not install flammable or heat-sensitive components in the immediate vicinity.
- Follow the actions described for heat dissipation.
- Check the temperature during the test run.

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

⚠ CAUTION

Destruction of the motor and loss of control

A shock or strong pressure against the motor shaft may destroy the motor.

- Protect the motor shaft during handling and transport.
- Prevent impacts against the motor shaft during mounting.
- Do not press parts on to the shaft. Attach parts to the shaft with adhesive, clamps, shrinkage or screws.

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

⚠ WARNING

Danger of loss of safety function by external objects

The safety function may fail because of conductive foreign bodies, dust or liquids.

- The STO safety function must only be used if the system is protected against conductive contamination.

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

⚠ WARNING**Unbraked motor**

In the case of power failure and faults which cause the power amplifier to be switched off, the motor is no longer controlled by the brake and increases its speed even more until it comes to a mechanical stop.

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

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



When installing the drive in less accessible positions, it may be useful to carry out the electrical installation first and then install the fully wired drive.

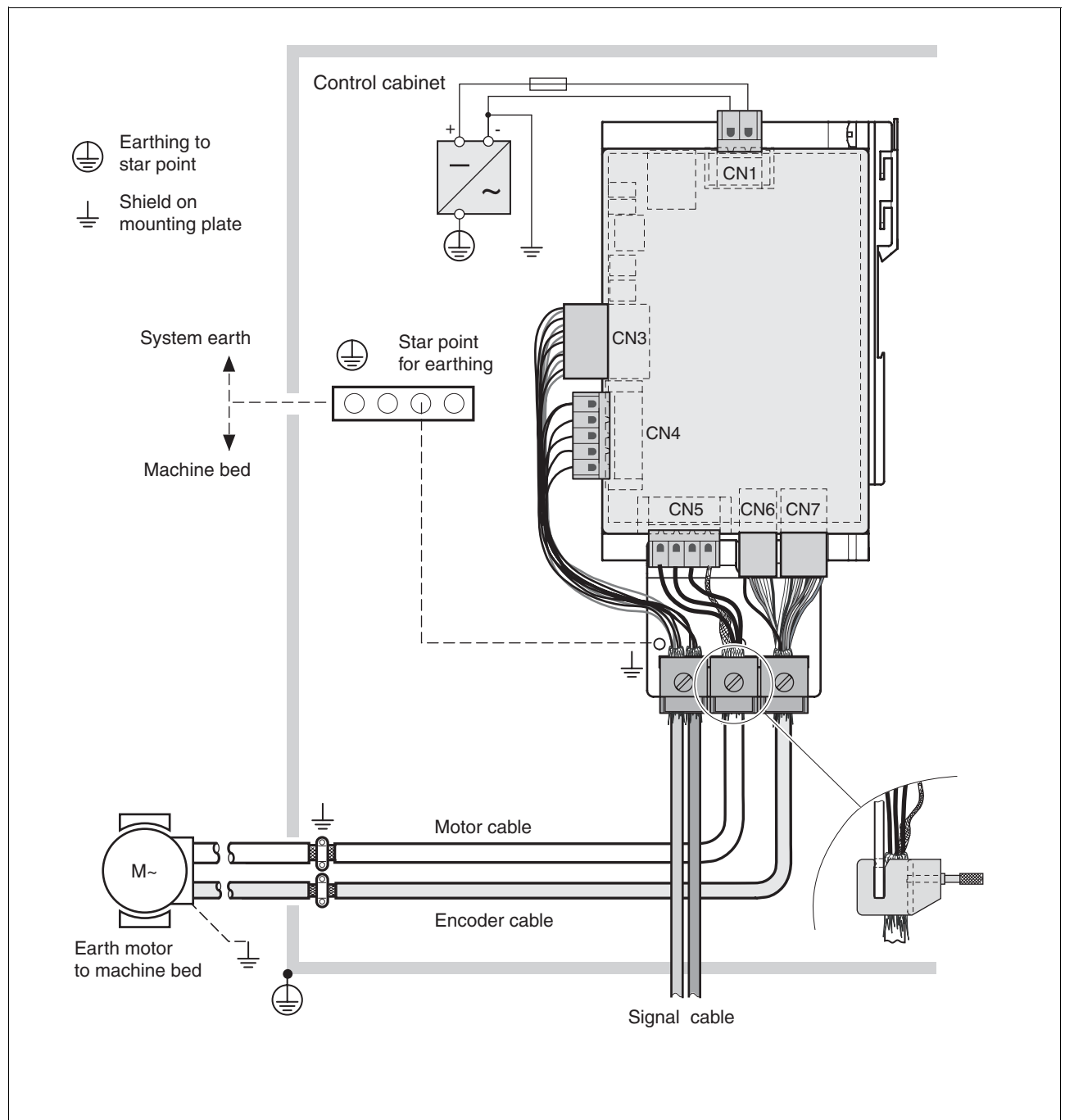


Figure 5.1 EMC measures

5.3 Mounting the device

Switch cabinet The switching cabinet must be dimensioned so all devices and accessories can be fixed in place and wired to meet EMC standards.

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

Installation spacing; ventilation When selecting the position of the device in the switching cabinet, note the following instructions:

- Adequate cooling of the device must be ensured by complying with the minimum installation distances. Prevent heat accumulation.
- The device must not be installed close to heat sources or mounted on flammable materials.
- The warm airflow from other devices and components must not heat the air used for cooling the device.
- The drive will switch off as a result of overtemperature when operated above the thermal limits.

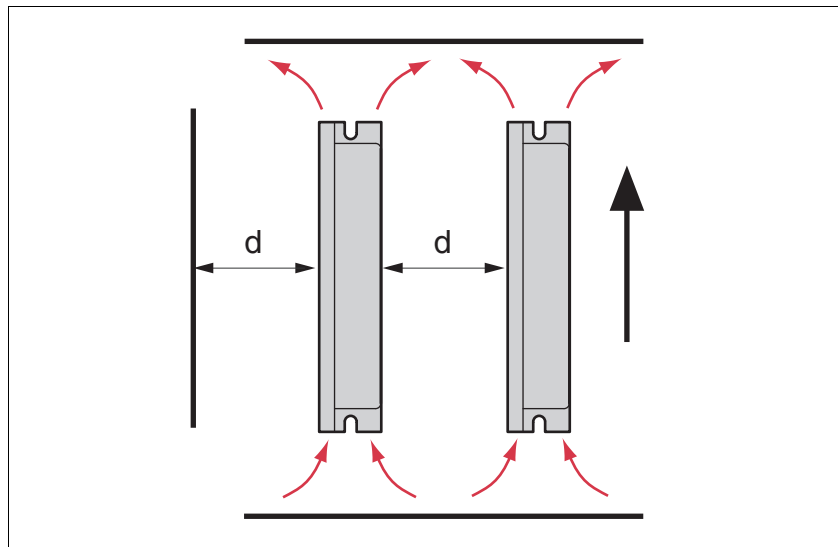


Figure 5.2 Installation spacing and air circulation

The specified continuous current is applicable if the following distances are maintained and the device is installed upright.

- At least 10 mm of free space is required in front of the device.
- At least 50 mm of free space is required above the device.
- At least 30 mm of free space is required for "d".
- At least 200 mm free space under the device is required to ensure that wiring can be installed without excessive bending.

If other components are installed in these areas, the possible continuous current is reduced.

Mounting the device

The product can be mounted directly on the narrow or wide mounting surface with two M4 screws. The product can optionally be snapped onto a standard TH35 rack (EN 60715) with a DIN rail adapter (accessory) (DIN rail 35 mm). For the dimensions of the fastening holes see Chapter 3.2.1 "Dimensions" from page 25.

- ▶ Install the device in a vertical position ($\pm 10^\circ$). This is particularly important for cooling the device.
- ▶ Use the EMC kit (see chapter 12 "Accessories and spare parts") or alternative attaching elements (comb bars, shield clamps, busbars) for the cable layout and connecting the shielding.



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

5.4 Electrical installation

DANGER

Motor out of view

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

- Only start the system if there are no persons in the operating zone of the moving components and the system can be operated safely.

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

DANGER

Electric shock

High voltages at the motor connection may occur unexpectedly.

- The motor generates voltage when the shaft is rotated. Lock the motor shaft to prevent rotation before starting work on the drive system.
- AC voltages may jump over unused wires in the motor cable. Isolate unused wires at both ends of the motor cable.
- It is the system manufacturer's responsibility to ensure compliance with all applicable regulations on earthing the drive system. Extend the earth through the motor cable with an additional earth at the motor housing.

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

WARNING

Unexpected behavior due to external objects

External objects, deposits or humidity can cause unexpected behavior.

- Do not use damaged products.
- Prevent external objects such as chips, screws or wire clippings from entering the product.
- Do not use products that contain external objects.

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

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

- Use as a trailing cable
- Temperature range
- Chemical resistance
- Layout outdoors
- Layout underground

5.4.1 Overview of procedure

- ▶ Make sure that the entire installation is performed when the device is disconnected from power.
- ▶ Connect the device to the grounded neutral point of the system.
- ▶ Connect all required terminals corresponding to the table below. Follow the EMC requirements, see chapter 12 "Accessories and spare parts" from page 363.
- ▶ At the end check the installation.

Chapter	from page
5.4.3 "Connection of power supply (CN1)"	53
5.4.4 "Connection of commissioning point (CN2)"	55
5.4.5 "Connection of I/O signal interface (CN3)"	57
5.4.6 "Connection Expanded I/O signal interface (CN4 optional)"	59
5.4.7 "Fieldbus connection (CN5)"	61
5.4.8 "Connection of motor (CN6)"	64
5.4.9 "Connection of hall sensors (CN7)"	66
5.4.10 "Connection of motor encoder (CN8)"	67



For wiring examples, see Kapitel „Wiring examples“, Seite 8-203.

5.4.2 Overview of all connections

The following diagram displays an overview of all connections:

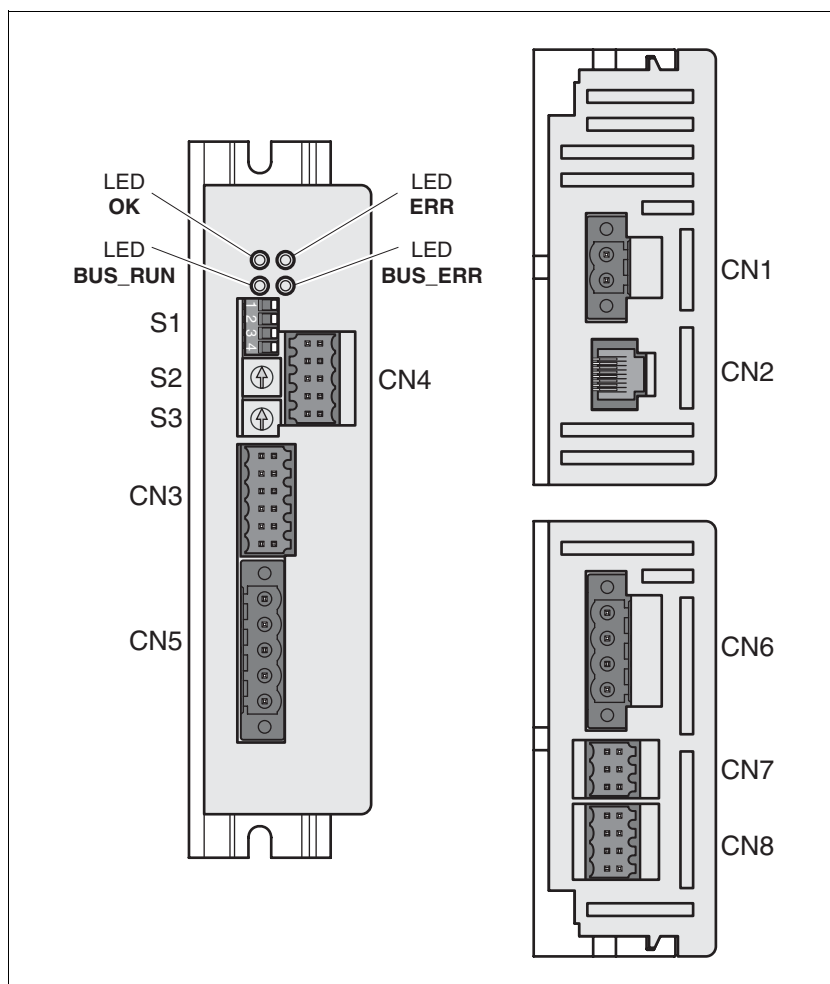


Figure 5.3 Overview of signal connections

Terminal	Configuration
CN1	Power supply
CN2	Commissioning interface
CN3	I/O signal interface
CN4	Expanded I/O signal interface (optional)
CN5	Fieldbus interface
CN6	Motor connection
CN7	Hall sensor interface
CN8	Motor encoder

5.4.3 Connection of power supply (CN1)

⚠ DANGER

Electric shock from incorrect power supply unit

The ∇ DC and +24 ∇ DC supply voltages are connected with many exposed signals in the drive system.

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

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

⚠ CAUTION

Loss of control by regeneration condition

A regeneration condition during braking or external drive may increase the ∇ DC supply voltage by an unexpected degree. Parts that are not designed for this voltage may be destroyed or malfunction.

- Check that all consumers on ∇ DC are designed for the voltage occurring during a regeneration condition (for example limit switches).
- Use only power supply units that will not be damaged by a regeneration condition.
- Use a braking resistor actuator if necessary.

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

CAUTION

Destruction of contacts

The connection for the controller supply voltage at the drive system does not have a inrush current limitation. If the voltage is switched on by switching contacts, the contacts may be destroyed or welded shut.

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

Failure to follow these instructions can result in equipment damage.

Pin assignment

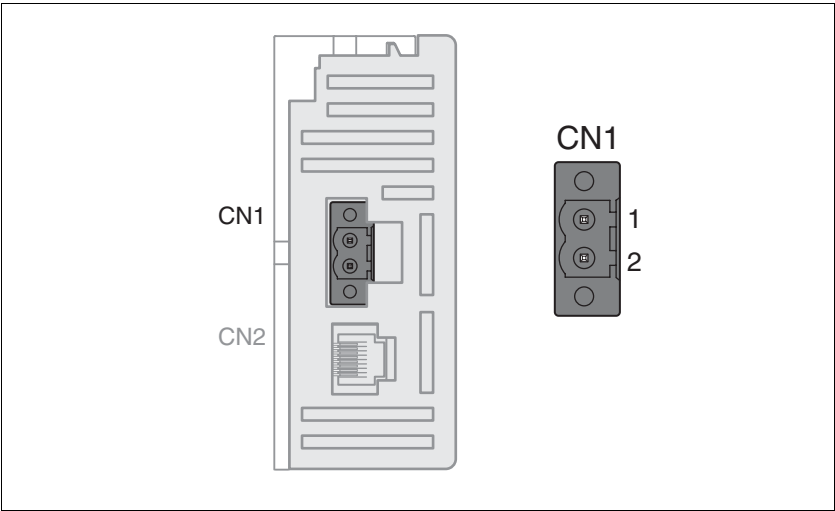


Figure 5.4 Connector CN1

Pin	Signal	Meaning
1	VDC	Power supply ¹⁾
2	0VDC	Reference potential to VDC

1) IMPORTANT: Please note the special requirements for the power supply parts. See 4.3 "External power supply units". (Energy recovery).

Fuses

required counter plug

Notes on fuses are listed under 12 "Accessories and spare parts".

The connector is available as a component of a connector set. See chapter 12 "Accessories and spare parts".

	Description	Type (Weidmüller)
Power supply	Socket board 2-pole 5.08, GOLD black	BLZF 5.08/02/180F AU SW

Fabricating cables Note the dimensions specified when fabricating cables.

	max. length [m] (shielded)	max. length [m] (unshielded)	Stripped length [mm]	Rigid or flexible cross section [mm ²]
Power supply cable	30	30	10	0.5 ... 2.5

5.4.4 Connection of commissioning point (CN2)

Function The unit is designed for connection to the Modbus

With Modbus, multiple network devices are interconnected by bus cable. Every network device must be configured before operation on the network. Each is given a unique node address.

The baud rate must be the same for all units in the fieldbus.

Address and baud rate are set during commissioning. See "First Setup", page 83

Cable specifications The cables used must conform to the following properties:

- Shielded cable
- Twisted pair line
- Minimum cross section of the signal wires 0.14 mm²
- Earthing of the screen at both ends
- maximum length 400 m.
- ▶ Use equipotential bonding conductors, see page 44.
- ▶ Use prefabricated cables to minimize the risk of a wiring errors (from page 363).

Pin assignment

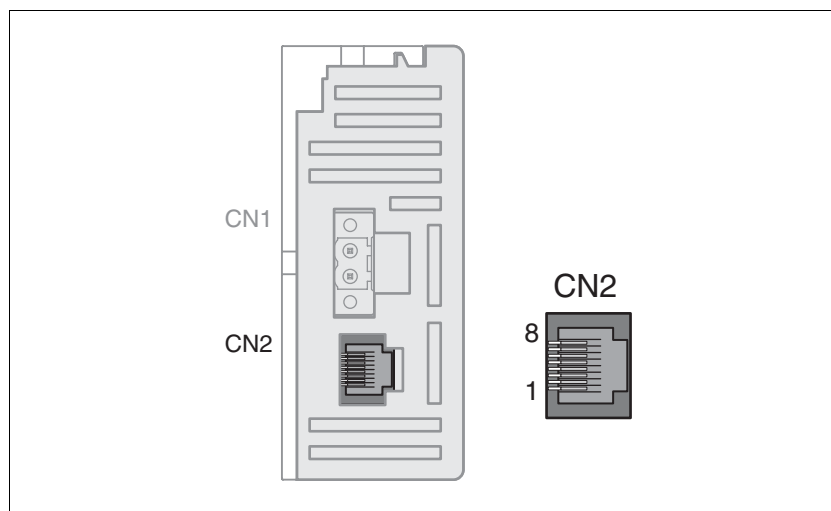


Figure 5.5 Pin assignment Modbus

Pin	Signal	Meaning	I/O
4	MOD_D1	Bidirectional transmit/receive signal	RS485 level
5	MOD_D0	Bidirectional transmit/receive signal, inverted	RS485 level
7	MOD+10V_OUT	12 V power supply, max. 200 mA	O
8	MOD_0V	Reference potential to MOD+10V_OUT	O

Required counter plug The connector is available as a component of a connector set. See chapter 12 "Accessories and spare parts".

Description	
Modbus	RJ45

Fabricating cables Note the dimensions specified when fabricating cables.

	max. length [m] (shielded)	max. length [m] (unshielded)	Stripped length [mm]	Rigid or flexible cross section [mm ²]
Modbus	10	2	-	0.14 ... 1.5

Connecting Modbus ► Connect the Modbus cable to CN4 with an RJ45 plug.

5.4.5 Connection of I/O signal interface (CN3)

Pin assignment

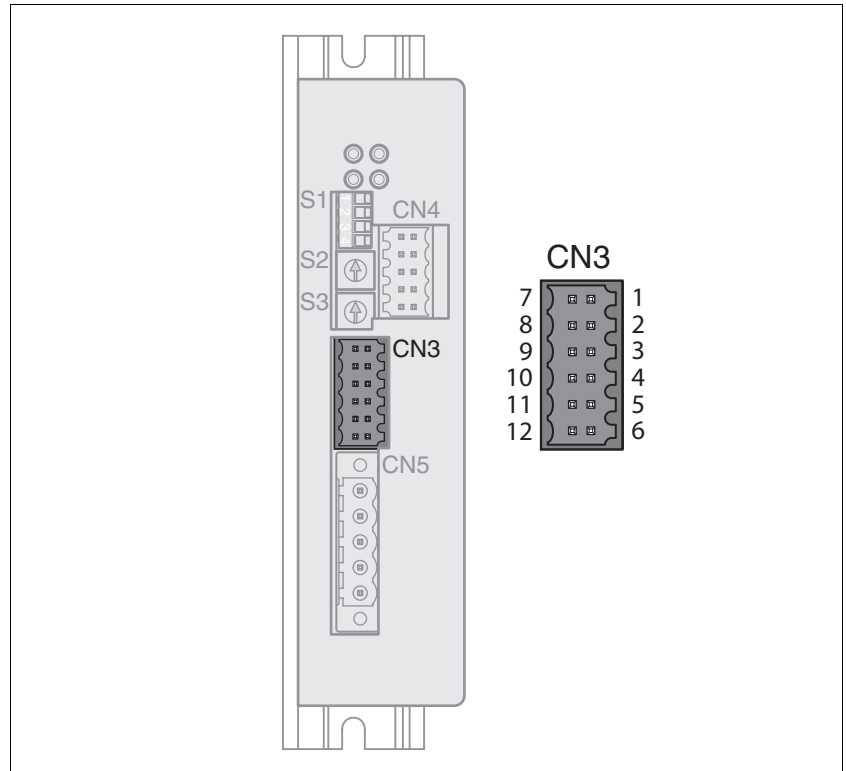


Figure 5.6 Pin assignment of signal interface

Pin	Signal	Meaning	I/O
7	ANA1+	Analog input 1	I
1	ANA1-	Reference potential to ANA1+	I
8	LO1_OUT	Digital output 1	O
2	LO2_OUT	Digital output 2	O
9	LI1	Digital input 1	I
3	LI2	Digital input 2	I
10	LI3	Digital input 3	I
4	LI4	Digital input 4	I
11	STO_A	Safety function STO	I
5	STO_B	Safety function STO	I
12	0VDC	Reference potential to +24VDC	I
6	+24VDC ¹⁾	24 V _{DC} supply voltage for the signal outputs	I

1) IMPORTANT: Do not bridge with supply voltage (recovery). See 4.3.2 "Signal power supply".

⚠ WARNING**Loss of safety function**

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

- Observe the requirements for the safety function.

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

Notes on the safety signals $\overline{\text{STO_A}}$ and $\overline{\text{STO_B}}$ can also be found in chapter 4.4 "Safety function STO ("Safe Torque Off")" and in the chapter 3.3.5 "STO safety function at CN3".

Connection information All inputs and outputs are electrically connected to the power supply. The reference potentials may not have an additional connection to 0VDC.

required counter plug The connector is available as a component of a connector set. See chapter 12 "Accessories and spare parts".

	Description	Type (Weidmüller)
Signal interface	Socket B2L , 12-pole in black with tension spring	B2L 3.5/12 SN SW

Fabricating cables Note the dimensions specified when fabricating cables.

	max. length [m] (shielded)	max. length [m] (unshielded)	Stripped length [mm]	Rigid or flexible cross section [mm ²]
Signal interface	30	30	9	0.14 ... 1.5

- Connecting signal interface*
- ▶ Make sure that the wiring and the cables meet the requirements for PELV.
 - ▶ Attach the connector to CN2.

5.4.6 Connection Expanded I/O signal interface (CN4 optional)

Pin assignment

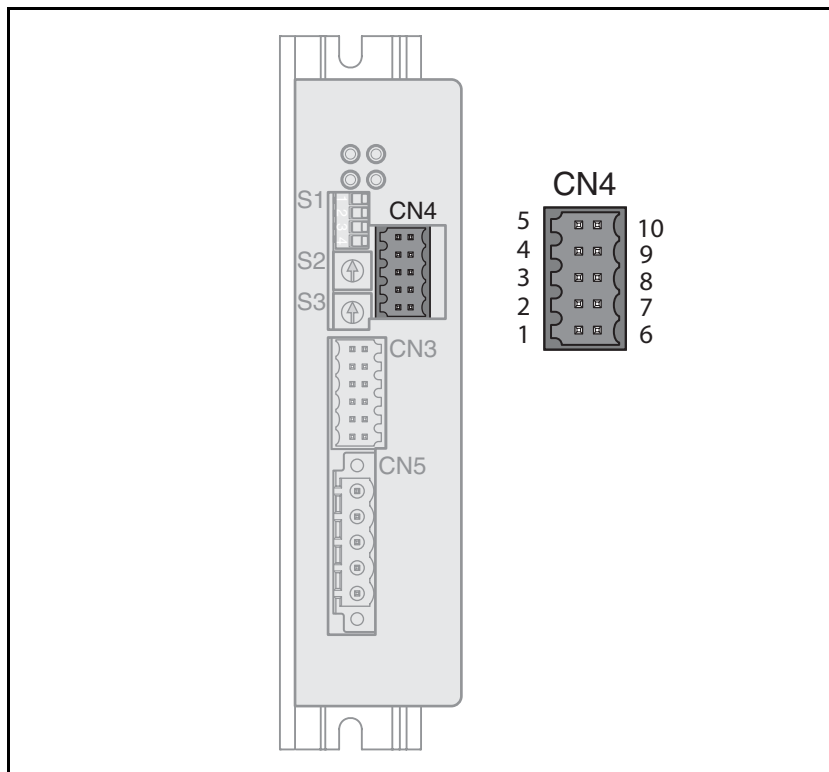


Figure 5.7 Pin assignment of signal interface

Pin	Signal	Meaning	I/O
6	XLO1_OUT	Digital output XLO1_OUT	O
1	XLO2_OUT	Digital output XLO2_OUT	O
7	XLI1	Digital input XLI1	I
2	XLI2	Digital input XLI2	I
8	XLI3	Digital input XLI3	I
3	XLI4	Digital input XLI4	I
9	XLI5	Digital input XLI5	I
4	XLI6	Digital input XLI6	I
10	XANA1+	Analog input XANA1	I
5	XANA1-	Reference potential to XANA1+	I

Connection information

All inputs and outputs are electrically connected to the power supply. The reference potentials may not have an additional connection to 0VDC.

required counter plug The connector is available as a component of a connector set. See chapter 12 "Accessories and spare parts".

	Description	Type (Weidmüller)
Signal interface	Socket B2L , 12-pole in black with tension spring	B2L 3.5/12 SN SW

Fabricating cables Note the dimensions specified when fabricating cables.

	max. length [m] (shielded)	max. length [m] (unshielded)	Stripped length [mm]	Rigid or flexible cross section [mm ²]
Signal interface	30	30	9	0.14 ... 1.5

- Connecting signal interface*
- ▶ Make sure that the wiring and the cables meet the requirements for PELV.
 - ▶ Attach the connector to CN4.

5.4.7 Fieldbus connection (CN5)

Function The device is suitable for connection to CANopen.

In CAN bus multiple network devices can be connected over one bus cable. Up to 110 devices can be connected and up to 127 devices addressed in one CAN bus network branch.

Every network device must be configured before operation on the network. It is given a unique, 7-bit node address (node-ID) between 1 (01_h) and 127 (7F_h). The baud rate must be the same for all devices in the fieldbus.

Address and baud rate are set during commissioning. See "First Setup", page 83.

- Cable specifications*
- Shielded cable
 - Twisted pair lines
 - Minimum cross section of the signal wires 0.14 mm²
 - Grounding of the shield at both ends
 - Maximum length depends on the number of devices, the baud rate and signal transmission times. The higher the baud rates the shorter the bus cable must be.
 - ▶ Use equipotential bonding conductors, see page 44.
 - ▶ Use prefabricated cables to minimize the risk of a wiring errors (from page 363).
 - ▶ Make sure that the wiring, the cables and the connected interfaces meet the requirements for PELV.

Terminating resistors The two ends of a bus cable string must be terminated. This can be achieved by a 120Ω terminating resistor between CAN_L and CAN_H.

Pin assignment

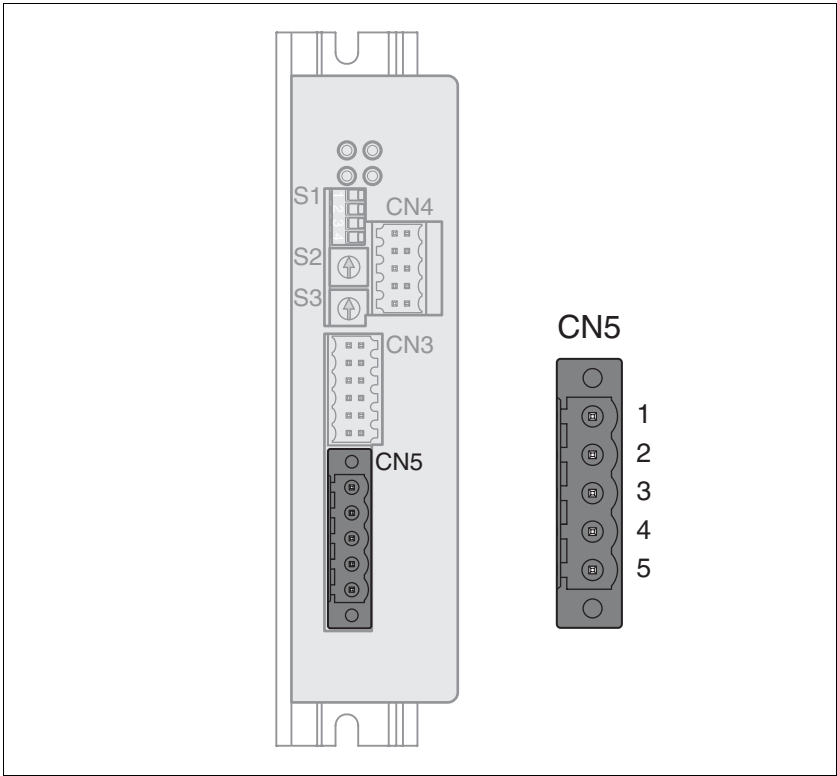


Figure 5.8 Pin assignment CAN to CN4

Pin	Signal	Meaning	I/O
1	Reserved	Reserved	-
2	CAN_H	Data cable	CAN level
3	SHLD	Shield connection	-
4	CAN_L	data wire, inverted	CAN level
5	CAN_0V	Reference potential CAN	-

required counter plug The connector is available as a component of a connector set. See chapter 12 "Accessories and spare parts".

	Description	Type (Weidmüller)
CAN	Socket board, BL, 5.08 mm, 5-pole gray, printed, GOLD, flange	BLDZ DN5.08/5/180F GR BED

Fabricating cables Note the dimensions specified when fabricating cables.

	max. length [m] (shielded)	max. length [m] (unshielded)	Stripped length [mm]	Rigid or flexible cross section [mm ²]
CAN cable	see table "maximum CAN bus length"	see table "maximum CAN bus length"	7	0.5 ... 2.5

009844113504, V1.01, 04.2008

maximum CAN bus length The maximum bus length depends on the selected baud rate. The following table shows the maximum recommended overall lengths.

Baud rate [kbit/s]	Maximum bus length [m]
50	1000
125	500
250	250
500	100
1000	20 ¹⁾

1) According to CANopen specification the maximum bus length is 4m. However, in practice, 20 m have been possible in most cases. This length may be reduced due to external interferences.

At a baud rate of 1 Mbit the spur lines are limited to 0.3m.

Connecting CAN ► Connect the CAN cable to CN4.

5.4.8 Connection of motor (CN6)

⚠ DANGER**Electric shock**

High voltages at the motor connection may occur unexpectedly.

- The motor generates voltage when the shaft is rotated. Lock the motor shaft to prevent rotation before starting work on the drive system.
- AC voltages may jump over unused wires in the motor cable. Isolate unused wires at both ends of the motor cable.
- It is the system manufacturer's responsibility to ensure compliance with all applicable regulations on earthing the drive system. Extend the earth through the motor cable with an additional earth at the motor housing.

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

Monitoring

The motor lines are monitored for:

- short circuit between the motor phases

A short circuit between the motor phases and VDC is not detected.

Connecting the motor cable

- ▶ Make sure that the wiring and the cables meet the requirements for PELV.
- ▶ Follow the EMC requirements for motor cables, see page 43.
- ▶ Connect the motor wires and protective conductor to terminals U, V, W and PE. The cable assignment at the motor and device sides must match.
- ▶ Fix the cable shielding flat on the optional EMC plate or the alternative supporting element.

Pin assignment

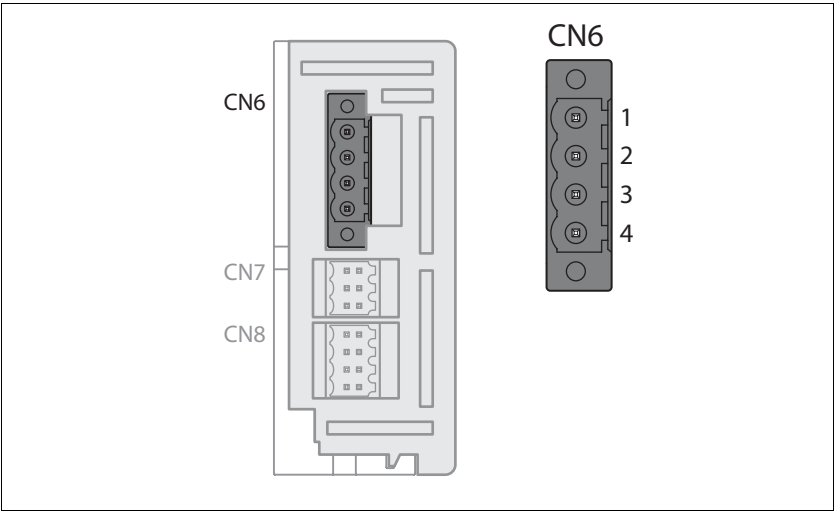


Figure 5.9 Motor pin assignment

Terminal	Meaning
1	Motor line U
2	Motor line V
3	Motor line W
4	Shield connection

Required counter plug

The connector is available as a component of a connector set. See chapter 12 "Accessories and spare parts".

	Description	Type (Weidmüller)
Motor	Socket board 4-pole 5.08, GOLD black	BLZF 5.08/04/180F AU SW

Fabricating cables

Note the dimensions specified when fabricating cables.

	max. length [m] (shielded)	max. length [m] (unshielded)	Stripped length [mm]	Rigid or flexible cross section [mm ²]
Motor cables	15	3	10	0.5 ... 2.5

5.4.9 Connection of hall sensors (CN7)

Pin assignment

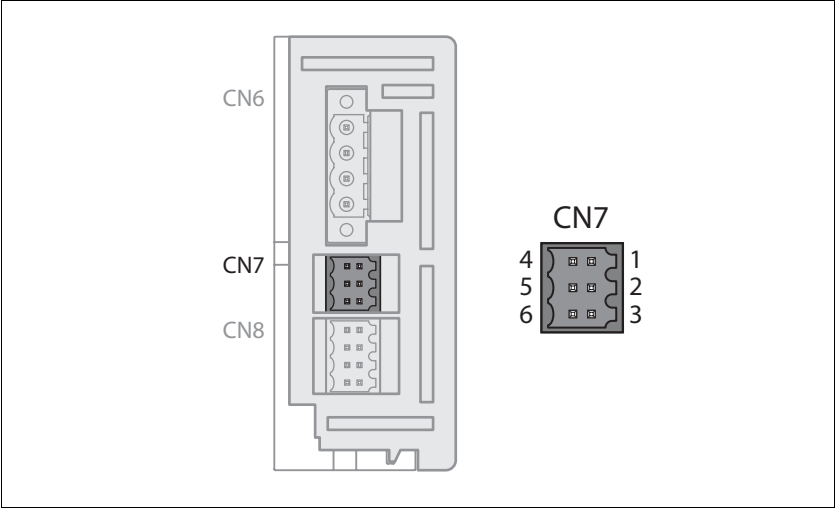


Figure 5.10 Pin assignment hall sensors

Pin	Signal	Meaning	I/O
1	HALL_U	Hall signal	I
2	HALL_V	Hall signal	I
3	HALL_W	Hall signal	I
4	SHLD	Shield connection	
5	HALL_0V	Reference potential to HALL_5VOUT	O
6	HALL_5VOUT	5V _{DC} supply for hall sensors	O

Required counter plug

The connector is available as a component of a connector set. See chapter 12 "Accessories and spare parts".

	Description	Type (Weidmüller)
Hall sensors	Socket B2L , 6-pole in black with tension spring	B2L 3.5/6 SN SW

Fabricating cables

Note the dimensions specified when fabricating cables.

	max. length [m] (shielded)	max. length [m] (unshielded)	Stripped length [mm]	Rigid or flexible cross section [mm ²]
Hall sensor cable	15	3	7	0.2 ... 1

5.4.10 Connection of motor encoder (CN8)

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

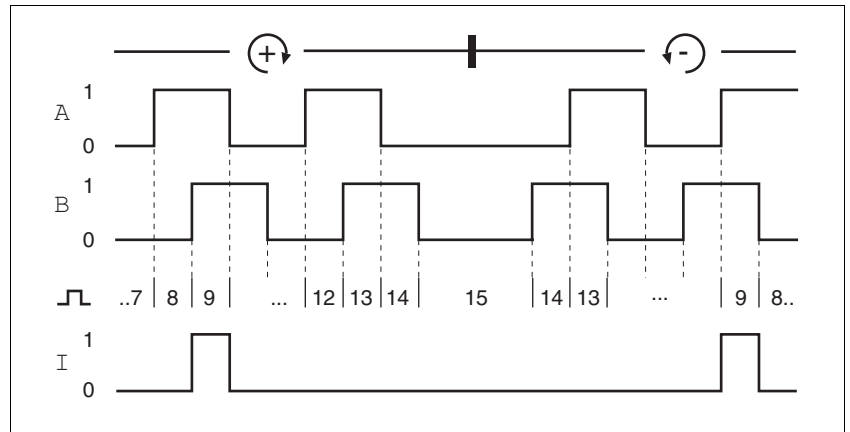


Figure 5.11 Timing diagram with A, B and index pulse signal, counting forwards and backwards

cable specification

- Shielded cable
- Twisted pair lines
- Minimum cross section of the signal wires 0.2 mm²
- Grounding of the shield at both ends
- Maximum cable length 15 m.
- Use equipotential bonding conductors, see page 44.
- Use prefabricated cables to minimize the risk of a wiring errors (from page 363).

Pin assignment

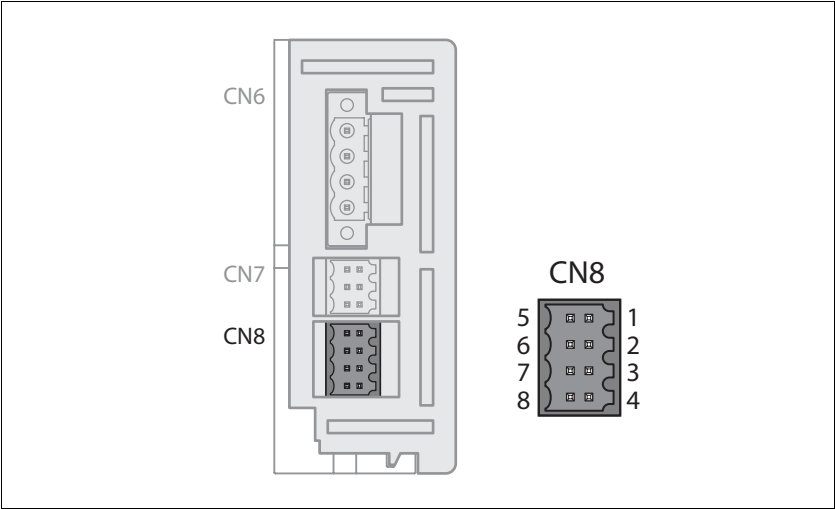


Figure 5.12 Pin assignment of encoder

Pin	Signal	Meaning	I/O
1	ENC_A	Encoder signal channel A	RS422 input signal
2	ENC_B	Encoder signal channel B	RS422 input signal
3	ENC_I	Encoder signal channel I	RS422 input signal
4	ENC_5V	Encoder power supply 5V _{DC}	O
5	$\overline{\text{ENC_A}}$	Channel A, inverted	RS422 input signal
6	$\overline{\text{ENC_B}}$	Channel B, inverted	RS422 input signal
7	$\overline{\text{ENC_I}}$	Channel I, inverted	RS422 input signal
8	ENC_0V	Reference potential to ENC_5V -	

Required counter plug

The connector is available as a component of a connector set. See chapter 12 "Accessories and spare parts".

	Description	Type (Weidmüller)
Encoder	Socket B2L , 8-pole in black with tension spring	B2L 3.5/8 SN SW

Fabricating cables

Note the dimensions specified when fabricating cables.

	max. length [m] (shielded)	max. length [m] (unshielded)	Stripped length [mm]	Rigid or flexible cross section [mm ²]
Encoder cable	15	3	7	0.2 ... 1

Connect the sensor

- Connect the plug at CN8. If you are not using prefabricated wiring, make sure the pin assignment is correct.
- Make the appropriate settings during commissioning. See "First Setup", page 83.

5.5 Checking installation

Check the following items:

- ▶ Are all cables and connectors safely installed and connected?
- ▶ Are any live cables exposed?
- ▶ Are the control lines connected correctly?
- ▶ Are all fuses correct?

6 Commissioning



*For an overview of **all** parameters can be found alphabetically sorted in the "parameters" section. The application and the function of some parameters are explained in more detail in this section.*

6.1 General safety instructions

DANGER

Motor out of view

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

- Only start the system if there are no persons in the operating zone of the moving components and the system can be operated safely.

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

WARNING

Unexpected movement

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

- If possible, run the first test movement without coupled loads.
- Make sure that a functioning button for EMERGENCY STOP is within reach.
- Also anticipate a movement in the incorrect direction or oscillation of the drive.
- Make sure 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.

⚠ WARNING**Unexpected behavior**

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

- Do not operate a drive system with unknown settings or data.
- Check the stored data or settings.
- When commissioning carefully run tests for all operating statuses and fault cases.
- Check 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 materials in the danger zone and the system can be operated safely.

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

⚠ WARNING**Unbraked motor**

In the case of power failure and faults which cause the power amplifier to be switched off, the motor is no longer controlled by the brake and increases its speed even more until it comes to a mechanical stop.

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

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

⚠ WARNING**Falling parts**

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

- Fasten the motor securely to prevent it from breaking loose during strong acceleration.

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

▲ CAUTION**Hot Surfaces**

Depending on the operation the surface may heat up to more than 100°C (212°F).

- Prevent contact with the hot surfaces.
- Do not install flammable or heat-sensitive components in the immediate vicinity.
- Follow the actions described for heat dissipation.
- Check the temperature during the test run.

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

6.2 Overview

This chapter describes the commissioning procedure for the drive.

The following components are required for commissioning:

- EDS file (www.berger-lahr.com/download)
- Commissioning software BLCT (www.berger-lahr.com/download)
- Fieldbus converter for the BLCT commissioning software



The following commissioning steps are also required if you are using a configured unit under changed operating conditions.

What must be done

- Carry out all of the steps below in the given order.

What you need to do...	Page
5.5 "Checking installation"	69
6.4.1 "Setting the device address and baud rate"	82
6.3.2 "BLCT commissioning software"	76
6.4.2 ""First Setup""	83

- Carry out the following steps using the commissioning software.

What you need to do...	Page
6.4.3 "Setting basic parameters and limit values"	90
6.4.4 "Checking the signals of limit switches"	92
6.4.5 "Testing safety functions"	93
6.4.6 "Check direction of rotation"	94

6.3 Tools for commissioning

6.3.1 Overview



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

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

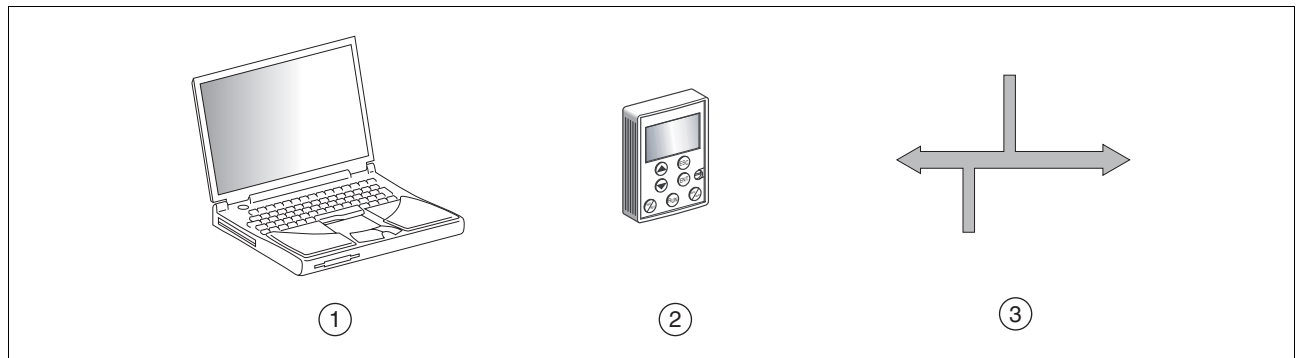


Figure 6.1 Commissioning tools

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

6.3.2 BLCT commissioning software

<i>Features</i>	<p>The commissioning software simplifies commissioning, parameterization, simulation and diagnostics.</p> <p>It provides extensive options such as:</p> <ul style="list-style-type: none">• Graphic interface for parameter setting and status display• Extensive diagnostic tools for optimization and maintenance• Long-time recording to evaluate operating behavior• Testing input and output signals• Tracking signal sequences on the monitor• Archiving all device settings and recordings with export functions for data processing
<i>Requirements</i>	<ul style="list-style-type: none">• Converter for fieldbus connection to PC• Product manual: BLCT commissioning software
<i>Factory setting Modbus</i>	<p>The factory settings set the device to 19200 Baud and the address 247.</p>
<i>Online help</i>	<p>The commissioning software offers comprehensive help functions, which can be accessed via "? - Help Topics" or by pressing F1.</p>
<i>Reference source of commissioning software</i>	<p>The current commissioning software is available for download from the internet.</p> <p>http://www.berger-lahr.com/download</p>

6.3.3 HMI: Human-Machine Interface

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

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

Control panel The following figure shows the remote control panel.

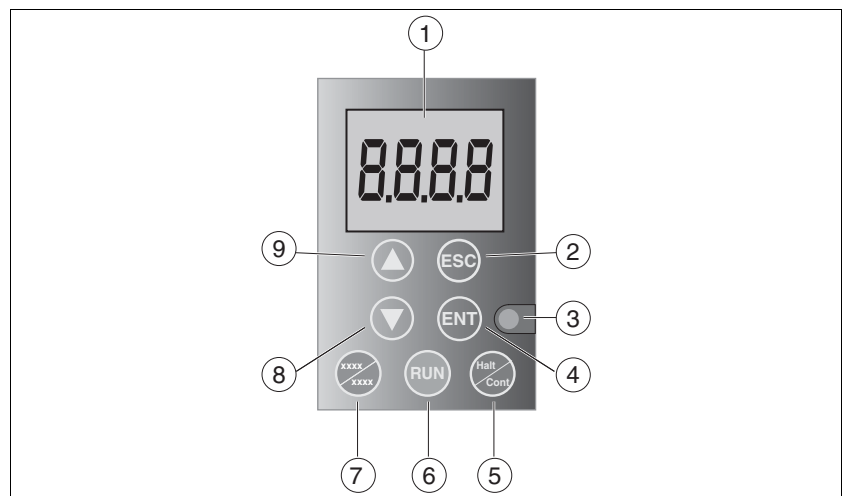


Figure 6.2 Remote control panel

- (1) Status indicator
- (2) ESC:
 - Closing a menu or parameter
 - Return from displayed to last saved value
- (3) Status LEDs
- (4) ENT:
 - Call up a menu or parameter
 - Save the displayed value in the EEPROM
- (5) Quick Stop (Software Stop)
- (6) No function
- (7) No function
- (8) Down arrow:
 - Change to next menu or parameter
 - Reduce the displayed value
- (9) Up arrow:
 - Switch to previous menu or parameter
 - Increase the displayed value

Font on HMI display

The following table shows the assignment of the letters and numbers on the HMI display for the parameter view. Upper and lower case are only distinguished for the letter "C".

O	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
R	b	cC	d	E	F	G	h	i	J	K	L	M	n	o	P	q	r

S	T	U	V	W	X	Y	Z	1	2	3	4	5	6	7	8	9	0
S	t	u	v	w	X	y	Z	1	2	3	4	5	6	7	8	9	0

Calling parameters via HMI

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

Figure 6.3 shows an example of calling a parameter (second level) and input or selection of a parameter value (third level).

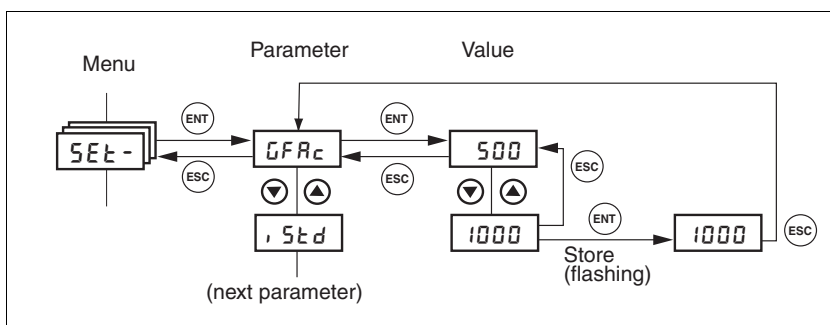


Figure 6.3 HMI, example of parameter setting

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

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

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

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

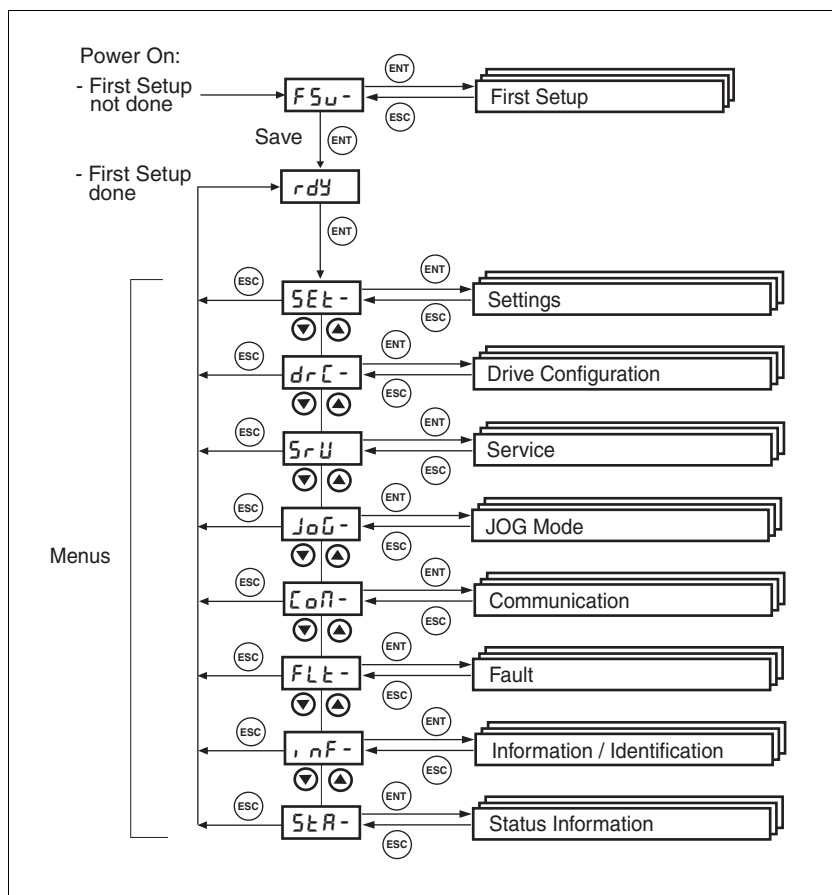


Figure 6.4 HMI menu structure

HMI menu		Description
FSU-	FSU-	First setup (F irst S et U p),
	dEUt	Specification of the control type
	ntYP	Motor selection
	EnCn	Processing of motor encoder position
	ioPi	Signal selection position interface
	io-n	Start-up operating mode for "Local Control Mode"
	CoAd	CANopen address = node number ("field bus" control mode only)
	CoBd	CANopen baud rate ("field bus" control mode only)
	nbAd	Modbus address ("field bus" control mode only)
	nbBd	Modbus baud rate ("field bus" control mode only)
	SRUE	Backing up the settings
SET-	SEt-	Device settings (S ETtings)
	R loF	Offset at analog input ANA1
	R iln	Zero voltage window at analog input ANA1
	R ln5	Scaling ANA1 for setpoint speed at +10V (oscillator mode)
	i Std	Phase current standstill component

HMI menu		Description
	<i>i r nP</i>	Phase current acceleration / deceleration component
	<i>i c nS</i>	Phase current component at constant movement
DRC-	<i>d r C -</i>	Device configuration (DR ive C onfiguration)
	<i>R2 n0</i>	Selection of limitation via ANA2
	<i>R2, n</i>	Scaling for current limiting by ANA2 at +10V
	<i>R2 n n</i>	Scaling for speed limiting by ANA2 at +10V
	<i>i o - n</i>	Start-up operating mode for "local control mode"
	<i>i o RE</i>	Auto. enable at PowerOn if ENABLE input active
	<i>P r o t</i>	Definition of direction of rotation
	<i>F C S</i>	Restore factory settings (default values)
	<i>b t C L</i>	Time delay when setting the brake
	<i>b t r E</i>	Time delay when opening or releasing the brake
	<i>S u P U</i>	HMI display if motor rotating
	<i>n t Y P</i>	Motor selection
	<i>S E n S</i>	Selection hall sensor / motor encoder
SRV-	<i>S r U -</i>	S ervice department
	<i>b r R H</i>	Opening / releasing the brake (requirement: amplifier supply is shut off)
JOG-	<i>J o G -</i>	Jog (JOG Mode)
	<i>S t r t</i>	Start jog
	<i>n S L L</i>	Speed for slow jog
	<i>n F S t</i>	Speed for fast jog
COM-	<i>C o n -</i>	Communication (COM munication)
	<i>C o R d</i>	CANopen address = node number ("fieldbus" control mode only)
	<i>C o b d</i>	CANopen baud rate ("fieldbus" control mode only)
	<i>P b R d</i>	Profibus address
	<i>n b R d</i>	Modbus address ("fieldbus" control mode and commissioning software)
	<i>n b F o</i>	Modbus data format ("fieldbus" control mode and commissioning software)
	<i>n b b d</i>	Modbus baud rate ("fieldbus" control mode and commissioning software)
	<i>n b L o</i>	Modbus word sequence for double words (32 bit values) ("fieldbus" control mode and commissioning software)
FLT-	<i>F L t -</i>	Error display (FauLT)
	<i>S t P F</i>	Error number of last stop fault
INF-	<i>i n F -</i>	Information/identification (INF ormation / Identification)
	<i>d E U C</i>	Current selection of control mode
	<i>- n R n</i>	Product Name
	<i>- P n r</i>	Program number firmware
	<i>- P U r</i>	Version number firmware
	<i>P o L o</i>	Number of power on cycles
	<i>P i n o</i>	Nominal current of power amplifier
	<i>n i n o</i>	Motor nominal current
	<i>n i n R</i>	Maximum motor current

HMI menu	Description
STA-	Observation/monitoring of device, motor and travel data (STA tus Information)
StR-	Status of digital inputs and outputs
IRL	Voltage value analog input ANA1
nRct	Actual motor speed
PRCw	Actual motor position in user units
Pd, F	Current deviation between reference and actual positions
IRct	Total motor current
udCR	DC bus voltage of the power amplifier supply voltage
tdEU	Device temperature
tPR	Power amplifier temperature
wrnS	Saved warnings, bit-coded
St, GS	Saved status of monitoring signals
oPh	Operating hours counter
I-O-	Configurable inputs/outputs (In Out)
L, 1	Function digital input LI1
L, 2	Function digital input LI2
L, 4	Function digital input LI4
oL, 1	Function digital input XLI1
oL, 2	Function digital input XLI2
oL, 3	Function digital input XLI3
oL, 4	Function digital input XLI4
oL, 5	Function digital input XLI5
oL, 6	Function digital input XLI6
Lo 1	Function digital output LO1_OUT
Lo2	Function digital output LO2_OUT
oLo 1	Function digital output XLO1_OUT
oLo2	Function digital output XLO2_OUT

Status display The status display in its default setting shows the current operating status, see page 109. You can specify the following with the menu item *dr c - / StPU*:

- **StRct** shows the current operating status by default
- **nRct** shows the current motor speed by default
- **IRct** shows the current motor current by default

A change is only imported with the power amplifier disabled.

6.4 Commissioning procedure

⚠ WARNING

Unsuitable parameter values

If unsuitable parameter values are used, safety functions may fail, unexpected movements or responses to signals may occur.

- Prepare a list with the parameters required for the functions in use.
- Check the parameters before operation.
- Only start the system if there are no persons or materials in the danger zone and the system can be operated safely.

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

6.4.1 Setting the device address and baud rate

Setting baud rate The baud rate is set with parameter switch S1.

- ▶ Switch off all power supplies. Make sure that power is no longer connected (safety instructions).
- ▶ Use parameter switches S1.1 to S1.3 to set the baud rate.

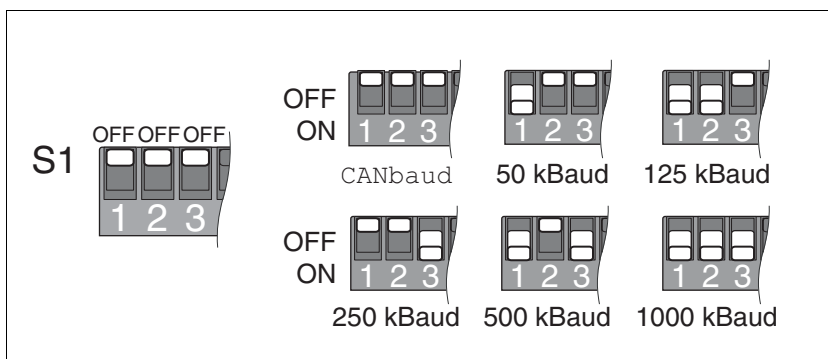


Figure 6.5 Parameter switch S1

With a switch setting of 01 ... 06 the selected switch setting corresponds with the baud rate.

With the switch setting 0, the baud rate will be set through the commissioning software.

Address setting Every device in the network is identified by a unique node address which can be set as desired.

The following diagram shows the factory setting for the device address.

- ▶ Switch off all power supplies. Make sure that power is no longer connected (safety instructions).
- ▶ Use parameter switches S2 and S3 to set the address.

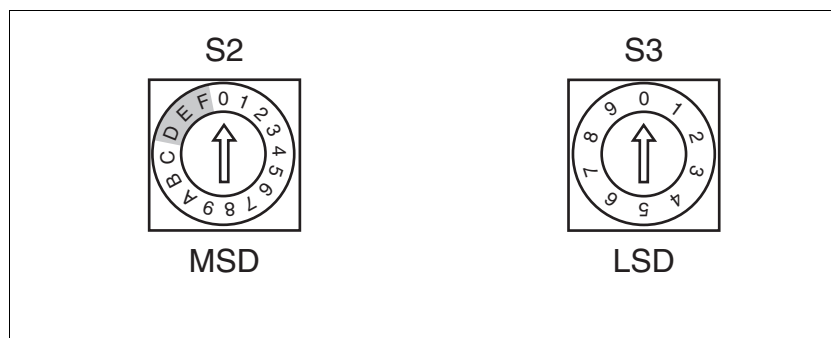


Figure 6.6 Rotary switch assignment

- (S2) MSD (most significant digit)
Determines the 10 position of the node address
- (S3) LSD (least significant digit)
Determines the 1 position of the node address

Example Parameter switch S2 = B
Parameter switch S3 = 8
Results in an address setting of 118.

With a switch setting of 01 ... 127, the selected switch setting corresponds with the address.

With switch setting 0, the address setting is made through the `CANadr` parameter.

Factory setting The factory setting for the device address is 0 in the parameter. It is read out with switch setting 0. To operate the device, either the switch setting or the `CANadr` parameter must be changes. This is to prevent that 2 devices have the same device address in the network.

6.4.2 "First Setup"

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

- Preparation**
- A PC with the commissioning software must be connected to the unit unless the commissioning is conducted exclusively through the HMI.
 - ▶ During commissioning disconnect the connection to the fieldbus to avoid conflicts caused by simultaneous access.
 - ▶ Switch on the controller power supply.

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

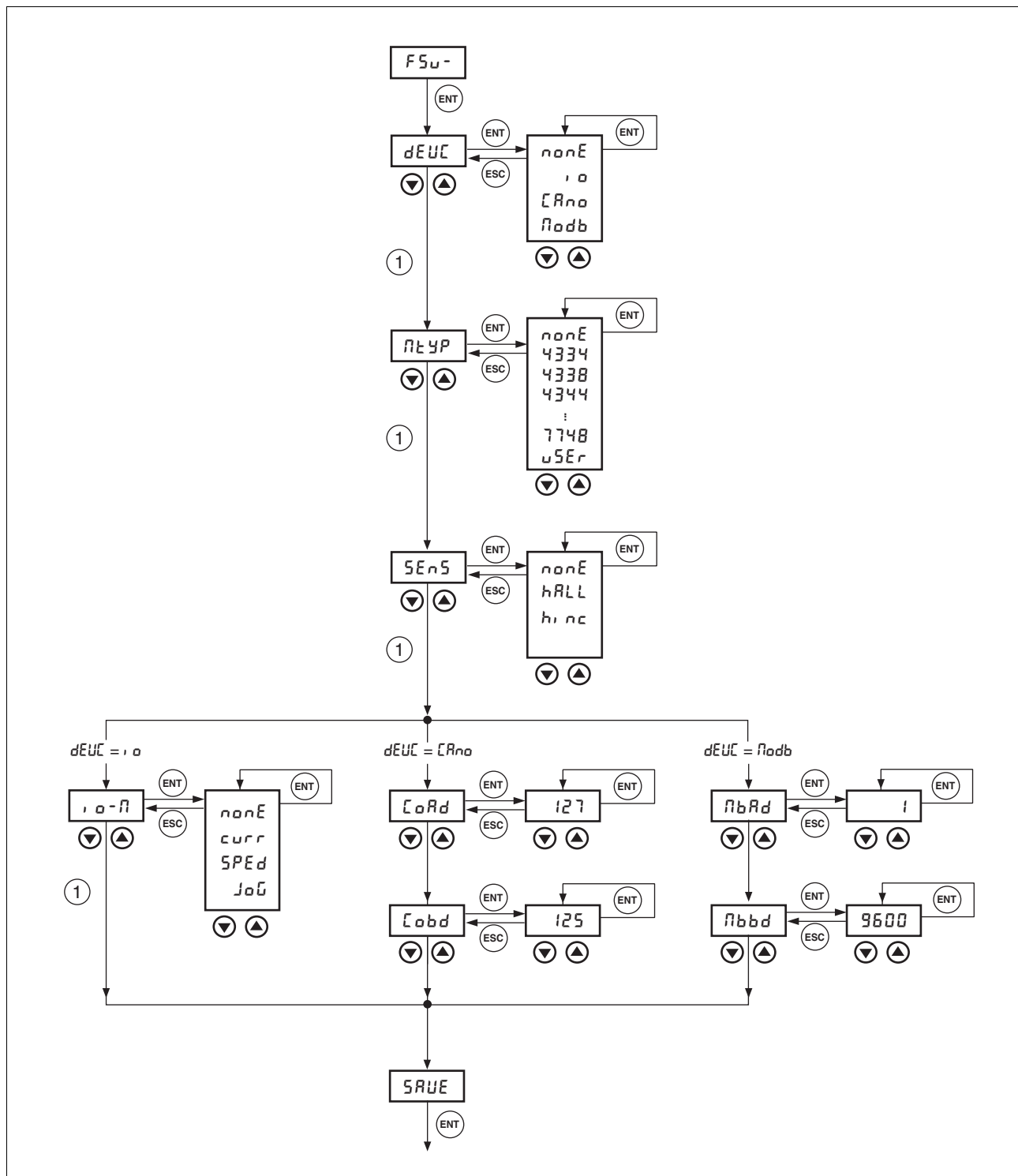


Figure 6.7 "First Setup" via HMI

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

Unit controller ► Specify how the unit will be controlled with the parameter DEVcmdinterf (*dEUE*).

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
DEVcmdinterf	Specification of the control mode	-	UINT16	CANopen 3005:1 _h
-- DEVC	0 / none / none : Undefined	0	UINT16	Modbus 1282
-- dEUE	1 / IODevice / io : Local control type	0	R/W	
	2 / CANopenDevice / CANopen	3	per.	
	3 / ModbusDevice / Modbus		-	
	IMPORTANT: Changed settings do not become active until the unit is switched on the next time (exception: change of value 0, for "Initial settings").			

Motor type ► Specify the motor that is connected to the device with the M_Type parameter (*MEYP*).

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

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

M_Sensor, M_n_max, M_n_nom, M_I_max, M_I_nom, M_U_nom, M_R_UV, M_I2t, M_I_0, M_Polepair, M_SenssLine, M_hallshift, M_hallpos, M_currcomp, M_kE_EC and M_L_q_EC.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
M_Type	Motor type	-	UINT32	CANopen 300D:2 _h
DRC- - MTYP	0 / none / none : No motor selected (default)	-	UINT32	Modbus 3332
drc - - mtyp	4334 / RECM343/3 24V / 4334 : RECM343/3 24V	-	R/-	
	4338 / RECM343/3 48V / 4338 : RECM343/3 48V	-	-	
	4344 / RECM343/4 24V / 4344 : RECM343/4 24V			
	4348 / RECM343/4 48V / 4348 : RECM343/4 48V			
	4534 / RECM345/3 24V / 4534 : RECM345/3 24V			
	4538 / RECM345/3 48V / 4538 : RECM345/3 48V			
	4544 / RECM345/4 24V / 4544 : RECM345/4 24V			
	4548 / RECM348/4 48V / 4548 : RECM345/4 48V			
	7224 / RECM372/2 24V / 7224 : RECM372/2 24V			
	7228 / RECM372/2 48V / 7228 : RECM372/2 48V			
	7244 / RECM372/4 24V / 7244 : RECM372/4 24V			
	7248 / RECM372/4 48V / 7248 : RECM372/4 48V			
	7424 / RECM374/2 24V / 7424 : RECM374/2 24V			
	7428 / RECM374/2 48V / 7428 : RECM374/2 48V			
	7444 / RECM374/4 24V / 7444 : RECM374/4 24V			
	7448 / RECM374/4 48V / 7448 : RECM374/4 48V			
	7528 / RECM375/2 48V / 7528 : RECM375/2 48V			
	7548 / RECM375/4 48V / 7548 : RECM375/4 48V			
	7728 / RECM377/2 48V / 7728 : RECM377/2 48V			
	7748 / RECM377/4 48V / 7748 : RECM377/4 48V			
	99999999 / user defined motor / user : User-defined			
	<p>After selection of a motor type from the list, the motor-specific parameters are automatically set.</p> <p>When you select 'user-defined', you must set the motor-specific parameters via the commissioning software or the fieldbus.</p>			

Hall sensor / motor encoder ► Specify whether a motor encoder is connected to the device and what its function will be with the `M_Sensor` parameter (5E75).

If a motor encoder is not connected, select `none`. If `hALL` or `hINC` is selected, a sensor must be connected for trouble-free operation.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
M_Sensor	Motor encoder type	-	UINT16	CANopen 300D:3h
DRC- - SENS	0 / unknown / none : Unknown	-	UINT16	Modbus 3334
drc- - 5E75	16 / Hallsensor / hALL : Hall signals	0	R/-	
	17 / Hall and Incremental / hINC : Hall and increment signals	-	-	

Start-up operating mode ■ DEVcmdinterf = IODevice
(dEUL = 10)

► Use the `IOdefaultMode` parameter (10-11) to set the operating mode that is to enable the device every time it is started.

The operating modes are described from section 7.5 "Operating modes".

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOdefaultMode	Start-up operating mode for 'Local control mode'	-	UINT16	CANopen 3005:3h
DRC- - io-M		0	UINT16	Modbus 1286
drc- - 10-11	0 / none / none : None	0	R/W	
	1 / CurrentControl / Curr : Current control (reference value from ANA1)	6	per.	
	2 / SpeedControl / SPED : Speed control (reference value from ANA1)		-	
	5 / Jog / Jog : Jog			
	6 / MotionSequence / MotS : Motion sequence			
	IMPORTANT: The operating mode is automatically activated as soon as the drive switches to the status 'OperationEnable' and 'IODevice / IO' is set in DEVcmdinterf.			

Baud rate and address using parameter

■ DEVcmdinerf = CANopenDevice

Parameter switch S1 = 0

Parameter switch S3 and S3 = 0

- Specify the node address with the CANadr parameter and the baud rate with the CANbaud parameter.



Every device must have its own unique node address, which must be assigned only once in the network.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CANadr	CANopen address (node number)	-	UINT16	CANopen 3017:2 _h
COM- - CoAD	Valid addresses (node numbers): 1 to 127	1	UINT16	Modbus 5892
CoA- - CoAd	Read access: Rotary switch (NodeID) = 0: NodeID = Parameter value Rotary switch (NodeID) = >0: NodeID = Value from rotary switch IMPORTANT: Changed settings do not become active until the unit is switched on the next time or until after an NMT reset.	127 127	R/W per. -	
CANbaud	CANopen Baud rate	-	UINT16	CANopen 3017:3 _h
COM- - CoBD	50 / 50KB / 50: 50 Kbaud 125 / 125KB / 125: 125 Kbaud 250 / 250KB / 250: 250 Kbaud 500 / 500KB / 500: 500 Kbaud 1000 / 1MB / 1000: 1 Mbaud	50 125 1000	UINT16 R/W per. -	Modbus 5894
CoB- - CoBd	Read access: Rotary switch (Baud) = 0 -> Baud rate = value of user parameter Rotary switch (Baud) >0 -> Baud rate = value selected via rotary switch IMPORTANT: Changed settings do not become active until the unit is switched on the next time			

Fieldbus Modbus

■ DEVcmdinerf = ModbusDevice
(dEUE = Modb)

- Specify the node address with the MBadr parameter (MbAd) and the baud rate with the MBbaud parameter (MbBd).

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MBadr	Modbus address	-	UINT16	CANopen 3016:4 _h
COM- - MBAD	Valid addresses: 1 to 247	1	UINT16	Modbus 5640
Com - MbAd		247	R/W per.	-
MBbaud	Modbus Baud rate	-	UINT16	CANopen 3016:3 _h
COM- - MBBD	9600 / 9.6KB / 96 : 9600 Baud	9600	UINT16	Modbus 5638
Com - MbBd	19200 / 19.2KB / 192 : 19200 Baud	19200	R/W	
	38400 / 38.4KB / 384 : 38400 Baud	38400	per.	-
	IMPORTANT: Changed settings do not become active until the unit is switched on the next time			

*Data back-up***⚠ CAUTION****Damage to the product from failure of the supply voltage**

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

- Never switch off supply voltage during the update.
- Always carry out the update with a reliable supply voltage.

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

- Back up all inputs on completion.
Commissioning software: Save your settings with the menu path "Configuration - Save in EEPROM"

◁ The device will save all settings in the EEPROM.

A restart of the device is required to allow the changes to be accepted.

Further steps

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

Note that you can only return to the "First Setup" by restoring the factory settings, see 7.6.9.2 "Restore factory settings" page 201.

6.4.3 Setting basic parameters and limit values

⚠ WARNING

Unexpected behavior

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

- Do not operate a drive system with unknown settings or data.
- Check the stored data or settings.
- When commissioning carefully run tests for all operating statuses and fault cases.
- Check 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 materials in the danger zone and the system can be operated safely.

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



Prepare a list with the parameters required for the functions in use.

Setting thresholds

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

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

Current limiting

To protect the drive system, the maximum current flowing can be modified with the `CTRL_I_max` parameter. The maximum current for the "Quick Stop" function can be limited with the `LIM_I_maxQSTP` parameter and for the "Halt" function with the `LIM_I_maxHalt` parameter.

In operating modes with profile generator, acceleration and delay are limited through ramp functions.

- ▶ Specify the maximum motor current with the `CTRL_I_max` parameter.
- ▶ Specify the maximum current for the "Quick Stop" function with the `LIM_I_maxQSTP` parameter.
- ▶ Specify the maximum current for the "Halt" function with the `LIM_I_maxHalt`.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_I_max	Current limitation	A _{pk}	UINT16	CANopen 3012:1 _h
SET- - iMAX	The value must not exceed the maximum permissible current of the motor or the power amplifier.	0.00	UINT16	Modbus 4610
SEt - - , nRH		-	R/W	
	Default: the smaller value of M_I_max and PA_I_max	299.99	per.	-
LIM_I_maxQSTP	Current limitation for Quick Stop	A _{pk}	UINT16	CANopen 3011:5 _h
SET- - LiQS	Max. current during braking via torque ramp due to an error of error classes 1 or 2 and when a software stop is triggered.	-	UINT16	Modbus 4362
SEt - - L, 95		-	R/W	
	Maximum and default settings depend on the motor and the power amplifier (settings M_I_max and PA_I_max)	-	per.	-
	In increments of 0.01A _{pk}			
LIM_I_maxHalt	Current limitation for Halt	A _{pk}	UINT16	CANopen 3011:6 _h
SET- - LihA	Max. current during braking after Halt or when an operating mode is terminated.	-	UINT16	Modbus 4364
SEt - - L, hR		-	R/W	
	Maximum and default settings depend on the motor and the power amplifier (settings M_I_max and PA_I_max)	-	per.	-
	In increments of 0.01A _{pk}			

Speed limitation The maximum speed can be limited with the parameter CTRL_n_max to protect the drive system.

- Specify the maximum motor speed with the parameter CTRL_n_max.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_n_max	Speed limitation	1/min	UINT16	CANopen 3012:2 _h
SET- - NMAX	The set value must not exceed the maximum motor speed.	0	UINT16	Modbus 4612
SEt - - nRH		-	R/W	
	Default: maximum motor speed (see M_n_max)	13200	per.	-

6.4.4 Checking the signals of limit switches

⚠ CAUTION**Loss of control**

The use of $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$ can offer some protection against dangers (e.g. impact on mechanical stop caused by incorrect movement targets).

- Use $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$ where possible.
- Check that the external sensors or switches are correctly connected.
- Check the correct functional installation of the limit switch. The limit switches must be mounted in a position far enough away from the mechanical stop to allow an adequate braking distance.
- The functions must be enabled to use $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$.
- This function cannot provide protection against faulty functioning of the product or the sensors.

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

- You must have configured functions "Negative limit switch (LIMN)" and "Positive limit switch (LIMP)", see chapter 7.6.7 "Configurable inputs and outputs".
- ▶ Set up the limit switches so the drive cannot traverse through the limit switch.
- ▶ Trigger the limit switches manually.
- ◁ The commissioning software displays an error status with a limit switch.

You can change the release of the limit switches and the evaluation to active 0 or active 1 using the parameters of the same name see chapter 7.6.1 "Monitoring functions".



Use the active 0 monitoring signals if possible, because they are proof against wire break.

6.4.5 Testing safety functions

Operation with STO You must perform the following steps if you want to use the "Safe Torque Of" STO safety function.

- Supply voltage switched off.
- ▶ Check that the inputs $\overline{\text{STO_A}}$ and $\overline{\text{STO_B}}$ are electrically isolated from each other. The two signals must not be electrically connected.
- Supply voltage switched on.
- ▶ Activate the power amplifier (without motor movement).
- ▶ Trigger the safety disconnection. $\overline{\text{STO_A}}$ and $\overline{\text{STO_B}}$ must be disconnected simultaneously (skew <1s).
- ◁ The power amplifier is deactivated and error message 1300 is displayed. (ATTENTION: Error message 1301 displays a wiring error.)
- ▶ Check that the `IO_AutoEnable` parameter is set to "off" to prevent unexpected restart.
- ▶ Check the behavior of the drive in error states.
- ▶ Record all tests of the safety function in the acceptance record.

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

- ▶ The signal inputs must be bridged to $24V_{DC}$. See 8.1 "Wiring examples".

6.4.6 Check direction of rotation

Direction of rotation Rotation of the motor shaft in a positive or negative direction of rotation. A positive direction of rotation is defined as the motor shaft rotating clockwise as the observer faces the end of the protruding shaft.

- ▶ Start the jog operating mode.
- ▶ Start a movement in clockwise rotation.
- ◁ The motor rotates in clockwise rotation.
- ▶ Start a movement in counterclockwise rotation.
- ◁ The motor rotates in counterclockwise rotation.
- ▶ If the arrow and direction of rotation do not match, correct this with the `POSdirOfRotat` parameter, see chapter 7.6.8 "Reversal of direction of rotation".

6.4.7 Controller optimization with step response

6.4.7.1 Controller structure

The controller structure corresponds to the classical cascade control of a closed positioning loop with current controller, speed controller and position controller. The reference value of the speed controller can also be smoothed by an upstream filter.

The controllers are set from "inside" to "outside" in the sequence current, speed and position controller. The higher-level control loop in each case stays switched out.

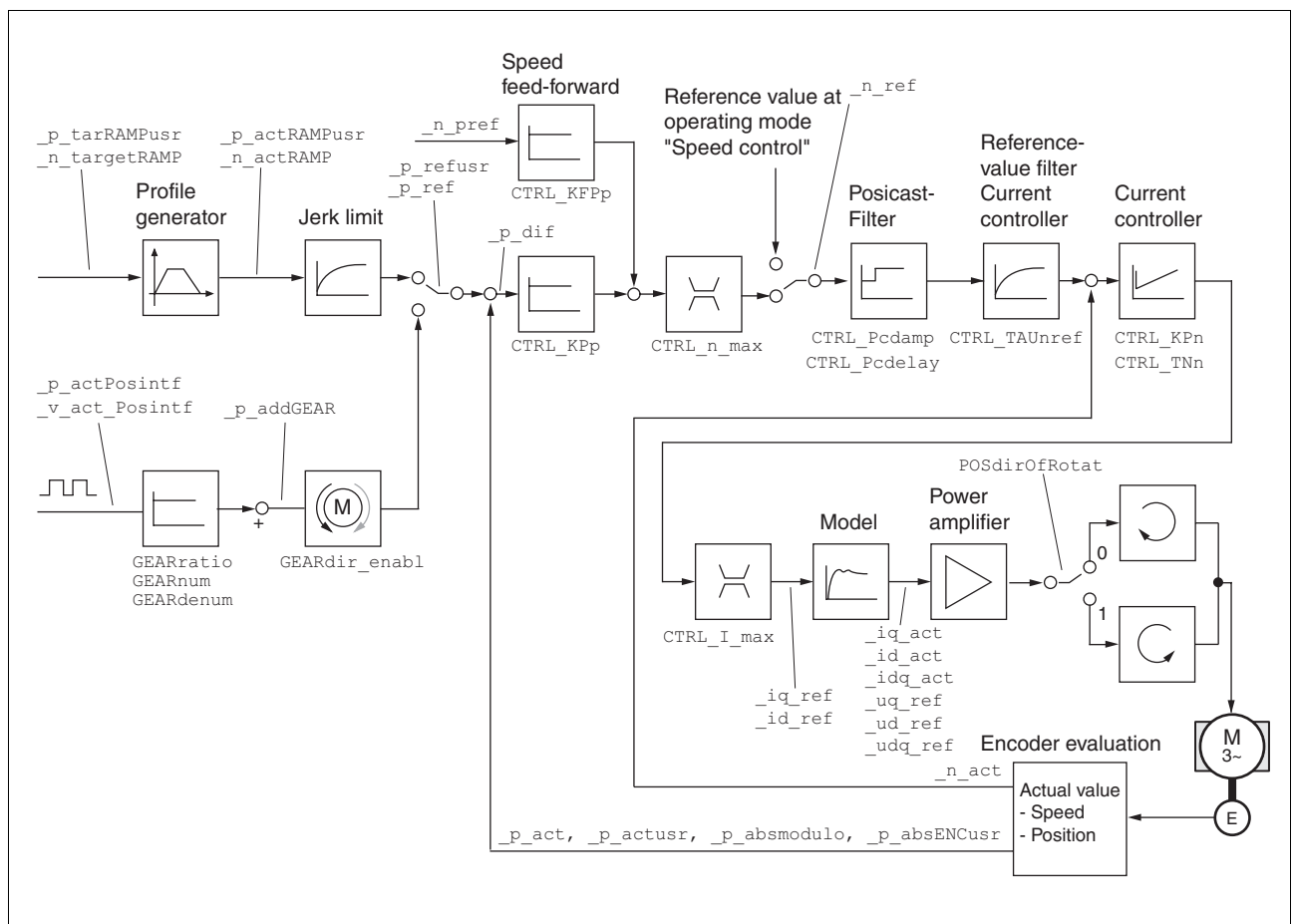


Figure 6.8 Controller structure

Current controller

The motor's drive torque is determined by the current controller. The current controller has been optimized automatically using the stored motor data.

Speed controller The speed controller maintains the required motor speed by varying the output motor torque depending on the load situation. It exerts a decisive influence on the speed with which the drive reacts. The dynamics of the speed controller depend on

- the moments of inertia of the drive and the control distance
- the torque of the motor
- the stiffness and elasticity of the components in the power flow
- the backlash of the mechanical drive components
- the friction

Position controller The closed positioning loop reduces the difference between setpoint and actual motor position (tracking error) to a minimum. At motor standstill the tracking error is virtually zero with a well-adjusted closed positioning loop. A speed-dependent tracking error occurs in movement mode.

The reference position for the closed positioning loop is generated by the internal motion profile generator during the profile position, profile velocity, homing and jog operating modes.

In the electronic gear operating mode the setpoint position for the closed positioning loop is generated by external A/B or pulse/direction input signals.

A requirement for good amplification of the closed positioning loop is an optimized speed control loop.

6.4.7.2 Optimization

The drive optimization function matches the unit to the operating conditions. The following options are available:

- Selecting control loops. Higher level control loops are automatically disconnected.
- Defining reference signal: signal form, height, frequency and starting point
- Testing control response with the signal generator.
- Recording and assessing the control behavior on the monitor with the commissioning software.

Setting reference signals

- ▶ Start controller optimization with the commissioning software using the menu path "Functions - Recording/optimization...".
- ▶ Switch to the "Tune" tab.
- ▶ Set the following values for the reference signal:
 - Amplitude: 100 rpm 1/min
 - Period: 100 ms
 - Signal: positive jump
 - Number of repetitions: 1
- ▶ Also note additional settings in the "Display - Specific Displays" menu.



The total dynamic behavior of a control loop can be only understood with the signal forms 'Jump' and 'Square wave'. Refer to the manual for all signal paths for the signal form 'Jump'.

Inputting controller values

Control parameters must also be input for the individual optimization steps described over the following pages. These parameters must be tested by initiating a jump function.

A jump function is triggered as soon as a recording is started in the commissioning software tool bar with the "Start" button (arrow icon).

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

6.4.7.3 Optimising the speed controller

The optimum setting for complex mechanical control systems requires practical experience with setting and adjustment procedures for control equipment. This includes the ability to calculate control parameters and to apply identification procedures.

Less complex mechanical systems can generally be successfully optimized with the experimental adjustment procedure using the aperiodic limiting case method. Here the following two parameters are set:

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_KPn	Speed controller P-term	A/(1/min)	UINT16	CANopen 3012:3 _h
-	The default value is calculated on the basis	0.0001	UINT16	Modbus 4614
-	of the motor parameters.	-	R/W	
		1.2700	per.	
			-	
CTRL_TNn	Speed controller setting time	ms	UINT16	CANopen 3012:4 _h
-		0.00	UINT16	Modbus 4616
-		9.00	R/W	
-		327.67	per.	
			-	

Check and optimize the calculated values in a second step, as described from page 102.

Determining the mechanics of the system

Decide which one of the following two systems fits the mechanics of your set-up to assess and optimize its transient response behavior.

- System with rigid mechanism
- System with less rigid mechanism

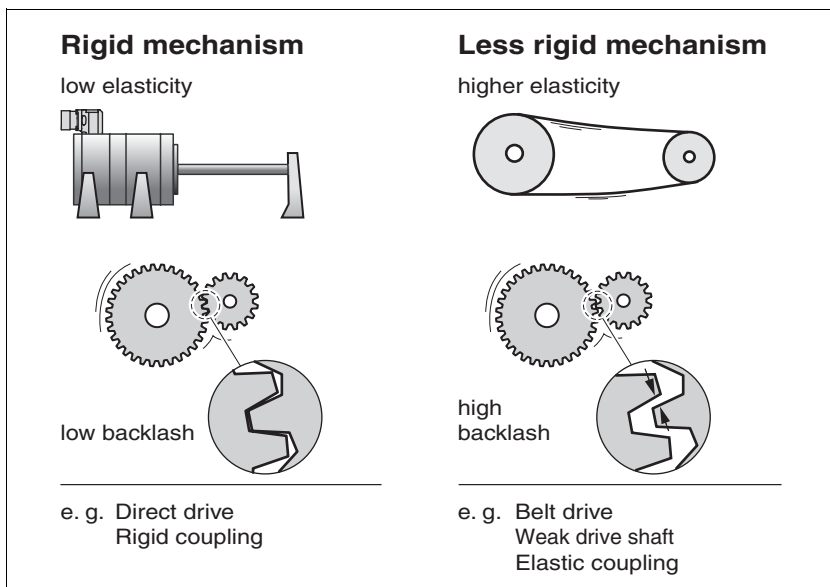


Figure 6.9 Mechanical systems with rigid and less rigid mechanisms

- Connect the motor to your system's mechanism.
- Test the limit switch function after installing the motor if limit switches are used.

Switch off reference value filter of speed controller

With the reference variable filter you can improve the response behavior under optimized speed control. The reference value filter must be switched off when setting the speed controller for the first time.

- Disable the reference value filter of the speed controller. Set the parameter CTRL_TAUUnref to the bottom limit value "0".

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_TAUUnref	Filter time constant ref.value filter of the ref. speed value	ms 0.00 9.00 327.67	UINT16 UINT16 R/W per. -	CANopen 3012:9 _h Modbus 4626
-				
-				



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

Determining controller values with rigid mechanics

Requirements for setting the control behavior as per the table are:

- a known and constant inertia of load and motor
- a rigid mechanism

The P-factor $CTRL_KPn$ and the correction time $CTRL_TNn$ depend on:

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

► Determine the controller values based on Table 6.1:

$J_L [kgcm^2]$	$J_L = J_M$		$J_L = 5 * J_M$		$J_L = 10 * J_M$	
	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 6.1 Determining controller values

Determining controller values with less rigid mechanics

For optimization purposes the P-factor of the speed controller at which the controller adjusts the speed `_n_act` as quickly as possible without overshooting is determined.

- Set the correction time `CTRL_TNn` to infinite.
`CTRL_TNn = 327.67 ms.`

If a load torque is acting on the stationary motor, the correction time must be set just high enough to prevent an uncontrolled change of the motor position.



In drive systems in which the motor is loaded while stationary, e.g. with vertical axis operation, the correction time "infinite" may result in unwanted position deviations, thereby requiring the value to be reduced. However, this can adversely affect optimization results.

⚠ WARNING

Unexpected movement

The step function moves the motor in speed mode at constant speed until the specified time has expired.

- Check that the selected values for speed and time do not exceed the available travel.
- If possible, use limit switches or stop as well.
- Make sure that a functioning button for EMERGENCY STOP is within reach.
- Make sure 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 jump function.
- After the first test check the maximum amplitude for the current setpoint `_Iq_ref`.

Set the amplitude of the reference value – default was 100 rpm – just high enough so the current setpoint `_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 mechanism will determine control loop response.

- Trigger a jump function again if you need to modify `_n_ref` and check the amplitude of `_Iq_ref`.
- Increase or decrease the P-factor in small steps until `_n_act` adjusts as fast as possible. The following diagram shows the adjustment response required on the left. Overshooting - as shown on the right - is reduced by reducing `CTRL_KPn`.

Deviations from `_n_ref` and `_n_act` result from setting `CTRL_TNn` to "infinite".

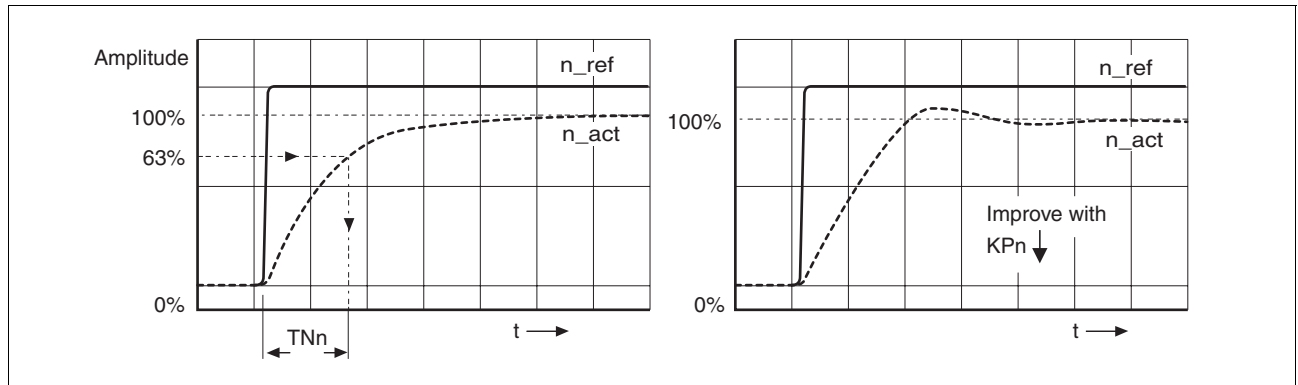


Figure 6.10 Determining 'TNn' in the aperiodic limiting case



For drive systems in which oscillations occur before the aperiodic limiting case is reached, the P-factor "KPn" must be reduced to the exact point where oscillations can no longer be detected. This occurs frequently with linear axes with a toothed belt drive.

Graphic determination of the 63% value

Determine graphically the point at which the actual speed n_{act} reaches 63% of the final value. The correction time $CTRL_TNn$ is then shown as a value on the time axis. The commissioning software will help you with the evaluation:

Malfunctions during optimization

High-frequency resonance in mechanical components may interfere with controller optimization. The values for $CTRL_KPn$ and $CTRL_TNn$ cannot be set satisfactorily if this occurs.

6.4.7.4 Checking and optimising default settings

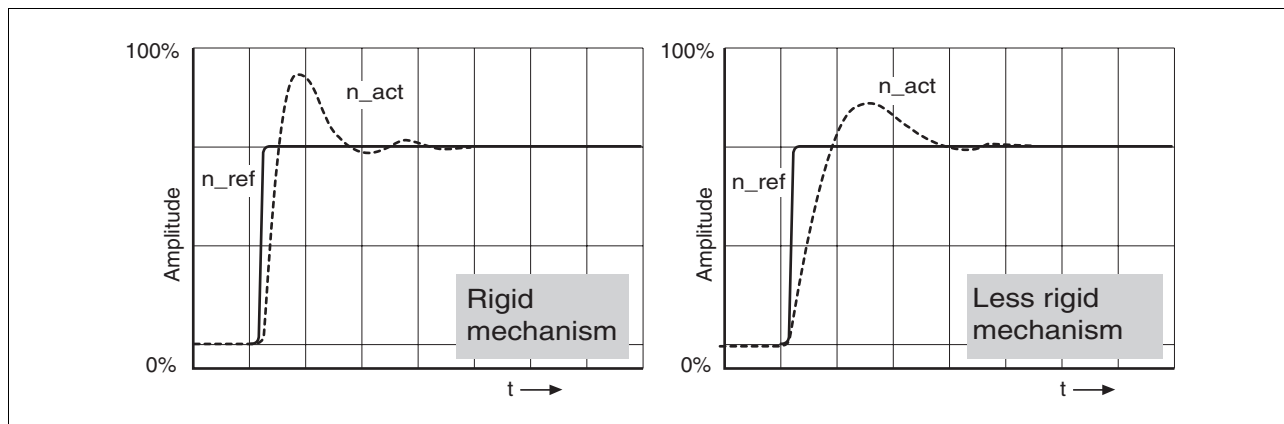


Figure 6.11 Step responses with good control behavior

The controller is properly set when the jump response is approximately identical to the signal path shown. Good control response can be recognized by

- Fast adjustment
- Overshooting up to a maximum of 40% - 20% is recommended.

If the control response does not correspond to the curve shown, change CTRL_KPn' in steps of about 10% and then initiate a jump function once again:

- If the controller is too slow: select CTRL_KPn greater.
- If the controller tends to oscillate: select CTRL_KPn smaller.

You can recognize an oscillation by the motor continuously accelerating and decelerating.

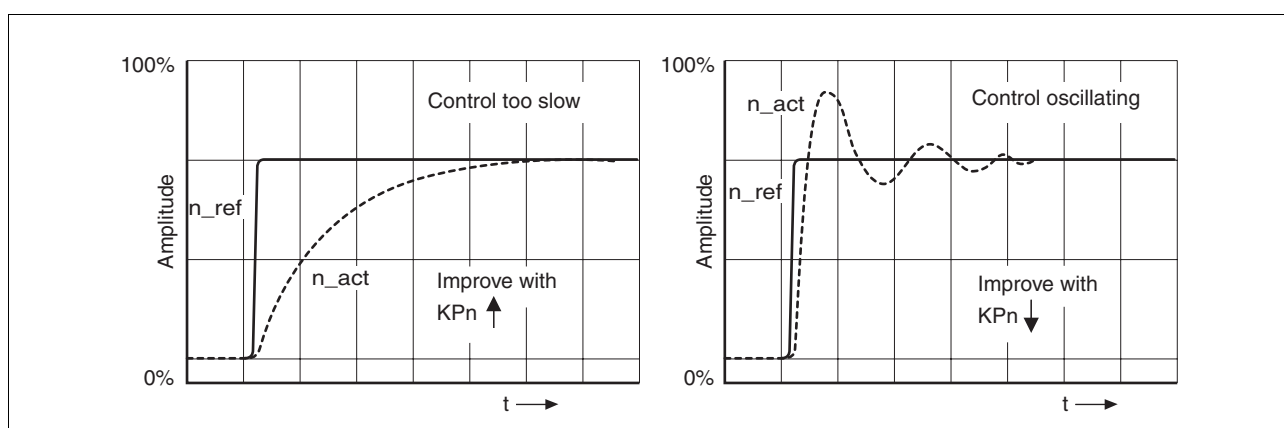


Figure 6.12 Optimize inadequate settings of the speed controller



If you cannot achieve sufficiently satisfactory controller properties in spite of optimization, contact your local dealer.

6.4.7.5 Optimising the position controller

Optimization requires a good control response in the lower-ranking speed control circuit.

When setting the position control the P-factor of the position controller CTRL_KPp must be optimized in two limits:

- CTRL_KPp too great: overshooting of the mechanism, instability of the controller
- CTRL_KPp too small: Large following error

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_KPp	Position controller P-term	1/s	UINT16	CANopen 3012:6h
-	The default value is calculated.	2.0	UINT16	Modbus 4620
-		-	R/W	
-		495.0	per.	
-			-	

⚠ WARNING

Unexpected movement

The step function moves the motor in speed mode at constant speed until the specified time has expired.

- Check that the selected values for speed and time do not exceed the available travel.
- If possible, use limit switches or stop as well.
- Make sure that a functioning button for EMERGENCY STOP is within reach.
- Make sure 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 signal

- ▶ Select the position controller reference value in the commissioning software.
- ▶ Set the reference signal:
 - Signal form: 'Jump'
 - Set amplitude for about 1/10 motor revolution.

The amplitude is input in user-defined units. At default scaling the resolution is 16384 usr per motor revolution.

Selecting recording signals

► Select the values in General Recording Parameters:

- Setpoint of the position controller `_p_refusr` (`_p_ref`)
- Actual position of the position controller `_p_actusr` (`_p_act`)
- actual speed `_n_act`
- current motor current `_Iq_ref`

Controller values for the position controller can be changed in the same parameter group used for the speed controller.

Optimizing the position control value

- Start a jump function with the default controller values.
- After the first test check the achieved values `_n_act` and `_Iq_ref` for current and speed control. The values must not cross into the range of current and speed limiting.

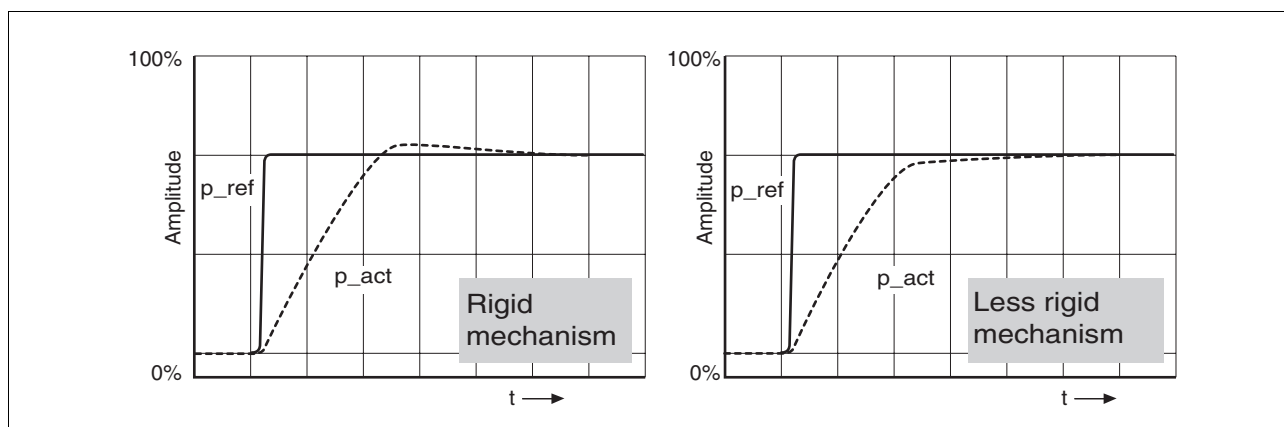


Figure 6.13 Step responses of a position controller with a good control behavior

The proportional factor `CTRL_KPp` is at its optimum setting when the motor reaches its target position rapidly and with little or no overshooting.

If the control behavior does not correspond to the curve shown, change the P-factor `CTRL_KPp` in steps of about 10% and then initiate a jump function once again.

- If the closed-loop control tends to oscillate: select `CTRL_KPp` smaller.
- If the actual value is too slow following the reference value: select `CTRL_KPp` larger.

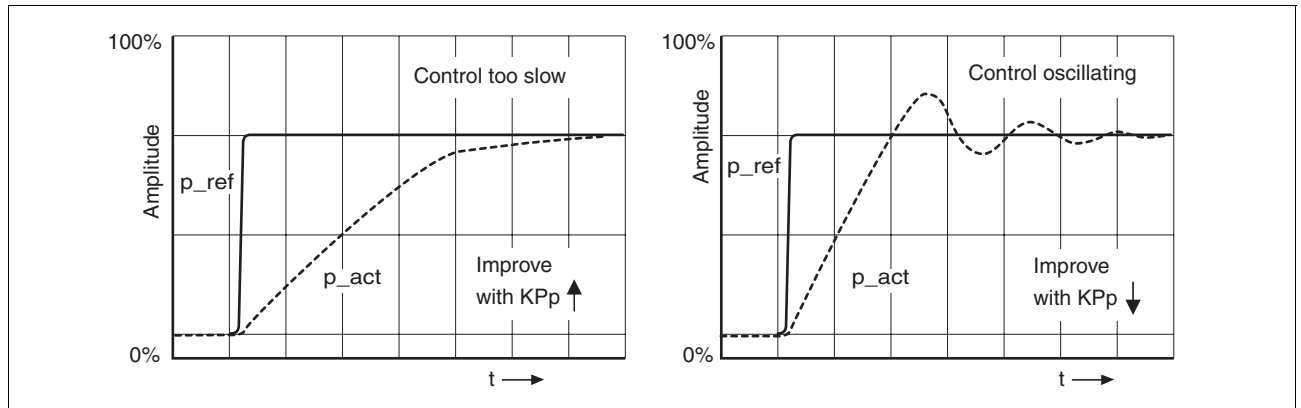


Figure 6.14 Optimising improper settings of the position controller

7 Operation

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



For an overview of **all** parameters can be found alphabetically sorted in the "parameters" section. The application and the function of some parameters are explained in more detail in this section.

7.1 Overview of operating modes

The following table is an overview of the operating modes and the type of reference value pre-selection.

Operating mode	in local control mode	in fieldbus control mode.	Description
Jog	digital inputs	digital inputs ¹⁾ Fieldbus commands	Page 121
Current control	analog input	analog input Fieldbus commands	Page 125
Speed control	analog input	analog input Fieldbus commands	Page 128
Profile position	-	Fieldbus commands	Page 130
speed profile	-	Fieldbus commands	Page 134
Motion sequence	digital inputs	digital inputs ¹⁾ Fieldbus commands	Page 136
Referencing	-	Fieldbus commands	Page 153

1) optional

Reference value for control loop

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

Operating mode	Control circuit	Profile generator
Jog	Position controller	X
Current control	Current controller	-
Speed control	Speed controller	-
Profile position	Position controller	X
speed profile	Position controller	X
Referencing	Position controller	X

7.2 Access monitor

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

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

The device has the following access channels:

- Fieldbus
- Commissioning software
- Signal inputs

7.2.1 via fieldbus

You can use the `AccessLock` parameter to restrict access control to the fieldbus. A controller can then no longer be performed using another access channel.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
AccessLock	Locking other access channels	-	UINT16	CANopen 3001:1E _h
-	0: Release other access channels	0	UINT16	Modbus 316
-	1: Lock other access channels	1	R/W	
			-	
	The fieldbus can lock active access to the device via the following access channels with this parameter:			
	- Commissioning software			
	- HMI			
	- A second fieldbus			
	Processing of the input signals (such as HALT) cannot be locked.			

7.2.2 via commissioning software

Using the "Access" field, you can restrict access control to the commissioning software. A controller can then no longer be performed using another access channel.

7.2.3 via signal inputs

Functions of the signal inputs `LI1 ...LI4` and `XLI1... XLI6`. are used to control the device. A controller is not possible while another access channel has exclusive access control.

Exceptions:

- The functions "Halt", "Positive limit switch (LIMP)", "Negative limit switch (LIMN)" and "Reference switch (REF)" still work.
- The digital signal inputs `STO_A` and `STO_B` always work.

7.3 Operating states

7.3.1 State diagram

After switching on and at the start of an operating mode, a sequence of operating states is progressed through.

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

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

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

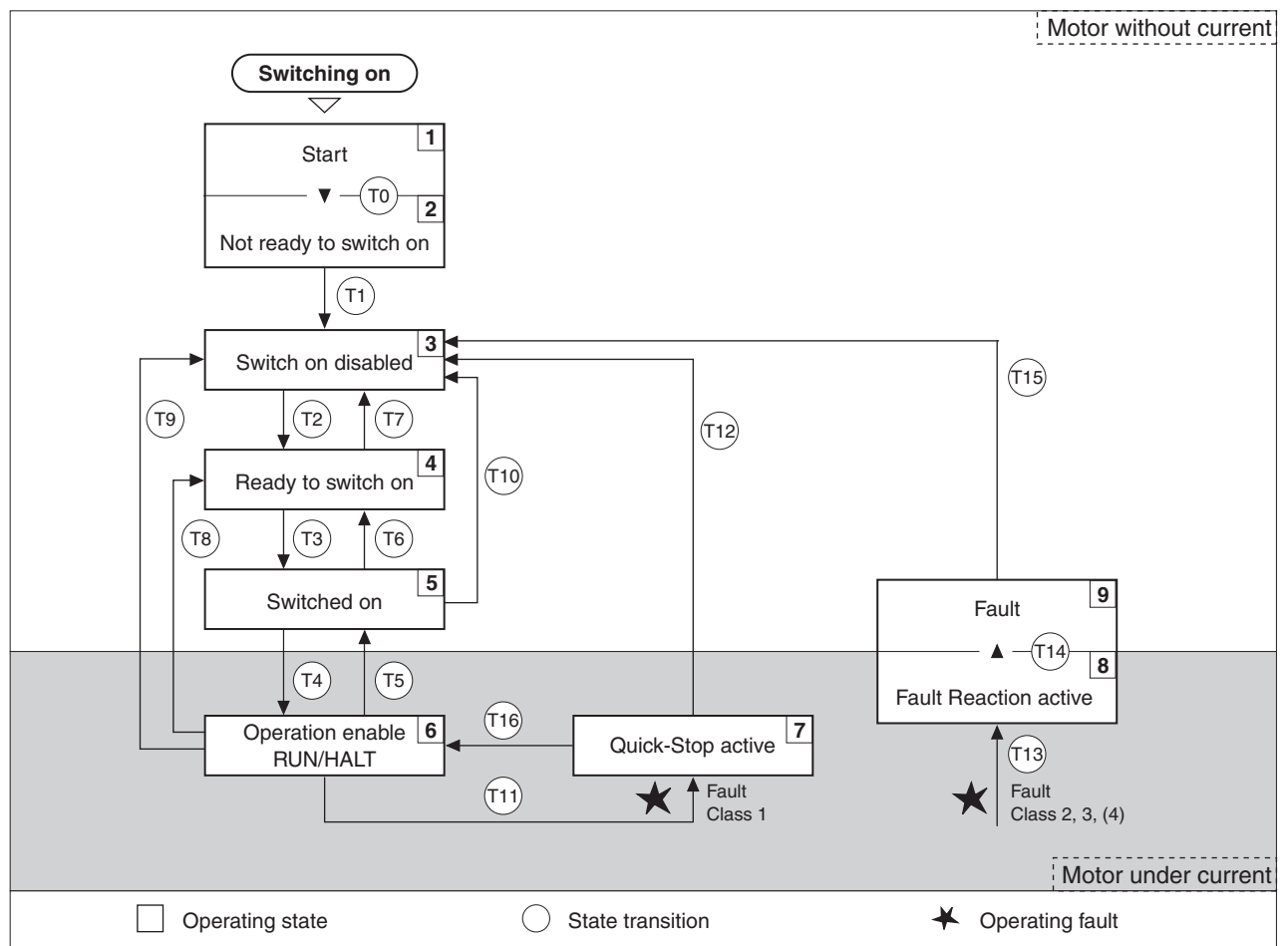


Figure 7.1 State diagram

Operating states You can display the operating statuses using the commissioning software.

Operating status	Description of operating status
1 Start	Controller supply voltage, electronics is initialized
2 Not ready to switch on	Power amplifier is not ready to switch on ¹⁾
3 Switch on disabled	Switching on the power amplifier is disabled
4 Ready to switch on	The power amplifier is ready to switch on
5 Switched on	Motor not under current Power amplifier ready No operating mode active
6 Operation enable	RUN: device running in the selected operating mode HALT: The motor is stopped with active power amplifier
7 Quick Stop active	"Quick Stop" is executed
8 Fault response active	Error detected, error response is enabled
9 Fault	device is in fault condition

1) The device must be switched off and then switched on again

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

Transition	Operating status	Condition / event ^{1) 2)}	Reaction
T0	1-> 2	<ul style="list-style-type: none"> Device electronics successfully initialized 	
T1	2-> 3	<ul style="list-style-type: none"> Parameter successfully initialized 	
T2	3 -> 4	<ul style="list-style-type: none"> no under-voltage Encoder successfully checked Actual speed: <1000 1/min $\overline{\text{STO_A}}$ and $\overline{\text{STO_B}}$ = +24V Fieldbus command: Shutdown ³⁾ 	
T3	4-> 5	<ul style="list-style-type: none"> Call-up for activation of power amplifier fieldbus command: Switch On 	
T4	5-> 6	<ul style="list-style-type: none"> Automatic transition fieldbus command: Enable Operation (only if T3 via fieldbus command Switch On) 	Power amplifier is activated User parameters are checked Holding brake is released (if present)
T5	6-> 5	<ul style="list-style-type: none"> fieldbus command: Disable Operation 	Travel command interrupted with "Halt" Brake is applied Power amplifier is deactivated.
T6	5-> 4	<ul style="list-style-type: none"> fieldbus command: Shutdown 	
T7	4 -> 3	<ul style="list-style-type: none"> Undervoltage $\overline{\text{STO_A}}$ and $\overline{\text{STO_B}}$ = 0V Actual speed: >1000 1/min (e.g. by remote drive) Fieldbus command: Disable Voltage 	-
T8	6-> 4	<ul style="list-style-type: none"> fieldbus command: Shutdown 	Power amplifier is immediately deactivated.

Transition	Operating status	Condition / event ^{1) 2)}	Reaction
T9	6-> 3	<ul style="list-style-type: none"> Call-up for deactivation of power amplifier fieldbus command: Disable Voltage 	Power amplifier is immediately deactivated.
T10	5-> 3	<ul style="list-style-type: none"> Call-up for deactivation of power amplifier fieldbus command: Disable Voltage 	
T11	6-> 7	<ul style="list-style-type: none"> Class 1 error fieldbus command: Quick Stop 	Interrupt travel command with "Quick Stop".
T12	7-> 3	<ul style="list-style-type: none"> Call-up for deactivation of power amplifier fieldbus command: Disable Voltage 	Power amplifier is deactivated immediately, even if "Quick Stop" is still active.
T13	x -> 8	<ul style="list-style-type: none"> Errors Class 2, 3 or 4 	Error response is carried out, see "Error response"
T14	8 -> 9	<ul style="list-style-type: none"> Error response terminated (error from class 2) Errors Class , 3 or 4 	
T15	9-> 3	<ul style="list-style-type: none"> Function: "Fault Reset" 	Error is reset (cause of error must be corrected).
T16	7-> 6	<ul style="list-style-type: none"> Function: "Fault Reset" fieldbus command: Enable Operation ⁴⁾ 	

1) In order to initiate status transition it is sufficient to fulfill just one point

2) fieldbus commands only with control mode fieldbus

3) Only required with fieldbus control mode, fieldbus CANopen and parameter DCOMcompatib= 1

4) Possible only if operating status was triggered through fieldbus

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

Error class	Response	Description
0	Warning	Message only, no interruption of movement mode.
1	"Quick Stop"	Motor stops with "Quick Stop", power amplifier and controller remain switched on and active.
2	"Quick Stop" with switch-off	Motor stops with "Quick Stop", power amplifier and controller switch off when at standstill.
3	Fatal error	Power amplifier and controller switch off immediately, without stopping the motor first.
4	Uncontrolled operation	Power amplifier and controller switch off immediately, without stopping the motor first. Error response can only be reset by switching the device off.

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

Error class	Status from -> to	Reaction
2	x -> 8	Braking with "Quick Stop" Brake is applied Power amplifier is switched off.
3,4 or Safety function STO	x -> 8 -> 9	Power amplifier is switched off immediately, even if "Quick Stop" is still active

An operating error can be indicated by a temperature sensor, for example. The device interrupts the travel command and carries out an error response e.g. braking and stopping with "Quick Stop" or switching off the power amplifier. Subsequently the operating status changes to "Fault".

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



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

7.3.2 Displaying the operating states

You can display the current operating status with the signal outputs, the commissioning software or the fieldbus.

Signal outputs The current operating status is displayed through the digital signal outputs.

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

1) Function is the factory setting at signal output L01

2) Function is the factory setting at signal output L02

3) This function must be configured, see chapter 7.6.7 "Configurable inputs and outputs"

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

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

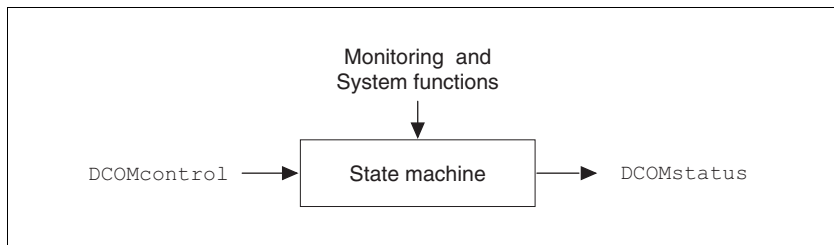


Figure 7.2 Changing and monitoring the operating status via parameters

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
DCOMstatus	Drivecom status word	-	UINT16	CANopen 6041:0 _h
-	Refer to chapter Operation, State Machine for bit coding information.	-	UINT16	Modbus 6916
-	Bit0-3,5,6: Status bits	0	R/-	
	Bit4: Voltage enabled	-	-	
	Bit7: Warning			
	Bit8: HALT request active			
	Bit9: Remote			
	Bit10: Target reached			
	Bit11: Reserved			
	Bit12: Op. mode-specific			
	Bit13: x_err			
	Bit14: x_end			
	Bit15: ref_ok			

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

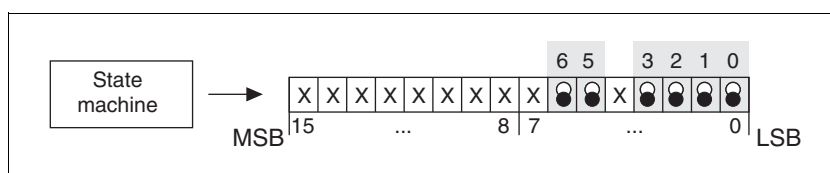


Figure 7.3 Display of operating status

Operating status	Bit 6 Switch on disable	Bit 5 Quick Stop	Bit 3 Fault	Bit 2 Operation enable	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 enable	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	1	1	1

<i>Bit 4, Voltage enabled</i>	Bit 4=1 indicates whether the DC bus voltage is correct. If the voltage is missing or is too low, then the device does not change from state 3 to state 4.
<i>Bit 7, Warning</i>	Bit 7 becomes 1 if a warning message is pending in parameter <code>_WarnActive</code> . The movement mode is not interrupted. The bit remains set so long as a warning message is pending in parameter <code>_WarnActive</code> . The bit remains set for at least 100ms, even if a warning message is pending for a shorter time. The bit is reset immediately at a "Fault Reset".
<i>Bit 8, Halt request active</i>	Bit 8=1 indicates that a "Halt" is active.
<i>Bit 9, Remote</i>	If Bit 9 is set, then the device carries out commands via the fieldbus bus. If Bit 9 is reset, then the device is controlled from a different interface. The fieldbus then allows other parameters to be read and written.
<i>Bit 10, Target reached</i>	Bit 10 only becomes "1", if the operating mode is completed successfully and the motor stops. Bit 10 has the value "0", as long as the motor is running, if the operating mode is interrupted by a "Halt" or discontinued because of an error.
<i>Bit 11</i>	reserved.
<i>Bit 12</i>	Bit 12 is used for the monitoring of the current operating mode. Details can be found in the chapter for the individual operating mode.
<i>Bit 13, x_err</i>	Bit 13 only becomes "1" if there is a fault present which needs to be rectified before further processing. The device responds corresponding to an error class, see from page .
<i>Bit 14, x_end</i>	Bit 14 changes to "0", if an operating mode is started. When the process is complete or if the process is discontinued e.g. by a "Halt", bit 14 changes back to "1" when the motor is at a standstill. Bit 14's signal change to "1" is suppressed if one process is followed immediately by a new process in a different operating mode.
<i>Bit 15, ref_ok</i>	Bit 15 is "1" if the motor or the axis has a valid reference point, e.g. through a reference movement.

7.3.3 Changing operating states

Local control mode In local control mode, the change of operating state takes place either via the commissioning software, the signal inputs or automatically.

Input signal	State transitions	State change to
ENABLE 0 -> 1	T3, T4	6: Operation enable
ENABLE 1 -> 0	T5, T6	4: Ready to switch on
FAULT_RESET 0 -> 1	T15 T16	4: Ready to switch on 6: Operation enable

Fieldbus control mode In the case of fieldbus control mode, the operating states are set either by the commissioning software or by the parameter `DCOMcontrol`. Bits 0 to 3 and Bit 7 are relevant for a state change.

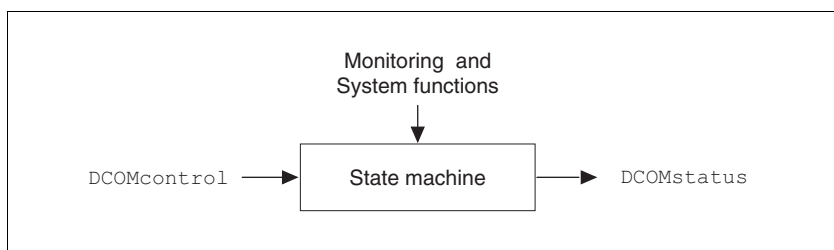


Figure 7.4 Changing and monitoring the operating status via parameters

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
DCOMcontrol	Drivecom control word	-	UINT16	CANopen 6040:0h
-	Refer to chapter Operation, Operating States, for bit coding information.	-	UINT16	Modbus 6914
-	Bit0: Switch on	0	R/W	
	Bit1: Enable Voltage	-	-	
	Bit2: Quick Stop			
	Bit3: Enable Operation			
	Bit4..6: Op. mode-specific			
	Bit7: Fault Reset			
	Bit8: Halt			
	Bit9..15: Reserved (must be 0)			

Bit 0 to 3 and 7

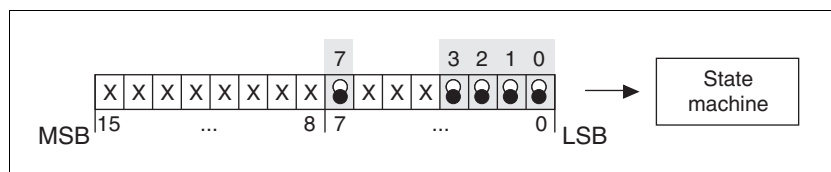


Figure 7.5 Change operating state

field bus command	status transitions	Status change open	Bit 7 Reset Fault	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, T10 T11	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 enable	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 that particular status change.

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

Bit 8, Halt Bit 8=1 can initiate a "Halt".

Bit 9 to 15 reserved.

7.4 Displaying, starting and changing operating modes

⚠ WARNING

Unmonitored operation

- Note that inputs to these parameters are executed by the drive controller immediately on receipt of the data set.
- Make sure that the system is free and ready for movement before changing these parameters

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

Requirements To start an operating mode the unit must be ready to start and correctly initialized.

An operating mode cannot be carried out in parallel with another operating mode. If an operating mode is active, then you can only change to a different operating mode if the current operating mode is completed or is discontinued.

An operating mode is completed if the drive is at a standstill, e.g. if the target position of a positioning process is reached or if the drive is stopped by a "Quick Stop" or "Halt". If a fault occurs during the process which leads to the discontinuation of a current operating mode, then, after the cause of the fault has been removed, the traverse operation can be resumed, or you can change to a different operating mode.

Changing the operating states and enabling the operating modes must be executed separately. An operating mode can generally only be enabled if the operating status is already "operation enable".

7.4.1 Start operating mode

Local control type In the case of local control mode, after starting, the device changes to the operating mode set using the `IDefaultMode` parameter.

The motor is placed under current by setting the input signal `ENABLE` and the set operating mode is started.

In addition, a "jog" or "Autotuning" can be started with the HMI.

Fieldbus control mode In the case of fieldbus control mode, the operating mode is started using the parameter `DCOMopmode`.

The following table shows the sequence of parameters for starting an operating mode with the example of the current control operating mode.

	Parameter	Meaning
1	<code>CUR_I_target</code>	Transmission of the reference value
2	<code>CURreference</code>	Setting the reference quantity
3	<code>DCOMopmode</code>	Calling up the operating mode (-3)

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CUR_I_target	Reference current in operating mode current control	A _{pk} -300.00 0.00 300.00	INT16 INT16 R/W -	CANopen 3020:4 _h Modbus 8200
-				
CURreference	Selection of the ref. value source for op. mode current control	- 0 0 2	UINT16 UINT16 R/W -	CANopen 301B:10 _h Modbus 6944
-				
-	0 / none: None 1 / Analog Input: Reference value via +/- 10V interface ANA1 2 / Parameter 'currTarg': Reference value via parameter CUR_I_target			
DCOMopmode	Operating mode	- -8 -	INT8 INT16 R/W	CANopen 6060:0 _h Modbus 6918
-	DSP402 operating modes: 1: Profile position 3: Profile velocity 6: Homing	6	- -	
-				
	----- Manufacturer operating modes: -1: Jog -3: Current control -4: Speed control -8: Motion sequence			

In the case of the Profile Position and Homing mode, the device receives the instruction to start the set operating mode by Bit 4 in the parameter DCOMcontrol.

In the other operating modes, bits 4 to 6 are assigned specific to operating mode.

7.4.2 Mode change

Local control type

When the drive is at a standstill, the default operating mode can be changed using the parameter IODEfaultMode. The operating modes cannot be changed whilst the operation is in process. The new settings only become effective after switching off and switching on the device again.

Fieldbus control mode

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

Exceptions to this are the operating modes current control and speed control. The motor need not be at a standstill to change between these two operating modes.

Two parameters are available for displaying the current operating mode and for switching the operating modes.

- Parameter for display: _DCOMopmd_act
- Parameter for change: DCOMopmode

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_DCOMopmd_act	Active operating mode	-	INT8	CANopen 6061:0 _h
-	See DCOMopmode for coding	-6	INT16	Modbus 6920
-		-	R/-	
		6	-	
DCOMopmode	Operating mode	-	INT8	CANopen 6060:0 _h
-	DSP402 operating modes:	-8	INT16	Modbus 6918
-	1: Profile position	-	R/W	
-	3: Profile velocity	6	-	
	6: Homing		-	

	Manufacturer operating modes:			
	-1: Jog			
	-3: Current control			
	-4: Speed control			
	-8: Motion sequence			

7.5 Operating modes

7.5.1 Operating mode Jog

⚠ WARNING

Unmonitored operation

- Note that inputs to these parameters are executed by the drive controller immediately on receipt of the data set.
- Make sure that the system is free and ready for movement before changing these parameters

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

Overview of jog

The motor traverses by one path unit or at constant speed in continuous operation. The length of the path unit, the speed levels and the wait time before continuous operation can be adjusted.

The current axis position is the start position for the jog operating mode. Position and speed values are input in user-defined units.

Start operating mode

The operating mode can be started with the following methods.

- In the case of the local control mode, the operating mode can be set directly as startup operating mode.

The functions "Jog positive" and "Jog negative" are used to start positioning. The function "Jog fast/slow" can be used to toggle between slow and fast travel.

- In the case of fieldbus control mode, the operating mode must be set using the parameter `DCOMopmode`. The writing of the parameter value simultaneously causes the start of the operating mode. Start positioning via the parameter `JOGactivate`.

The Functions "Automatic/Manual", "Jog positive", "Jog negative" and "Jog fast/slow" must be configured, see chapter 7.6.7 "Configurable inputs and outputs".

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

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

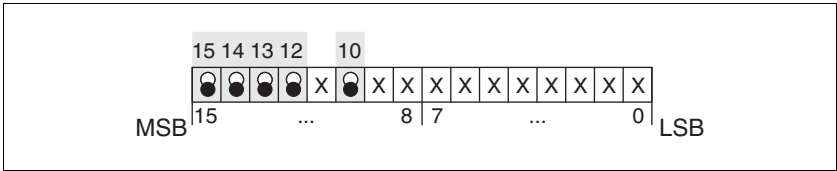


Figure 7.6 Status reports for operating mode

Parameter value	Description
Bit 10: Target reached	Always 0
Bit 12: Mode-dependent	reserved
Bit 13: <code>x_err</code>	1: Error arisen
Bit 14: <code>x_end</code>	1: Mode completed, motor at a standstill
Bit 15: <code>ref_ok</code>	1: drive has valid reference point

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

The graph below shows an overview in local control mode.

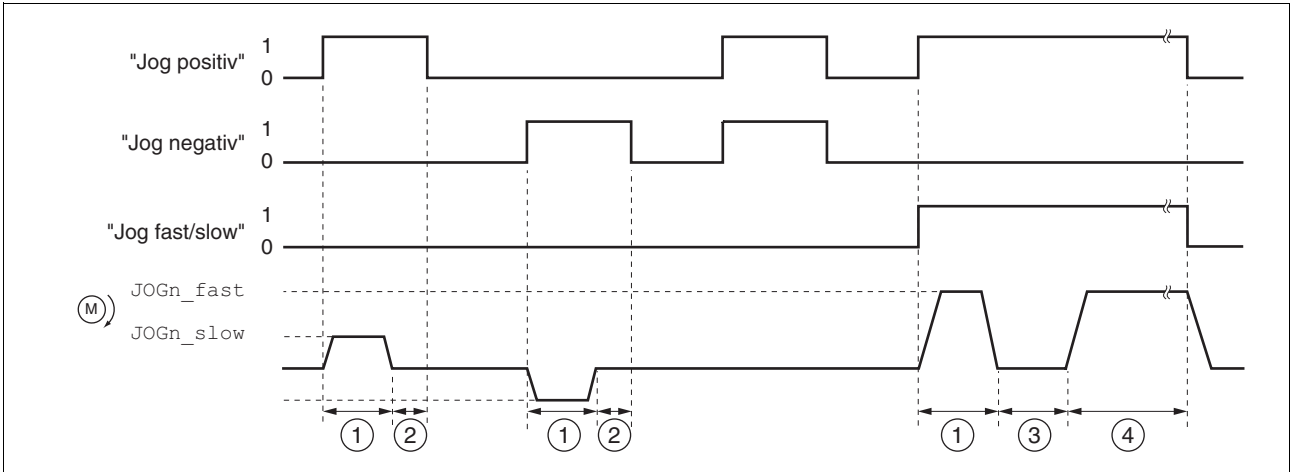


Figure 7.7 Jog, slow and fast

The graph below shows an overview in fieldbus control mode.

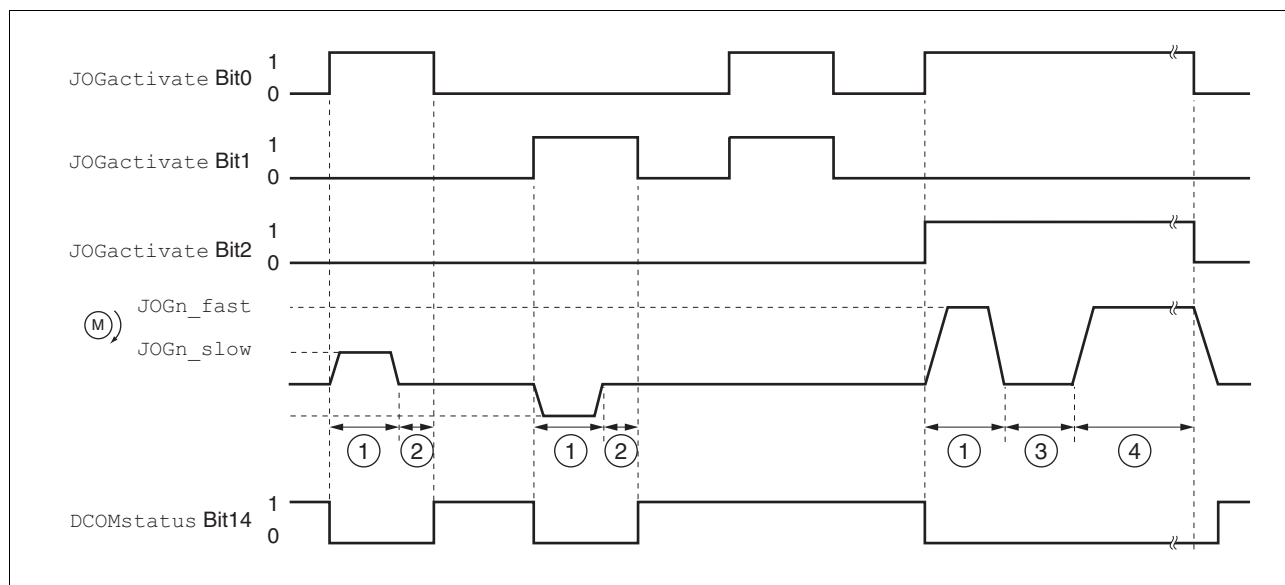


Figure 7.8 Jog, slow and fast

- (1) Path unit
- (2) $t < \text{wait time}$
- (3) $t > \text{wait time}$
- (4) Continuous operation

The path unit, wait time and speed levels can be set. If the path unit is zero, jog starts directly with continuous operation irrespective of the wait time.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
JOGactivate	Activation of jog	-	UINT16	CANopen 301B:9 _h
-	Bit0: positive direction of rotation	0	UINT16	Modbus 6930
-	Bit1: negative direction of rotation	0	R/W	
-	Bit2: 0=slow 1=fast	7	-	
JOGn_slow	Speed for slow jog	1/min 1	UINT16	CANopen 3029:4 _h
JOG- - NSLW	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	60	UINT16	Modbus 10504
$\text{JOGn_slow} - \text{rNSLW}$		13200	R/W per. -	
JOGn_fast	Speed for fast jog	1/min 1	UINT16	CANopen 3029:5 _h
JOG- - NFST	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	180	UINT16	Modbus 10506
$\text{JOGn_fast} - \text{rNFST}$		13200	R/W per. -	
JOGstepusr	Jog distance prior to continuous run	usr	INT32	CANopen 3029:7 _h
-	0: Direct activation of continuous run	0	INT32	Modbus 10510
-	>0: Positioning distance per jog cycle	20	R/W per. -	

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
JOGtime	Wait time prior to continuous run	ms 1	UINT16 UINT16	CANopen 3029:8 _h Modbus 10512
-	This time is only effective if you have set a jog distance not equal to 0, otherwise the drive immediately starts a continuous run.	500	R/W	
-		32767	per. -	

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

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

Further possibilities For further setting possibilities and functions for the operating mode see from page 166.

7.5.2 Operating mode Current control

⚠ WARNING

Unmonitored operation

- Note that inputs to these parameters are executed by the drive controller immediately on receipt of the data set.
- Make sure that the system is free and ready for movement before changing these parameters

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

Overview of current control

In the current control operating mode the reference value for the motor current is preset.

The following overview shows the effectivity of the parameters which can be set for this operating mode.

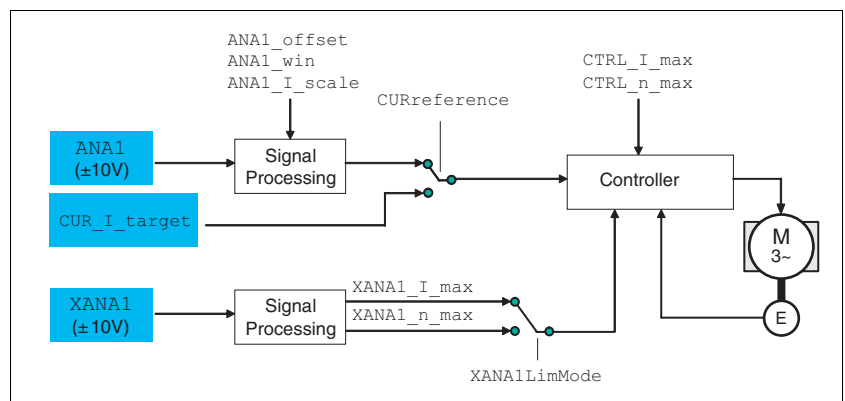


Figure 7.9 Operating mode current control, effects of settable parameters

Start operating mode

In the case of local control mode, the operating mode must be set using the parameter `IOdefaultMode`. The power amplifier is activated, the motor receives current and the inputs are evaluated in accordance with the setting by setting the input signal `ENABLE`.

In the case of fieldbus control mode, the operating mode must be set using the parameter `DCOMopmode`. The writing of the parameter value simultaneously causes the start of the operating mode.

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

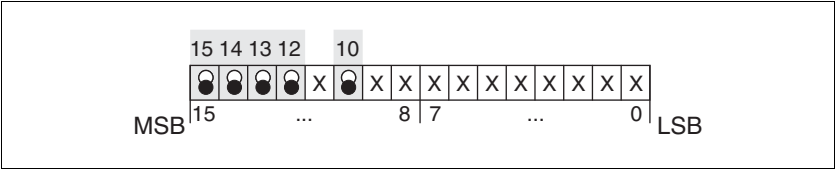



Figure 7.10 Status reports for operating mode

Parameter value	Description
Bit 10: Target reached	Always 0
Bit 12: Mode-dependent	0: Speed higher than 0 1/min 1: Speed is 0 1/min
Bit 13: x_err	1: Error arisen
Bit 14: x_end	1: Mode completed, motor at a standstill
Bit 15: ref_ok	1: drive has valid reference point

Setting thresholds For setting current limiting and speed limiting see .

 **WARNING**

Unexpectedly high speed of rotation

The motor in current control mode can reach extreme speeds when operated without limits or load.

- Check the configured speed limiter.

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

Setting to the set value In the case of local control mode, the analog input ANA1 is automatically evaluated.

In the case of fieldbus control mode, the parameter CURreference determines whether the analog input ANA1 or the parameter CUR_I_target is to be evaluated.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CURreference	Selection of the ref. value source for op. mode current control	- 0 0 2	UINT16 UINT16 R/W -	CANopen 301B:10 _h Modbus 6944
-	0 / none: None			
-	1 / Analog Input: Reference value via +/- 10V interface ANA1			
-	2 / Parameter 'currTarg': Reference value via parameter CUR_I_target			
CUR_I_target	Reference current in operating mode current control	A _{pk} -300.00 0.00 300.00	INT16 INT16 R/W -	CANopen 3020:4 _h Modbus 8200
-				
-				

Reference value at +10V input signal The progress of the reference value in relation to the $\pm 10V$ input value can be altered:

- Setting the reference value at +10V
- Setting parameters for a zero voltage window
- Setting parameters for a voltage offset

For setting options for the analog inputs see .

The device calculates a current value, with which the motor accelerates to a speed which is limited by the load moment, from the $\pm 10 V$ analog value preset. Without a load the motor therefore accelerates to the variable speed limit.

Example local control mode An example of setting by parameters in the case of local control mode can be found on page .

End operating mode The processing in the operating mode is completed if the operating mode has been "deactivated" and the drive is at a standstill, or if the motor speed has taken the value = 0 as a result of a fault.

7.5.3 Operating mode Speed control

⚠ WARNING

Unmonitored operation

- Note that inputs to these parameters are executed by the drive controller immediately on receipt of the data set.
- Make sure that the system is free and ready for movement before changing these parameters

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

Overview of speed control

In the speed control operating mode the reference value for the motor speed is preset.

Transitions between two speeds take place in relation to the set control parameters.

The following overview shows the effectivity of the parameters which can be set for this operating mode.

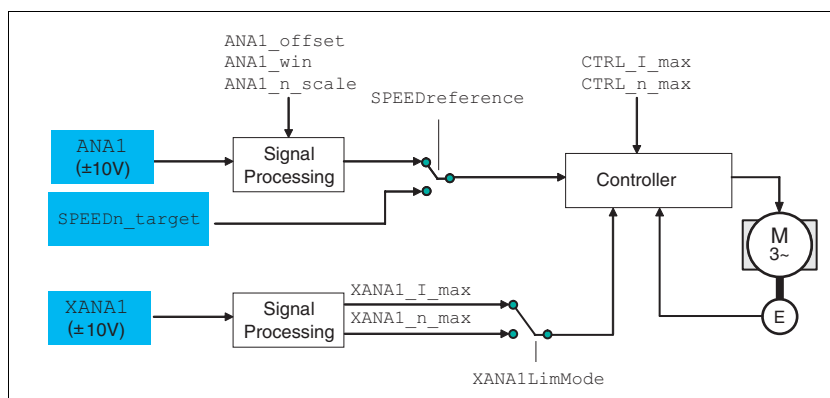


Figure 7.11 Operating mode current control, effects of settable parameters

Start operating mode

In the case of local control mode, the operating mode must be set using the parameter `IOdefaultMode`. The power amplifier is activated, the motor receives current and the inputs are evaluated in accordance with the setting by setting the input signal `ENABLE`.

In the case of fieldbus control mode, the operating mode must be set using the parameter `DCOMopmode`. The writing of the parameter value simultaneously causes the start of the operating mode.

Status information

Information about the operating mode is displayed by using the word "driveStat".

bit	Name	Meaning
13	x_info	0: Motor rotating 1: Motor standstill
14	x_end	0: Operating mode active 1: Operating mode completed
15	x_err	0: no error 1: error occurred

- Setting thresholds* For setting current limiting and speed limiting see .
- Setting to the set value* In the case of local control mode, the analog input **ANA1** is automatically evaluated.
- In the case of fieldbus control mode, the parameter **SPEEDreference** determines whether the analog input **ANA1** or the parameter **SPEEDn_target** is to be evaluated.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPEEDreference	Selection of the ref. value source for op. mode speed control	- 0 0 2	UINT16 UINT16 R/W -	CANopen 301B:11 _h Modbus 6946
-	0 / none: None			
-	1 / Analog Input: Reference value via +/- 10V interface ANA1			
-	2 / Parameter 'speedTarg': Reference value via parameter SPEEDn_target			
SPEEDn_target	Reference speed in operating mode speed control	1/min -30000 0 30000	INT16 INT16 R/W -	CANopen 3021:4 _h Modbus 8456
-	The internal maximum speed is limited to the current setting in CTRL_n_max .			

Reference value at +10V input signal The progress of the reference value in relation to the $\pm 10V$ input value can be altered:

- Setting the reference value at +10V
- Setting parameters for a zero voltage window
- Setting parameters for a voltage offset

For setting options for the analog inputs see .

Example local control mode An example of setting by parameters in the case of local control mode can be found on page .

End operating mode The processing in the operating mode is completed if the operating mode has been "deactivated" and the drive is at a standstill, or if the motor speed has taken the value = 0 as a result of a fault.

7.5.4 Operating mode Profile position

The operating mode can only be used with fieldbus control mode and can only be executed via fieldbus.

⚠ WARNING

Unmonitored operation

- Note that inputs to these parameters are executed by the drive controller immediately on receipt of the data set.
- Make sure that the system is free and ready for movement before changing these parameters

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

In profile position operating mode a movement with an adjustable travel profile is run from a start position to a target position. The value of the target position can be given as either a relative or an absolute position.

A movement profile can be set with values for acceleration and deceleration ramps and final speed.

Relative and absolute positioning,

At an absolute positioning the positioning path is specified absolutely with reference to the zero point of the axis. A zero point must be defined with the homing operating mode before the first absolute positioning.

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

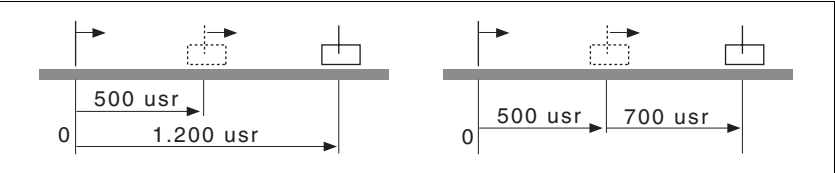


Figure 7.12 Absolute positioning (left) and relative positioning (right)

Trigger positioning

Parameter value	Description
Bit 4: New setpoint	0->1: Start positioning or prepare next positioning
Bit 5: Change set immediately (applicable only with new setpoint 0->1)	0: enable new position values when target position is reached 1: enable new position values immediately
Bit 6: Absolute / relative	0: Absolute positioning 1: Relative positioning

A positioning of rising edge is started by bit 4 in parameter-`DCOMcontrol`. Alternatively a positioning can be started also over a digital input, see chapter 7.6.7 "Configurable inputs and outputs".

The positioning can be triggered in 2 ways depending upon Bit 5.

- Bit 5=0:

Position values (`PPp_targetusr`, `PPn_target`, `RAMPacc` and `RAMPdecel`), that are transferred during a positioning, are saved temporarily. The target position of the current positioning is approached. The new position values are executed only when the target position is reached.

If new position values are transferred again, the temporarily saved position values are overwritten again.

- Bit 5=1:

Position values (`PPp_targetusr`, `PPn_target`, `RAMPacc` and `RAMPdecel`), that are transferred during a positioning, are executed immediately. The target position of the new positioning is directly approached.

Status messages

The drive provides information concerning positioning via Bits 10 and 12 to 15 in the parameter `DCOMstatus`.

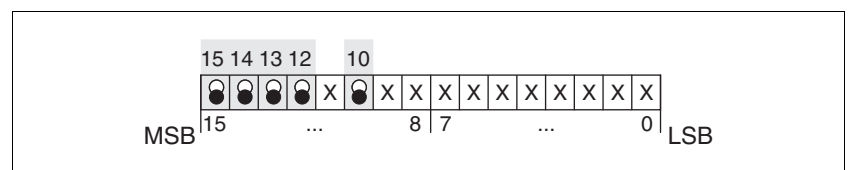


Figure 7.13 Status reports for operating mode

Parameter value	Description
Bit 10: Target reached	0: Target position not reached (even with "Halt" or error) 1: Target position reached
Bit 12: setpoint acknowledge	0: Transfer of new position possible 1: New target positioning accepted
Bit 13: <code>x_err</code>	1: Error arisen
Bit 14: <code>x_end</code>	1: Positioning completed, motor at a standstill
Bit 15: <code>ref_ok</code>	1: drive has valid reference point

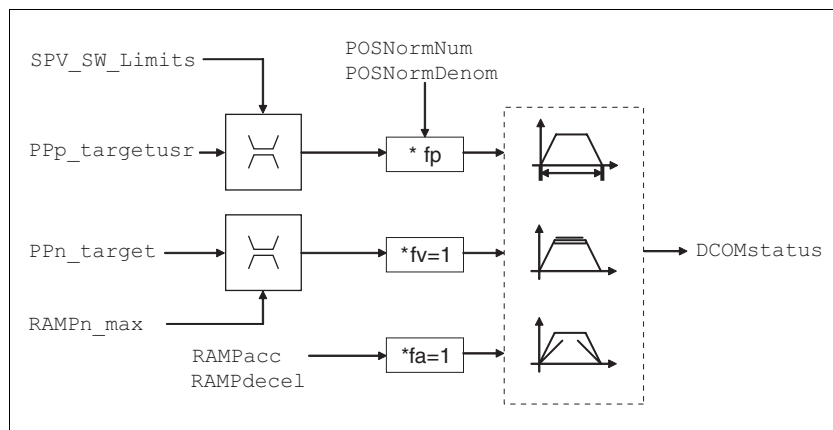


Figure 7.14 Profile position operating mode, effect of settable parameters

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
<u>p_actusr</u>	Actual motor position in user units	usr - 0 -	INT32 INT32 R/- -	CANopen 6064:0 _h Modbus 7706
STA- - PACu				
5tR- - PRLu				
<u>p_actRAMPusr</u>	Actual position of motion profile generator	usr - 0 -	INT32 INT32 R/- -	CANopen 301F:2 _h Modbus 7940
-	In user units			
-				

Target position A new position value is transmitted with the parameter pP_targetusr.


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

At a relative positioning the positioning path is specified relative to the current axis position or the target position. This depends on the setting in parameter pPoption.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PpN_target	Reference speed in operating mode profile position	1/min 1 60 -	UINT32 UINT32 R/W -	CANopen 6081:0 _h Modbus 6942
-	The adjusted value is internally limited to the current parameter value in <u>RAMPn_max</u> .			
-				

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PPOption	Options for operating mode profile position	-	UINT16	CANopen 60F2:0 _h
-	Determines the reference position for relative positioning:	0	UINT16	Modbus 6960
-	0: Relative with reference to the previous target position of the motion profile generator	0	R/W	
	1: Not supported	2	-	
	2: Relative with reference to the actual position of the motor		-	
AbsHomeRequest	Absolute positioning only after homing	-	UINT16	CANopen 3006:16 _h
-	0 / no: No	0	UINT16	Modbus 1580
-	1 / yes: Yes	0	R/W	
		1	per.	
			-	
PPp_targetusr	Target position in operating mode profile position	usr	INT32	CANopen 607A:0 _h
-		-	INT32	Modbus 6940
-	Min./max values depend on:	0	R/W	
	- Scaling factor	-	-	
	- Software limit switches (if they are activated)		-	

7.5.5 Operating mode Profile velocity

 **WARNING**

Unmonitored operation

- Note that inputs to these parameters are executed by the drive controller immediately on receipt of the data set.
- Make sure that the system is free and ready for movement before changing these parameters

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

In the profile velocity operating mode it is accelerated to an adjustable setpoint speed. A movement profile can be set with values for acceleration and deceleration.

Start operating mode

If the type of operation, the operating state and the parameter values are set, the operating mode can be started by transfer of a set velocity in the parameter `PVn_target`.

Status messages

The drive provides information concerning positioning via Bits 10 and 12 to 15 in the parameter `DCOMstatus`.

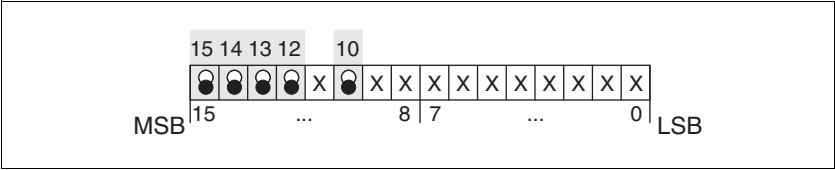


Figure 7.15 Status reports for operating mode

Parameter value	Description
Bit 10: Target reached	0: Reference speed not reached 1: Reference speed reached (even in the event of motor standstill via "Halt")
Bit 12: speed=0	0: motor moves 1: motor stopped
Bit 13: x_err	1: Error arisen
Bit 14: x_end	1: Operating mode finished
Bit 15: ref_ok	1: drive has valid reference point

Overview The following overview shows the effect of the parameters which can be set for the velocity profile operating mode.

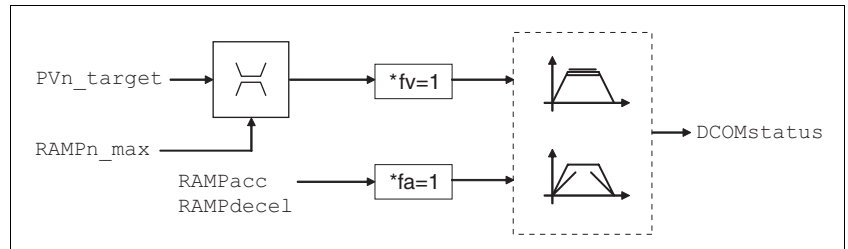


Figure 7.16 Operating mode velocity profile, effect of settable parameters

setpoint velocity The reference speed is transferred via the parameter `PVn_target` in 1/min and can be changed during the movement. The operating mode is not limited by range limits of the positioning. New speed values are accepted immediately during a travel command.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PVn_target	Reference speed in operating mode profile velocity	1/min - 0 -	INT32 INT32 R/W -	CANopen 60FF:0 _h Modbus 6938
-	The adjusted value is internally limited to the current parameter value in <code>RAMPn_max</code> .	-	-	-

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_n_act	Actual motor speed	1/min - 0 -	INT32 INT16 R/- -	CANopen 606C:0 _h Modbus 7696
STA- - NACT				
StR- - nRLt				
_n_actRAMP	Actual speed of motion profile generator	1/min - 0 -	INT32 INT32 R/- -	CANopen 606B:0 _h Modbus 7948
-				
-				

7.5.6 Operating mode motion sequence



There are fewer digital inputs or outputs available in local control mode without the expanded I/O signal interface. This puts a severe restriction on the scope of functions of the direct selection of the data sets. In local control mode without the expanded I/O signal interface, preferably use the sequential selection of the data sets.



If a positive limit switch is to be used instead of the reference switch with the fieldbus control mode, it must be configured, see chapter 7.6.7 "Configurable inputs and outputs".

Basis

The operating mode motion sequence is based on the basic principles and functions of the operating modes homing and profile position. The operation is described in the relevant sections for the operating mode.

Overview of motion sequence

The motor is controlled by freely programmable data sets in the motion sequence operating mode.

The data sets are parameterized via the commissioning software or the fieldbus.



Parameterization through the commissioning software is considerably easier, because this provides a graphic interface.

There are two processing modes for the data sets:

- Direct selection of the data sets

Direct selection of the data sets is used if a master controller (e.g. PLC) runs time coordination between the various data sets.

In the local control mode without expanded I/O interface, the data set number always starts with 0. With the expanded I/O signal interface, the data set number to be processed is always selected with the functions "DataSet Bit0" ... "DataSet Bit3". The activation of the selected data set is triggered with the "DataSet start" function. All data sets can be enabled directly.

In the field bus control mode the parameter `MSMsetNum` defines the starting data set number. The data set number is activated when the respective continued transition condition is fulfilled.

- Sequential selection of the data sets

The sequential selection of the data sets is typically used with simple process sequences. The time coordination and the sequence between the various data sets is defined in the drive. The globally defined continued transition condition is always checked to start the first data set. Special conditions can be parameterized for all the subsequent data sets.

In the local control mode, an external signal can perform a continued transition condition between the data sets through the function "Start DataSet".

For example, for control mode fieldbus, a transition condition can be met through the parameter `MSMstartReq`.

In local control mode, the processing state of a data set can be output via a signal output with the "DataSet start acknowledge" function.

In addition, an internal processing status such as "Motor standstill" can be output via an additional signal output.

The following table provides an overview of the processing modes and control modes of the motion sequence operating mode.

Processing mode	Fieldbus control mode	Local control type	Description
Direct selection of the data sets	All data sets can be selected directly via a parameter.	Without the expanded I/O signal interface, the data set number 0 will be started. With the expanded I/O signal interface, all data sets can be selected directly with the functions.	Page 146
Sequential selection of the data sets	Any sequences can be started, interrupted and continued from any data set.	Without the expanded I/O signal interface, the sequence is always started with data set number 0. With the expanded I/O signal interface, any sequences can be started, interrupted and continued from any data set.	Page 149

7.5.6.1 Global settings

Selection of processing mode The processing mode is defined with the parameter MSMprocMode.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MSMprocMode	Processing mode	-	UINT16	CANopen 302D:7 _h
-	0 / direct: Direct selection	0	UINT16	Modbus 11534
-	1 / sequential: Sequential selection	1	R/W per. -	

Global transition condition The parameter `MSMglobalCond` defines the global transition condition which is valid for the start of the first data set, as well as for stepping to all following data sets in which the global transition condition is defined as condition. Moreover, the globally defined transition condition can be replaced by a special transition condition in every single data set.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MSMglobalCond	Global transition condition	-	UINT16	CANopen 302D:8 _h
-	0 / rising edge: Rising edge	0	UINT16	Modbus 11536
-	1 / falling edge: Falling edge	0	R/W	
-	2 / 1-level: 1 level	3	per.	
-	3 / 0-level: 0 level		-	
	The global transition condition defines the way the start request is to be processed. This setting is used for the first start after activation of the operating mode. In addition, this setting can be used as transition condition in the individual data sets (default assignment).			

7.5.6.2 Structure of a data set

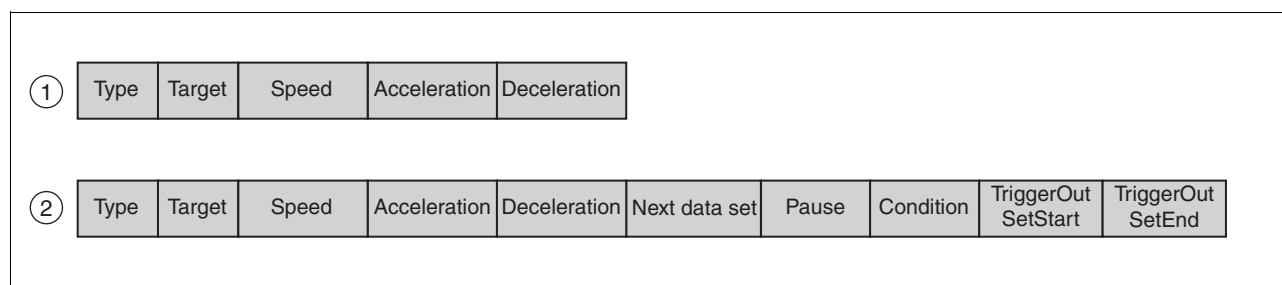


Figure 7.17 Structure of a data set

- (1) Direct selection of the data sets
- (2) Sequential selection of the data sets

Type Selection of data set type

The settings in Target and Profile have the following different meanings depending on the selected data set type:

Type	Description
Pos. absolute	Absolute positioning see chapter 7.5.4 "Operating mode Profile position"
Pos. relative	Relative positioning see chapter 7.5.4 "Operating mode Profile position"
Referencing	Reference movement on limit switch with and without index pulse, see chapter 7.5.7 "Operating mode Homing"
Dimension setting	Set dimensions see chapter 7.5.7.4 "Homing by dimension setting"

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MSMdataType	Selection of movement type	-	UINT16	CANopen 302D:11 _h
-	0 / None: None	0	UINT16	Modbus 11554
-	1 / absolute positioning: Absolute positioning	0	R/W	
-	2 / relative positioning: Relative positioning	4	per.	
	3 / homing: Homing		-	
	4 / set position: Position setting			
	Sequential selection: Processing of wait time and transition condition only. Direct selection: Triggering of a data set without movement, but compliance with handshake mechanism.			

Target Corresponds to different values according to data set type. In case of positioning, an absolute or relative position change. In case of homing, the method of reference movement can be selected here. In case of set dimensions, an absolute position is specified.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MSMdataTarget	Target value of movement type	-	INT32	CANopen 302D:12 _h
-	The value depends on the selected processing type (see MSMdataType for settings):	-2147483648	INT32	Modbus 11556
-	- None: no meaning	0	R/W	
	- Absolute positioning: absolute position in usr	2147483647	per.	
	- Relative positioning: relative distance in usr		-	
	- Reference movement: type of reference movement (see HMmethod)			
	- Position setting: position setting position in usr			

Speed, acceleration and deceleration

For each individual data set, the values for speed [1/min], acceleration [(1/min)/s] and deceleration [(1/min)/s] can be specified separately.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MSMdataSpeed	Speed	1/min	UINT16	CANopen 302D:13 _h
-	In the case of relative or absolute movements, this value corresponds to the reference speed, in the case of homing to the search speed.	0	UINT16	Modbus 11558
-		0	R/W	
		13200	per.	
			-	
MSMdataAcc	Acceleration	(1/min)/s	UINT32	CANopen 302D:14 _h
-	0: Use of current acceleration, no change	0	UINT32	Modbus 11560
-	>0: Special acceleration value, see parameter RAMPacc for adjustment range	0	R/W	
		3000000	per.	
			-	
MSMdataDec	Deceleration	(1/min)/s	UINT32	CANopen 302D:15 _h
-	0: Use of current deceleration, no change	0	UINT32	Modbus 11562
-	>0: Special deceleration value, see parameter RAMPdecel for adjustment range	0	R/W	
		3000000	per.	
			-	

Following data set

Defines the number of the data set that is to be executed to follow.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MSMdataNext	Number of subsequent data set	-	UINT16	CANopen 302D:18 _h
-	This setting is only effective in the processing mode 'sequential selection'.	0	UINT16	Modbus 11568
-		0	R/W	
		15	per.	
			-	

Pause

Defines the wait time after end of positioning. The value can be set from 0 to 30000 ms. The data set is considered ended only after this period.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MSMdataDelay	Wait time	ms	UINT16	CANopen 302D:16 _h
-	Additional wait time in ms after termination of the movement.	0	UINT16	Modbus 11564
-		0	R/W	
		30000	per.	
			-	
	This setting is only effective in the processing mode 'sequential selection'.			

Condition Defines the transition condition that must be met before the next data set is executed. The following setting options are available for the parameter:

Condition	Meaning
Auto	The next data set is started immediately after the current data set.
Rising edge	The "DataSet Start" function is monitored and the condition is considered fulfilled at a rising edge.
Falling edge	The "DataSet Start" function is monitored and the condition is considered fulfilled at a falling edge.
0 level	The "DataSet Start" function is monitored and the condition is considered fulfilled at a level of 0.
1 level	The "DataSet Start" function is monitored and the condition is considered fulfilled at a level of 1.
Globally defined transition condition.	Uses the transition condition defined globally in the chapter 7.5.6.1 "Global settings".
Blended movement	<p>The motor movement between the data sets is not stopped. Transition condition between the data sets is reaching the target position.</p> <p>The condition "blended movement" is possible only for:</p> <ul style="list-style-type: none"> absolute positioning. In case of subsequent data sets, whose target position is higher than that of the current data set.
Blended movement a)	The speed of the following data set is adjusted after reaching the target position.
Blended movement b) ¹⁾ .	The speed of the following data set is adjusted before reaching the target position.

1) Only possible with linear ramps. See 7.6.3 "Movement profile"

Example of blended movements

The following illustration is a diagram showing the difference between blended movement a and b, using 3 data sets.

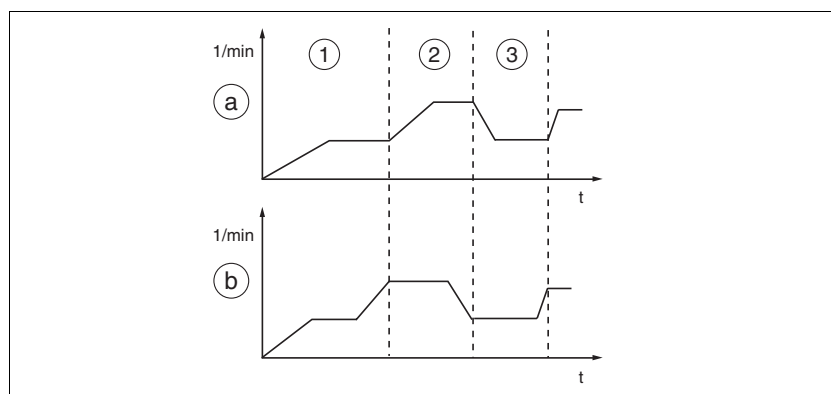


Figure 7.18 Blended movement

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MSMdataNextCond	Transition condition	-	UINT16	CANopen 302D:17 _h
-	0 / rising edge: Rising edge	0	UINT16	Modbus 11566
-	1 / falling edge: Falling edge	4	R/W	
-	2 / 1-level: 1 level	7	per.	
	3 / 0-level: 0-Pegel		-	
	4 / global next condition: Global transition condition (see MSMglobalCond)			
	5 / auto: Auto			
	6 / blended move typ A: Blended movement a			
	7 / blended move typ B: Blended movement b			
	This setting is only effective in the processing mode 'sequential selection'.			

TriggerOut SetStart / SetEnd

Every data set can actuate a signal output during the start (SetStart) and also after ending the data set including after expiration of the wait time (SetEnd), if the corresponding signal output is set to the "DataSet trigger output" function.

TriggerOut SetStart	TriggerOut SetEnd	Description
unchanged	unchanged	output level remains unchanged
1 level	1 level	output level becomes 1 level
0 level	0 level	output level becomes 0 level
inverted	inverted	output level becomes inverted

7.5.6.3 Start operating mode

Start operating mode

In the case of local control mode, the operating mode must be set using the parameter `IOdefaultMode`. The power amplifier is activated, the motor receives current and the inputs are evaluated in accordance with the setting by setting the input signal `ENABLE`.

In the case of fieldbus control mode, the operating mode must be set using the parameter `DCOMopmode`. The writing of the parameter value simultaneously causes the start of the operating mode.

Start data set for local control mode

For the local control mode, the globally defined transition condition refers to the state of the function "DataSet Start". The first data set (always data set number 0) is started when the globally defined sequencing condition is fulfilled. Separate transition conditions can be defined after the first data set for each subsequent data set.

Start data set for local control mode fieldbus.

In the fieldbus control mode, the globally defined transition condition refers to the parameter `MSMstartReq` or `DCOMcontrol` bit 4. The first data set is started if the globally defined transition condition is fulfilled. Separate transition conditions can be defined after the first data set for each of the subsequent data sets.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MSMstartReq	Start request for processing of a data set	-	UINT16	CANopen 302D:3 _h
-	Direct selection:	0	UINT16	Modbus 11526
-	The data set is always triggered by a rising edge. The number of the data set to be triggered must first adjusted via <code>MSMsetNum</code> .	0	R/W	-
-	Sequential selection: Triggering of a data set with start or transition condition. The start condition is defined with <code>MSMglobalCond</code> . The transition condition can be specially adjusted for each data set.	1	-	-

Status messages The drive registers information on positioning in the motion sequence mode via the Bits 7, 8, 13, 14 and 15 in the parameter `DCOMstatus`.

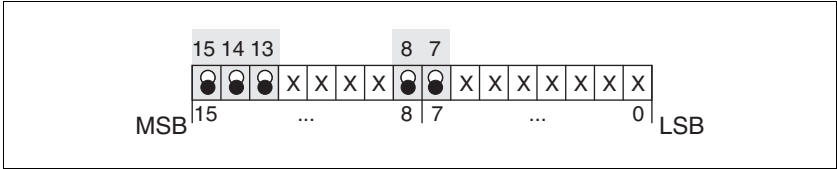


Figure 7.19 Status reports for operating mode

Parameter value	Description
Bit 7: Warning	1: Indicates that there is a warning in the parameter <code>_WarnActive</code>
Bit 8: Halt request active	1: Indicates that a "Halt" is active.
Bit 13: <code>x_err</code>	1: Error arisen
Bit 14: <code>x_end</code>	1: Data set completed, motor at a stand-still
Bit 15: <code>ref_ok</code>	1: Drive is referenced.

7.5.6.4 Switching on the drive system

⚠ DANGER**Unexpected movement**

With suitable parameterization the product can start movements automatically after application of the VDC power supply. An unexpected restart may occur after a power failure.

- Check the behavior of the system during application of the power supply.
- Make sure that no persons can be endangered by a restart of the system after a power failure.
- Make sure that there are no persons in the range of action of the moving system components.

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

If the motion sequence is selected as start-up operating mode, the input signals and settings are processed in the following sequence on switching on the drive system:

Activating the power amplifier

If the parameter `IO_AutoEnable` is parameterized in the value 2, the power amplifier is activated automatically on switching on.

If the parameter `IO_AutoEnable` is parameterized to 0, the power amplifier must be activated separately.

Selection of the data sets

In the case of the local control mode without the expanded I/O signal interface, the data set number 0 will be started. With the expanded I/O signal interface, the data set number to be processed is selected directly with the functions "DataSet Bit0" ... "DataSet Bit1". The activation of the selected data set is enabled with the "DataSet start" function. All data sets can be enabled directly.

In the field bus control mode the parameter `MSMSetnum` defines the starting data set number.

Start of a data set

The globally defined transition condition `MSMGlobalCond` must be fulfilled before the start of the first data set.

In local control mode, the parameter `MSMGlobalCond` evaluates the function "DataSet start" function.

In the field bus control mode the parameter `MSMGlobalCond` evaluates the value of the parameter `MSMstartReq`.

If a static condition is parameterized as globally defined transition condition `MSMGlobalCond` and this is present at the time of activating the power amplifier, the data set is started directly.

A movement can be started automatically by this sequence with suitable parameterization when switched on.

7.5.6.5 "Direct selection of data sets" processing mode



There are fewer digital inputs or outputs available in local control mode without the expanded I/O signal interface. This puts a severe restriction on the scope of functions of the direct selection of the data sets. In local control mode without the expanded I/O signal interface, preferably use the sequential selection of the data sets.

The direct selection of the data sets is parameterized through the parameter `MSMsetNum`.

In the field bus control mode the parameter `MSMSetnum` defines the starting data set number.

Operation with master controller

The sequence timing is controlled by I/O signals of a master controller, e.g. PLC. The current processing status of the drive can be found with suitable return signals. The signals are exchanged in the handshake process.

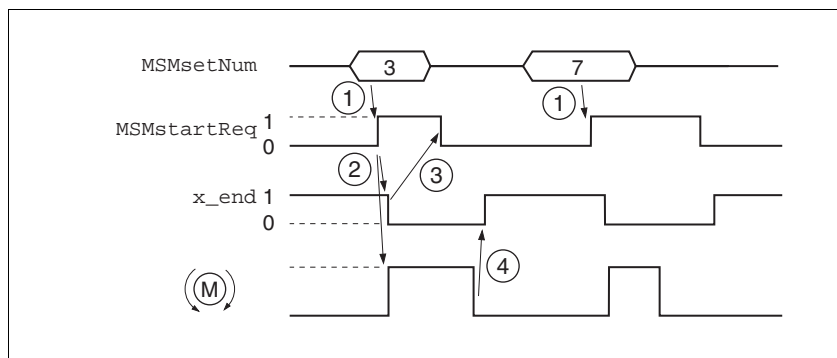
Example of a processing sequence with fieldbus control mode

Figure 7.20 Example processing sequence in direct selection of the data sets

- (1) **PLC:** In the fieldbus control mode the parameter `MSMsetNum` defines the starting data set number.
- (2) **Drive amplifier:** A change in the parameter `MSMstartReq` from 0 to 1 starts the positioning of the selected data set. Simultaneously the bit `x_end` of the parameter `DCOMstatus` is set to 0.
- (3) **PLC:** After detection of the activation of the data set, the parameter `MSMstartReq` can be set to 0 again.
- (4) **Drive amplifier:** The termination of the positioning is reported to the PLC by a 1 on bit `x_end` of the parameter `DCOMstatus` (`MSMstartReq` must be on 0).

The handshake signal checks the function "motor stand still" internally. If this and the parameter `MSMstartReq` are set to inactive, the bit `x_end` of the parameter `DCOMstatus` is on 1 and the cycle as terminated. This results in a synchronization with the speed of the master controller. The second positioning job in the display is a short positioning that is completed more quickly than the cycle time of the master PLC. The processing of the `MSMstartReq` parameter ensures that the PLC detects the activation of the data set.

*Example of a processing sequence
with local control mode*

With the local control mode, the data set to be started is created with the functions "DataSet Bit0" ... "DataSet Bit3" and started with the "DataSet start" function. The processing state can be reported via the "DataSet start acknowledge" function.

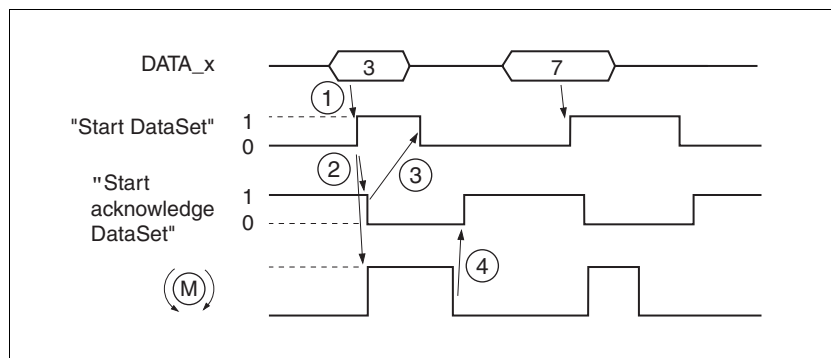


Figure 7.21 Handshake with direct selection of data sets

- (1) **PLC:** Connecting the data set number to the signal inputs and the positive edge to the "DataSet start" function.
- (2) **Drive amplifier:** Edge on the "DataSet start" function starts the positioning of the selected data set. At the same time, the output is set to 0 with the "DataSet start acknowledge" function.
- (3) **PLC:** After the activation of the data set has been acknowledged by the "DataSet start acknowledge" function, the "DataSet start" function can be deactivated again.
- (4) **Drive amplifier:** The ending of positioning is reported to the PLC by 1 level of the "DataSet start acknowledge" function (a 0 level must be on the "DataSet start" function).

The "DataSet start" function checks the "Motor movement active" function internally. If it is at 0-level and the start signal is also inactive, the "DataSet start acknowledge" function is set to 1-level and the cycle is reported as complete. This results in a synchronization with the speed of the master controller. The second positioning job in the display is a short positioning that is completed more quickly than the cycle time of the master PLC. Processing the "DataSet start" function ensures that the PLC acknowledges the activation of the data set (0-level of the "DataSet start acknowledge" function).

Example The data sets in the controller must be assigned as follows for control by PLC:

Data set number	Type	Target	Speed	Acceleration	Deceleration
0	Reference drive	LIMN	1000	500	500
1	absolute	1000	1000	750	200
2	absolute	5000	2000	1000	1000
3	relative	-1000	500	500	500
4	relative	1000	1000	250	250

Setting The following settings are made in the commissioning software:

Name
 XEND XERR Satznummer

Forced value

No	Type	Target	Speed	Acc	Dec
0	homing	LIMN	1000 1/min	500 (1/min)/s	500 (1/min)/s
1	absolute	1000	1000 1/min	750 (1/min)/s	200 (1/min)/s
2	absolute	-5000	2000 1/min	1000 (1/min)/s	1000 (1/min)/s
3	relative positioning	-1000	500 1/min	500 (1/min)/s	500 (1/min)/s
4	relative positioning	1000	1000 1/min	250 (1/min)/s	250 (1/min)/s

Figure 7.22 Example for direct selection of the data sets

7.5.6.6 "Sequential selection of data sets" processing mode

The sequential selection of the data sets is parameterized via parameter `MSMprocMode`.

The processing sequence is preset by parameterization of data sets. The globally defined continued transition condition is used at the starting of the first data set `MSMglobCond`.

The "Start DataSet" function can be used for fulfilling a condition in the local control mode.

The parameter `MSMstartReq` can be used for fulfilling a condition in the fieldbus control mode.

Operation without external controller (minimized external circuitry)

The specified positioning jobs including wait time are processed sequentially. The stepping conditions between the data sets can be set specifically for the application. It is possible to set whether each data set must be activated separately with a condition or if a number of data sets should be completed by the same condition (e.g. static 1-level).

If multiple data sets are enabled in sequence by the same start command, the processing of the sequence can be stopped if the condition is not fulfilled. This is possible if a static state was set as the transition condition, e.g. 1-level. If the sequence is stopped the current data set is still completed. When the transition condition is met again the next data set in the sequence is processed.

In the case of fieldbus control mode, the parameter `MSMsetNum` determines the starting data set number. The setting is imported when the power amplifier is enabled.

Example of sequential selection of the data sets

The following steps are required after enabling the power amplifier:

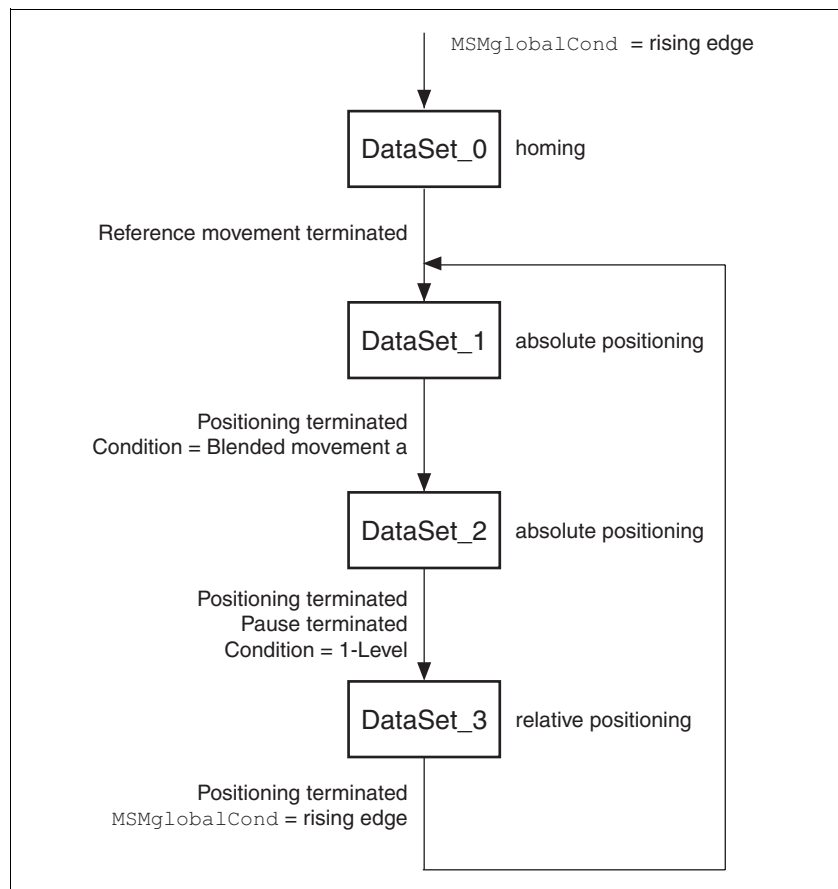


Figure 7.23 Processing principle for sequential data sets

- **Data set0:** Reference movement to negative limit switch, no wait time, profile selection, next data set = data set1, continue process directly with next data set (data set1).
- **Data set1:** Absolute positioning at 200000 usr, no wait time, next data set = data set2, continue process directly with the next data set on reaching the position, the speed does not go to 0 due to the blended movement condition.
- **Data set2:** Absolute positioning at 1000000 usr, then wait time 2000ms, next data set = data set 3, continue process directly with next data set if condition is still met.
- **Data set3:** Relative positioning at 1200000 usr, no wait time, next data set = data set1, continue process with next data set, if rising edge parameterized under the parameter `MSMglobalCond` is fulfilled. During positioning, the "DataSet trigger output" function should be at level 1.

Setting One digital signal output is configured with the "DataSet trigger output" function.

The following settings are made in the commissioning software:

Name

sequential

XEND

XERR

Satznummer

teach-in

Forced value

No	Type	Target	Speed	Acc	Dec	Next	Delay	NectCond	TriggerOutSetStart	TriggerOutSetEnd
0	homing	LIMN	1000 1/min	500 (1/min)/s	500 (1/min)/s	1	0 ms	auto	0-level	unchanged level
1	absolute	200000	1000 1/min	750 (1/min)/s	200 (1/min)/s	2	0 ms	blended move typ A	unchanged level	unchanged level
2	absolute	1000000	2000 1/min	1000 (1/min)/s	1000 (1/min)/s	3	2000 ms	1-level	unchanged level	unchanged level
3	relative positioning	1200000	500 1/min	500 (1/min)/s	500 (1/min)/s	1	0 ms	global next condition	1-level	0-level

Figure 7.24 Example for sequential selection of the data sets

- Processing principle**
- (1) MSMglobalCond = positive edge
 - (2) Reference movement complete
 - (3) Positioning terminated, flowing transition
 - (4) Positioning completed AND DelayTime expired AND condition level 1 fulfilled
 - (5) Positioning complete AND MSMglobalCond fulfilled with rising edge

The data sets are processed in sequence. The specified data set 0 is selected after enabling the power amplifier. Processing of the first data set is started when the global start condition is fulfilled. The end of the process is signaled by an acknowledgement signal.

A return value can be issued through the parameter DCOMstatus (field-bus control mode) or the "DataSet start acknowledge" function (local control mode).

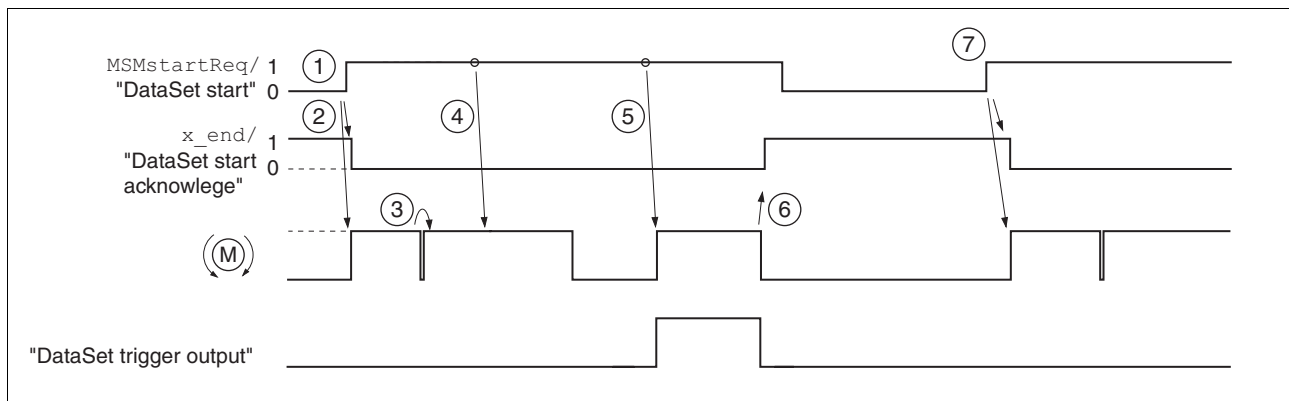
Example of a processing sequence

Figure 7.25 Handshake with the sequential processing mode

- (1) The change from 0 to 1 in the parameter `MSMstartReq` activates the first data set (here 0). It was already selected when the power amplifier was activated.
- (2) Processing of the selected data set is started, simultaneously the bit `x_end` is set to 0.
- (3) Transition of reference movement to data set 1 immediately after end of reference movement.
- (4) Transition from Data set1 to Data set2 takes place without standstill of the motor, because condition is motion sequence.
- (5) Transition from data set2 after expiry of wait time to data set3 immediately because transition condition is met. While data set3 carries out positioning, the "DataSet trigger output" function is at level 1.
- (6) After completion of data set3, a change from 0 to 1 is expected in parameter `MSMstartReq` for continued processing. The completion of a processing sequence is reported through value 1 of the Bits `x_end`. When the data set is ended, the "DataSet trigger output" function is reset to level 0.
- (7) The change from 0 to 1 in parameter `MSMstartReq` activates the data set 1.

7.5.7 Operating mode Homing

⚠ WARNING

Unmonitored operation

- Note that inputs to these parameters are executed by the drive controller immediately on receipt of the data set.
- Make sure that the system is free and ready for movement before changing these parameters

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

Overview of homing

In homing mode, an absolute scale reference of the motor position at a defined axis position is established. Referencing can be carried out by a homing movement or by dimension setting.

- A reference movement performs movement to a defined point, the reference point, on the axis, in order to create the absolute measurement reference of the motor position. The reference point simultaneously defines the zero point that is used for all subsequent absolute positionings as a reference point. Displacement of the zero point can be set by parameters.

The reference movement must be carried out completely to ensure that the new zero point is valid. If it is interrupted, then the reference movement has to be started again. Unlike the other operating modes a reference movement must be completed before you can switch to a new operating mode.

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

- Set dimensions provides the option of setting the current motor position to a desired position value to which the subsequent position specifications will refer.

Types of reference movements

4 standard reference movements are available

- Movement to negative limit switch $\overline{\text{LIMN}}$
- Movement to positive limit switch $\overline{\text{LIMP}}$
- Movement to reference switch $\overline{\text{REF}}$ with movement in counter-clockwise rotation
- Movement to reference switch $\overline{\text{REF}}$ with movement in clockwise rotation

A reference movement can be conducted with or without index pulse.

- Reference movement without index pulse
Movement from the edge of the switch to a distance set by parameters from the edge of the switch.
- Reference movement with index pulse
Movement from the edge of the switch to the next index pulse of the motor. The current motor position can be read out with the parameter `_p_absENCusr`. The index pulse is at position value 0.

- Start operating mode

Homing via Bit 4=1 in parameter `DCOMcontrol` is triggered.
- Status messages

The drive provides information concerning positioning via Bits 10 and 12 to 15 in the parameter `DCOMstatus`.

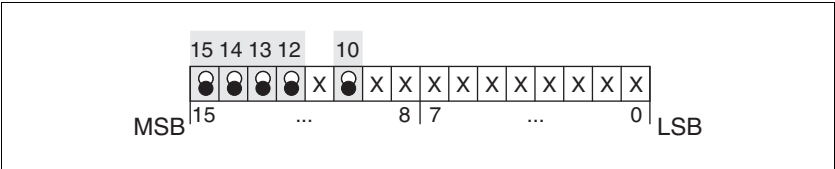


Figure 7.26 Status reports for operating mode

Parameter value	Description
Bit 10: Target reached	0: Homing not finished 1: Homing finished (even in the event of termination via "Halt")
Bit 12: Homing attained	1: Homing successfully completed
Bit 13: x_err	1: Error arisen
Bit 14: x_end	1: Homing completed, motor at a standstill
Bit 15: ref_ok	1: drive has valid reference point

- Operating mode finished

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

When deactivating the power amplifier the valid reference point is retained.
- Description

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMmethod	Reference movement method	-	INT8	CANopen 6098:0 _h
-	1: LIMN with index pulse	1	INT16	Modbus 6936
-	2: LIMP with index pulse	18	R/W	
-	7: REF+ with index pulse, inv., outside	35	-	
	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			
	Abbreviations: REF+: Search movement in pos. direction REF-: Search movement in pos. direction inv.: Invert direction in switch not inv.: Direction not inverted in switch outside: Index pulse / distance outside switch inside: Index pulse / distance inside switch			

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

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



Use the active 0 monitoring signals if possible, because they are proof against wire break.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOsigRef	Signal evaluation REF	-	UINT16	CANopen 3006:E _h
-	1 / normally closed: Normally closed NC	1	UINT16	Modbus 1564
-	2 / normally open: Normally open NO	1	R/W	
		2	per.	
	The reference switch is only activated (to REF) while homing is processed.		-	
IOsigLimN	Signal evaluation LIMN	-	UINT16	CANopen 3006:F _h
-	0 / inactive: Inactive	0	UINT16	Modbus 1566
-	1 / normally closed: Normally closed NC	1	R/W	
-	2 / normally open: Normally open NO	2	per.	
			-	
IOsigLimP	Signal evaluation LIMP	-	UINT16	CANopen 3006:10 _h
-	0 / inactive: Inactive	0	UINT16	Modbus 1568
-	1 / normally closed: Normally closed NC	1	R/W	
-	2 / normally open: Normally open NO	2	per.	
			-	

The parameters HMn and HMn_out are used for setting the speeds for the reference movement.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMn	Reference speed for searching the switch	1/min	UINT32	CANopen 6099:1 _h
-	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	1	UINT16	Modbus 10248
-		60	R/W	
		13200	per.	
			-	
HMn_out	Reference speed for moving away from switch	1/min	UINT32	CANopen 6099:2 _h
-		1	UINT16	Modbus 10250
-	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	6	R/W	
		3000	per.	
			-	

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMP_homeusr	Position at reference point	usr	INT32	CANopen 3028:B _h
-	After a successful reference movement, this position is automatically set at the reference point.	-2147483648	INT32	Modbus 10262
-		0	R/W	
		2147483647	per.	
			-	

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMoutdisusr	Maximum run-out distance	usr	INT32	CANopen 3028:6 _h
-	0: Run-off check inactive	0	INT32	Modbus 10252
-	>0: Run-off in user-defined units	0	R/W	
	The switch must be disabled again inside this run-off, otherwise the reference movement is aborted.	2147483647	per.	-
HMsrchdisusr	Max. search distance after overrun of switch	usr	INT32	CANopen 3028:D _h
-	0: Search distance processing disabled	0	INT32	Modbus 10266
-	>0: Search distance in user units	0	R/W	
	The switch must be activated again within this search distance, otherwise the reference movement is cancelled.	2147483647	per.	-

7.5.7.1 Reference movement without index pulse

Description First the defined limit switch or reference switch will be enabled. A movement is then carried out to a defined distance from the switching edge.

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMdisusr	Distance from switching edge to reference point	usr 1 200 2147483647	INT32 INT32 R/W per. -	CANopen 3028:7 _h Modbus 10254
-	After the drive 'leaves' the switch, it is positioned into the working area by a defined distance. This target point is defined as the reference point.			
-	The parameter is only effective during reference movements without index pulse search.			

Reference movement towards limit switch A reference movement to the negative limit switch is shown below with the distance to the switch edge (HMmethod = 17).

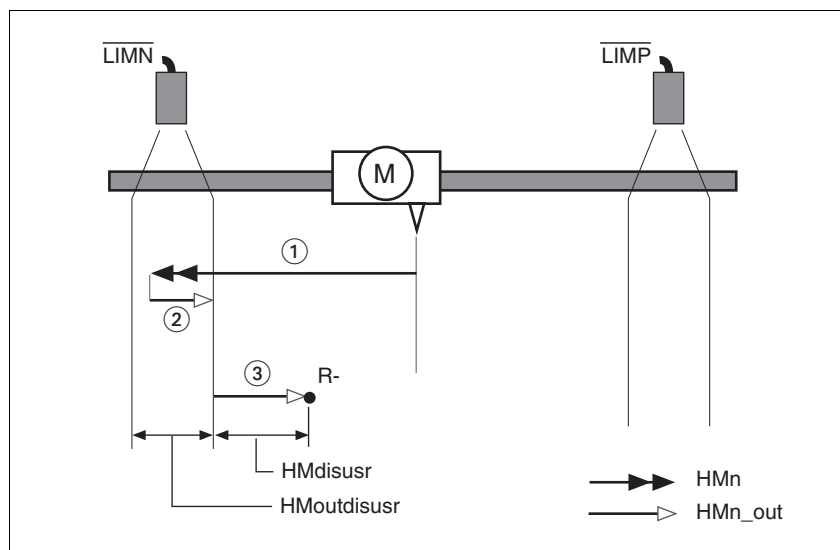


Figure 7.27 Reference movement to the negative limit switch

- (1) Movement to limit switch at search speed
- (2) Movement to switching edge with clearance speed
- (3) Movement at the distance to switching edge with clearance speed

Reference movement to reference switch

Reference movements to the reference switch with the distance to the switch edge are shown below (HMmethod = 27 to 30).

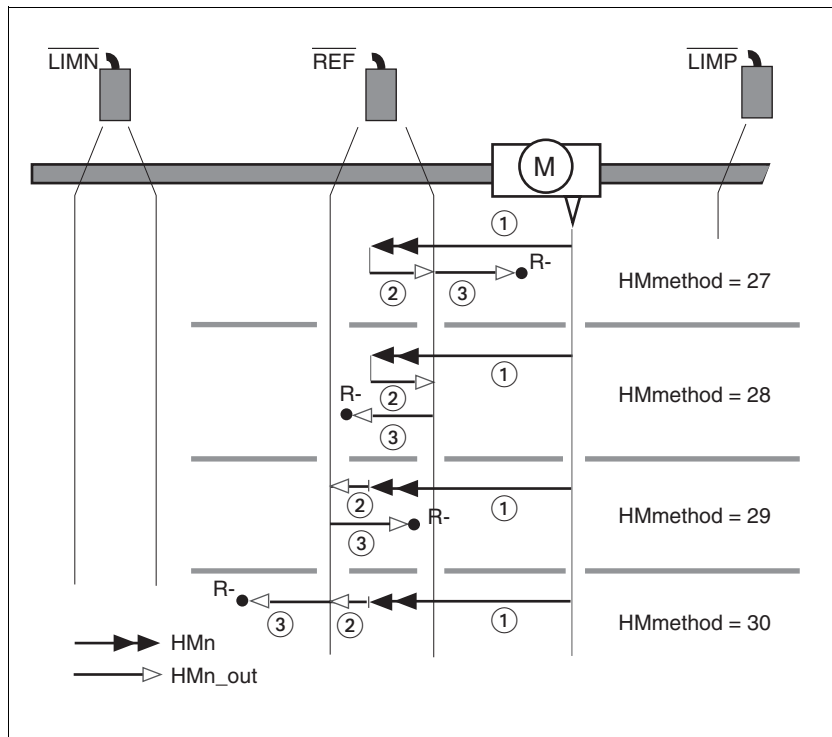


Figure 7.28 Reference movements to the reference switch

- (1) Movement to reference switch at search speed
- (2) Movement to switching edge with clearance speed
- (3) Movement at the distance to switching edge with clearance speed

Examples

Reference movements to the reference switch with the distance to the switch edge are shown below (HMmethod = 27). Various responses at different search speeds and start positions are shown.

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

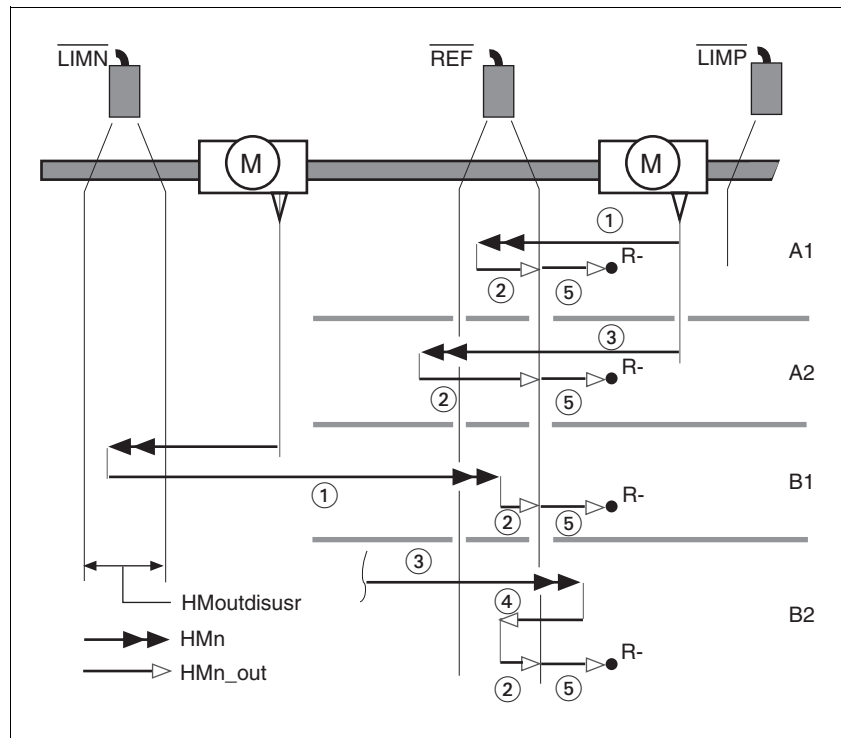


Figure 7.29 Reference movements to the reference switch

- (1) Movement to reference switch at search speed
- (2) Movement to switching point with clearance speed
- (3) Excessively fast movement to reference switch with search speed
- (4) Return movement to switch area at clearance speed
- (5) Movement at the distance to switching point with clearance speed

7.5.7.2 Reference movement with index pulse

Description First the defined limit switch or reference switch will be enabled. A search movement is then made to the nearest index pulse.

Parameter possibilities The position distance between switching edge and index pulse can be calculated with the parameter `HMdisREFtoIDX`. The value should be >0.05 revolutions.

If the index pulse is too close to the switching edge, the limit switch or reference switch can be moved mechanically. This ensures that a reference movement with index pulse can be reproduced at any time.

Otherwise the position of the index pulse can be moved with the parameter `ENC_pabsusr`, see Chapter .

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMdisREFtoIDX	Distance from switching edge to index pulse	revolution	INT32	CANopen 3028:C _h
-	This read value delivers the difference between the index pulse position and the position at the switching edge of the limit or reference switch.	-	INT32	Modbus 10264
-	It allows to check the distance between the index pulse and the switching edge and serves as a criterion for determining whether the reference movement with index pulse processing can be safely reproduced. In increments of 1/10000 revolutions	0.0000	R/-	-
-		-	-	-

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

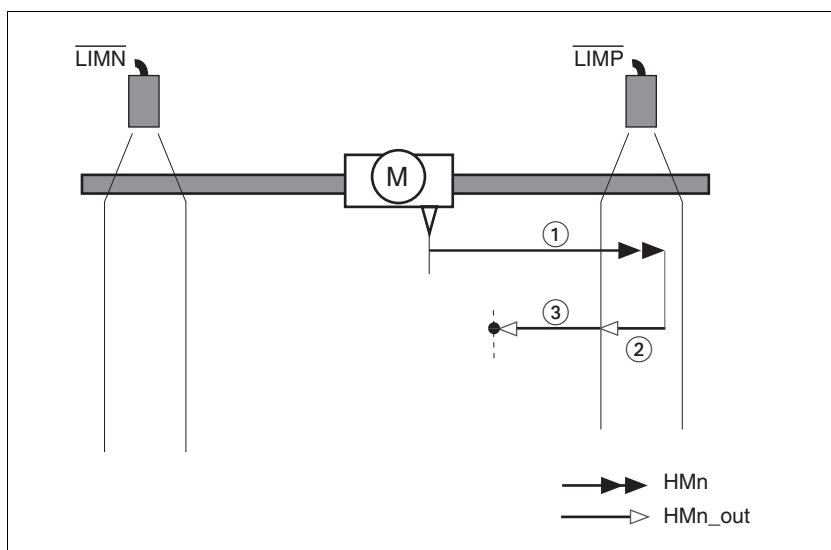


Figure 7.30 Reference movement to the positive limit switch

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

Reference movement to reference switch

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

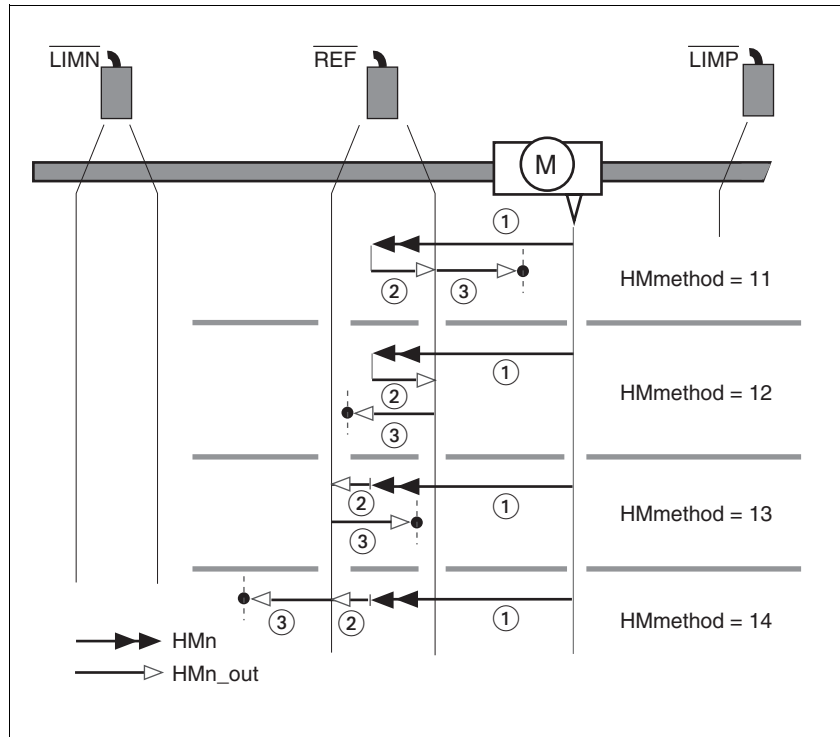


Figure 7.31 Reference movements to the reference switch

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

Examples

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

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

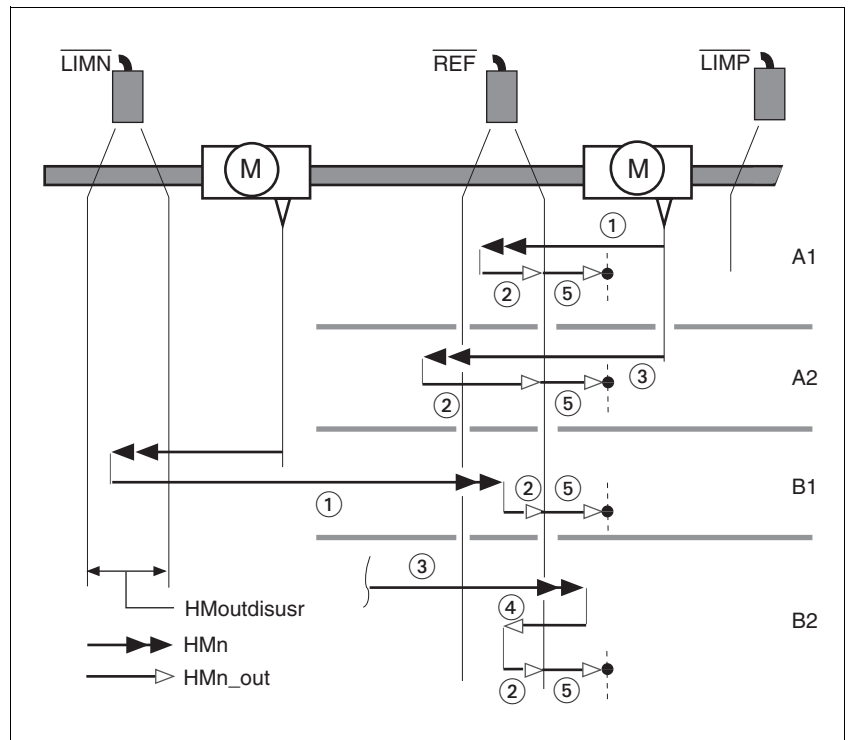


Figure 7.32 Reference movements to the reference switch

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

7.5.7.3 Reference movement to the index pulse

Description A motor movement from the current motor position to the index pulse is carried out.

Reference movement on index pulse In the following descriptions the reference movements are shown on the index pulse (HMmethod = 33 and 34).

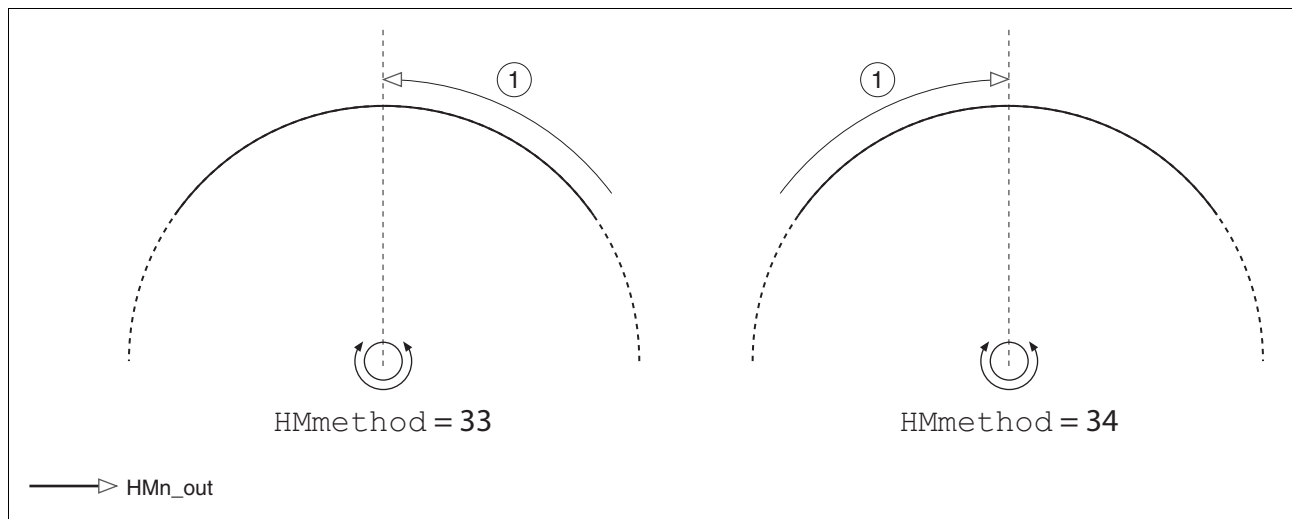


Figure 7.33 Reference movement on index pulse

(1) Movement on index pulse with clearance speed

7.5.7.4 Homing by dimension setting

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

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMp_setpusr	Position for position setting	usr	INT32	CANopen 301B:16 _h
-	Position setting position for homing method	-	INT32	Modbus 6956
-	35	0	R/W	
-		-	-	

Example Dimension setting can be used to carry out a continuous motor movement without exceeding positioning limits.

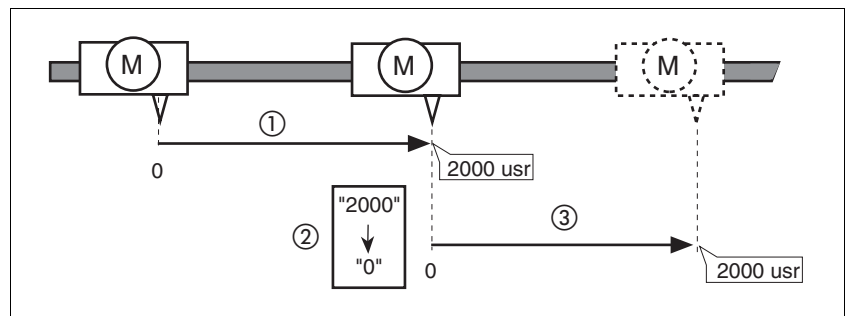


Figure 7.34 Positioning by 4000 usr units with dimension setting

- (1) The motor is positioned by 2000 usr.
- (2) By setting dimensions to 0 the current motor position is set to position value 0 and the new zero point is simultaneously defined.
- (3) After triggering a new travel command of 2000 usr, the new target position is 2000 usr.

This method avoids crossing absolute position limits during a positioning operation because the zero point is continuously tracked.

The read out of the setpoint is by the parameter `_p_refusr`.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_p_refusr	Reference position in user units	usr	INT32	CANopen 301E:C _h
-		-	INT32	Modbus 7704
-		0	R/-	
-		-	-	

7.6 Functions

7.6.1 Monitoring functions

7.6.1.1 Status monitoring in movement mode

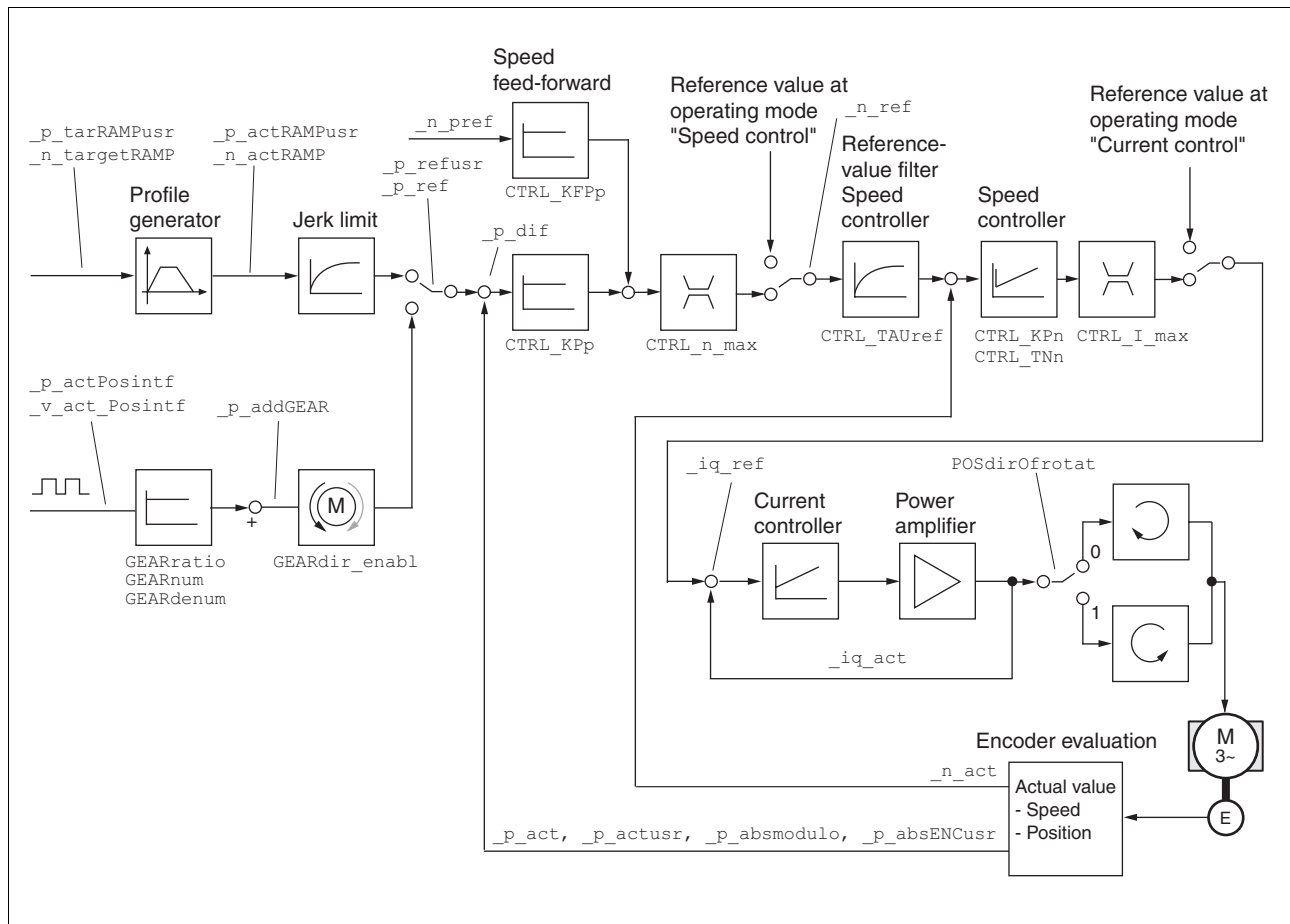


Figure 7.35 Status monitoring of the control loops

7.6.1.2 Positioning range

Positioning range The motor can be moved to any point on the axis within the axis positioning range by specifying an absolute positioning process.

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

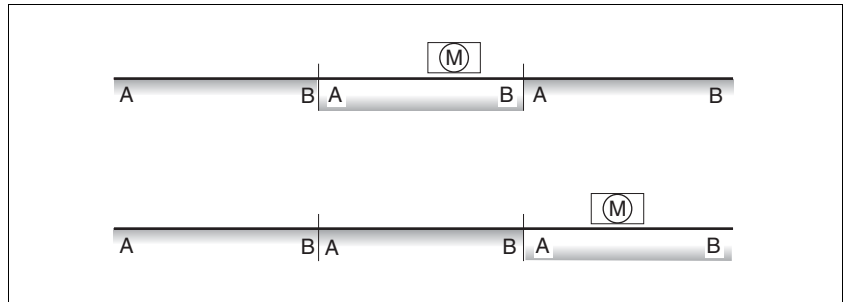


Figure 7.36 Positioning range

The positioning limits, with default scaling, are:

- (A) -1073741824 usr
- (B) 1073741823 usr

An overshoot of the positioning limits is possible in all operating modes, except during an absolute positioning in profile position mode.

Overshoot of motor at a positioning limit loses the reference point.

During a relative position in profile position mode a check of whether the absolute positioning limits will be overshoot is made before starting the movement. If yes, an internal dimension setting to 0 is made before starting the movement. The reference point is lost (`ref_ok = 1->0`).

Software limit switches The positioning range can be limited by software limit switch. This is possible as soon as the drive has a valid zero point (`ref_ok = 1`). The positioning values are quoted relative to the zero point. The software limit switches are set using the parameters `SPVswLimPusr` and `SPVswLimNusr` are activated using `SPV_SW_Limits`.

The determining factor for position monitoring of the software limit switch range is the setpoint of the position controller. Depending on the controller setting, therefore, the motor can stop before it reaches the limit switch position. Bit 2 of parameter `_SigLatched` signals the triggering of a software limit switch.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPVswLimPusr	Positive position limit for software limit switch	usr	INT32	CANopen 607D:2 _h
-	If a user value entered is outside of the permissible user range, the limit switch limits are automatically set to the max. user value.	-2147483647	INT32	Modbus 1544
-		-	R/W per.	
-			-	
SPVswLimNusr	Negative position limit for software limit switch	usr	INT32	CANopen 607D:1 _h
-		-2147483648	INT32	Modbus 1546
-	Refer to description 'SPVswLimPusr'	-	R/W per.	
-			-	

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPV_SW_Limits	Monitoring of software limit switches	-	UINT16	CANopen 3006:3 _h
-	0 / none: None (default)	0	UINT16	Modbus 1542
-	1 / SWLIMP: Activation of software limit switches positive direction	0	R/W	
-	2 / SWLIMN: Activation of software limit switches negative direction	3	per.	
	3 / SWLIMP+SWLIMN: Activation of software limit switches both directions		-	
Monitoring of software limit switches only works in case of successful homing (ref_ok = 1).				

Limit switch

⚠ CAUTION

Loss of control

The use of $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$ can offer some protection against dangers (e.g. impact on mechanical stop caused by incorrect movement targets).

- Use $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$ where possible.
- Check that the external sensors or switches are correctly connected.
- Check the correct functional installation of the limit switch. The limit switches must be mounted in a position far enough away from the mechanical stop to allow an adequate braking distance.
- The functions must be enabled to use $\overline{\text{LIMP}}$ and $\overline{\text{LIMN}}$.
- This function cannot provide protection against faulty functioning of the product or the sensors.

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

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

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



Use the active 0 monitoring signals if possible, because they are proof against wire break.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOsigLimN	Signal evaluation LIMN	-	UINT16	CANopen 3006:F _h
-	0 / inactive: Inactive	0	UINT16	Modbus 1566
-	1 / normally closed: Normally closed NC	1	R/W	
-	2 / normally open: Normally open NO	2	per.	
			-	
IOsigLimP	Signal evaluation LIMP	-	UINT16	CANopen 3006:10 _h
-	0 / inactive: Inactive	0	UINT16	Modbus 1568
-	1 / normally closed: Normally closed NC	1	R/W	
-	2 / normally open: Normally open NO	2	per.	
			-	
IOsigRef	Signal evaluation REF	-	UINT16	CANopen 3006:E _h
-	1 / normally closed: Normally closed NC	1	UINT16	Modbus 1564
-	2 / normally open: Normally open NO	1	R/W	
-		2	per.	
			-	
	The reference switch is only activated (to REF) while homing is processed.			

Moving drive out The drive can be moved back from the limit switch area to the movement area by using manual movement.

If the drive does not go back to the movement area, check whether the manual drive is activated and that the correct direction of movement has been selected.

7.6.1.3 Monitoring internal signals

The monitoring systems protect the product and contribute to the functioning and operating safety. You will find a list of all safety devices in the chapter entitled 2.6 "Monitoring functions"

Temperature monitoring

Sensors monitor the temperature of motor and power amplifier. All temperature limits are permanently set. If the temperature of a component approaches its permissible temperature limit, the device creates a warning signal. If the temperature exceeds the limit value for more than 5 seconds, then the power amplifier and the regulation switches off. The device signals a temperature error.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_Temp_act_PA STA- - TPA StR- - tPR	Power amplifier temperature	°C - 0 -	INT16 INT16 R/- -	CANopen 301C:10 _h Modbus 7200
PA_T_max - -	Maximum permissible power amplifier temperature	°C - 0 -	INT16 INT16 R/- per. -	CANopen 3010:7 _h Modbus 4110
PA_T_warn - -	Temperature warning threshold of power amplifier	°C - 0 -	INT16 INT16 R/- per. -	CANopen 3010:6 _h Modbus 4108

I²t monitoring

If the device operates with high peak currents, then temperature monitoring with sensors can be too sluggish. With the ²t monitoring, the closed-loop control anticipates a rise in temperature in time and if the ²t threshold is exceeded, it reduces the current to the nominal value.

If the limit value is not reached, the individual components can be taken to the output limit again.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_I2t_act_M - -	Current motor overload	% - 0 -	INT16 INT16 R/- -	CANopen 301C:19 _h Modbus 7218
_I2t_mean_M STA- - i2TM StR- - , ztñ	Motor load	% - 0 -	INT16 INT16 R/- -	CANopen 301C:1A _h Modbus 7220

Tracking error monitoring

The drive monitors the tracking error at 1 ms intervals. The tracking error is the difference between the current setpoint and the actual position. If the value of this position difference exceeds the limit value set in parameter `SPV_P_maxDiff`, this will directly result in a travel stop (tracking error) with an error class that can be parameterized.

Select the limit value in parameter `SPV_P_maxDiff` clearly greater than the maximum tracking error that may occur with error-free operation. This will ensure that a shutdown as a result of tracking error will only occur in case of error, e.g. with illegally increased external load torque, faulty position encoder etc.

The maximum control deviation occurring during operation can be determined with the parameter `_p_DifPeak` and compared with the maximum permissible tracking distance. This allows the actual distance to the shut-off limit to be detected.

The error class for a tracking error can also be changed, see also 7.6.1 "Monitoring functions".

Parameter Name	Description	Unit Minimum value Default value 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	revolution 0.0000	UINT32 UINT32 R/W	CANopen 3011:F _h Modbus 4382
-	The tracking error is the current position control deviation minus the position control deviation caused by the speed. See <code>SPV_p_maxDiff</code> for more information. A write access resets this value.	- 429496.7295	- -	
<code>_p_dif</code>	Current deviation between reference and actual position	revolution -214748.3648	INT32 INT32 R/-	CANopen 60F4:0 _h Modbus 7716
<code>STA- - PDiF</code> <code>5tR- - Pd, F</code>	Corresponds to the current control deviation of the position controller without consideration of any dynamic components. Please note the difference in terms of <code>SPV_p_maxDiff</code> .	- 214748.3647	- -	
<code>SPV_p_maxDiff</code>	Max. permissible tracking error of the position controller	revolution 0.0001 1.0000 200.0000	UINT32 UINT32 R/W per. -	CANopen 6065:0 _h Modbus 4636
-	The tracking error is the current position control deviation minus the position control deviation caused by the speed. Actually, only the position control deviation caused by the torque request is used for tracking error monitoring.			

Monitoring parameters The unit and operating status can be monitored with various objects.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_SigActive	Current status of monitoring signals	-	UINT32	CANopen 301C:7 _h
-	See _SigLatched for more details on the bit codes.	-	UINT32	Modbus 7182
-		0	R/-	
-		-	-	
_SigLatched	Saved status of monitoring signals	-	UINT32	CANopen 301C:8 _h
STA- - SiGS	Signal status:	-	UINT32	Modbus 7184
5tR- - 5, 55	0: Not activated	0	R/-	
	1: Activated	-	-	
	Bit assignments:			
	Bit0: General fault			
	Bit1: Limit switches (LIMP/LIMN/REF)			
	Bit2: Out of range (SW limit switches, tuning)			
	Bit3: Quickstop via fieldbus			
	Bit4: Inputs STO are 0			
	Bit6: RS485 fault			
	Bit7: CAN fault			
	Bit9: Frequency of reference signal too high			
	Bit10: Fault current operating mode			
	Bit12: Profibus fault			
	Bit14: Low voltage DC bus			
	Bit15: High voltage DC buss			
	Bit16: Mains phase missing			
	Bit17: Motor connection fault			
	Bit18: Motor overcurrent/short circuit			
	Bit19: Motor encoder fault			
	Bit20: Undervoltage 24VDC			
	Bit21: Overtemperature (power amplifier, motor)			
	Bit22: Tracking error			
	Bit23: Max. speed exceeded			
	Bit24: Inputs STO different			
	Bit29: EEPROM fault			
	Bit30: System booting (Hardware fault or parameter error)			
	Bit31: System error (e.g. watchdog)			
	Monitoring functions are product-dependent.			
_WarnActive	Active warnings, bit-coded	-	UINT16	CANopen 301C:B _h
-	See _WarnLatched for more details on the bit codes.	-	UINT16	Modbus 7190
-		0	R/-	
-		-	-	

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_WarnLatched	Saved warnings, bit-coded	-	UINT16	CANopen 301C:C _h
STA- - WRNS	Saved warning bits are deleted in the case of a FaultReset.	-	UINT16	Modbus 7192
StR- - Warn5	Bits 10, 11, 13 are deleted automatically.	0	R/-	
	Signal status: 0: Not activated 1: Activated	-	-	
	Bit assignments: Bit 0: General warning (see _LastWarning) Bit 1: Temperature of power amplifier high Bit 2: Temperature of motor high Bit 3: Reserved Bit 4: Power amplifier overload (I ² t) Bit 5: Motor overload (I ² t) Bit 6: Braking resistor overload (I ² t) Bit 7: CAN warning Bit 8: Motor encoder warning Bit 9: RS485 protocol warning Bit 10: STO_A and/or STO_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: Reserved Bit 15: Reserved			
	Monitoring functions are product-dependent.			
_actionStatus	Action word	-	UINT16	CANopen 301C:4 _h
-	Signal status:	-	UINT16	Modbus 7176
-	0: not activated	0	R/-	
-	1: activated	-	-	
	Bit0: Error class 0 Bit1: Error class 1 Bit2: Error class 2 Bit3: Error class 3 Bit4: Error class 4 Bit5: Reserved Bit6: Drive is at standstill (Actual speed _n_act [1/min] < 9) Bit7: Drive rotates clockwise Bit8: Drive rotates counter-clockwise Bit9: Reserved Bit10: Reserved Bit11: Profile generator idle (reference speed is 0) Bit12: Profile generator decelerates Bit13: Profile generator accelerates Bit14: Profile generator moves at constant speed Bit15: Reserved			
_StopFault	Error number of last stop fault	-	UINT16	CANopen 603F:0 _h
FLT- - STPF		-	UINT16	Modbus 7178
FLt- - StPF		0	R/-	
		-	-	

Set fault response The response of the unit to a fault is classified into error classes, and can be set for certain monitoring functions. This allows the error response of the unit to be matched to the operational requirements.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPV_Flt_pDiff	Error response to tracking error	-	UINT16	CANopen 3005:B _h
-	1 / ErrorClass1: Error class 1	1	UINT16	Modbus 1302
-	2 / ErrorClass2: Error class 2	3	R/W	
-	3 / ErrorClass3: Error class 3	3	per.	
			-	

7.6.2 Scaling

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

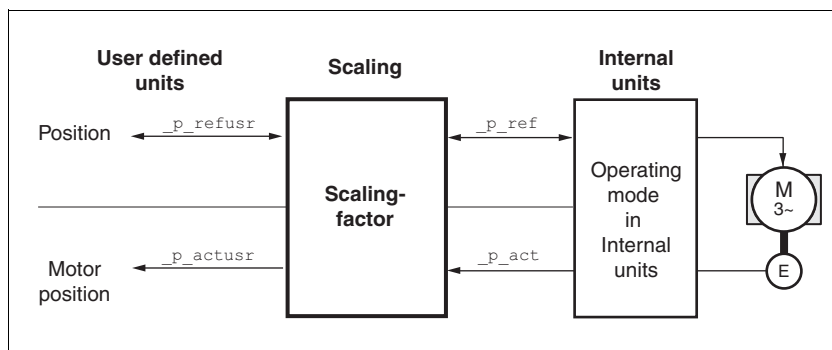


Figure 7.37 Scaling

Scaling factor The scaling factor creates the relationship between the number of motor rotations and the required user units [usr] needed for this. It is specified in [rev/usr].

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

Figure 7.38 Calculation of the scaling factor

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

⚠ WARNING

Unexpected movement by changing the scaling

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

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

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

The scaling factor is set using the parameters POSscaleNum and POSscaleDenom. A new scaling factor is activated by transfer of the numerator value.

When quoting the scaling factor, take care that the relationship can be completely represented by a fraction.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
POSscaleNum	Numerator of position scaling	revolution	INT32	CANopen 3006:8 _h
-	Specification of the scaling factor:	1	INT32	Modbus 1552
-	Motor revolutions [U]	1	R/W	
	-----	2147483647	per.	
	Change of user position [usr]		-	
	A new scaling is activated when the numerator value is supplied.			
	User limit values may be reduced due to the calculation of an internal factor.			
POSscaleDenom	Denominator of position scaling	usr	INT32	CANopen 3006:7 _h
-	Refer to numerator (POSscaleNum) for a description.	1	INT32	Modbus 1550
-		16384	R/W	
		2147483647	per.	
	A new scaling is activated when the numerator value is supplied.			



If the existing unit is replaced by this unit, and if the same positioning orders are to be used, then the scaling is to be set in accordance with the settings used previously.

Value change of the scaling factor is only possible with inactive power amplifier. Values in user-defined units are converted to internal units with the power amplifier active.

Examples

The following different cases apply for setting user-defined units.

- Scaling corresponds to default scaling
1 motor revolution = 16384 user-defined units
=> every motor position can be approached.
- Scaling is lower than the default scaling
1 motor revolution = e.g. 4096 user-defined units
=> Every fourth motor position can be approached.



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

If the parameters are not adjusted, this can cause problems such as an error during the reference movement, because the distance to the switching edge of the limit or reference switch is no longer sufficient for safely leaving the switching range.

Example 1 Positioning of 1111 user-defined units is to correspond to 3 motor revolutions. This will result in

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

Figure 7.39 Calculation scaling factor, Example 1

If you carry out a relative positioning operation of 900 user-defined units now, the motor will move $900 \text{ usr} * 3/1111 \text{ rev/usr} = 2.4302 \text{ revolutions}$.

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

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

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

Figure 7.40 Calculation scaling factor, Example 2

Example 3 Setting positioning in 1/1000 rad

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

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

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

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

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

Figure 7.41 Calculation scaling factor, Example 3

7.6.3 Movement profile

Profile generator Target position and final speed are input values to be entered by the user. The profile generator uses these values to calculate a motion profile dependent on the selected operating mode.

The initial values of the profile generator and the addable jolt limiting are transformed into a motor movement by the drive regulator.

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 steepness The steepness of the ramp determines the speed changes of the motor per unit time. It can be specified for the acceleration ramp via parameter RAMPacc for the deceleration ramp via RAMPdecel.

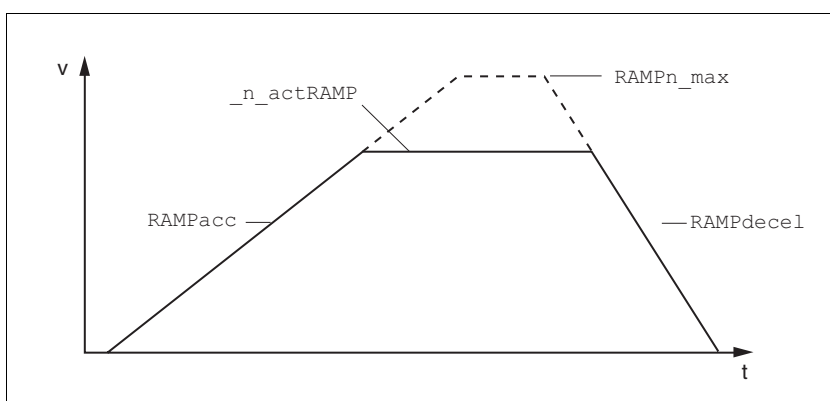


Figure 7.42 Acceleration and deceleration ramps

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMPacc	Acceleration of profile generator	(1/min)/s 30 600 3000000	UINT32 UINT32 R/W per. -	CANopen 6083:0 _h Modbus 1556
RAMPdecel	Deceleration of profile generator	(1/min)/s 750 750 3000000	UINT32 UINT32 R/W per. -	CANopen 6084:0 _h Modbus 1558

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMPn_max	Limitation of ref. speed for op. modes with profile generation	1/min 60	UINT32 UINT16	CANopen 607F:0h Modbus 1554
-	The parameter is active in the following operating modes:	13200 13200	R/W per. -	
-	<ul style="list-style-type: none"> - Profile position - Profile velocity - Homing - Jog <p>If a greater reference speed is set in one of these operating modes, it is automatically limited to RAMPn_max. This way, commissioning at limited speed is easy to perform.</p>			

Jolt limiting The jolt limiting removes the jump-like acceleration changes to create a smooth, soft virtually jolt-free speed change.

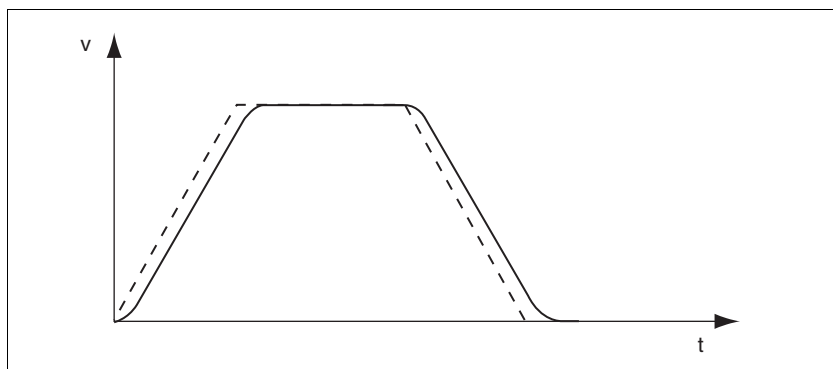


Figure 7.43 Speed curve with and dotted without jolt limitation

The jolt limitation is set and switched on using the parameter RAMP_TAUjerk.

The end of travel ($x_{end} = 1$) is not reported until the target position at the output of the jerk limiting has been reached.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMP_TAUjerk	Jerk limitation	ms	UINT16	CANopen 3006:D _h
-	0 / off: Off	0	UINT16	Modbus 1562
-	1 / 1: 1 ms	0	R/W	
-	2 / 2: 2 ms	128	per.	
	4 / 4: 4 ms		-	
	8 / 8: 8 ms			
	16 / 16: 16 ms			
	32 / 32: 32 ms			
	64 / 64: 64 ms			
	128 / 128: 128 ms			
	Limits the acceleration change (jerk) of the reference position generation during the positioning transitions: Standstill - acceleration Acceleration - constant speed Constant speed - deceleration Deceleration - standstill			
	Processing in the following operating modes: - Profile velocity - Profile position - Jog - Homing			
	Adjustments can only be made if the operating mode is inactive (x_end=1).			

7.6.4 Quick Stop

Function "Quick Stop" is a fast braking function which stops the motor as a result of a fault of error class 1 and 2 or by a software stop.

In the event of a fault category 1 fault response, the power amplifier remains on. In the case of error class 2, the output stage switches off after the drive is at a standstill.

You can stop the motor using a deceleration ramp or a maximum current. Set the type of deceleration with the parameter `LIM_QStopReact`.

- ▶ Use parameter `LIM_QStopReact` to define the required type of deceleration.
- ▶ Use parameter `RAMPquickstop` to define a required deceleration ramp or parameter `LIM_I_maxQSTP` to set a required maximum current.

Overvoltage The device absorbs the excess braking energy. If the DC bus voltage exceeds the permissible limit the power amplifier switches off and the device signals "DC bus overvoltage". The motor runs down without braking.

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

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
<code>LIM_I_maxQSTP</code>	Current limitation for Quick Stop	A_{pk}	UINT16	CANopen 3011:5 _h
<code>SET- - LiQS</code>	Max. current during braking via torque ramp due to an error of error classes 1 or 2 and when a software stop is triggered.	-	UINT16	Modbus 4362
<code>SET- - LiQS</code>		-	R/W	
			per.	
			-	
	Maximum and default settings depend on the motor and the power amplifier (settings <code>M_I_max</code> and <code>PA_I_max</code>)			
	In increments of 0.01A _{pk}			

7.6.5 Halt

Function The "HALT" function is a function used to interrupt the motor: it stops the motor and briefly interrupts movement mode.

Internal position calibration is performed once the drive comes to a standstill. The position control is activated and the motor is stopped while the power amplifier is active.

After cancellation of all "Halt" requests the interrupted movement is continued. If the "HALT" request is already canceled during the braking procedure, the drive continues to run down until it reaches a standstill and only then accelerates again.

The "Halt" function can be set from any desired source (such as commissioning software or input signal $\overline{\text{HALT}}$).

You can stop the motor using a deceleration ramp or a maximum current. Set the type of deceleration with the parameter `LIM_HaltReaction`.

- Use parameter `LIM_HaltReaction` to define the required type of deceleration.
- Use parameter `RAMPdecel` to define a required deceleration ramp or parameter `LIM_I_maxHalt` to set a required maximum current.

Overvoltage The device absorbs the excess braking energy. If the DC bus voltage exceeds the permissible limit the power amplifier switches off and the device signals "DC bus overvoltage". The motor runs down without braking.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMPdecel	Deceleration of profile generator	(1/min)/s 750 750 3000000	UINT32 UINT32 R/W per. -	CANopen 6084:0 _h Modbus 1558
LIM_I_maxHalt	Current limitation for Halt	A _{pk} -	UINT16 UINT16 R/W per. -	CANopen 3011:6 _h Modbus 4364
SET- - LiA	Max. current during braking after Halt or when an operating mode is terminated.	-		
SEt - - L, hR	Maximum and default settings depend on the motor and the power amplifier (settings M_I_max and PA_I_max)			
	In increments of 0.01A _{pk}			

7.6.6 Standstill window

The standstill window can be used to check whether the drive has reached the setpoint position.

If the control deviation $_p_dif$ of the position controller remains in the standstill window after the end of the positioning for time $STANDpwinTime$, the device reports the end of the process ($x_end = 0- >1$).

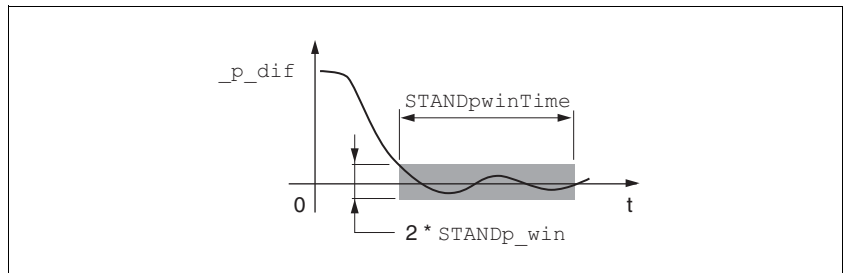


Figure 7.44 Standstill window

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

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
STANDp_win	Standstill window, permissible control deviation	revolution 0.0000	UINT32	CANopen 6067:0 _h
-		0.0010	UINT16	Modbus 4370
-	The control deviation for the standstill window time must be within this range for a standstill of the drive to be detected.	3.2767	R/W per.	-
	Processing of the standstill window must be activated via the parameter 'STANDpwinTime'.			
STANDpwinTime	Standstill window, time	ms 0	UINT16	CANopen 6068:0 _h
-	0: Monitoring of standstill window deactivated	0	UINT16	Modbus 4372
-	>0: Time in ms during which the control deviation must be in the standstill window	32767	R/W per.	-
STANDpwinTout	Timeout time for standstill window monitoring	ms 0	UINT16	CANopen 3011:B _h
-	0 : Timeout monitoring deactivated	0	UINT16	Modbus 4374
-	>0 : Timeout time in ms	16000	R/W per.	-
	Standstill window processing values are set via $STANDp_win$ und $STANDpwinTime$.			
	Time monitoring starts when the target position (reference position of position controller) is reached or when the profile generator has finished processing.			

7.6.7 Configurable inputs and outputs

⚠ WARNING

Unforeseen behavior of inputs and outputs

The functions of the inputs and outputs depend on the selected start-up operating mode and the settings of the corresponding parameters.

- Check that the wiring is appropriate for the settings.
- Only start the system if there are no persons or materials in the danger zone and the system can be operated safely.
- When commissioning carefully run tests for all operating statuses and fault cases.

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

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

The parameters `IOfunc_LI1`, `IOfunc_LI2`, and `IOfunc_LI4` are available for signal inputs. The parameters `IOfunc_LO1` and `IOfunc_LO2` are available for signal outputs.

In addition, the optional "expanded I/O interface" provides the parameters `IOfunc_XL1 ... IOfunc_XLI6`, `IOfunc_XLO1_OUT` and `IOfunc_XLO2_OUT`.

The digital signal inputs and outputs are assigned with functions depending on the start-up operating mode.

The signal input `ENABLE` is an exception. This signal input is always assigned with the "Enable" function, see chapter 7.3 "Operating states".

The digital signal inputs `STO_A` and `STO_B` are always assigned with the STO safety function.

Current status The current state of the digital signal inputs and signal outputs can be displayed through the parameters `_IO_LI_act` and `_IO_LO_act`.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
<code>_IO_LI_act</code>	Status of digital inputs	-	UINT16	CANopen 3008:F _h
-	Coding of the individual signals:	-	UINT16	Modbus 2078
-	Bit0: LI1	0	R/-	
	Bit1: LI2	-	-	
	...			
	Bit8: XLI1			
	Bit9: XLI2			
	...			
<code>_IO_LO_act</code>	Status of digital outputs	-	UINT16	CANopen 3008:10 _h
-	Coding of the individual signals:	-	UINT16	Modbus 2080
-	Bit0: LO1_OUT	0	R/-	
	Bit1: LO2_OUT	-	-	
	...			
	Bit8: XLO1_OUT			
	Bit9: XLO2_OUT			
	...			

Factory settings, local control mode The table shows the factory settings for local control mode depending on the start-up operating mode.

Pin Signal	Jog	Current control	Speed control	Motion sequence
CN3.9 LI1	Jog negative	No function / free available	No function / free available	Reference switch (REF)
CN3.3 LI2	Jog positive	Fault reset	Fault reset	Negative limit switch (LIMN)
CN3.10 LI3	Enable ¹⁾	Enable ¹⁾	Enable ¹⁾	Enable ¹⁾
CN3.4 LI4	Jog fast/slow	Halt	Halt	DataSet Start
CN4.7 XLI1	No function / free available	No function / free available	No function / free available	DataSet Select
CN4.2 XLI2	No function / free available	No function / free available	No function / free available	DataSet Bit0
CN4.8 XLI3	No function / free available	No function / free available	No function / free available	DataSet Bit1
CN4.3 XLI4	No function / free available	No function / free available	No function / free available	DataSet Bit2
CN4.9 XLI5	No function / free available	No function / free available	No function / free available	DataSet Bit3
CN4.4 XLI6	No function / free available	No function / free available	No function / free available	No function / free available
CN3.8 LO1_OUT	No fault	No fault	No fault	No fault
CN3.2 LO2_OUT	Active	Active	Active	Active
CN4.6 XLO1_OUT	No function / free available	No function / free available	No function / free available	DataSet start acknowledge

Pin Signal	Jog	Current control	Speed control	Motion sequence
CN4.1 XLO2_OUT	No function / free available	No function / free available	No function / free available	DataSet trigger output

1) Function cannot be modified.

After modifying the start-up operating mode and switching the device off and on the signal inputs and signal outputs are pre-assigned corresponding to the factory settings.

Factory settings, fieldbus control mode

The table below shows the factory settings for fieldbus control mode.

Pin Signal	For all operating modes
CN3.9 LI1	Reference switch (REF)
CN3.3 LI2	Negative limit switch (LIMN)
CN3.10 LI3	Positive limit switch (LIMP) ¹⁾
CN3.4 LI4	Halt
CN4.7 XLI1	No function / free available
CN4.2 XLI2	No function / free available
CN4.8 XLI3	No function / free available
CN4.3 XLI4	No function / free available
CN4.9 XLI5	No function / free available
CN4.4 XLI6	No function / free available
CN3.8 LO1_OUT	No fault
CN3.2 LO2_OUT	Active
CN4.6 XLO1_OUT	No function / free available
CN4.1 XLO2_OUT	No function / free available

1) Function cannot be modified.

7.6.7.1 Description of functions of the signal inputs

<i>No function / free available</i>	The "No function / free available" function does not have an internal-device function. The signal input which is freely available can be read via parameter <code>_IO_LI_act</code> .
<i>Fault reset</i>	An error message is reset with the function, see 7.3 "Operating states".
<i>Enable</i>	The power amplifier is activated with the function, see 7.3 "Operating states".
<i>Halt</i>	A "Halt" is triggered with the function, see chapter 7.6.5 "Halt".
<i>Start profile positioning</i>	<p>This function sets the start signal (parameter <code>DCOMcontrol</code>, Bit4, New setpoint) for the profile position operating mode via a digital input. The fieldbus must not set the start signal for a positioning in the parameter <code>DCOMcontrol</code> after transferring the position value. The positioning is then executed with rising edge at the digital input.</p> <p>A position can also be started by using the parameter <code>DCOMcontrol</code>. A start signal must not be pending at the digital input in this case.</p> <p>If the positioning cannot be executed, e.g. still no "Operation enable" operating status, no error message is sent.</p>
<i>Enable positive motor move</i>	<p>The function releases or locks positive reference values through a position switch. Positive reference values are locked on moving past the switching edge of the positive position switch and the motor stops. Only negative reference values are executed until the motor is again travelled over the switching edge.</p> <p>The function is available in the operating modes electronic gear and oscillator. The requirement is a correct wiring of the position switch, see chapter .</p>
<i>Enable positive motor move</i>	<p>The function releases or locks positive reference values through a position switch. Positive reference values are locked on moving past the switching edge of the positive position switch and the motor stops. Only negative reference values are executed until the motor is again travelled over the switching edge.</p> <p>The function is available in the operating mode speed control. The requirement is a correct wiring of the position switch, see chapter .</p>
<i>Enable negative motor move</i>	The function corresponds to the operation of "Enable positive motor move", but negative reference values are enabled or locked through a position switch.
<i>Jog positive</i>	A jog movement in clockwise rotation is executed with the function, see 7.5.1 "Operating mode Jog".
<i>Jog negative</i>	A jog movement in counterclockwise rotation is executed with the function, see 7.5.1 "Operating mode Jog".
<i>Jog fast/slow</i>	The device switches between slow and fast jog with the function, see 7.5.1 "Operating mode Jog".
<i>Automatic/Manual</i>	The function "Automatic/Manual" allows you to start a jog movement in the operating mode "Motion Sequence". For this function to work, the functions "Jog positiv", "Jog negativ" and, if required, "Jog fast/slow" must have been configured appropriately.

<i>Enable2</i>	The power amplifier is activated with the function, see 7.3 "Operating states". This function is possible only if the parameter <code>IOposInterfac</code> has the value "PDinput" set in it.
<i>DataSet Start</i>	This function fulfils the globally defined transition condition for the motion sequence operating mode, see Chapter 7.4.1 "Start operating mode".
<i>DataSet Select</i>	As soon as a sequence is waiting for a transition condition, a data set can be selected with the "DataSet Select" function. When the globally defined transition condition is fulfilled, the data set is started.
<i>Reference switch (REF)</i>	The operation of the reference switch is set with the function. See chapter 7.5.7 "Operating mode Homing".
<i>Positiv limit switch (LIMP)</i>	The operation of the positive limit switch is set with the function. See chapter 7.5.7 "Operating mode Homing" and chapter 7.6.1.2 "Positioning range".
<i>Negative limit switch (LIMN)</i>	The operation of the negative limit switch is set with the function. See chapter 7.5.7 "Operating mode Homing" and chapter 7.6.1.2 "Positioning range".

7.6.7.2 Configuration of signal inputs

The digital inputs can be assigned with functions by using the parameters IOfunct_LI1, IOfunct_LI2 and IOfunct_LI4. In addition, the optional expanded I/O interface provides the parameters IOfunct_XLI1 ... IOfunct_XLI6.

The following table gives an overview of the functions in local control mode depending on the start-up operating mode.

Function	Jog	Current control	Speed control	Motion sequence
No function / free available	LI1, LI2, LI4, XLI1 ... XLI6	LI1, LI2, LI4	LI1, LI2, LI4	LI1, LI2, LI4, XLI1 ... XLI6
Fault reset	LI2	LI2	LI2	LI1, LI2, LI4
Halt	LI4	LI4	LI4	LI1, LI2, LI4
Enable positive motor move	-	-	LI1, LI2, LI4	-
Enable negative motor move	-	-	LI1, LI2, LI4	-
Jog positive	LI1, LI2, LI4	-	-	XLI1 ... XLI6
Jog negative	LI1, LI2, LI4	-	-	XLI1 ... XLI6
Jog fast/slow	LI1, LI2, LI4	-	-	XLI1 ... XLI6
DataSet Start	-	-	-	LI1, LI2, LI4, XLI1 ... XLI6
DataSet Select	-	-	-	LI1, LI2, LI4, XLI1 ... XLI6
DataSet Bit0	-	-	-	XLI1 ... XLI6
DataSet Bit1	-	-	-	XLI1 ... XLI6
DataSet Bit2	-	-	-	XLI1 ... XLI6
DataSet Bit3	-	-	-	XLI1 ... XLI6

The following table shows an overview of the functions in fieldbus control mode.

Function	For all operating modes
No function / free available	LI1, LI2, LI4, XLI1 ... XLI6
Halt	LI4
Start profile positioning	LI1, LI2, LI4
No function / free available	LI1, LI2, LI4, XLI1 ... XLI6
Halt	LI4
Reference switch (REF)	LI1
Negative limit switch (LIMP)	LI3
Negative limit switch (LIMN)	LI2

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOfuncn_LI1	Function Input LI1	-	UINT16	CANopen 3007:1 _h
I-O - - LI1	1 / Free available / none: Available as required	-	UINT16	Modbus 1794
1 - 0 - - LI1	2 / Fault reset / FrE5: Reset fault (local control mode only)	0	R/W	
	4 / Halt / hALt: Halt	-	per.	
	6 / Enable positive motor move / Po5N: Enable positive motor movement (local control mode only)		-	
	7 / Enable negative motor move / nEGN: Enable negative motor movement (local control mode only)			
	9 / Jog positive / JoGP: Jog right/positive			
	10 / Jog negative / JoGN: Jog left/negative			
	11 / Jog fast/slow / JoGF: Jog fast/slow			
	13 / DataSet Start / dSEtR: Motion sequence: start request			
	14 / DataSet Select / dSEL: Motion sequence: data set selection			
	20 / Reference switch (REF) / rEF: Reference switch (REF)			
	21 / Positive limit switch (LIMP) / L, nP: Positive limit switch (LIMP)			
	22 / Negative limit switch (LIMN) / L, nN: Negative limit switch (LIMN)			
IOfuncn_LI2	Function Input LI2	-	UINT16	CANopen 3007:2 _h
I-O - - LI2	1 / Free available / none: Available as required	-	UINT16	Modbus 1796
1 - 0 - - LI2	2 / Fault reset / FrE5: Reset fault (local control mode only)	0	R/W	
	4 / Halt / hALt: Halt	-	per.	
	6 / Enable positive motor move / Po5N: Enable positive motor movement (local control mode only)		-	
	7 / Enable negative motor move / nEGN: Enable negative motor movement (local control mode only)			
	9 / Jog positive / JoGP: Jog right/positive			
	10 / Jog negative / JoGN: Jog left/negative			
	11 / Jog fast/slow / JoGF: Jog fast/slow			
	13 / DataSet Start / dSEtR: Motion sequence: start request			
	14 / DataSet Select / dSEL: Motion sequence: data set selection			
	20 / Reference switch (REF) / rEF: Reference switch (REF)			
	21 / Positive limit switch (LIMP) / L, nP: Positive limit switch (LIMP)			
	22 / Negative limit switch (LIMN) / L, nN: Negative limit switch (LIMN)			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOfunct_LI4	Function Input LI4	-	UINT16	CANopen 3007:4 _h
I-O- - LI4	1 / Free available / none: Available as required	-	UINT16	Modbus 1800
,-o- - LI, 4	2 / Fault reset / FRES: Reset fault (local control mode only) 4 / Halt / HALT: Halt 6 / Enable positive motor move / POSN: Enable positive motor movement (local control mode only) 7 / Enable negative motor move / NEGn: Enable negative motor movement (local control mode only) 9 / Jog positive / JOGP: Jog right/positive 10 / Jog negative / JOGn: Jog left/negative 11 / Jog fast/slow / JOGF: Jog fast/slow 13 / DataSet Start / dSESt: Motion sequence: start request 14 / DataSet Select / dSEL: Motion sequence: data set selection 20 / Reference switch (REF) / rEF: Reference switch (REF) 21 / Positive limit switch (LIMP) / L, nP: Positive limit switch (LIMP) 22 / Negative limit switch (LIMN) / L, nN: Negative limit switch (LIMN)	0 -	R/W per. -	
IOfunct_XLI1	Function Module Input XLI1	-	UINT16	CANopen 3007:19 _h
I-O- - oLi1	1 / Free available / none: Available as required	-	UINT16	Modbus 1842
,-o- - oLi, 1	9 / Jog positive / JOGP: Jog right/positive 10 / Jog negative / JOGn: Jog left/negative 11 / Jog fast/slow / JOGF: Jog fast/slow 13 / DataSet Start / dSESt: Motion sequence: start request 14 / DataSet Select / dSEL: Motion sequence: data set selection 15 / DataSet Bit0 / d5b0: Motion sequence: data set selection Bit0 16 / DataSet Bit1 / d5b1: Motion sequence: data set selection Bit1 17 / DataSet Bit2 / d5b2: Motion sequence: data set selection Bit2 18 / DataSet Bit3 / d5b3: Motion sequence: data set selection Bit3 19 / Automatic/Manual / Auto: Automatic/manual mode	0 -	R/W per. -	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOfunc_XLI2	Function Module Input XLI2	-	UINT16	CANopen 3007:1A _h
I-O - - oLi2	1 / Free available / none : Available as required	-	UINT16	Modbus 1844
1 - - - oLi2	9 / Jog positive / JoGP : Jog right/positive 10 / Jog negative / JoGN : Jog left/negative 11 / Jog fast/slow / JoGF : Jog fast/slow 13 / DataSet Start / dStA : Motion sequence: start request 14 / DataSet Select / dSEL : Motion sequence: data set selection 15 / DataSet Bit0 / dSb0 : Motion sequence: data set selection Bit0 16 / DataSet Bit1 / dSb1 : Motion sequence: data set selection Bit1 17 / DataSet Bit2 / dSb2 : Motion sequence: data set selection Bit2 18 / DataSet Bit3 / dSb3 : Motion sequence: data set selection Bit3 19 / Automatic/Manual / RuLo : Automatic/manual mode	0 -	R/W per. -	
IOfunc_XLI3	Function Module Input XLI3	-	UINT16	CANopen 3007:1B _h
I-O - - oLi3	1 / Free available / none : Available as required	-	UINT16	Modbus 1846
1 - - - oLi3	9 / Jog positive / JoGP : Jog right/positive 10 / Jog negative / JoGN : Jog left/negative 11 / Jog fast/slow / JoGF : Jog fast/slow 13 / DataSet Start / dStA : Motion sequence: start request 14 / DataSet Select / dSEL : Motion sequence: data set selection 15 / DataSet Bit0 / dSb0 : Motion sequence: data set selection Bit0 16 / DataSet Bit1 / dSb1 : Motion sequence: data set selection Bit1 17 / DataSet Bit2 / dSb2 : Motion sequence: data set selection Bit2 18 / DataSet Bit3 / dSb3 : Motion sequence: data set selection Bit3 19 / Automatic/Manual / RuLo : Automatic/manual mode	0 -	R/W per. -	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOfunct_XLI4	Function Module Input XLI4	-	UINT16	CANopen 3007:1C _h
I-O- - oLi4	1 / Free available / none: Available as required	-	UINT16	Modbus 1848
1 - 0 - 0L, 4	9 / Jog positive / JogP: Jog right/positive 10 / Jog negative / JogN: Jog left/negative 11 / Jog fast/slow / JogF: Jog fast/slow 13 / DataSet Start / dStR: Motion sequence: start request 14 / DataSet Select / dSEL: Motion sequence: data set selection 15 / DataSet Bit0 / d5b0: Motion sequence: data set selection Bit0 16 / DataSet Bit1 / d5b1: Motion sequence: data set selection Bit1 17 / DataSet Bit2 / d5b2: Motion sequence: data set selection Bit2 18 / DataSet Bit3 / d5b3: Motion sequence: data set selection Bit3 19 / Automatic/Manual / Auto: Automatic/manual mode	0 -	R/W per. -	
IOfunct_XLI5	Function Module Input XLI5	-	UINT16	CANopen 3007:1D _h
I-O- - oLi5	1 / Free available / none: Available as required	-	UINT16	Modbus 1850
1 - 0 - 0L, 5	9 / Jog positive / JogP: Jog right/positive 10 / Jog negative / JogN: Jog left/negative 11 / Jog fast/slow / JogF: Jog fast/slow 13 / DataSet Start / dStR: Motion sequence: start request 14 / DataSet Select / dSEL: Motion sequence: data set selection 15 / DataSet Bit0 / d5b0: Motion sequence: data set selection Bit0 16 / DataSet Bit1 / d5b1: Motion sequence: data set selection Bit1 17 / DataSet Bit2 / d5b2: Motion sequence: data set selection Bit2 18 / DataSet Bit3 / d5b3: Motion sequence: data set selection Bit3 19 / Automatic/Manual / Auto: Automatic/manual mode	0 -	R/W per. -	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOfuncn_XLI6	Function Module Input XLI6	-	UINT16	CANopen 3007:1E _h
I-O- - oLi6	1 / Free available / none : Available as required	-	UINT16	Modbus 1852
, -o- - oLi, 6	9 / Jog positive / JoGP : Jog right/positive 10 / Jog negative / JoGN : Jog left/negative 11 / Jog fast/slow / JoGF : Jog fast/slow 13 / DataSet Start / dStA : Motion sequence: start request 14 / DataSet Select / dSEL : Motion sequence: data set selection 15 / DataSet Bit0 / dSb0 : Motion sequence: data set selection Bit0 16 / DataSet Bit1 / dSb1 : Motion sequence: data set selection Bit1 17 / DataSet Bit2 / dSb2 : Motion sequence: data set selection Bit2 18 / DataSet Bit3 / dSb3 : Motion sequence: data set selection Bit3 19 / Automatic/Manual / RuLo : Automatic/manual mode	0 -	R/W per. -	

7.6.7.3 Description of functions of the signal outputs

<i>No function / free available</i>	The function "No function / free available" provides the option of setting an output directly by using the parameter <code>IO_LO_set</code> .
<i>No fault</i>	The function shows the error status, see chapter 7.3.2 "Displaying the operating states".
<i>Active</i>	The function shows the operating status "Operation enable", see chapter 7.3.2 "Displaying the operating states".
<i>Motor move disable</i>	The function shows whether a reference value is preset in a locked direction of rotation. The function "Enable positive motor move" or "Enable negative motor move" must be configured for this.
<i>Halt acknowledge</i>	The function shows that the function "Halt" was triggered and the motor is at standstill.
<i>Brake release</i>	<p>The function offers the option of using the signal as a control signal for a holding brake, see chapter .</p> <p>The holding brake can be directly connected to signal output <code>LO1_OUT</code>. However, the voltage will not drop.</p>
<i>DataSet start acknowledge</i>	The current processing state can be reported via the "DataSet start acknowledge" function. This function is comparable to the <code>x_end</code> bit of parameter <code>DCOMstatus</code> . See Figure 7.25 "Handshake with the sequential processing mode".
<i>DataSet trigger output</i>	<p>The corresponding signal output can be actuated directly by every data set. The behavior of the signal output can be defined for every data set on starting and ending the data set. This function can be used to trigger or switch external actuators. Special handshake requests can also be implemented. See chapter 7.5.6.2 "Structure of a data set".</p> <p>This function is only available in the "Sequential data set selection" processing mode.</p>
<i>Motor standstill</i>	The "Motor standstill" function shows whether the motor is in motion and can be used, for example, as feedback for a PLC.

7.6.7.4 Configuration of signal outputs

The digital inputs can be assigned with functions by using the parameters IOfunct_LO1, IOfunct_LO2, IOfunct_XLO1 and IOfunct_XLO2.

The following table gives an overview of the functions in local control mode depending on the start-up operating mode.

Function	Jog	Current control	Speed control	Motion sequence
No function / free available	LO1_OUT, LO2_OUT, XLO1_OUT, XLO2_OUT	LO1_OUT, LO2_OUT, XLO1_OUT, XLO2_OUT	LO1_OUT, LO2_OUT, XLO1_OUT, XLO2_OUT	LO1_OUT, LO2_OUT, XLO1_OUT, XLO2_OUT
No fault	LO1_OUT, LO2_OUT	LO1_OUT, LO2_OUT	LO1_OUT, LO2_OUT	LO1_OUT, LO2_OUT
Active	LO1_OUT, LO2_OUT	LO1_OUT, LO2_OUT	LO1_OUT, LO2_OUT	LO1_OUT, LO2_OUT
Motor move disable	-	-	LO1_OUT, LO2_OUT	-
Halt acknowledge	LO1_OUT, LO2_OUT	LO1_OUT, LO2_OUT	LO1_OUT, LO2_OUT	LO1_OUT, LO2_OUT
Brake release	LO1_OUT, LO2_OUT	LO1_OUT, LO2_OUT	LO1_OUT, LO2_OUT	LO1_OUT, LO2_OUT
DataSet start acknowledge	-	-	-	LO1_OUT, LO2_OUT, XLO1_OUT, XLO2_OUT
DataSet trigger output	-	-	-	LO1_OUT, LO2_OUT, XLO1_OUT, XLO2_OUT
Motor standstill	LO1_OUT, LO2_OUT	LO1_OUT, LO2_OUT	LO1_OUT, LO2_OUT	LO1_OUT, LO2_OUT

The following table shows an overview of the functions in fieldbus control mode.

Function	For all operating modes
No function / free available	LO1_OUT, LO2_OUT, XLO1_OUT, XLO2_OUT
No fault	LO1_OUT, LO2_OUT
Active	LO1_OUT, LO2_OUT
Halt acknowledge	LO1_OUT, LO2_OUT
Brake release	LO1_OUT
Motor standstill	LO1_OUT, LO2_OUT

The signal outputs XLO1_OUT and XLO2_OUT are only available in connection with the expanded I/O signal interface.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOfuncn_LO1 I-O - Lo1 I-O - Lo1	Function Output LO1_OUT 1 / Free available / none : Available as required 2 / No fault / nFLt : No fault 3 / Active / Rct : Ready 4 / Motor move disable / Nd : Direction of movement disabled 9 / Halt acknowledge / hRLt : Halt confirmation 10 / Brake release / brRH : Holding brake control 11 / DataSet start acknowledge / dSRc : Motion sequence: acknowledgement of start request 12 / DataSet trigger output / tRok : Motion sequence: trigger output 13 / Motor standstill / nStd : Motor standstill	- - 0 -	UINT16 UINT16 R/W per. -	CANopen 3007:9 _h Modbus 1810
IOfuncn_LO2 I-O - Lo2 I-O - Lo2	Function Output LO2_OUT 1 / Free available / none : Available as required 2 / No fault / nFLt : No fault 3 / Active / Rct : Ready 4 / Motor move disable / Nd : Direction of movement disabled 9 / Halt acknowledge / hRLt : Halt confirmation 10 / Brake release / brRH : Holding brake control 11 / DataSet start acknowledge / dSRc : Motion sequence: acknowledgement of start request 12 / DataSet trigger output / tRok : Motion sequence: trigger output 13 / Motor standstill / nStd : Motor standstill	- - 0 -	UINT16 UINT16 R/W per. -	CANopen 3007:A _h Modbus 1812
IOfuncn_XLO1 I-O - oLo1 I-O - oLo1	Function Module Output XLO1_OUT 1 / Free available / none : Available as required 11 / DataSet start acknowledge / dSRc : Motion sequence: acknowledgement of start request 12 / DataSet trigger output / tRok : Motion sequence: trigger output	- - 0 -	UINT16 UINT16 R/W per. -	CANopen 3007:21 _h Modbus 1858
IOfuncn_XLO2 I-O - oLo2 I-O - oLo2	Function Module Output XLO2_OUT 1 / Free available / none : Available as required 11 / DataSet start acknowledge / dSRc : Motion sequence: acknowledgement of start request 12 / DataSet trigger output / tRok : Motion sequence: trigger output	- - 0 -	UINT16 UINT16 R/W per. -	CANopen 3007:22 _h Modbus 1860

7.6.8 Reversal of direction of rotation

The parameter `POSdirOfRotat` can be used to change the direction of rotation of the motor. Note that changing the parameter value will only be effective after switching the device off and on again.

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
<code>POSdirOfRotat</code>	Definition of direction of rotation	- 0	UINT16	CANopen 3006:Ch
<code>DRC- - PRoT</code>	0 / clockwise: Clockwise	0	UINT16	Modbus 1560
<code>drC- - PrOt</code>	1 / counter clockwise: Counter-clockwise	1	R/W per. -	
	Meaning: At positive speeds, the drive rotates clockwise (looking at the motor shaft at the flange).			
	IMPORTANT: If you use limit switches, you must interchange the limit switch connections after changing the settings. The limit switch which is reached with a jog movement in positive direction must be connected to the LIMP input and vice versa.			
	IMPORTANT: Changed settings do not become active until the unit is switched on the next time.			

If the direction of rotation of the motor must be reversed, all parameter values can be imported unchanged.

By reversing the direction of rotation, the absolute position of the motor `_p_absworkusr` changes, which is read from the rotary encoder, and also the actual position evaluated by the device `_p_actusr`.

Therefore, the direction of rotation must be set during commissioning as it will be used during later operation of this motor.

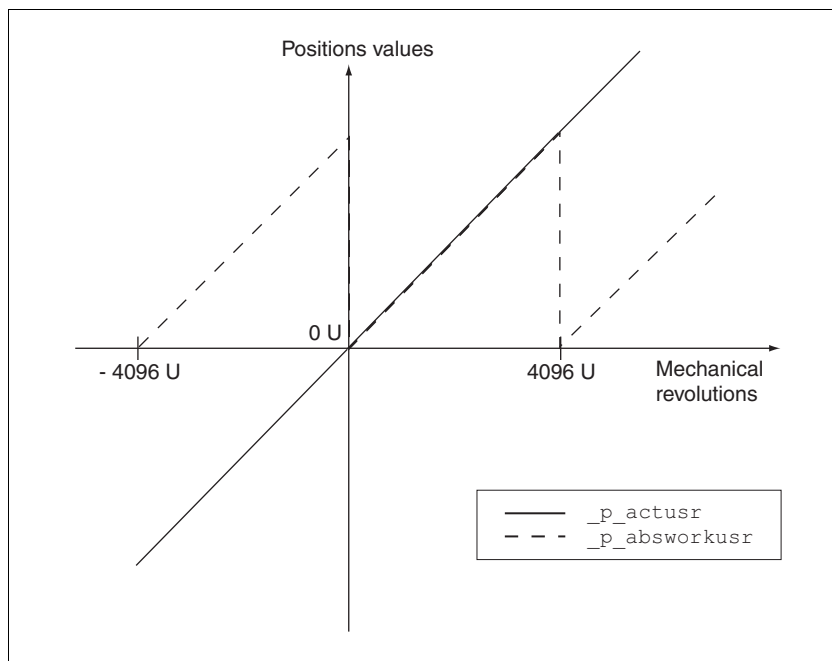


Figure 7.45 Position values without direction reversal

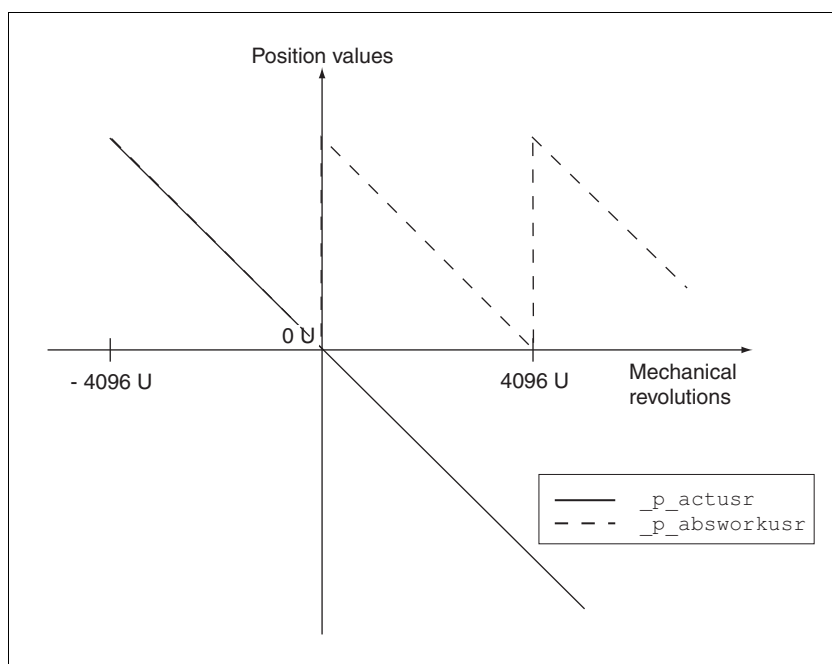


Figure 7.46 Position values with direction reversal

7.6.9 Restoring default values



All parameter values set by the user are lost during this process.

It is possible at any time to save all parameter values set for a device as a configuration using the commissioning software.

7.6.9.1 Resetting user parameters

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PARuserReset	Reset user parameters	-	UINT16	CANopen 3004:8 _h
-	Bit 0 = 1: Set persistent parameters to default values.	0	UINT16	Modbus 1040
-	All parameters are reset with the exception of:	-	R/W	
	- Communication parameters	7	-	
	- Device control		-	
	- I/O functions			
	- Type of encoder			
	IMPORTANT: The new settings are not saved to the EEPROM!			

7.6.9.2 Restore factory settings

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

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PARfactorySet	Restore factory settings (default values)	- 0	R/W -	
DRC- - FCS	0 / No / no: No	-	-	
drL- - FL5	1 / Yes / YES: Yes	3		
	All parameters are set to their default values, these are saved to the EEPROM. Restoring the factory settings is possible via the HMI or the commissioning software. The saving process is complete when the parameter is read and 0 is returned.			
	IMPORTANT: The default becomes active only when the unit is switched on the next time.			

Factory settings via commissioning software

The factory settings are set via the menu points Configuration => Factory Settings. All parameter values are reset to the default values. The new settings only become effective after switching off and switching on the device again.

8 Examples

8.1 Wiring examples

The following figure shows an example of wiring with electrical isolation.

- Local control mode in the Jog operating mode
- Inputs and outputs with factory settings in the Jog operating mode
- Motor with hall sensors
- The STO safety function is not used and bridged to 24V_{DC}.

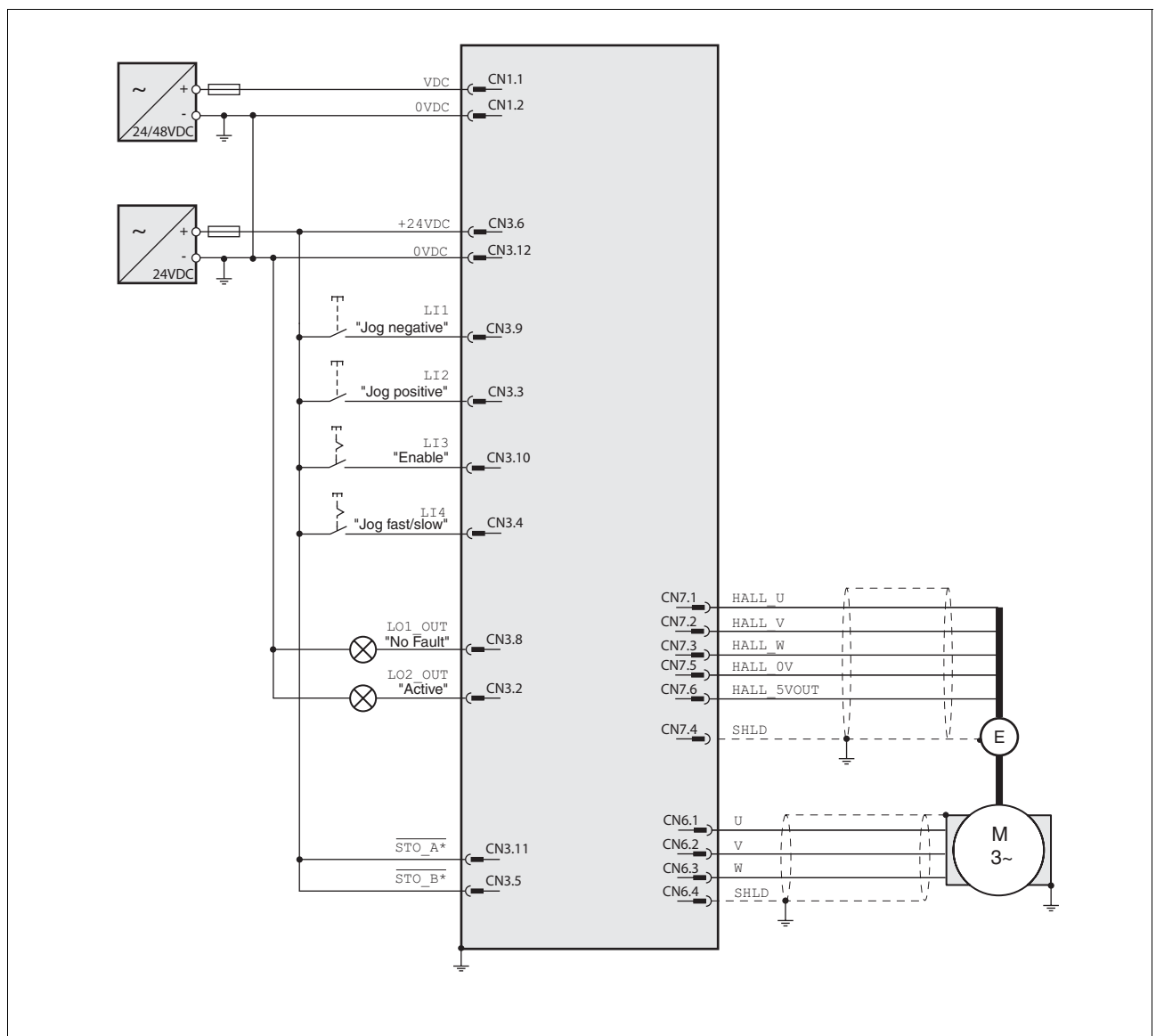


Figure 8.1 Local control mode in the Jog operating mode

The following figure shows an example of wiring with electrical isolation.

- Fieldbus control mode
- Inputs and outputs with factory settings in the Fieldbus operating mode
- STO safety function with EMERGENCY OFF switch without emergency off module
- Motor with hall sensors and incremental encoder
- Braking Resistor Controller UBC60 (accessory)

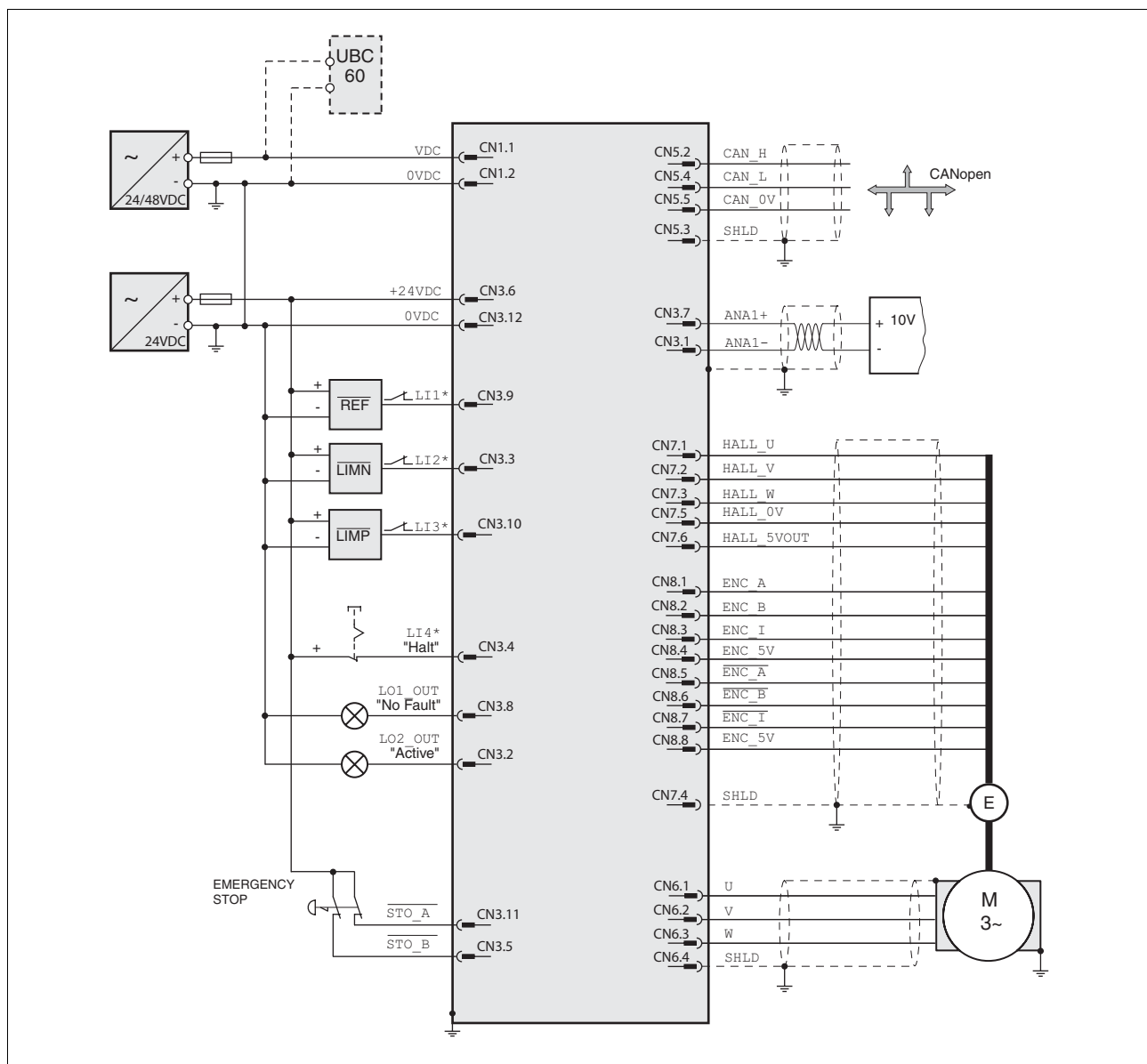


Figure 8.2 Wiring example in fieldbus control mode.

The following figure shows an example of wiring with electrical isolation.

- Local control mode in the movement sequence operating mode
- Inputs and outputs with factory settings in the movement sequence operating mode
- Motor with hall sensors
- The STO safety function is not used and bridged to 24V_{DC}.

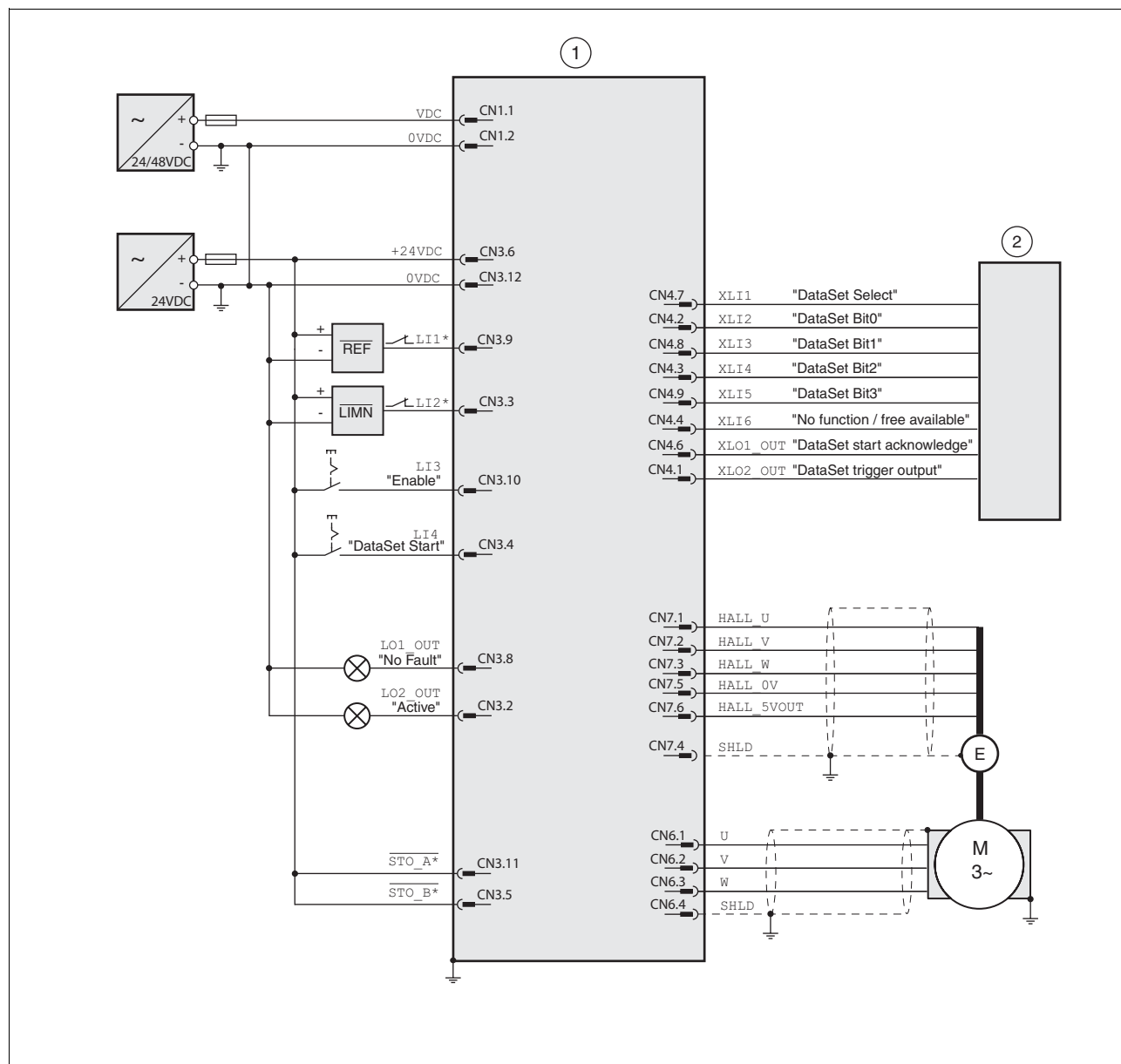


Figure 8.3 Local control mode in the Jog operating mode

- (1) BLP14
(2) PLC

8.2 Wiring STO

Using the safety functions integrated in this product requires careful planning. For more information see chapter 4.4 "Safety function STO ("Safe Torque Off")" on page 38.

8.3 Settings as examples

8.3.1 Standardized operating modes

8.3.1.1 Operating mode: point-to-point mode

For the profile position mode, the PDO2 must be activated. It can be used to specify motion parameters such as ramps and speeds.

Example Node address 1

Work step COB-ID / Data	Object Value
► Enable R_PDO2 601 / 23 01 14 01 01 03 00 04	1401:1 _h 0400 0301 _h
◁ 581 / 60 01 14 01 00 00 00 00	
► Enable T_PDO2 601 / 23 01 18 01 81 02 00 04	1801:1 _h 0400 0281 _h
◁ 581 / 60 01 18 01 00 00 00 00	
► Set speed ramp to 2000 rev/min*s 601 / 23 83 60 00 D0 07 00 00	6083 _h 0000 07D0 _h
◁ 581 / 60 83 60 00 00 00 00 00	
► Set delay ramp to 4000 rev/min*s 601 / 23 84 60 00 A0 0F 00 00	6084 _h 0000 0FA0 _h
◁ 581 / 60 84 60 00 00 00 00 00	
► Limiting the setpoint speed to 6000 rpm 601 / 23 7F 60 00 70 17 00 00	607F _h 0000 1770 _h
◁ 581 / 60 7F 60 00 00 00 00 00	
► Set setpoint speed to 4000 rpm 601 / 23 81 60 00 A0 0F 00 00	6081 _h 0000 0FA0 _h
◁ 581 / 60 81 60 00 00 00 00 00	
► NMT Start remote node 0 / 01 00	
◁ T_PDO1 with status word 181 / 31 66	
► Activating the power amplifier with PDO1 201 / 00 00 201 / 06 00 201 / 0F 00	
◁ T_PDO1 (Status: Operation enabled) 181 / 37 46	
► Start operating mode 601 / 2F 60 60 00 01 00 00 00	6060 _h 01 _h
◁ 581 / 60 60 60 00 00 00 00 00	

Work step COB-ID / Data	Object Value
► Check operating status ¹⁾ 601 / 40 61 60 00 00 00 00 00	6061 _h
◁ Operating mode active 581 / 4F 61 60 00 01 00 01 00	01 _h
► PDO2: Set relative position with NewSetpoint=1 301 / 5F 00 30 75 00 00	
◁ T_PDO2 with status word and position actual value 281 / 37 56 00 00 00 00	
◁ position reached 281 / 37 56 30 75 00 00	
► PDO2: NewSetpoint=0 301 / 4F 00 30 75 00 00	

1) The operating status must be checked until the device has enabled the specified operating mode.

8.3.1.2 Operating mode Profile velocity

For the Profile Velocity operating mode, the PDO3 must be activated.

Example Node address 1

Work step COB-ID / Data	Object Value
► Enable R_PDO3 601 / 23 02 14 01 01 04 00 04	1402:1 _h 0400 0401 _h
◁ 581 / 60 02 14 01 00 00 00 00	
► Enable T_PDO3 601 / 23 02 18 01 81 03 00 04	1802:1 _h 0400 0381 _h
◁ 581 / 60 02 18 01 00 00 00 00	
► Set speed ramp to 2000 rev/min*s 601 / 23 83 60 00 D0 07 00 00	6083 _h 0000 07D0 _h
◁ 581 / 60 83 60 00 00 00 00 00	
► Set delay ramp to 10000 rev/min*s 601 / 23 84 60 00 10 27 00 00	6084 _h 0000 2710 _h
◁ 581 / 60 84 60 00 00 00 00 00	
► Limiting the setpoint speed to 10000 rpm 601 / 23 7F 60 00 10 27 00 00	607F _h 0000 2710 _h
◁ 581 / 60 7F 60 00 00 00 00 00	
► NMT Start remote node 0 / 01 00	
◁ T_PDO1 with status word 181 / 31 66	
► Activating the power amplifier with PDO1 201 / 00 00 201 / 06 00 201 / 0F 00	
◁ T_PDO1 (Status: Operation enabled) 181 / 37 46	
► Start operating mode 601 / 2F 60 60 00 03 00 00 00	6060 _h 03 _h
◁ 581 / 60 60 60 00 00 00 00 00	
► Check operating status ¹⁾ 601 / 40 61 60 00 00 00 00 00	6061 _h
◁ Operating mode active 581 / 4F 61 60 00 03 00 01 00	03 _h
► PDO3: send setpoint speed 1000 rpm 401 / 0F 00 E8 03 00 00	
◁ T_PDO2 with status word and velocity actual value 381 / 37 02 00 00 00 00	
◁ Setpoint speed reached 381 / 37 06 E8 03 00 00	

1) The operating status must be checked until the device has enabled the specified operating mode.

8.3.1.3 Operating mode Homing

The Homing operating mode is parameterized with SDOs and activated with PDO1.

Example Node address 1

Work step COB-ID / Data	Object Value
► Set speed for displacement to limit switch 100 rpm 601 / 23 99 60 01 64 00 00 00	6099:1 _h 0000 0064 _h
◁ 581 / 60 99 60 01 00 00 00 00	
► Set speed for displacement to limit switch 10 rpm 601 / 23 99 60 02 0A 00 00 00	6099:2 _h 0000 000A _h
◁ 581 / 60 99 60 02 00 00 00 00	
► NMT Start remote node 0 / 01 00	
◁ T_PDO1 with status word 181 / 31 66	
► Activating the power amplifier with PDO1 201 / 00 00 201 / 06 00 201 / 0F 00	
◁ T_PDO1 (Status: Operation enabled) 181 / 37 46	
► Start operating mode 601 / 2F 60 60 00 06 00 00 00	6060 _h 06 _h
◁ 581 / 60 60 60 00 00 00 00 00	
► Check operating status ¹⁾ 601 / 40 61 60 00 00 00 00 00	6061 _h
◁ Operating mode active 581 / 4F 61 60 00 06 00 01 00	06 _h
► Select reference displacement method, LimN (17) 601 / 2F 98 60 00 11 00 00 00	6098 _h 11 _h
◁ 581 / 60 98 60 00 00 00 00 00	
► Reference movement with PDO1 (homing operation start) 201 / 1F 00	
◁ TPDO1 Reference displacement active 181 / 37 02	
◁ TPDO1 Reference displacement complete 181 / 37 D6	

1) The operating status must be checked until the device has enabled the specified operating mode.

8.3.2 Manufacturer-specific operating modes

8.3.2.1 Current control mode.

Example Node address 1

Work step COB-ID / Data	Object Value
► R_PDO4 Mapping: Number of mapped objects = 0 601 / 2F 03 16 00 00 00 00 00	1603:0 _h 00 _h
◁ 581 / 60 03 16 00 00 00 00 00	
► R_PDO4 first parameter = CUR_I_target (3020:4 _h) 601 / 23 03 16 01 10 04 20 30	1603:1 _h 3020 0410 _h
◁ 581 / 60 03 16 01 00 00 00 00	
► R_PDO4 Number of mapped objects = 1 601 / 2F 03 16 00 01 00 00 00	1603:0 _h 01 _h
◁ 581 / 60 03 16 00 00 00 00 00	
► T_PDO4 Mapping: Number of mapped objects = 0 601 / 2F 03 1A 00 00 00 00 00	1A03:0 _h 00 _h
◁ 581 / 60 03 1A 00 00 00 00 00	
► T_PDO4 first parameter = _p_actusr (6064:0) 601 / 23 03 1A 01 20 00 64 60	1A03:1 _h 6064 0020 _h
◁ 581 / 60 03 1A 01 00 00 00 00	
► T_PDO4 Number of mapped objects = 1 601 / 2F 03 1A 00 01 00 00 00	1A03:0 _h 01 _h
◁ 581 / 60 03 1A 00 00 00 00 00	
► Enable R_PDO4 (COB-ID) 601 / 23 03 14 01 01 05 00 04	1403:1 _h 0400 0501 _h
◁ 581 / 60 03 14 01 00 00 00 00	
► Enable T_PDO4 (COB-ID) 601 / 23 03 18 01 81 04 00 04	1803:1 _h 0400 0481 _h
◁ 581 / 60 03 18 01 00 00 00 00	
► Reference value preset by parameter 601 / 2B 1B 30 10 02 00 00 00	301B:10 _h 02 _h
◁ 581 / 60 1B 30 10 00 00 00 00	
► NMT Start remote node 0 / 01 00	
◁ T_PDO1 with status word 181 / 31 66	
► Activating the power amplifier with PDO1 201 / 00 00 201 / 06 00 201 / 0F 00	
◁ T_PDO1 (Status: Operation enabled) 181 / 37 46	
► Start operating mode 601 / 2F 60 60 00 FD 00 00 00	6060 _h -03 _h
◁ 581 / 60 60 60 00 00 00 00 00	

Work step COB-ID / Data	Object Value
► Check operating status ¹⁾ 601 / 40 61 60 00 00 00 00 00	6061 _h
◁ Operating mode active 581 / 4F 61 60 00 FD 00 01 00	-03 _h
► PDO4 send setpoint current 1000 (10A) 501 / E8 03	
◁ T_PDO4 with current position 481 / 00 CE 09 00	

1) The operating status must be checked until the device has enabled the specified operating mode.

8.3.2.2 Speed control operating mode

Example Node address 1

Work step COB-ID / Data	Object Value
► R_PDO4 Mapping: Number of mapped objects = 0 601 / 2F 03 16 00 00 00 00 00	1603:0 _h 00 _h
◁ 581 / 60 03 16 00 00 00 00 00	
► R_PDO4 first parameter = SPEEDn_target (3021:4 _h) 601 / 23 03 16 01 10 04 21 30	1603:1 _h 3021 0410 _h
◁ 581 / 60 03 16 01 00 00 00 00	
► R_PDO4 Number of mapped objects = 1 601 / 2F 03 16 00 01 00 00 00	1603:0 _h 01 _h
◁ 581 / 60 03 16 00 00 00 00 00	
► T_PDO4 Mapping: Number of mapped objects = 0 601 / 2F 03 1A 00 00 00 00 00	1A03:0 _h 00 _h
◁ 581 / 60 03 1A 00 00 00 00 00	
► T_PDO4 first parameter = _p_actusr (6064:0) 601 / 23 03 1A 01 20 00 64 60	1A03:1 _h 6064 0020 _h
◁ 581 / 60 03 1A 01 00 00 00 00	
► T_PDO4 Number of mapped objects = 1 601 / 2F 03 1A 00 01 00 00 00	1A03:0 _h 01 _h
◁ 581 / 60 03 1A 00 00 00 00 00	
► Enable R_PDO4 (COB-ID) 601 / 23 03 14 01 01 05 00 04	1403:1 _h 0400 0501 _h
◁ 581 / 60 03 14 01 00 00 00 00	
► Enable T_PDO4 (COB-ID) 601 / 23 03 18 01 81 04 00 04	1803:1 _h 0400 0481 _h
◁ 581 / 60 03 18 01 00 00 00 00	
► NMT Start remote node 0 / 01 00	
◁ T_PDO1 with status word 181 / 31 66	
► Activating the power amplifier with PDO1 201 / 00 00 201 / 06 00 201 / 0F 00	
◁ T_PDO1 (Status: Operation enabled) 181 / 37 46	
► Start operating mode 601 / 2F 60 60 00 FC 00 00 00	6060 _h -04 _h
◁ 581 / 60 60 60 00 00 00 00 00	
► Check operating status ¹⁾ 601 / 40 61 60 00 00 00 00 00	6061 _h
◁ Operating mode active 581 / 4F 61 60 00 FC 00 01 00	-04 _h

Work step COB-ID / Data	Object Value
► Reference value preset by parameter 601 / 2B 1B 30 11 02 00 00 00 ◁ 581 / 60 1B 30 11 00 00 00 00	301B:11 _h 02 _h
► PDO4: send setpoint speed 1000 rpm 501 / E8 03 ◁ T_PDO4 with current position 481 / 6E 97 04 00	

1) The operating status must be checked until the device has enabled the specified operating mode.

8.3.2.3 Jog mode

Example Node address 1

Work step COB-ID / Data	Object Value
► Speed slow displacement to 100 rpm 601 / 2B 29 30 04 64 00 00 00	3029:4 _h 0064 _h
◁ 581 / 60 29 30 04 00 00 00 00	
► Speed fast displacement to 250 rpm 601 / 2B 29 30 05 FA 00 00 00	3029:5 _h 00FA _h
◁ 581 / 60 29 30 05 00 00 00 00	
► NMT Start remote node 0 / 01 00	
◁ T_PDO1 with status word 181 / 31 66	
► Activating the power amplifier with PDO1 201 / 00 00 201 / 06 00 201 / 0F 00	
◁ T_PDO1 (Status: Operation enabled) 181 / 37 46	
► Start operating mode 601 / 2F 60 60 00 FF 00 00 00	6060 _h -01 _h
◁ 581 / 60 60 60 00 00 00 00 00	
► Check operating status ¹⁾ 601 / 40 61 60 00 00 00 00 00	6061 _h
◁ Operating mode active 581 / 4F 61 60 00 FF 00 01 00	-01 _h
► Jog (clockwise rotation, slow) 601 / 2B 1B 30 09 01 00 00 00	301B:9 _h 01 _h
◁ 581 / 60 1B 30 09 00 00 00 00	
◁ T_PDO1 with status word 181 / 37 02	
► Jog (clockwise rotation, fast) 601 / 2B 1B 30 09 05 00 00 00	301B:9 _h 05 _h
◁ 581 / 60 1B 30 09 00 00 00 00	
◁ T_PDO1 with status word 181 / 37 42	

1) The operating status must be checked until the device has enabled the specified operating mode.

9 Basics

9.1 Safety functions

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

In general the safety engineering requirements depend on the application. The degree of the requirements is oriented to the risk and the hazard potential arising from the specific application.

Working with IEC61508

IEC 61508 standard

The IEC 61508 standard "Functional safety of electrical/electronic/programmable electronic safety-related systems" covers the relevant safety related function. This means that it is not only one single component but always a complete function chain (e.g. from the sensor through the logical processing unit to the actuator) that is considered as one single unit. The function chain must meet the requirements of the specific safety level as a whole. Systems and components that can be used in various applications for safety tasks with comparable risk can be developed on this basis.

SIL, Safety Integrity Level

The standard IEC61508 specifies four safety integrity levels (SIL) for safety functions. SIL1 is the lowest level and SIL4 is the highest level. This is based on an assessment of the hazard potential derived from the hazard and risk analysis. This is used to decide whether the relevant function chain requires a safety function and which hazard potential it must cover.

PFH, Probability of a dangerous failure per hour

To maintain the safety function the IEC61508 standard, depending on the required SIL, requires staged fault-control and fault-prevention measures. All components of a safety function must be subjected to a probability analysis to assess the effectiveness of the fault-control measures that were taken. This assessment determines the dangerous probability of failure PFH (probability of a dangerous failure per hour) for protective systems. This is the probability per hour that a protective system fails in a hazardous manner and the protective function cannot be correctly executed. The PFH must not exceed the values calculated for the complete protective system depending on the SIL. The individual PFH of a chain must be calculated together, the total of the PFH must not exceed the maximum value specified in the standard.

SIL	PFH at high requirement rate or continuous requirement
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 The standard also requires a specific hardware fault tolerance HFT for the safety system depending on the SIL in connection with a specific proportion of safe failures SFF (safe failure fraction). The hardware fault tolerance is the property of a system that enables it to execute the desired 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. Under IEC 61508 the maximum achievable SIL of a system is determined by the hardware fault tolerance HFT and the safe failure fraction SFF of the system.

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

Fault-prevention measures Systematic faults in the specifications, in the hardware and the software, usage faults and maintenance faults of the safety system must be avoided as much as possible. IEC61508 specifies a series of fault-prevention measures that must be implemented depending on the required SIL. The fault-prevention measures must accompany the complete life cycle of the safety system, i.e. from design to decommissioning of the system.

9.2 Fieldbus CANopen bases

9.2.1 CAN-Bus

The CAN bus (CAN:**C**ontroller **A**rea **N**etwork) was originally developed for fast, economical data transmission in automotive engineering. In the meantime the CAN bus is also used in industrial automation technology and has been further developed for communication at fieldbus level.

Features of the CAN bus

The CAN bus is a standardized open bus, through which devices, sensors and actuators from different manufacturers communicate with each other. The features of the CAN bus are

- Multimaster capacity

Every device in the fieldbus can send and receive data independently without being assigned to an "ordering" master function.

- Message-oriented communication

Devices can be linked into an existing network without requiring reconfiguration of the entire system. The address of a new device does not need to be specified on the network.

- Prioritization of messages

Messages with higher priority are sent first for time-critical applications.

- Residual error probability

Various backup processes in the network reduce the probability of an undetected, faulty data transfer to less than 10^{-11} . In practice, 100%-secure transmission can be assumed.

Transmission technology

In the CAN bus multiple devices are connected via a bus cable. Every network device can send and receive messages. Data between network devices are transmitted serially.

Network devices

Examples of CAN bus devices are

- automation devices, e.g. PLCs
- PCs
- input/output modules
- drive controllers
- analysis devices
- Sensors and actuators

9.2.2 CANopen technology

9.2.2.1 CANopen description language

CANopen is a device and manufacturer-independent description language for communication on the CAN bus. CANopen offers a unified base for exchanging commands and data between CAN bus devices.

9.2.2.2 Communications layers

CANopen uses the CAN bus technology for data communications.

CANopen is based on the ISO-OSI layer model on the data communications basic network service. 3 layers secure data communications in the CAN bus.

- Physical Layer
- Data Link Layer
- Application Layer

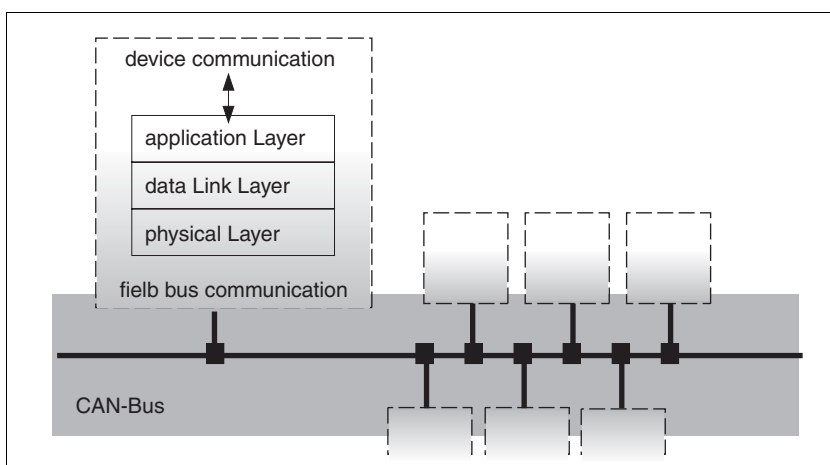


Figure 9.1 CANopen layer model

Physical Layer The physical layer defines the electrical properties of the CAN bus such as plug connectors, cable length and cable properties such as bit-coding and bit-timing.

Data Link Layer The data link layer connects the network devices. It sets the priorities of individual data packets and monitors and corrects errors.

Application Layer The application layer uses communications objects (COB) to exchange data between the various devices. Communication objects are elementary components for creating a CANopen application.

9.2.2.3 Objects

All processes under CANopen are executed via objects. Objects carry out different tasks; they act as communications objects for data transport to the fieldbus, control the process of establishing a connection or monitor the network devices. If objects are directly connected to the device (device-specific objects), the device functions can be used and changed with device-specific objects.



The product includes corresponding parameters for CANopen object groups 3000_h and 6000_h. The names of the parameters and the data type of the parameters may be different from the DS402 definition for object group 6000_h. In this case, the data type corresponding to DS402 must be input.

Object Directory The central controller connection for all objects is the object directory of every network device. Other devices find all objects here with which they can establish a connection with the device.

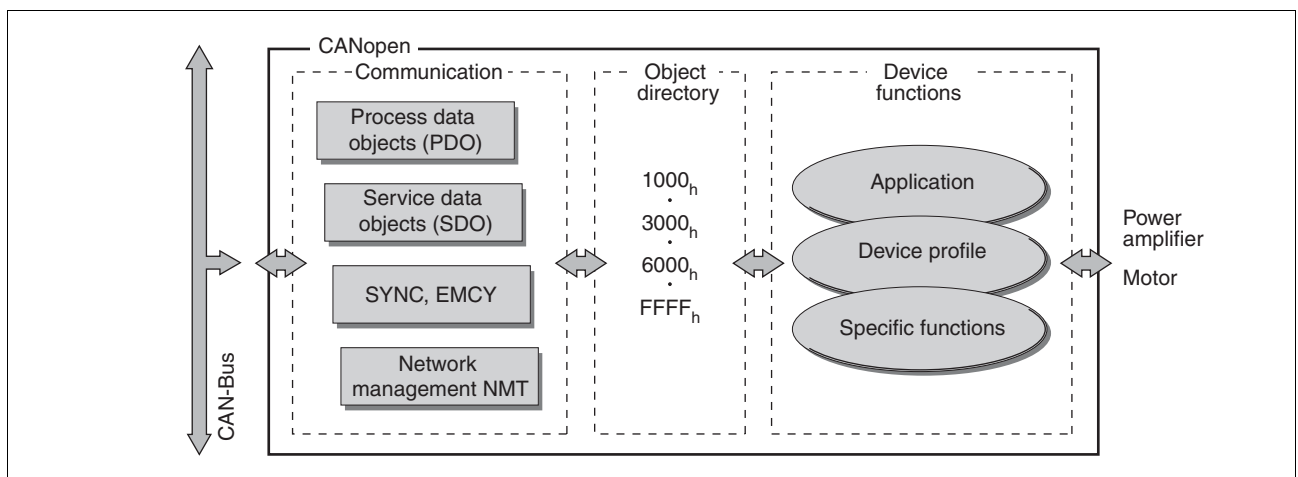


Figure 9.2 Device model with object directory

Objects for describing the data types and executing the communications tasks and device functions under CANopen are registered.

Object index Every object is addressed over a 16-bit index, which is displayed as a four-character hexadecimal number. The objects are arranged in groups in the object directory. The following table shows an overview of the object directory as per the CANopen agreement.

Index range (hex)	Object groups
1000 _h -2FFF _h	Communications profile
3000 _h -5FFF _h	Manufacturer-specific objects
6000 _h -9FFF _h	Standardized device profiles
A000 _h -FFFF _h	Reserved

For a list of all CANopen objects see 11 "Parameters".

9.2.2.4 CANopen profiles

Standardized profiles Standardized profiles describe objects that can be applied to various devices without additional configuration. The Interessengemeinschaft CAN in Automation e. V. (CiA) [Syndicate for CAN in Automation] has standardized different profiles. They include:

- the communications profile CiA 301
- the device profile CiA 402

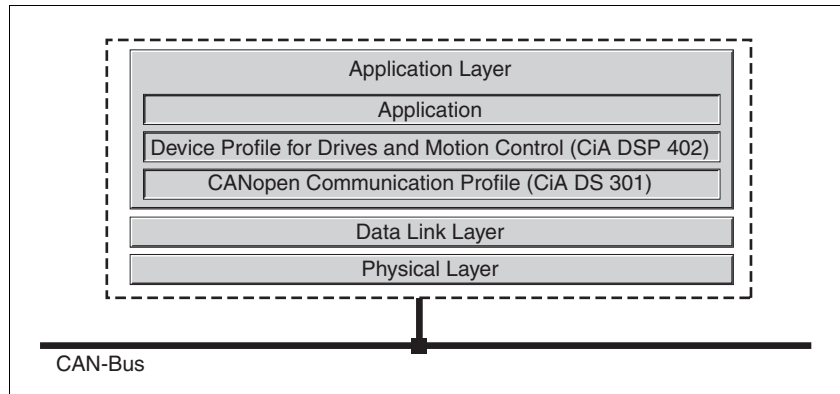


Figure 9.3 CANopen reference model

Communications profile CiA 301 The DS301 communications profile forms the interface between device profiles and CAN bus. It was specified in 1995 under the name DS301 and defines unified standards for common data exchange between different device types under CANopen.

The communications profile objects in the device carry out the tasks of data and parameter exchange with other network devices and initialize, control and monitor the device in the network.

Device profile CiA 402 The CiA 402 device profile describes standardized objects for positioning, monitoring and settings of drives. The tasks of the objects are:

- Device control and status monitoring (Device Control)
- Standardized parameter setting
- Switching, verification and execution of operating modes

Manufacturer-specific profiles The basic functions of a device can be used with device profiles standardized with objects. Only manufacturer-specific device profiles offer the complete range of functions. The objects with which the special functions of a device can be used under CANopen are defined in them.

9.2.3 Communications profile

CANopen manages communications between the network devices with object directories and objects. A network device can use process data objects (PDO) and service data objects (SDO) to request the object data from the object directory of another device and, if permissible, write back modified values.

The following can be done with the access to the objects of the network devices

- exchange parameter values
- start movement functions of individual CAN bus devices
- query status information

9.2.3.1 Object Directory

Every CANopen device administers an object directory, in which all objects for communications are listed.

Index, subindex

The objects are addressed in the object directory with a 16-bit long index. One or more 8-bit-long subindex entries to every object point to individual data fields in the object. Index and subindex are shown in hexadecimal characters, recognisable by the attached "h".

Example

The following table shows index and subindex entries with the example of the object `software position limit` (607D_h) for identifying the position of the software limit switch.

Index	Subindex	Name	Meaning
607D _h	00 _h	-	Number of data fields
607D _h	01 _h	min. position limit	Bottom limit value switch
607D _h	02 _h	max. position limit	Top limit value switch

Table 9.1 Example for index and subindex entries

Object descriptions in the manual

The objects of the following object groups are described to distinguish them for the CANopen programming of a device:

- 1xxx_h objects: Communications objects in this chapter
- 3xxx_h objects: Manufacturer-specific objects required for the control of the device, in chapter 7 "Operation".
- 6xxx_h objects: standardized objects of the device profile in chapter 7 "Operation"

Standardized objects

Standardized objects form the basis of applying the same applications for the various network devices of a device type. This requires the devices to list the objects in their directory. Standardized objects are defined in the CiA 301 communications profile and the CiA 402 device profile.

9.2.3.2 Communications objects

Overview The communications objects are standardized with the CiA 301 CAN-open communications profile. The objects can be classified into 4 groups according to their tasks.

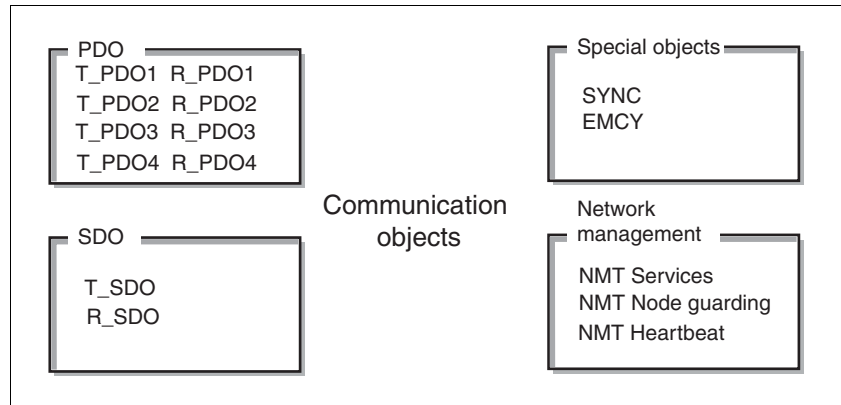


Figure 9.4 The following are considered communications objects from the point of view of the device: T_...: "Transmit", R_...: "Receive"

- PDO (process data objects) for real-time transmission of process data
- SDO (service data object) for read and write access to the object directory
- Objects for controlling CAN messages:
 - SYNC object (synchronization object) for synchronization of network devices
 - EMCY object (emergency object) for the error display of a device or its peripheral equipment.
- Network management services:
 - NMT services for initialization and network control (NMT: network management)
 - NMT Node Guarding for monitoring the network devices
 - NMT heartbeat for monitoring the network devices

CAN message Data are exchanged on the CAN bus as CAN messages. A CAN message sends the communications object and a variety of administration and control information to ensure data transmission without loss and errors.

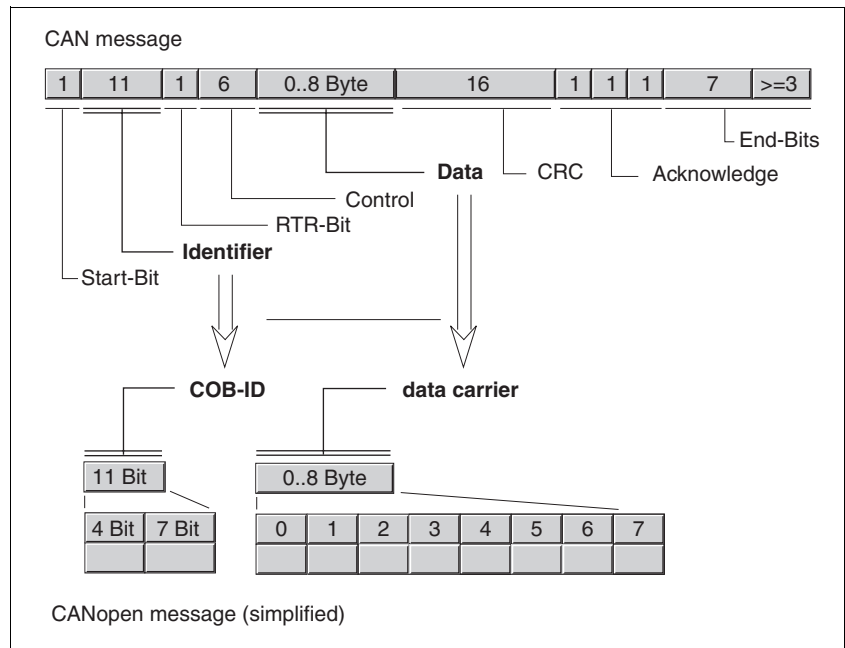


Figure 9.5 CAN message and simplified display of CANopen message

CANopen message The CAN message can be displayed in simplified form for work with CANopen objects and for data exchange, because most of the bits are used to ensure error-free data transmission. These bits are automatically removed from the received message by the data security layer, the data link layer of the OSI layer model, and added to a message before transmission.

The two bit fields "identifier" and "data" form the simplified CANopen message. The "identifier" corresponds to the "COB ID" and the "data" field to the maximum 8-byte data frame of a CANopen message.

COB-ID The COB ID (**C**ommunication **O**bject **I**dentifier) has two tasks in the control of communications objects:

- Bus arbitration: Specification of transmission priorities
- identification of communications objects

An 11-bit COB identifier as per the CAN 3.0A specification is defined for CAN communications. It comprises two parts:

- Function code, 4 bit size
- Node address (node-Id), 7 bit size.

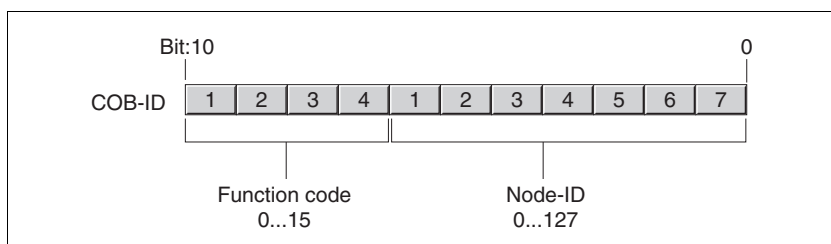


Figure 9.6 COB Id with function code and node address

COB-IDs of the communications objects

The following table shows the COB-IDs of all communications objects in the factory setting. The column "index of object parameters" shows the index of special objects with which the settings of the communications objects can be read or modified by SDO.

Communications object	Function code	Node address-Node-ID [1...127]	COB-IDdecimal (hexadecimal)	Index of object parameters
NMT Start/Stop Service	0 0 0 0	0 0 0 0 0 0 0	0 (0 _h)	-
SYNC object	0 0 0 1	0 0 0 0 0 0 0	128 (80 _h)	1005 _h ...1007 _h
EMCY object	0 0 0 1	x x x x x x x	128 (80 _h) + Node-ID	1014 _h , 1015 _h
T_PDO1	0 0 1 1	x x x x x x x	384 (180 _h) + Node-ID	1800 _h
R_PDO1	0 1 0 0	x x x x x x x	512 (200 _h) + Node-ID	1400 _h
T_PDO2	0 1 0 1	x x x x x x x	640 (280 _h) + Node-ID	1801 _h
R_PDO2	0 1 1 0	x x x x x x x	768 (300 _h) + Node-ID	1401 _h
T_PDO3	0 1 1 1	x x x x x x x	896 (380 _h) + Node-ID	1802 _h
R_PDO3	1 0 0 0	x x x x x x x	1024 (400 _h) + Node-ID	1402 _h
T_PDO4	1 0 0 1	x x x x x x x	1152 (480 _h) + Node-ID	1803 _h
R_PDO4	1 0 1 0	x x x x x x x	1280 (500 _h) + Node-ID	1403 _h
T_SDO	1 0 1 1	x x x x x x x	1408 (580 _h) + Node-ID	-
R_SDO	1 1 0 0	x x x x x x x	1536 (600 _h) + Node-ID	-
NMT error control	1 1 1 0	x x x x x x x	1792 (700 _h) + Node-ID	
LMT Services ¹⁾	1 1 1 1	1 1 0 0 1 0 x	2020 (7E4 _h), 2021 (7E5 _h)	
NMT Identify Service ¹⁾	1 1 1 1	1 1 0 0 1 1 0	2022 (7E6 _h)	
DBT Services ¹⁾	1 1 1 1	1 1 0 0 x x x	2023 (7E7 _h), 2024 (7E8 _h)	
NMT Services ¹⁾	1 1 1 1	1 1 0 1 0 0 x	2025 (7E9 _h), 2026 (7EA _h)	

1) not supported by the device

Table 9.2 COB Ids of all communications objects



COB IDs of PDOs can be changed as required. The assignment scheme for COB IDs specifies only one basic setting.

<i>Function code</i>	The function code classifies the communication objects. Because the bits of the function code in the COB ID are more significant, the function code simultaneously controls the transmission priorities: Objects with a lower function code are transmitted with greater priority. For example, with simultaneous bus access an object with the function code "1" is sent before an object with the function code "3".
<i>Node address</i>	Every network device is configured before network operation. It is given a unique, 7-bit long node address (Node ID) between 1 (01 _h) and 127 (7F _h). The device address "0" is reserved for "broadcast" transmissions, which are used to send the messages to all devices simultaneously.
<i>Example</i>	<p>Selection of a COB ID</p> <p>For a device with the node address 5 the COB ID of the communication object is T_PDO1:</p> $384 + \text{Node-ID} = 384 (180_{\text{h}}) + 5 = 389 (185_{\text{h}}).$
<i>Data frame</i>	<p>The data frame of the CANopen message can hold up to 8 bytes of data. In addition to the data frame for SDOs and PDOs special frame types are specified in the CANopen profile:</p> <ul style="list-style-type: none"> • Error data frame • Remote data frame for requesting a message <p>The data frames are described with the relevant communications objects.</p>

9.2.3.3 Communications relationships

CANopen uses three relationships for communications between network devices:

- Master-slave relationship
- Client-server relationship
- Producer-consumer relationship

Master-slave relationship A "master" in the network controls the message traffic. A "slave" only responds when addressed by the master.

The master-slave relationship is used with network management objects to guarantee a controlled network start and to monitor the connection of devices.

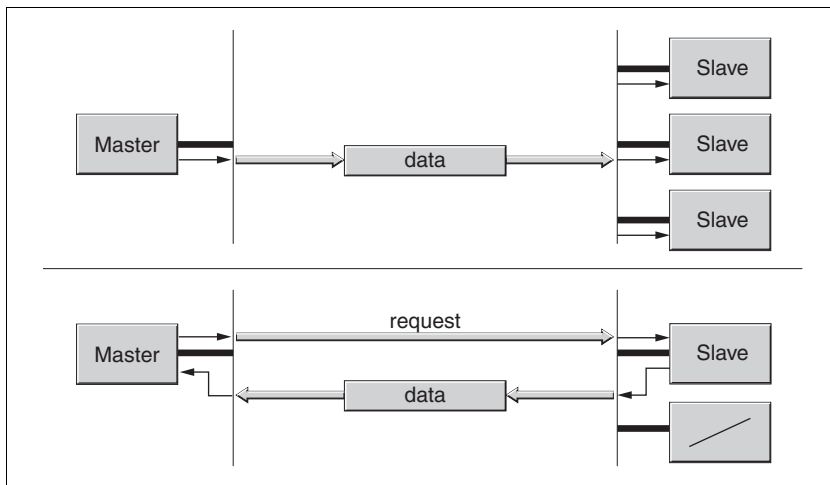


Figure 9.7 Master-slave relationships

The exchange of messages can be executed unconfirmed and confirmed. If the master sends an unconfirmed CAN message, it can be received by multiple slaves or by no slave.

To confirm the message, the master requests a message from a specific slave, which then responds with the desired data.

Client-server relationship A client-server relationship is always established between two devices. The "server" is the device whose object list is used during the data exchange. The "client" addresses and starts the exchange of messages and waits for a response from the server.

A client-server relationship is implemented with SDOs to send configuration data and long messages.

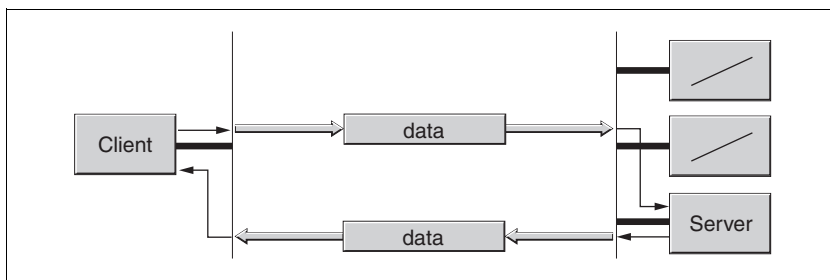


Figure 9.8 Client-server relationship

The client addresses and sends a CAN message to a server. The server evaluates the message and sends the answer data as response.

Producer-consumer relationship

The producer-consumer relationship is used for exchanging messages with process data, because this relationship enables fast data exchange without administration data.

A "producer" sends data, a "consumer" receives data.

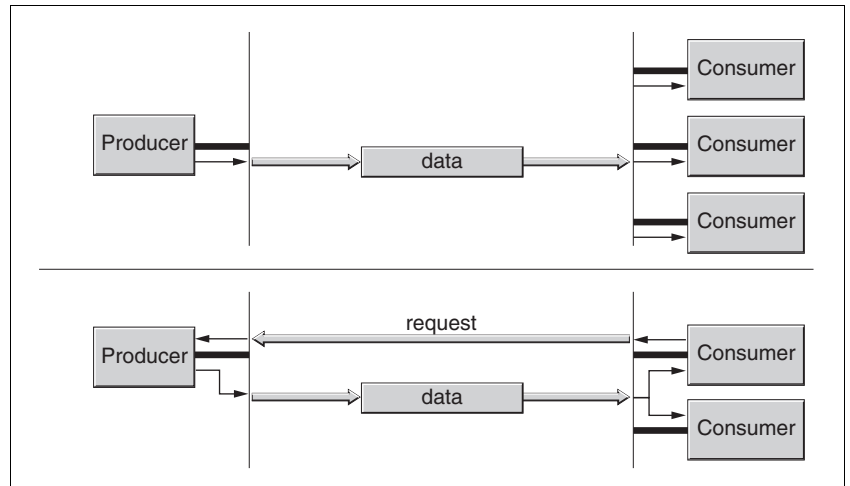


Figure 9.9 Producer-consumer relationships

The producer sends a message that can be received by one or more network devices. The producer does not receive a receipt response. The message transmission can be triggered

- by an internal event, e.g. "target position reached"
- by the synchronization object SYNC
- by request of a consumer

For details on the function of the producer-consumer relationship and the request of messages see chapter 9.2.5 "Process data communication".

9.2.4 Service data communication

9.2.4.1 Overview

Service Data Object (SDO: **S**ervice **D**ata **O**bject) can be used to access the entries of an object directory via index and subindex. The values of the objects can be read and, if permissible, also be changed.

Every network device has at least one server SDO to be able to respond to read and write requests from a different device. A client SDO is only required to request SDO messages from the object directory of a different device or to change them there.

The T_SDO of a SDO client can be used to send the request for data exchange and to receive with the R_SDO. The data frame of a SDO is always 8 bytes.

SDOs have a higher COB ID than PDOs and therefore are sent over the CAN bus at a lower priority.

9.2.4.2 SDO data exchange

A service data object (SDO) sends parameter data between two devices. The data exchange conforms to the client-server relationship. The server is the device to whose object directory a SDO message refers.

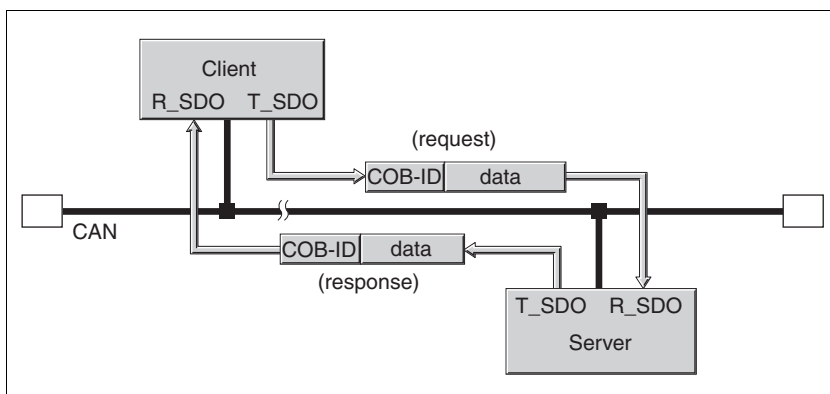


Figure 9.10 SDO message exchange with request and response

Message types

Client-server communications are triggered by the client to send parameter values to the server or to obtain them from the server. In both cases the client starts the communication with a request and receives a response from the server.

9.2.4.3 SDO message

An SDO message in simplified form consists of the COB ID and the SDO data frame, in which up to 4 bytes of data can be sent. Longer data strings are distributed over multiple SDO messages with a special protocol.

The device sends SDOs of up to 4 bytes data length (data). Larger quantities of data such as 8.byte values of the "Visible String 8" data type can be distributed over multiple SDOs and are sent successively in 7-byte blocks.

Example The following diagram shows an example of a SDO message.

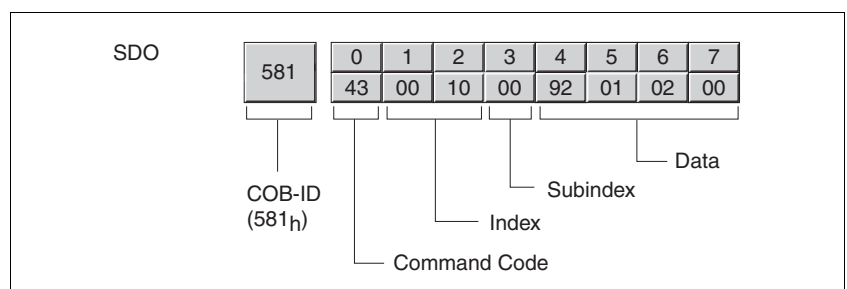


Figure 9.11 SDO message, example

COB-ID and data frame R_SDO and T_SDO have different COB IDs. The data frame of an SDO messages consists of:

- Command code (ccd: command code), in which the SDO message type and the data length of the transmitted value are encrypted
- Index and subindex, which point to the object whose data are transported with the SDO message
- Data that comprises up to 4 bytes

Evaluation of numeric values

Index and data are transmitted left-aligned in Intel format. If the SDO contains numerical values over 1 byte in length, the data must be converted bit-by-bit before and after a transmission.

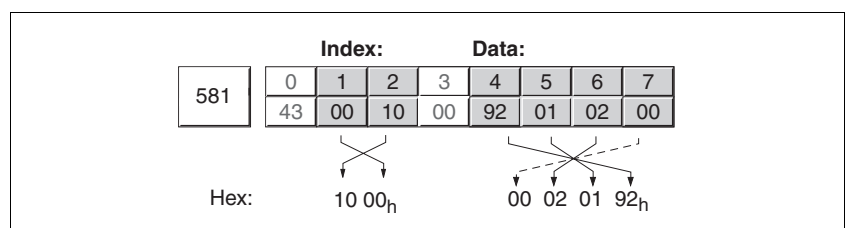


Figure 9.12 Repositioning numeric values greater than 1 byte

9.2.4.4 Read and write data

Write data The client starts a write request by sending index, subindex, data length and value.

The server sends a response indicating whether the data were correctly processed. The response contains the same index and subindex, but no data.

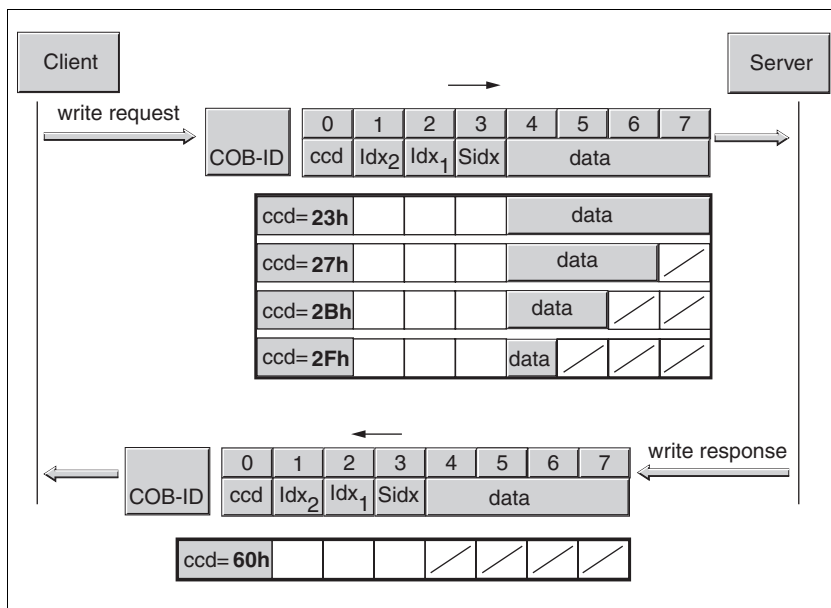


Figure 9.13 Writing parameter values

Unused bytes in the data field are shown with a slash in the graphic. The content is not defined.

ccd-coding The table below shows the command code for writing parameter values. It depends on the message type and the transmitted data length.

Message type	Data length used				
	4 byte	3 byte	2 byte	1 byte	
write request	23 _h	27 _h	2B _h	2F _h	Send parameters
write response	60 _h	60 _h	60 _h	60 _h	response
error response	80 _h	80 _h	80 _h	80 _h	Error

Table 9.3 Command codes for writing parameter values

Read data The client starts a read request by sending index and subindex that point to the object or the object value whose value it wants to read out.

The server responds to the query with the desired data. The SDO response contains the same index and subindex. The length of the response data is specified in the command code "ccd".

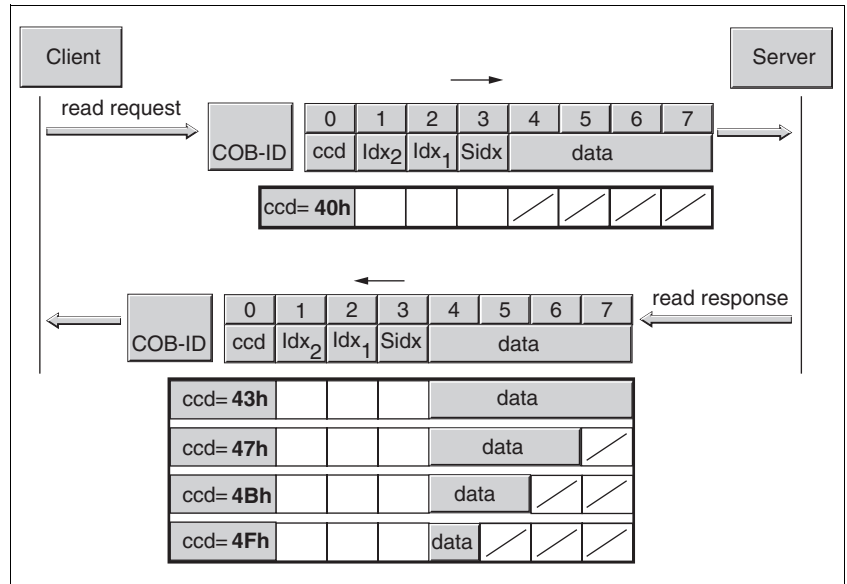


Figure 9.14 Reading parameter value

Unused bytes in the data field are shown with a slash in the graphic. The content is not defined.

ccd-coding The table below shows the command code for sending a read value. It depends on the message type and the transmitted data length.

Message type	Data length used				
	4 byte	3 byte	2 byte	1 byte	
read request	40 _h	40 _h	40 _h	40 _h	Request read value
read response	43 _h	47 _h	4B _h	4F _h	Return read value
error response	80 _h	80 _h	80 _h	80 _h	Error

Table 9.4 Command code for sending a read value

Error response If a message could not be evaluated without errors, the server sends an error message. For details on the evaluation of the error message see chapter 10.1.4.5 "SDO error message ABORT".

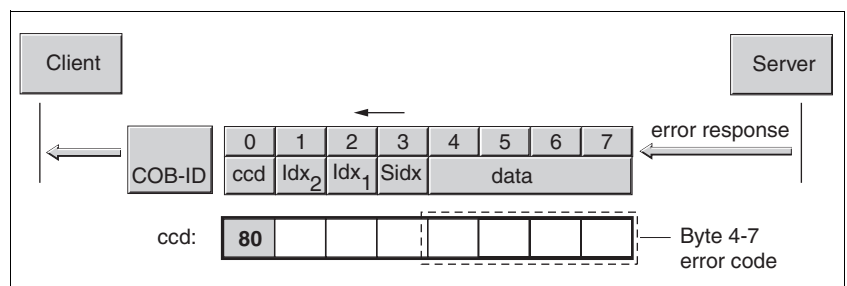


Figure 9.15 Response with error message (error response)

9.2.5 Process data communication

9.2.5.1 Overview

Process data objects (PDO: **P**rocess **D**ata **O**bject) are used for real-time data exchange of process data such as actual and setpoint or operating status of the device. The transmission can be executed very fast, because it is sent without additional administration data and does not require a response from the recipient.

The flexible data length of a PDO message also increases the data throughput. A PDO message can send up to 8 bytes of data. If only 2 bytes are occupied, only 2 data bytes are sent.

The length of a PDO message and the allocation of the data fields is specified by PDO mapping. For more information see chapter 9.2.5.4 "PDO mapping".

PDO messages can be exchanged between devices that generate or process process data.

9.2.5.2 PDO data exchange

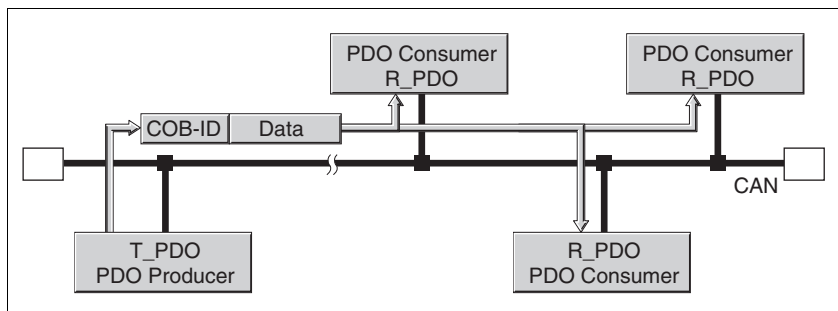


Figure 9.16 PDO data exchange

Data exchange with PDOs conforms to the producer-consumer relationship and can be triggered by three methods

- synchronized
- event-driven, asynchronous
- by request of a consumer, asynchronous

The synchronized data processing is controlled by the SYNC object. Synchronous PDO messages are sent immediately like the standard PDO messages, but are only evaluated on the next SYNC. For example, multiple drives can be started simultaneously by synchronized data exchange.

The device evaluates PDO messages that are called on request or are event-controlled immediately.

The transmission type can be specified separately for every PDO with subindex 02_n (transmission type) of the PDO communications parameter. The objects are shown in Table 9.5.

9.2.5.3 PDO message

T_PDO, R_PDO A PDO always is available for sending and receiving a PDO message:

- The T_PDO for sending PDO messages (T: Transmit),
- The R_PDO for receiving PDO messages (R: Receive).



The following settings for PDOs correspond to the standard defaults for the device, unless otherwise specified. They can be read and set via objects of the communications profile.

The device uses 8 PDOs, 4 receive PDOs and 4 send PDOs. All PDOs are evaluated or transmitted event-controlled in the default setting.

PDO settings The settings for PDOs can be read and changed with 8 communications objects:

Object	Description
1st receive PDO parameter (1400 _h)	Settings for R_PDO1
2nd receive PDO parameter (1401 _h)	Settings for R_PDO2
3rd receive PDO parameter (1402 _h)	Settings for R_PDO3
4th receive PDO parameter (1403 _h)	Settings for R_PDO4
1st transmit PDO parameter (1800 _h)	Settings for T_PDO1
2nd transmit PDO parameter (1801 _h)	Settings for T_PDO2
3rd transmit PDO parameter (1802 _h)	Settings for T_PDO3
4th transmit PDO parameter (1803 _h)	Settings for T_PDO4

Table 9.5 Communications objects for PDO

Enable PDO In the default setting of the PDOs R_PDO1 and T_PDO1 are enabled. The other PDOs must be enabled first.

A PDO is enabled with bit 31 (valid bit) in subindex 01_h of that communications object:

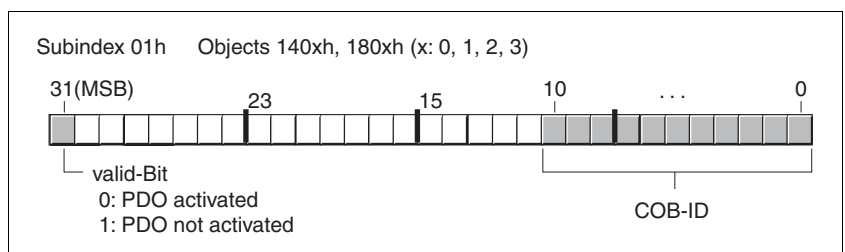


Figure 9.17 Enable PDOs with subindex 01_h, enable bit 31

Example Setting for R_PDO3 in object 1402_h

- Subindex 01_h = 8000 04xx_h: R_PDO3 not enabled
- Subindex 01_h = 0000 04xx_h: R_PDO3 enabled.

Values for "x" in the example depend on the setting of the COB ID.

PDO time intervals The time intervals "inhibit time" and "event timer" can be set for every send PDO.

- The time interval "inhibit time" can be used to reduce the load on the CAN bus, which can be the result of continuous transmission of T_PDOs. If an interval time that is not equal to zero is entered, a sent PDO will only be sent again when the interval time expires. The time is set with subindex 03_h.
- The time interval "event timer" triggers an event message periodically. After the interval time has expired the device transmits the event-controlled T_PDO. The time is set with subindex 05_h.

Receive PDOs The objects for R_PDO1, R_PDO2 and R_PDO3 are permanently specified. The object that is represented in the PDO R_PDO4 can be modified by PDO mapping.

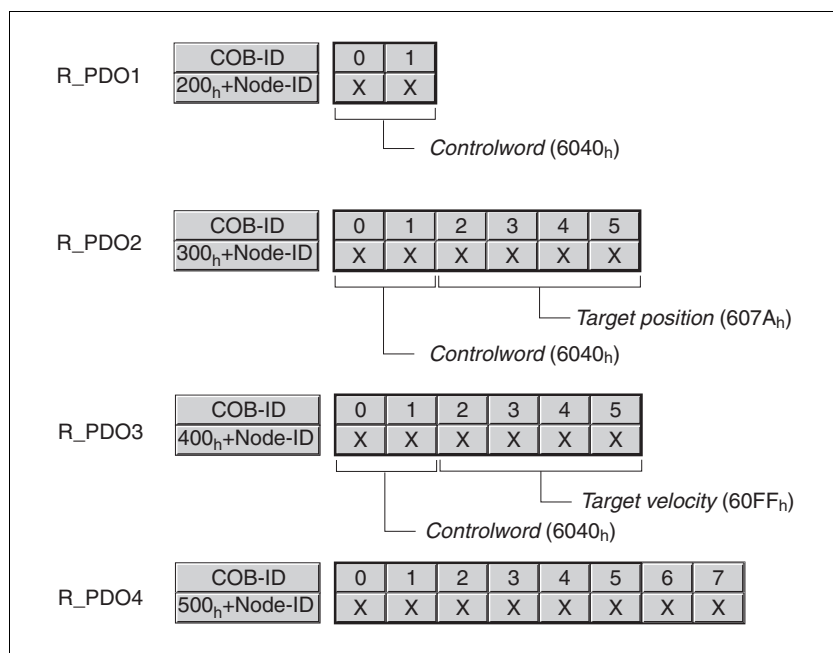


Figure 9.18 Receive PDOs

R_PDO1 In the R_PDO1 the control word, object `controlword (6040h)`, of the status machine is represented, which can be used to set the operating status of the device.

R_PDO1 is evaluated asynchronously, i.e. is event-controlled. R_PDO1 is permanently set.

R_PDO2 With the R_PDO2 the control word and the target position of a travel command, object `target position (607Ah)`, is received for a profile positioning in the "profile position mode".

R_PDO2 is evaluated asynchronously, i.e. is event-controlled. R_PDO2 is permanently set.

For details on the SYNC object see chapter 9.2.6 "Synchronization".

R_PDO3 In R_PDO3 the control word and the setpoint speed, object *Target velocity* (60FF_h), is mapped for the speed mode in the "profile velocity mode".

R_PDO3 is evaluated asynchronously, i.e. is event-controlled. R_PDO3 is permanently set.

R_PDO4 Manufacturer-specific object values are transmitted with the R_PDO4. R_PDO4 is empty by default.

R_PDO4 is evaluated asynchronously, i.e. is event-controlled. R_PDO4 can be used to map various manufacturer-specific objects with PDO mapping.

The chapter 11.3 "Objects for PDO mapping" contains a list of manufacturer-specific objects that are available for PDO mapping.

Transmit PDOs The objects for T_PDO1, T_PDO2 and T_PDO3 are permanently specified. The object that is represented in the PDO T_PDO4 can be modified by PDO mapping.

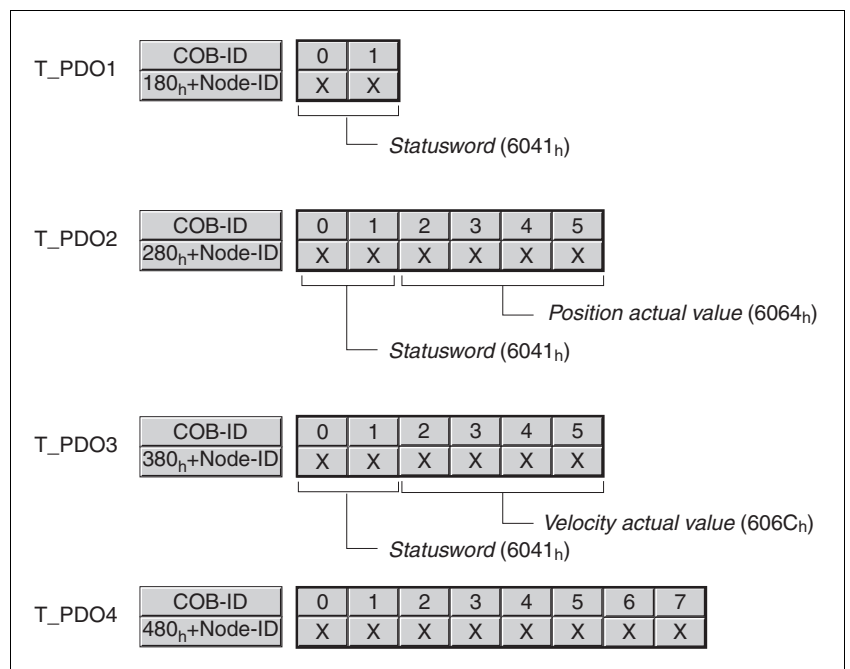


Figure 9.19 Send PDOs

T_PDO1 In the T_PDO1 the status word, object *statusword* (6041_h), of the status machine is mapped.

T_PDO1 is sent asynchronously and event-controlled at every change of the status information. No other objects can be mapped with T_PDO1.

T_PDO2 In T_PDO2 the status word and the current position of the motor, object *Position actual value* (6064_h), is mapped to monitor point-to-point positioning in the "profile position mode".

T_PDO2 is sent after receipt of a SYNC object and event-controlled. No other objects can be mapped with T_PDO2.

T_PDO3 In the T_PDO3 the status word and the current speed, object `velocity actual value (606Ch)`, is mapped for monitoring the speed mode in "profile velocity mode".

T_PDO3 is sent asynchronously and event-controlled at every change of the status information. No other objects can be mapped with T_PDO3.

T_PDO4 Manufacturer-specific object values (for monitoring) are sent with the T_PDO4. T_PDO4 is empty by default.

T_PDO4 is sent asynchronously and event-controlled at every change of the status information. The specification of which objects trigger an event can be set with the parameter `CANpdo4Event`. With the default setting of the parameter all mapped objects trigger an event.

T_PDO4 can be used to map various manufacturer-specific objects with PDO mapping.

The chapter 11.3 "Objects for PDO mapping" contains a list of manufacturer-specific objects that are available for PDO mapping.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CANpdo4Event	PDO4 event mask	-	UINT16	CANopen 3017:5 _h
-	Changes of values in the object trigger an event:	0	UINT16	Modbus 5898
-	Bit 0 = 1: first PDO4 object	15	UINT16	Profibus 5898
	Bit 1 = 1: second PDO4 object	15	UINT16	DeviceNet 123.1.5
	Bit 2 = 1: third PDO4 object		R/W	
	Bit 3 = 1: fourth PDO4 object		-	
	Bit 4..15 : reserved		-	

9.2.5.4 PDO mapping

Up to 8 bytes of data from different areas of the object directory can be sent with a PDO message. The mapping of data in a PDO message is referred to as PDO mapping.

The chapter 11.3 "Objects for PDO mapping" contains a list of manufacturer-specific objects that are available for PDO mapping.

The picture below shows the data exchange between PDOs and object directory with two examples of objects in T_PDO4 and R_PDO4 of the PDOs.

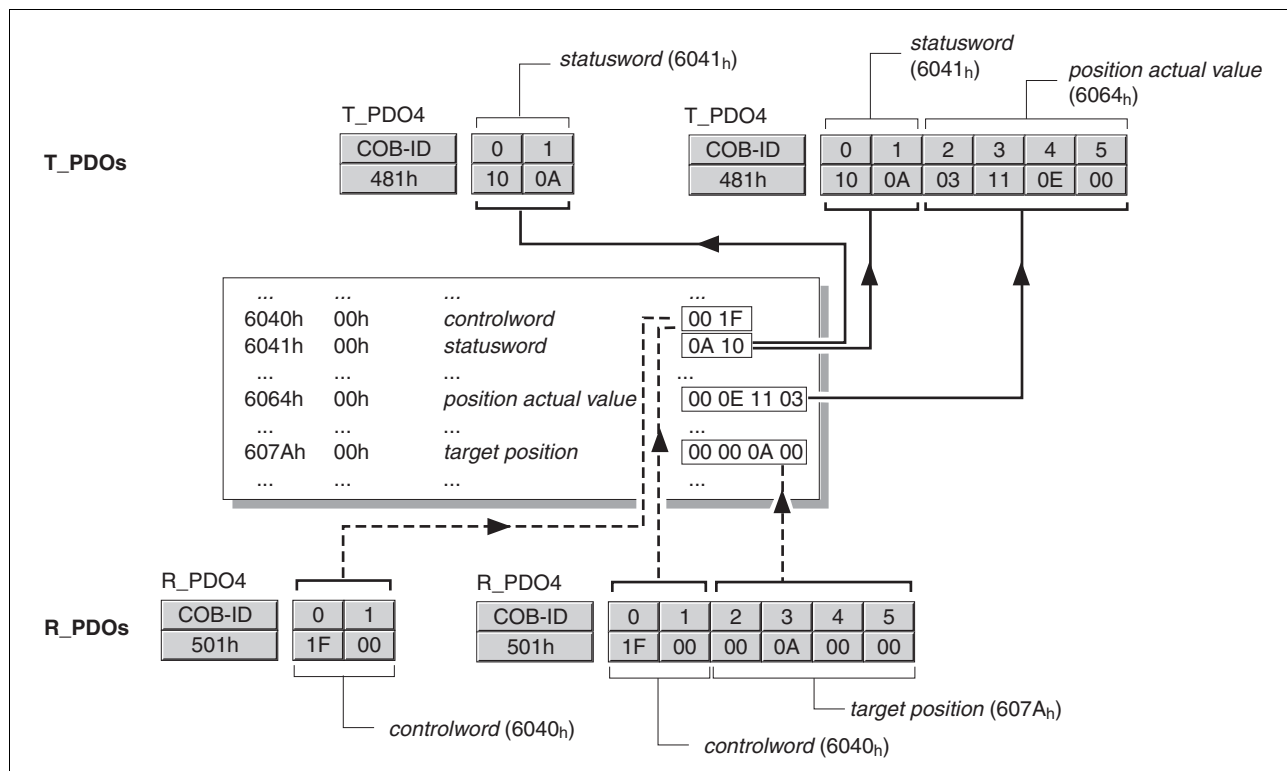


Figure 9.20 PDO mapping, in this case for a device with node address 1

Static PDO mapping

The device uses static and dynamic PDO mapping. In static PDO mapping all objects are mapped in accordance with a fixed, non-modifiable setting in the relevant PDO.

The settings for PDO mapping are defined in an assigned communications object for every PDO.

Object	PDO mapping for	type
1st receive PDO mapping (1600 _h)	R_PDO1	static
2nd receive PDO mapping (1601 _h)	R_PDO2	static
3rd receive PDO mapping (1602 _h)	R_PDO3	static
4th receive PDO mapping (1603 _h)	R_PDO4	dynamic
1st transmit PDO mapping (1A00 _h)	T_PDO1	static
2nd transmit PDO mapping (1A01 _h)	T_PDO2	static
3rd transmit PDO mapping (1A02 _h)	T_PDO3	static
4th transmit PDO mapping (1A03 _h)	T_PDO4	dynamic

Structure of entries Up to 8 bytes of 8 different objects can be mapped in a PDO. Every communications object for setting the PDO mapping provides 4 subindex entries. A subindex entry contains 3 pieces of information on the object: the index, the subindex and the number of bits that the object occupies in the PDO.

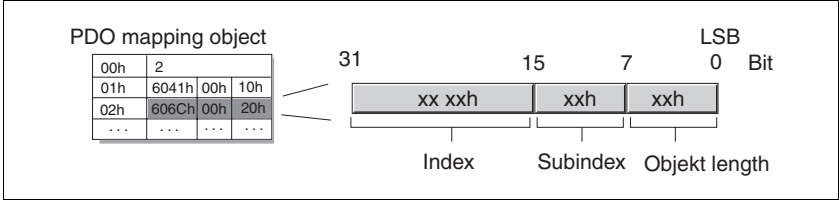


Figure 9.21 Structure of entries for the PDO mapping

The number of valid subindex entries is contained in subindex 00_h of the communications object.

9.2.6 Synchronization

The synchronization object SYNC controls the synchronous exchange of messages between network devices for purposes such as the simultaneous start of multiple drives.

The data exchange conforms to the producer-consumer relationship. The SYNC object is sent to all devices by a network device and can be evaluated by all devices that support synchronous PDOs.

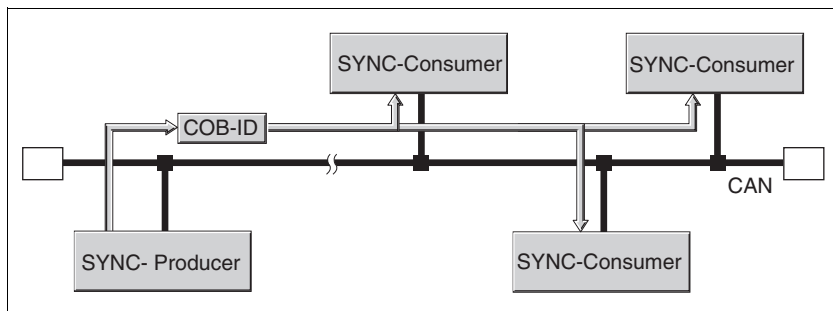


Figure 9.22 SYNC message

Time values for synchronization

2 time values define the behavior of synchronous data transfer:

- The cycle time specifies the time intervals between 2 SYNC messages. It is set with the object *Communication cycle period* (1006_h).
- The synchronous time window specifies the time interval in which the synchronous PDO messages must be received and sent. The time window is defined with the object *Synchronous window length* (1007_h).

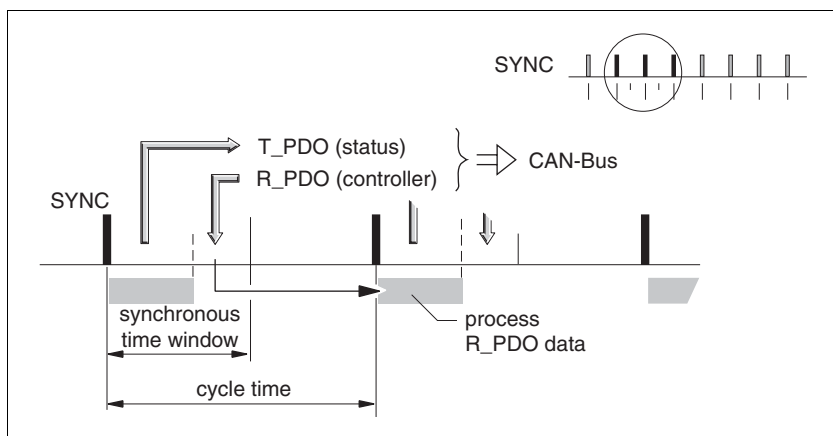


Figure 9.23 Synchronization periods

Synchronous data transmission

From the point of view of a SYNC receiver, the status data are first sent in a T_PDO and the new control data are received via an R_PDO in one time window. However, the control data are only processed when the next SYNC message is received. The SYNC object itself does not transmit data.

Cyclic and acyclic data transfer

Synchronous exchange of messages can be executed cyclically or acyclically.

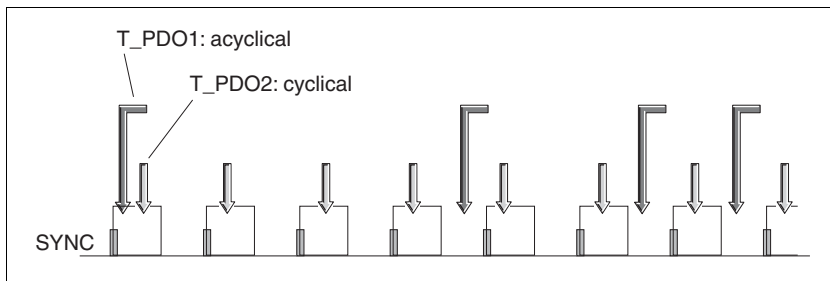


Figure 9.24 Cyclic and acyclic transmission

In cyclic transmission PDO messages are exchanged continuously in a specified cycle, e.g. with every SYNC message.

If a synchronous PDO message is sent acyclically, it can be sent or received at any time, but will only be valid with the next SYNC message.

The cyclic or acyclic behavior of PDOs is stored in subindex `transmission type (02h)` of the corresponding PDO parameter, e.g. for `R_PDO1` in the object `1st receive PDO parameter (1400h:02h)`.

COB-ID, SYNC object

For fast transmission the SYNC object is transmitted unconfirmed and with high priority.

The COB-ID of the SYNC object is set to the value 128 (80_h) by default. The value can be changed after initializing the network with the object `COB-ID SYNC Message (1005h)`.

"Start" PDO

In the default setting of the PDOs `R_PDO2/T_PDO2` and `R_PDO3/T_PDO3` are received and transmitted synchronously. Both PDOs are used for starting and monitoring operating modes. The synchronization allows an operating mode to be started simultaneously on multiple devices and, for example, synchronization of the feed of a multi-motor portal drive.

9.2.7 Emergency service

The emergency service reports internal device error over the CAN bus. The error message is sent to all devices with an EMCY object in accordance with the consumer-producer relationship.

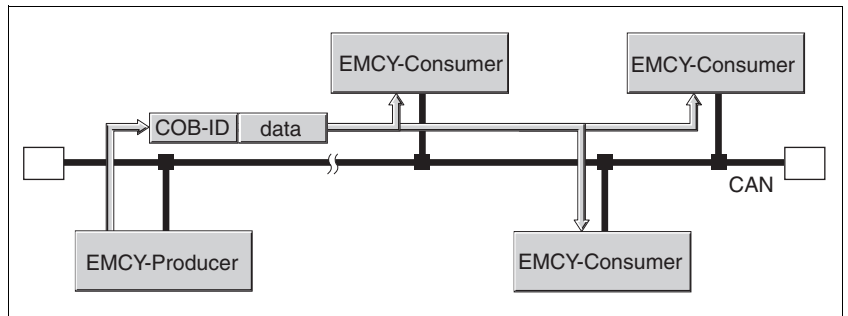


Figure 9.25 Error message via EMCY objects

Boot Up message The communications profile CiA 301, version 3.0, defines an additional task for the EMCY object: sending a boot-up message. A boot-up message informs all network devices that the device that sent the message is ready for operation in the CAN network.

The boot-up message is sent with the COB-ID 700h + Node-ID and one data byte (00h).

9.2.7.1 Error evaluation and handling

EMCY message If an internal device error occurs, the device switches to error status as per the CANopen status machine. At the same time it sends an EMCY message with error register and error code.

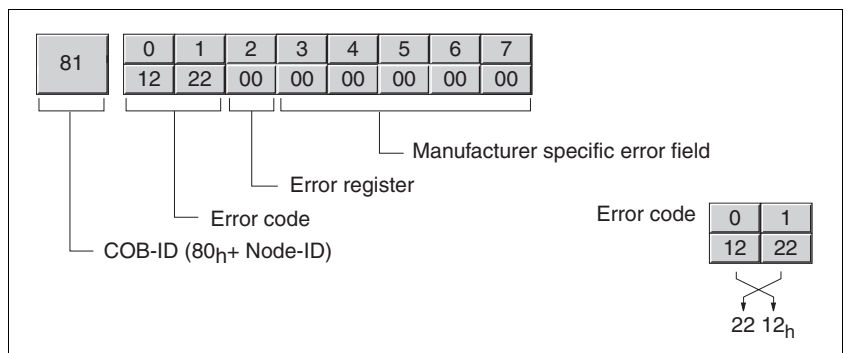


Figure 9.26 EMCY message

Byte 0, 1 - error code: Error code, value is also saved in the object Error code (603F_h)

Byte 2 - error register: Error register, value is also saved in the object Error register (1001_h), see 10.1.4.3 "error register".

Byte 3, 4 - Manufacturer-specific error code of mapped object

Byte 5, 6 - Index of mapped object

Byte 7 - Subindex of mapped object

<i>COB-ID</i>	<p>The COB-ID is calculated from the node address for every device in the network that supports an EMCY object:</p> $\text{COB-ID} = \text{function code EMCY object (80}_{\text{h}}) + \text{node-ID}$ <p>The function code of the COB-ID can be changed with the object COB-ID emergency(1014_h).</p>
<i>Error register and error code</i>	<p>The error register reports the error status of the device in bit-coded form. Bit 0 remains set so long as an error is pending. The remaining bits identify the error type. The precise cause of error can be found with the error code. The error code is sent in Intel format as a 2-byte value and must be reversed by bytes for evaluation.</p> <p>A list of all error messages and responses by the device and remedies can be found in chapter 10 "Diagnostics and troubleshooting".</p>
<i>Error memory</i>	<p>The device saves the error register in the object <code>Error register</code> (1001_h) and the last error that occurred in the object <code>Error code</code> (603F_h). The last 20 error messages are backed up in sequence of occurrence in the object <code>FLT_err_num</code> (303C:1_h). <code>FLT_MemReset</code> (303B:5_h) resets the read flag of the error memory to the oldest error.</p>

9.2.8 Network management services

Network management (NMT) is a component of the CANopen communications profile and is used to initialize the network and start, stop and monitor the network devices in network mode.

NMT services are executed in a master-slave relationship. The NMT master addresses individual NMT slaves through their node address. A message with node address "0" is directed to all NMT slaves simultaneously.

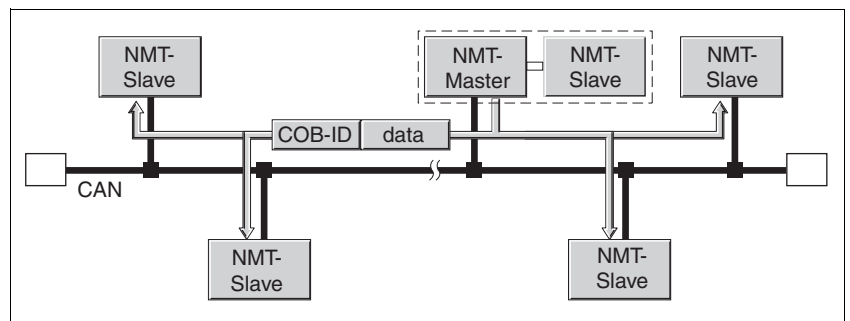


Figure 9.27 NMT services over the master-slave relationship

The device can only take on the function of a NMT slave.

NMT services NMT services can be divided into two groups:

- Services for device control, to initialize devices for CANopen communications and to control the behavior of devices in network operation
- Services for connection monitoring, to ensure error-free network operation

9.2.8.1 NMT services for device control

NMT status machine The NMT status machine describes the initialising and status of an NMT slave in mains operation.

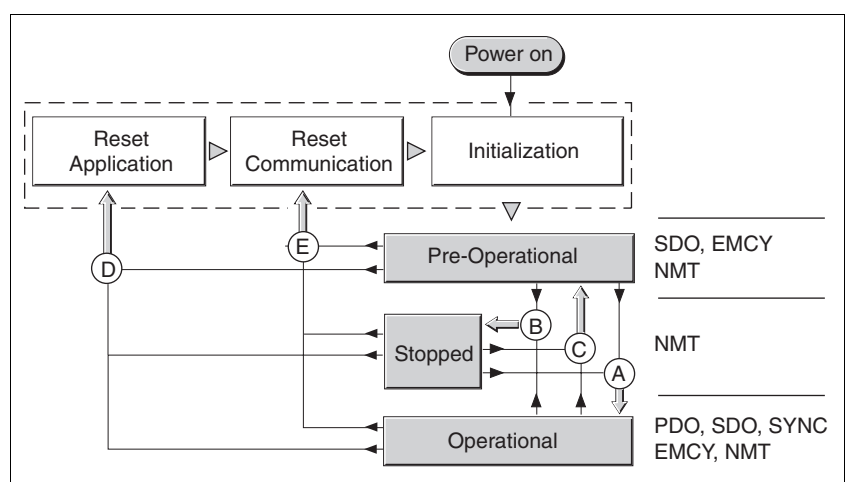


Figure 9.28 NMT status machine and available communications objects

The graphic shows on the right side all communications objects that can be used in the specific network status.

Initialization A NMT slave automatically runs through an initialization phase after the supply voltage is switched on (power on) to prepare it for CAN bus operation. On completion of the initialising process the slave switches to the "pre-operational" status and sends a boot-up message. Now a NMT master can control the operational behavior of a NMT slave in the network with 5 NMT services, shown in the above graph with the letters A to E.

NMT service	Transition	Description
Start remote node (Start network nodes)	A	Switch to "Operational" status Start normal mains operation to all devices
Stop remote node (Stop network nodes)	B	Switch to "Stopped" status Stop communications of the device in the network. If connection monitoring is active, it remains switched on. With an active power amplifier (status "Operation Enabled" or "Quick Stop") an error of error class 2 is triggered. The drive is stopped and switched off.
Enter Pre-Operational (Switch to "Pre-Operational")	C	Switch to "Pre-Operational" status All communications objects except for PDOs can be used. The "Pre-Operational" status can be used for configuration by SDOs: - PDO mapping - start of synchronization - start of connection monitoring
Reset node (Reset nodes)	D	Switch to "Reset application" status Load saved data of the device profiles and switch automatically to "pre-operational" via "Reset communication"
Reset communication (Reset communications data)	E	Switch to "Reset communication" status Load stored data of the communication profile and switch automatically to "Pre-Operational" status. With an active power amplifier (status "Operation Enabled" or "Quick Stop") an error of error class 2 is triggered. The drive is stopped and switched off.

Non-volatile saved data If the supply voltage is switched on (power on), the device loads the non-volatile saved object data from the EEPROM to the RAM.

NMT message The NMT services for device control are sent as unconfirmed message with the COB-ID = 0. By default they receive top priority on the CAN bus.

The data frame of the NMT device service consists of 2 bytes.

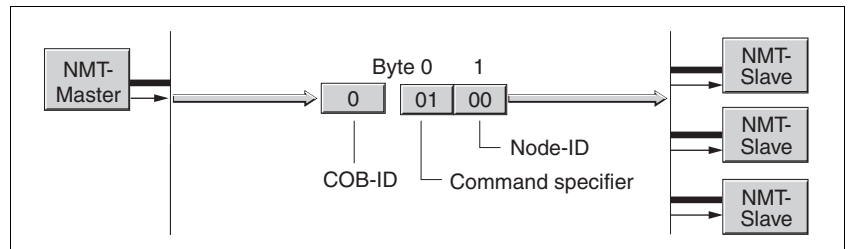


Figure 9.29 NMT message

The first byte, the "command specifier" identifies the NMT service in use.

Command Specifier	NMT service	Transition
1 (01 _h)	Start remote node	A
2 (02 _h)	Stop remote node	B
128 (80 _h)	Enter Pre-Operational	C
129 (81 _h)	Reset node	D
130 (82 _h)	Reset communication	E

The second byte addresses the receiver of an NMT message with a node address between 1 and 127 (7F_h). A message with the node address "0" is directed to all NMT slaves.

9.2.8.2 NMT services for connection monitoring

Connection monitoring monitors the communications status of network devices, so a response to the failure of a device or an interruption in the network is possible.

Three NMT services for connection monitoring are available:

- "Node guarding" for monitoring the connection of a NMT slave
- "Life guarding" (monitoring for signs of life) for monitoring the connection of a NMT master
- "Heartbeat" for the unconfirmed connection message from network devices.

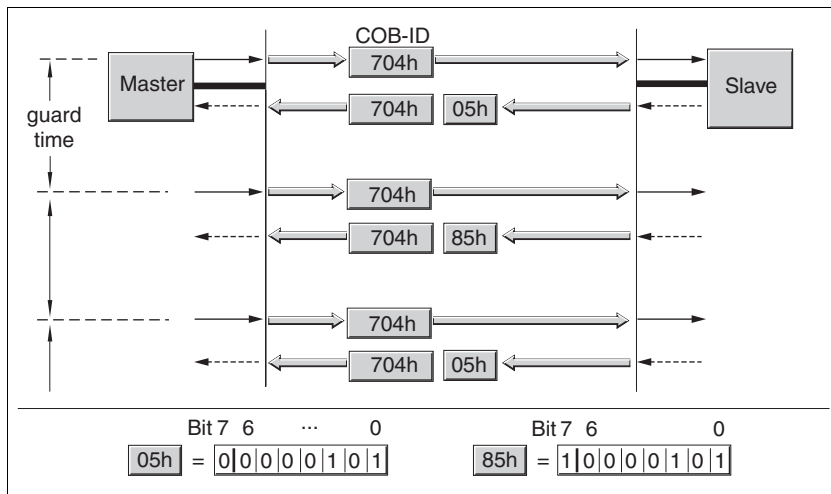
Node/Life guarding

COB-ID Connection monitoring is executed with the communications object `NMT error control (700h+Node-ID)`. The COB-ID for every NMT slave is calculated from the node address:

$\text{COB-ID} = \text{function code NMT error control (700}_{\text{h}}) + \text{Node-ID}.$

Structure of the NMT message

On request of the NMT master the NMT slave responds with one data byte.

**Acknowledgement of the NMT slave**

Bit 0 to 6 identify the NMT status of the slave:

- 4 (04_h): "Stopped"
- 5 (05_h): "Operational"
- 127 (7F_h): "Pre-Operational"

After every interval "guard-time" bit 7 switches its status between "0" and "1", so the NMT master can detect and ignore a second acknowledgement within the "guard-time" interval time. The first request when starting connection monitoring begins with bit 7 = 0.

Connection monitoring must not be enabled during the initialization phase of a device. The status of bit 7 is reset as soon as the device runs though the NMT status "Reset communication".

In NMT status "Stopped" the connection monitoring continues to operate.

Configuration

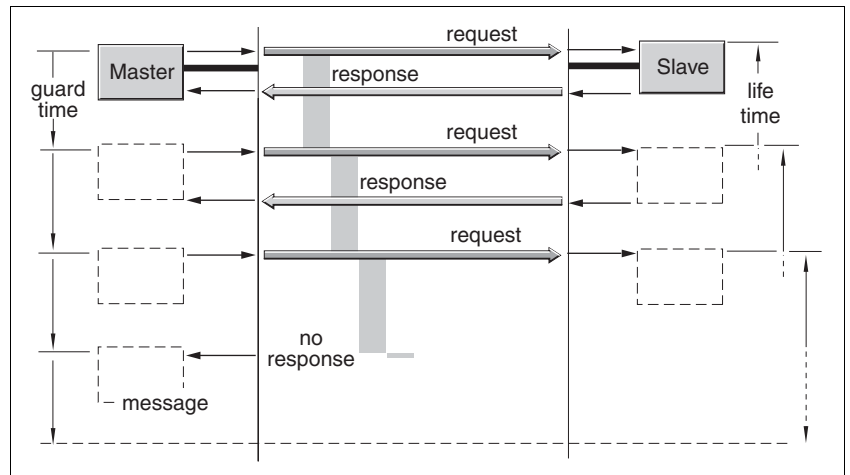
Node/life guarding is configured by:

- Guard time (100C_h)
- Life time factor (100D_h)
- Error Behavior (1029_h)

Connection error The NMT master reports a connection error to the higher level master program if:

- the slave does not acknowledge within the "guard-time" period
- the NMT status of the slave has changed without the initiation of the NMT master.

shows an error message after the end of the third cycle because of a missing answer of a NMT slave.



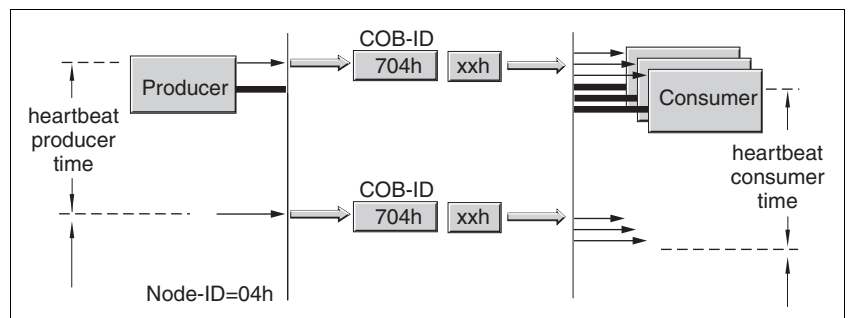
"Node guarding" and "Life guarding" with time intervals

Heartbeat

The optional heartbeat protocol replaces the node/life guarding protocol. It is recommended for new device versions.

A heartbeat producer transmits a heartbeat message cyclically at the frequency defined in the object `Producer heartbeat time` (`1017h`). One or more consumers can receive this message. `Producer heartbeat time` (`1016h`) = 0 disables heartbeat monitoring.

The relationship between producer and consumer can be configured with objects. If a consumer does not receive a signal within the time interval specified in the object `Consumer heartbeat time` (`1016h`), it generates an error message (heartbeat event). `Consumer heartbeat time` (`1016h`) = 0 disables the monitoring by a consumer.



"Heartbeat" monitoring

Data byte for NMT status evaluation of the "heartbeat" producer:

- 0 (00_h): "boot-up"
- 4 (04_h): "Stopped"
- 5 (05_h): "Operational"
- 127 (7F_h): "Pre-Operational"

Time intervals

The time intervals are set in 1-ms steps and must not be set smaller for the consumer than for the producer. Whenever the "heartbeat" message is received the time interval of the consumer is restarted.

Start of monitoring

"Heartbeat" monitoring starts as soon as the time interval of the producer is greater than zero. If "heartbeat" monitoring is active during the NMT status change to "Pre-Operational", the "heartbeat" monitoring starts by sending the boot up message. The boot up message is a heartbeat message with one data byte 00_h.

Devices can monitor each other by "heartbeat" message. They have consumer and producer function simultaneously.

9.3 Fieldbus CANopen object directory

9.3.1 Overview of object group 1000_h

Index	Subindex	Name	Obj. code	Data type	Access	Description	Page
1000 _h		device type	VAR	Unsigned32	ro	Device type and profile	254
1001 _h		error register	VAR	Unsigned8	ro	error register	254
1003 _h		predefined error field	ARR		rw	Error history, memory for error messages	255
1003 _h	00 _h	number of errors	VAR	Unsigned8	rw	Number of error entries	255
1003 _h	01 _h	error field	VAR	Unsigned32	ro	Error number	255
1005 _h		COB-ID SYNC	VAR	Unsigned32	rw	Identifier of the synchronization object	256
1008 _h		manufacturer device name	VAR	Visible String8	ro	user-defined device name	256
1009 _h		manufacturer hardware version	VAR	Visible String8	ro	Hardware status	257
100Ah		manufacturer software version	VAR	Visible String8	ro	Software version	257
100C _h		guard time	VAR	Unsigned16	rw	Time span for node guarding [ms]	258
100D _h		life time factor	VAR	Unsigned8	rw	Repeat factor for the node guarding protocol	258
1010 _h		save parameters	ARR	Unsigned32	rw	Saves parameters:	259
1010 _h	01 _h	save all parameters	VAR	Unsigned32	rw	Saves all parameters	259
1010 _h	02 _h	save communication parameters	VAR	Unsigned32	rw	Saves parameters for communications	259
1010 _h	03 _h	save application parameters	VAR	Unsigned32	rw	Saves parameters for application	259
1011 _h		restore default of parameters	ARR	Unsigned32	rw	Resets parameter values to the default setting	260
1011 _h	01 _h	restore default of all parameters	VAR	Unsigned32	rw	Resets all parameter values to the default setting	260
1011 _h	02 _h	restore default of application parameters	VAR	Unsigned32	rw	Restores parameter settings for communications to default	260
1011 _h	03 _h	restore default of communication parameters	VAR	Unsigned32	rw	sets parameter settings for the application to default	260
1014 _h		COB-ID EMCY	VAR	Unsigned32	rw	Unsigned16	261
1015 _h		inhibit time EMCY	VAR	Unsigned16	rw	Unsigned16	262
1016 _h		Consumer Heartbeat Time	ARR	Unsigned32	rw	Unsigned16	262
1016 _h	01 _h	Consumer Heartbeat Time	VAR	Unsigned32	rw	Time interval and Node-ID of the "Heartbeat" receiver	262
1017 _h		Producer Heartbeat Time	VAR	Unsigned16	rw	Time interval for producer "heartbeat"	263
1018 _h		Identity Object	REC	Identity	ro	Identification object:	263
1018 _h	01 _h	Vendor ID	VAR	Unsigned32	ro	Vendor ID	263
1018 _h	02 _h	Product code	VAR	Unsigned32	ro	Product code	263
1018 _h	03 _h	Revision number	VAR	Unsigned32	ro	Revision Number	263

Index	Subindex	Name	Obj. code	Data type	Access	Description	Page
1018 _h	04 _h	Serial number	VAR	Unsigned32	ro	Serial Number	263
1020 _h		Verify configuration	ARR	Unsigned32	rw	Retains data for configuration	265
1020 _h	01 _h	Configuration date	VAR	Unsigned32	rw	Date of configuration	265
1020 _h	02 _h	Configuration time	VAR	Unsigned32	rw	Time of configuration	265
1029 _h		Number of elements	ARR	Unsigned8	ro	Number of values for the object	265
1029 _h	01 _h	Communication error	ARR	Unsigned8	rw	Communication error	265
1200 _h		1st server SDO parameter	REC	SDO server param.	ro	First server SDO, settings	266
1200 _h	01 _h	COB-ID Client -> Server	VAR	Unsigned32	ro	Identifier Client -> Server	266
1200 _h	02 _h	COB-ID Server -> Client	VAR	Unsigned32	ro	Identifier Server -> Client	266
1201 _h		2nd server SDO parameter	REC	SDO server param.	rw	Second server SDO, settings	267
1201 _h	01 _h	COB-ID Client -> Server	VAR	Unsigned32	rw	Identifier Client -> Server	267
1201 _h	02 _h	COB-ID Server -> Client	VAR	Unsigned32	rw	Identifier Server -> Client	267
1201 _h	03 _h	Node-ID SDO Client	VAR	Unsigned32	rw	Node-ID SDO Client	267
1400 _h		1st receive PDO parameter	REC	PDO comm. param.	rw	First receive PDO (R_PDO1), settings	268
1400 _h	01 _h	COB-ID R_PDO1	VAR	Unsigned32	rw	Identifier of the R_PDO1	268
1400 _h	02 _h	transmission type R_PDO1	VAR	Unsigned8	rw	Transmission type	268
1401 _h		2nd receive PDO parameter	REC	PDO comm. param.	rw	Second receive PDO (R_PDO2), settings	271
1401 _h	01 _h	COB-ID R_PDO2	VAR	Unsigned32	rw	Identifier of the R_PDO2	271
1401 _h	02 _h	transmission type R_PDO2	VAR	Unsigned8	rw	Transmission type	271
1402 _h		3rd receive PDO parameter	REC	PDO comm. param.	rw	Third receive PDO (R_PDO3), settings	272
1402 _h	01 _h	COB-ID R_PDO3	VAR	Unsigned32	rw	Identifier of the R_PDO3	272
1402 _h	02 _h	transmission type R_PDO3	VAR	Unsigned8	rw	Transmission type	272
1403 _h		4th receive PDO parameter	REC	PDO comm. param.	rw	Fourth receive PDO (R_PDO4), settings	273
1403 _h	01 _h	COB-ID R_PDO4	VAR	Unsigned32	rw	Identifier of the R_PDO4	273
1403 _h	02 _h	transmission type R_PDO4	VAR	Unsigned8	rw	Transmission type	273
1600 _h		1st receive PDO mapping	REC	PDO Mapping	ro	PDO mapping for R_PDO1, settings	274
1600 _h	01 _h	1st mapped object R_PDO1	VAR	Unsigned32	ro	First object for the mapping in R_PDO1	274
1601 _h		2nd receive PDO mapping	REC	PDO Mapping	ro	PDO mapping for R_PDO2, settings	275
1601 _h	01 _h	1st mapped object R_PDO2	VAR	Unsigned32	ro	First object for the mapping in R_PDO2	275

Index	Subindex	Name	Obj. code	Data type	Access	Description	Page
1601 _h	02 _h	2nd mapped object R_PDO2	VAR	Unsigned32	ro	Second object for the mapping in R_PDO2	275
1602 _h		3rd receive PDO mapping	REC	PDO Mapping	ro	PDO mapping for R_PDO3, settings	276
1602 _h	01 _h	1st mapped object R_PDO3	VAR	Unsigned32	ro	First object for the mapping in R_PDO3	276
1602 _h	02 _h	2nd mapped object R_PDO3	VAR	Unsigned32	ro	Second object for the mapping in R_PDO3	276
1603 _h		4th receive PDO mapping	REC	PDO Mapping	rw	PDO mapping for R_PDO3, settings	277
1603 _h	01 _h	1st mapped object R_PDO4	VAR	Unsigned32	rw	First object for the mapping in R_PDO4	277
1603 _h	02 _h	2nd mapped object R_PDO4	VAR	Unsigned32	rw	Second object for the mapping in R_PDO4	277
1603 _h	03 _h	3rd mapped object R_PDO4	VAR	Unsigned32	rw	Third object for the mapping in R_PDO4	277
1800 _h		1st transmit PDO parameter	REC	PDO comm. param.	rw	First send PDO (T_PDO1), settings	278
1800 _h	01 _h	COB-ID T_PDO1	VAR	Unsigned32	rw	Identifier of the T_PDO1	278
1800 _h	02 _h	transmission type T_PDO1	VAR	Unsigned8	rw	Transmission type	278
1800 _h	03 _h	inhibit time T_PDO1	VAR	Unsigned16	rw	Blocking period for bus access (1=100μs)	278
1800 _h	04 _h	reserved T_PDO1	VAR	Unsigned8	rw	Priority for CAN bus arbitration ([0-7]).	278
1800 _h	05 _h	event timer T_PDO1	VAR	Unsigned16	rw	Time span for event triggering (1=1 ms)	278
1801 _h		2nd transmit PDO parameter	REC	PDO comm. param.	rw	Second send PDO (T_PDO2), settings	280
1801 _h	01 _h	COB-ID T_PDO2	VAR	Unsigned32	rw	Identifier of the T_PDO2	280
1801 _h	02 _h	transmission type T_PDO2	VAR	Unsigned8	rw	Transmission type	280
1801 _h	03 _h	inhibit time T_PDO2	VAR	Unsigned16	rw	Blocking period for bus access (1=100μs)	280
1801 _h	04 _h	reserved T_PDO2	VAR	Unsigned8	rw	Reserved	280
1801 _h	05 _h	event timer T_PDO2	VAR	Unsigned16	rw	Time span for event triggering (1=1 ms)	280
1802 _h		3rd transmit PDO parameter	REC	PDO comm. param.	rw	Third send PDO (T_PDO3), settings	281
1802 _h	01 _h	COB-ID T_PDO3	VAR	Unsigned32	rw	Identifier of the T_PDO3	281
1802 _h	02 _h	transmission type T_PDO3	VAR	Unsigned8	rw	Transmission type	281
1802 _h	03 _h	inhibit time T_PDO3	VAR	Unsigned16	rw	Blocking period for bus access (1=100μs)	281
1802 _h	04 _h	reserved T_PDO3	VAR	Unsigned8	rw	Reserved	281
1802 _h	05 _h	event timer T_PDO3	VAR	Unsigned16	rw	Time span for event triggering (1=1 ms)	281
1803 _h		4th transmit PDO parameter	REC	PDO comm. param.	rw	Fourth send PDO (T_PDO4), settings	283
1803 _h	01 _h	COB-ID T_PDO4	VAR	Unsigned32	rw	Identifier of the T_PDO4	283
1803 _h	02 _h	transmission type T_PDO4	VAR	Unsigned8	rw	Transmission type	283
1803 _h	03 _h	inhibit time T_PDO4	VAR	Unsigned16	rw	Blocking period for bus access (1=100μs)	283

Index	Subindex	Name	Obj. code	Data type	Access	Description	Page
1803 _h	04 _h	reserved T_PDO4	VAR	Unsigned8	ro	Reserved	283
1803 _h	05 _h	event timer T_PDO4	VAR	Unsigned16	rw	Time span for event triggering (1=1 ms)	283
1A00 _h		1st transmit PDO mapping	REC	PDO Mapping	rw	PDO mapping for T_PDO1, settings	285
1A00 _h	01 _h	1st mapped object T_PDO1	VAR	Unsigned32	ro	First object for the mapping in T_PDO1	285
1A01 _h		2nd transmit PDO mapping	REC	PDO Mapping	rw	PDO mapping for T_PDO2, settings	285
1A01 _h	01 _h	1st mapped object T_PDO2	VAR	Unsigned32	ro	First object for the mapping in T_PDO2	285
1A01 _h	02 _h	2nd mapped object T_PDO2	VAR	Unsigned32	ro	Second object for the mapping in T_PDO2	285
1A02 _h		3rd transmit PDO mapping	REC	PDO Mapping	rw	PDO mapping for T_PDO3, settings	286
1A02 _h	01 _h	1st mapped object T_PDO3	VAR	Unsigned32	ro	First object for the mapping in T_PDO3	286
1A02 _h	02 _h	2nd mapped object T_PDO3	VAR	Unsigned32	ro	Second object for the mapping in T_PDO3	286
1A03 _h		4th transmit PDO mapping	REC	PDO Mapping	rw	PDO mapping for T_PDO4, settings	287
1A03 _h	01 _h	1st mapped object T_PDO4	VAR	Unsigned32	rw	First object for the mapping in T_PDO4	287
1A03 _h	02 _h	2nd mapped object T_PDO4	VAR	Unsigned32	rw	Second object for the mapping in T_PDO4	287
1A03 _h	03 _h	3rd mapped object T_PDO4	VAR	Unsigned32	rw	Third object for the mapping in T_PDO4	287
1A03 _h	04 _h	4th mapped object T_PDO4	VAR	Unsigned32	rw	Fourth object for the mapping in T_PDO4	287

9.3.2 Details of object group 1000h

Index This index shows the position of the object in the object directory. The index value is shown in hexadecimal.

Object code The object code shows the data structure of the object.

Object code	Meaning	Coding
VAR	A single value, for example of the type Integer8, Unsigned32 or Visible String8.	7
ARR (ARRAY)	A data field in which every entry is of the same data type.	8
REC (RECORD)	A data field that contains entries that are a combination of single data types.	9

Data type	Value range	data length	CiA 301 Coding
Boolean	0 = false, 1 = true	1 byte	0001
Integer8	-128 .. +127	1 byte	0002
Integer16	-32768 .. +32767	2 byte	0003
Integer32	-2147483648 .. +2147483647	4 byte	0004
Unsigned8	0 .. 255	1 byte	0005
Unsigned16	0 .. 65535	2 byte	0006
Unsigned32	0 .. 4294967295	4 byte	0007
Visible String8	ASCII characters	8 byte	0009
Visible String16	ASCII characters	16 byte	0010

RO/RW Note on readability and writability of values
 RO: values can only be read
 RW: values can be read and written.

PDO R_PDO: Mapping for R_PDO possible
 T_PDO: Mapping for T_PDO possible
 no entry: PDO mapping not possible with the object

Min/max values Show the permissible range in which the object value is defined and valid.

Default value Factory setting.

persistent Designation of whether the value of the parameter is persistent, i.e. after switching off the device it is retained in the memory. When changing a value via commissioning software or fieldbus, the user must explicitly store the value change in the persistent memory.

9.3.2.1 1000_h Device type

The object shows the implemented device profile and the device type.

Object description

Index	1000 _h
Object name	device type
Object code	VAR
Data type	Unsigned32

Value description

Subindex	00 _h , device type
Meaning	Device type and profile
Access	read-only
PDO mapping	–
Value range	–
Default value	0042 0194 _h
can be saved	–

Bit coding, subindex 00_h

bit	Access	Value	Meaning
31-24	ro	00 _h	not used
15-0	ro	0192 _h	Device profile DS402 (192 _h)

9.3.2.2 1001_h Error register

The object shows the error status of the device. The detailed cause of error can be found with the object `predefined error field` (1003_h) and - for reasons of compatibility to devices with different field-bus profiles - the object `error code` (603F_h).

Errors are signaled by an EMCY message as soon as they occur.

Object description

Index	1001 _h
Object name	error register
Object code	VAR
Data type	Unsigned8

Value description

Subindex	00 _h , error register
Meaning	error register
Access	read-only
PDO mapping	–
Value range	–
Default value	–
can be saved	–

Bit coding, subindex 00_h

bit	Access	Value	Meaning
0	ro	–	Error! (generic error)
1	ro	–	Reserved
2	ro	–	Reserved
3	ro	–	Reserved
4	ro	–	Communication profile (communication error)
5	ro	–	Device profile (device profile error)
6	ro	–	Reserved
7	ro	–	manufacturer-specific

9.3.2.3 1003_h Predefined error field

The object saves the latest error messages that were shown as EMCY messages.

- The entry under subindex 00_h contains the number of saved error messages.
- The current error message is stored under subindex 01_h, older messages are moved to high subindex entries.
- Writing 0 to subindex 00_h resets the error list.

Object description

Index	1003 _h
Object name	predefined error field
Object code	ARRAY
Data type	Unsigned32

Value description

Subindex	00 _h , number of errors
Meaning	Number of error entries
Access	read-write
PDO mapping	–
Value range	0...1
Default value	1
can be saved	–
Subindex	01 _h , error field
Meaning	Error number
Access	read-only
PDO mapping	–
Value range	–
Default value	0
can be saved	–

Bit-coding, sub-index 00_h..05_h

Byte 0..15: Error code. Byte 16..31 additional error information, not assigned in the device.

9.3.2.4 1005_h COB-ID SYNC message

The object shows the COB-ID of the SYNC object and specifies whether a device sends or receives SYNC messages.

The device can only receive SYNC messages.

For synchronization a device in the network must send SYNC objects.

The COB-ID can be changed in the NMT "Pre-Operational" status.

Object description

Index	1005 _h
Object name	COB-ID SYNC
Object code	VAR
Data type	Unsigned32

Value description

Subindex	00 _h , COB-ID SYNC
Meaning	Identifier of the synchronization object
Access	read-write
PDO mapping	–
Value range	0...4294967295
Default value	8000 0080 _h
can be saved	Yes

Bit coding, subindex 00_h

bit	Access	Value	Meaning
31	ro	0 _b	1: Device can receive SYNC messages (SYNC consumer)
30	ro	1 _b	1: Device can send SYNC messages (SYNC producer)
29	ro	0 _b	0: 11-Bit Identifier (CAN 3.0A) 1: 29-Bit Identifier (CAN 3.0B)
28-11	ro	0000 _h	Only relevant if bit 29=1 is not used by the device.
10-7	rw	0001 _b	Function code, bit 10..7 of the COB-ID
6-0	ro	7F _h	Node address, bit 6..0 of the COB-ID

9.3.2.5 1008_h Manufacturer device name

The object shows the device name of the manufacturer.

Object description

Index	1008 _h
Object name	manufacturer device name
Object code	VAR
Data type	Visible String8

Value description

Subindex	00 _h , manufacturer device name
Meaning	user-define device name
Access	read-only
PDO mapping	–
Value range	–
Default value	–
can be saved	–

The following objects contain additional information on the device:
 - Objects 6404_h, 6410_h: Motor data

9.3.2.6 1009_h Manufacturer hardware version

The object shows the version of the device hardware.

Object description

Index	1009 _h
Object name	manufacturer hardware version
Object code	VAR
Data type	Visible String8

Value description

Subindex	00 _h , manufacturer hardware version
Meaning	Hardware status
Access	read-only
PDO mapping	–
Value range	–
Default value	–
can be saved	–

9.3.2.7 100A_h Manufacturer software version

The object shows the version of the device software.

Object description

Index	100A _h
Object name	manufacturer software version
Object code	VAR
Data type	Visible String8

Value description

Subindex	00 _h , manufacturer software version
Meaning	Software version
Access	read-only
PDO mapping	–
Value range	–
Default value	–
can be saved	–

9.3.2.8 100C_h Guard time

The object shows the time span for connection monitoring (node guarding) of an NMT slave.

The time span for the connection monitoring of an NMT master is derived from the time span "guard time" multiplied by the "life time factor", `object Life time factor(100Dh)`.

The time span can be changed in the NMT "Pre-Operational" status.

Object description

Index	100C _h
Object name	guard time
Object code	VAR
Data type	Unsigned16

Value description

Subindex	00 _h , guard time
Meaning	Time span for node guarding [ms]
Access	read-write
PDO mapping	–
Value range	0...65535
Default value	0
can be saved	Yes

9.3.2.9 100D_h Life time factor

The object shows the factor that together with the time span "guard time" gives the time interval for the connection monitoring of an NMT master. Within this period the NMT slave device waits for a monitoring request by node guarding by the NMT master device.

$\text{life time} = \text{guard time} * \text{life time factor}$

The value "0" disables the monitoring of the NMT master.

If the connection monitoring by the NMT master remains disabled during the time interval "life time", the device reports an error and switches to error status.

The time factor can be changed in the NMT "Pre-Operational" status.

The time span "guard time" is set with the object `Guard time (100Ch)`.

Object description

Index	100D _h
Object name	life time factor
Object code	VAR
Data type	Unsigned8

Value description

Subindex	00 _h , life time factor
Meaning	Repeat factor for the node guarding protocol.
Access	read-write
PDO mapping	–
Value range	0...255
Default value	0
can be saved	Yes

9.3.2.10 1010_h Save Parameters

The object is used to save parameters.

- Subindex 01_h, all parameters
- Subindex 02_h, parameters for communications
- Subindex 03_h, parameters for application

Object description

Index	1010 _h
Object name	Save Parameters
Object code	ARRAY
Data type	Unsigned32

Value description

Subindex	00 _h , number of elements
Meaning	Number of values for the object
Access	read-only
PDO mapping	–
Value range	–
Default value	3
can be saved	–

Subindex	01 _h , save all parameters
Meaning	saves all parameters
Access	read-write
PDO mapping	–
Value range	–
Default value	1
can be saved	–

Subindex	02 _h , save communication parameters
Meaning	saves parameters for communications
Access	read-write
PDO mapping	–
Value range	–
Default value	1
can be saved	–

Subindex	03 _h , save application parameters
Meaning	saves parameters for application
Access	read-write
PDO mapping	–
Value range	–
Default value	1
can be saved	–

9.3.2.11 1011_h Restore Default Parameters

The object is used to restore the default parameters.

- Subindex 01_h, all parameters
- Subindex 02_h, parameters for communications
- Subindex 03_h, parameter for application

Object description

Index	1011 _h
Object name	Restore Default Parameters
Object code	ARRAY
Data type	Unsigned32

Value description

Subindex	00 _h , number of elements
Meaning	Number of values for the object
Access	read-only
PDO mapping	–
Value range	–
Default value	3
can be saved	–

Subindex	01 _h , restore default of all parameters
Meaning	Resets all parameter values to the default setting
Access	read-write
PDO mapping	–
Value range	–
Default value	1
can be saved	–

Subindex	02 _h , restore default of communication parameters
Meaning	Restores parameter settings for communications to default
Access	read-write
PDO mapping	–
Value range	–
Default value	1
can be saved	–

Subindex	03 _h , restore default of application parameters
Meaning	Restores parameter settings for the application to default
Access	read-write
PDO mapping	–
Value range	–
Default value	1
can be saved	–

9.3.2.12 1014_h COB-ID emergency message

The object shows the COB-ID of the emergency object "EMCY".

Object description

Index	1014 _h
Object name	COB-ID EMCY
Object code	VAR
Data type	Unsigned32

Value description

Subindex	00 _h , COB-ID EMCY
Meaning	Identifier of the emergency object
Access	read-write
PDO mapping	–
Value range	0...4294967295
Default value	4000 0080 _h + Node-ID
can be saved	Yes

Bit coding, subindex 00_h

bit	Access	Value	Meaning
31, 30	ro	0 _b	Reserved
29	ro	0 _b	0: 11-Bit Identifier (CAN 3.0A) 1: 29-Bit Identifier (CAN 3.0B)
28-11	ro	0000 _h	Only relevant if bit 29=1 is not used by the device.
10-7	rw	0001 _b	Function code, bit 10-7 of the COB-ID
6-0	ro	–	Node address, bit 6-0 of the COB-ID

The COB-ID can be changed in the NMT "Pre-Operational" status.

9.3.2.13 1015_h Inhibit time emergency message

The object specifies the waiting period for the repeated transmission of EMCY messages as a multiple of 100µs.

Object description

Index	1015 _h
Object name	inhibit time EMCY
Object code	VAR
Data type	Unsigned16

Value description

Subindex	00h, inhibit time EMCY
Meaning	Waiting time for repeated transmission of an EMCY
Access	read-write
PDO mapping	–
Value range	0...65535
Default value	0
can be saved	Yes

9.3.2.14 1016_h Consumer Heartbeat Time

The object saves the settings of the "heartbeat" consumer for NMT monitoring by "heartbeat" connection message.

Object description

Index	1016 _h
Object name	Consumer Heartbeat Time
Object code	ARRAY
Data type	Unsigned32

Value description

Subindex	00h, number of elements
Meaning	Number of values for the object
Access	read-only
PDO mapping	–
Value range	–
Default value	3
can be saved	–
Subindex	01 _h , Consumer Heartbeat Time
Meaning	Time interval and Node-ID of the "Heartbeat" receiver
Access	read-write
PDO mapping	–
Value range	0...4294967295
Default value	0
can be saved	Yes

Bit-coding Subindex 01_h..03_h

bit	Meaning
31..24	Reserved
23..16	Node-ID
15..0	Time interval for "heartbeat" message

The time interval is given as a multiple of 1 ms and must be greater than the producer "heartbeat" time, object `Producer Heartbeat Time` (1017_h). If the time interval is zero, the device specified via the Node-ID is not monitored.

9.3.2.15 1017_h Producer Heartbeat Time

The object saves the time interval of the "heartbeat" producer for NMT monitoring by "heartbeat" connection message as a multiple of 1 ms.

The producer "heartbeat" time must be less than the time interval of the "heartbeat" consumer, object `Consumer Heartbeat Time` (1016_h). Time interval zero switches monitoring off.

Object description

Index	1017 _h
Object name	Producer Heartbeat Time
Object code	VAR
Data type	Unsigned16

Value description

Subindex	00 _h , Producer Heartbeat Time
Meaning	Time interval for producer "heartbeat"
Access	read-write
PDO mapping	–
Value range	0...65535
Default value	0
can be saved	Yes

9.3.2.16 1018_h Identity Object

The object shows information on the device.

- Subindex 01_h (vendor ID) contains the identification identifier of the manufacturer
- subindex 02_h (product ID) shows the manufacturer-specific product code
- subindex 03_h (revision number) identifies special CANopen properties for the device
- subindex 04_h (serial number) contains the serial number

Object description

Index	1018 _h
Object name	Identity Object
Object code	RECORD
Data type	Identity

Value description

Subindex	00h, number of elements
Meaning	Number of values for the object
Access	read-only
PDO mapping	–
Value range	–
Default value	4
can be saved	–
Subindex	01 _h , Vendor ID
Meaning	Vendor ID
Access	read-only
PDO mapping	–
Value range	–
Default value	0800 0054 _h
can be saved	–
Subindex	02 _h , Product code
Meaning	Product code
Access	read-only
PDO mapping	–
Value range	–
Default value	8401
can be saved	–
Subindex	03 _h , Revision number
Meaning	Revision Number
Access	read-only
PDO mapping	–
Value range	–
Default value	1
can be saved	–
Subindex	04 _h , Serial number
Meaning	Serial Number
Access	read-only
PDO mapping	–
Value range	–
Default value	0
can be saved	–

9.3.2.17 1020_h data for configuration

The object is used to verify the configuration.

- Subindex 01_h, date of configuration
- Subindex 02_h, time of configuration

Object description

Index	1020 _h
Object name	
Object code	RECORD
Data type	Identity

Value description

Subindex	00 _h , verify configuration
Meaning	Retains data for configuration
Access	read-only
PDO mapping	–
Value range	–
Default value	2
can be saved	–

Subindex	01 _h , configuration date
Meaning	Date of configuration
Access	read-write
PDO mapping	–
Value range	–
Default value	
can be saved	Yes

Subindex	02 _h , configuration time
Meaning	Time of configuration
Access	read-write
PDO mapping	–
Value range	–
Default value	
can be saved	Yes

9.3.2.18 1029_h Error Behavior

The object shows the behavior of the NMT status machine in the event of a communication error.

Object description

Index	1029 _h
Object name	Error Behavior
Object code	ARRAY
Data type	Unsigned8

Value description

Subindex	00 _h , number of elements
Meaning	Number of values for the object
Access	read-only
PDO mapping	–
Value range	–
Default value	1
can be saved	–

Subindex	01 _h , Communication Error
Meaning	Communication error
Access	read-write
PDO mapping	–
Value range	0...2
Default value	0
can be saved	Yes

Settings, subindex 01_h

Value	Meaning
0	pre-operational (with operational status only)
1	no status change
2	stopped

9.3.2.19 1200_h 1st server SDO parameter

The object saves the settings for the first server SDO.

Object description

Index	1200 _h
Object name	1st server SDO parameter
Object code	RECORD
Data type	SDO server parameter

Value description

Subindex	00 _h , number of elements
Meaning	Number of values for the object
Access	read-only
PDO mapping	–
Value range	–
Default value	2
can be saved	–

Subindex	01 _h , COB-ID Client -> Server
Meaning	Identifier Client -> Server
Access	read-only
PDO mapping	–
Value range	0...4294967295
Default value	1536 + Node-ID
can be saved	Yes

Subindex	02 _h , COB-ID Server -> Client
Meaning	Identifier Server -> Client
Access	read-only
PDO mapping	–
Value range	0...4294967295
Default value	1408 + Node-ID
can be saved	Yes

9.3.2.20 1201_h 2nd server SDO parameter

The object saves the settings for the second server SDO.

Object description

Index	1201 _h
Object name	2nd server SDO parameter
Object code	RECORD
Data type	SDO server parameter

Value description

Subindex	00 _h , number of elements
Meaning	Number of values for the object
Access	read-only
PDO mapping	–
Value range	–
Default value	3
can be saved	–

Subindex	01 _h , COB-ID Client -> Server
Meaning	Identifier Client -> Server
Access	read-write
PDO mapping	–
Value range	0...4294967295
Default value	8000 0000 _h
can be saved	Yes

Subindex	02 _h , COB-ID Server -> Client
Meaning	Identifier Server -> Client
Access	read-write
PDO mapping	–
Value range	0...4294967295
Default value	8000 0000 _h
can be saved	Yes

Subindex	03 _h , Node-ID SDO Client
Meaning	Node-ID SDO Client
Access	read-write
PDO mapping	–
Value range	1...127
Default value	–
can be saved	Yes

9.3.2.21 1400_h 1st receive PDO parameter

The object saves the settings for the first receive PDO R_PDO1.

Object description

Index	1400 _h
Object name	1st receive PDO parameter
Object code	RECORD
Data type	PDO Communication Parameter

Value description

Subindex	00 _h , number of entries
Meaning	Number of values for the object
Access	read-only
PDO mapping	–
Value range	–
Default value	2
can be saved	–

Subindex	01 _h , COB-ID used by PDO
Meaning	Identifier of the R_PDO1
Access	read-write
PDO mapping	–
Value range	0...4294967295
Default value	0200 _h + Node-ID
can be saved	Yes

Subindex	02 _h , transmission type = asynchronous
Meaning	Transmission type
Access	read-write
PDO mapping	–
Value range	0...255
Default value	255
can be saved	Yes

Bit assignment subindex 01_h

bit	Access	Value	Meaning
31	rw	0 _b	0: PDO is enabled 1: PDO is disabled
30	ro	0 _b	0: RTR (see below) is possible 1: RTR not permitted
29	ro	0 _b	0: 11-Bit Identifier (CAN 3.0A) 1: 29-Bit Identifier (CAN 3.0B)
28-11	ro	0000 _h	Only relevant if bit 29=1 is not used by the device.
10-7	rw	0100 _b	Function code, bit 10-7 of the COB-ID
6-0	ro	–	Node address, bit 6-0 of the COB-ID

Bit 31 A R_PDO can only be used if bit 31="0".

Bit 30: RTR Bit If a device supports R_PDOs with RTR (remote transmission request), it can request a PDO from a PDO producer with RTR = "0" in accordance with the producer-consumer relationship.

The device cannot request PDOs, but it can respond to the request for a PDO, see RTR bit for T_PDO1 settings (1800_h).

Bit coding, subindex 02_h

The controller for evaluating R_PDO data is specified via subindex 02_h. The values 241..251 are reserved.

Transmission type	cyclic	acyclic	synchronous	asynchronous	RTR controlled
0	–	X	X	–	–
1-240	X	–	X	–	–
252	–	–	X	–	X
253	–	–	–	X	X
254	–	–	–	X	–
255	–	–	–	X	–

If an R_PDO is transmitted synchronously (transmission type=0..252), the device evaluates the received data in accordance with the SYNC object.

- With acyclic transmission (transmission type=0) the evaluation is linked to the SYNC object, but not the transmission of the PDO. A received PDO message is evaluated with the following SYNC.

A value between 1 and 240 shows the number of SYNC cycles after which a received PDO is evaluated.

The values 252 to 254 are relevant for updating T_PDOs but not for sending them.

- 252: Updating transmit data with receipt of the next SYNC
- 253 updating transmit data with receipt of a request from a PDO consumer
- 254: Data update event-controlled, the triggering event is manufacturer-specific specified

R_PDOs with the value 255 are updated immediately with receipt of the PDOs. The triggering event is the data that is sent corresponding to the definition of the CiA 402 device profile in the PDO.

Settings

R_PDO1 is processed asynchronously and event-controlled.

The byte assignment of the R_PDO1 is specified via PDO mapping with the object `1st receive PDO mapping` (1600_h). The following assignment is the default for R_PDO1:

- Byte 0..1: Control word `controlword` (6040_h).

The COB-Id of the object can be changed in the NMT "Pre-Operational" status.

9.3.2.22 1401_h 2nd receive PDO_parameter

The object saves settings for the second receive PDO R_PDO2.

Object description

Index	1401 _h
Object name	2nd receive PDO parameter
Object code	RECORD
Data type	PDO Communication Parameter

Value description

Subindex	00 _h , Largest subindex supported
Meaning	Maximum supported subindex
Access	read-only
PDO mapping	–
Value range	–
Default value	2
can be saved	–

Subindex	01 _h , COB-ID R_PDO2
Meaning	Identifier of the R_PDO2
Access	read-write
PDO mapping	–
Value range	0...4294967295
Default value	8000 0300 _h + Node-ID
can be saved	Yes

Subindex	02 _h , transmission type
Meaning	Transmission type
Access	read-write
PDO mapping	–
Value range	0...255
Default value	255
can be saved	Yes

The meaning of the bit states and subindex values is described with the object 1st receive PDO parameters (1400_h).

Settings R_PDO2 is processed synchronously, acyclically and event-controlled and must be enabled with bit 31=1 in subindex 01_h.

The byte assignment of R_PDO2 is specified via PDO mapping with the object 2nd Receive PDO mapping (1601_h). The following assignment is preset in the "profile position mode":

- Byte 0..1: Control word `controlword` (6040_h).
- Byte 2..5: target position of the travel command `target position` (607A_h)

The COB-Id of the object can be changed in the NMT "Pre-Operational" status.

The transmission type for the receive PDO can have three value ranges:

0	for an asynchronous cycle
1 to 240	assigns the receive PDO, only becomes active if a SYNC object is received
255	shows that the PDO is executed on receipt

9.3.2.23 1402_h 3rd receive PDO parameter

The object saves settings for the third receive PDO R_PDO3.

Object description

Index	1402 _h
Object name	3rd receive PDO parameter
Object code	RECORD
Data type	PDO Communication Parameter

Value description

Subindex	00 _h , Largest subindex supported
Meaning	Maximum supported subindex
Access	read-only
PDO mapping	–
Value range	–
Default value	2
can be saved	–
Subindex	01 _h , COB-ID used by PDO
Meaning	Identifier of the R_PDO3
Access	read-write
PDO mapping	–
Value range	0...4294967295
Default value	8000 0400 _h + Node-ID
can be saved	Yes

Subindex	02 _h , transmission type
Meaning	Transmission type
Access	read-write
PDO mapping	–
Value range	0...255
Default value	255
can be saved	Yes

The meaning of the bit states and subindex values is described with the object `1st receive PDO-parameters` (1400_h).

Settings R_PDO3 is processed synchronously, acyclically and event-controlled and must be enabled with bit 31=1 in subindex 01_h.

The byte assignment of the R_PDO3 is specified via PDO mapping with the object `3rd Receive PDO mapping` (1602_h). The following assignment is preset for speed mode in the "profile velocity mode":

- Byte 0..1: Control word `controlword` (6040_h)
- Byte 2..5: set speed of the travel command `Target velocity` (60FF_h)

The COB-Id of the object can be changed in the NMT "Pre-Operational" status.

The transmission type for the receive PDO can have three value ranges:

0	for an asynchronous cycle
1 to 240	assigns the receive PDO, only becomes active if a SYNC object is received
255	shows that the PDO is executed on receipt

9.3.2.24 1403_h 4th receive PDO parameter

The object saves settings for the fourth receive PDO R_PDO4.

Object description

Index	1403 _h
Object name	4th receive PDO parameter
Object code	RECORD
Data type	PDO Communication Parameter

Value description

Subindex	00 _h , Largest subindex supported
Meaning	Maximum supported subindex
Access	read-only
PDO mapping	–
Value range	–
Default value	2
can be saved	–

Subindex	01 _h , COB-ID used by PDO
Meaning	Identifier of the R_PDO4
Access	read-write
PDO mapping	–
Value range	0...4294967295
Default value	8000 0500 _h + Node-ID
can be saved	Yes

Subindex	02 _h , transmission type
Meaning	Transmission type
Access	read-only
PDO mapping	–
Value range	–
Default value	254
can be saved	Yes

The meaning of the bit states and subindex values is described under object 1st receive PDO-parameters (1400_h).

PDO settings R_PDO4 is processed asynchronously and event-controlled and must be enabled with bit 31=1 in subindex 01_h.

The COB-Id of the object can be changed in the NMT "Pre-Operational" status.

9.3.2.25 1600_h 1st receive PDO mapping

The object shows which objects are mapped in R_PDO1 and transmitted with the PDO. When reading the object subindex 00_h the number of mapped objects is given.

Object description

Index	1600 _h
Object name	1st receive PDO mapping
Object code	RECORD
Data type	PDO Mapping

Value description

Subindex	00 _h , number of mapped objects
Meaning	Number of values for the object
Access	read-only
PDO mapping	–
Value range	1...8
Default value	1
can be saved	–

Subindex	01 _h , CMD: Control word
Meaning	First object for the mapping in R_PDO1
Access	read-only
PDO mapping	–
Value range	0...4294967295
Default value	6040 0010 _h
can be saved	–

Bit coding from subindex 01_h

Every subindex entry from subindex 01_h gives the object and the bit length of the object. The object is identified via index and subindex, which refer to the object directory of the device.

bit	Meaning
31..16	Index
15..8	Subindex
7..0	Object length in bit

Settings The PDO assignment for R_PDO1 cannot be modified. The following assignment is the default:

- Subindex 01_h: PDO mapping of the control word, object controlword (6040_h).

9.3.2.26 1601_h 2nd receive PDO mapping

The object shows which objects are mapped in R_PDO2 and transmitted with the PDO. When reading the object subindex 00_h the number of mapped objects is given.

Object description

Index	1601 _h
Object name	2nd receive PDO mapping
Object code	RECORD
Data type	PDO Mapping

Value description

Subindex	00 _h , number of mapped application objects in PDO
Meaning	Number of values for the object
Access	read-only
PDO mapping	–
Value range	1...8
Default value	2
can be saved	–

Subindex	01 _h , PDO mapping for the first application object to be mapped (control word)
Meaning	First object for the mapping in R_PDO2
Access	read-only
PDO mapping	–
Value range	0...4294967295
Default value	6040 0010 _h
can be saved	–

Subindex	02 _h , PDO mapping for the second application object to be mapped (target position)
Meaning	Second object for the mapping in R_PDO2
Access	read-only
PDO mapping	–
Value range	0...4294967295
Default value	607A 0020 _h
can be saved	–

The meaning of the bit states is described with the object `1st receive PDO-mapping` (1600_h).

Settings

The PDO assignment for R_PDO2 cannot be modified. The following assignment is preset for point-to-point operation in the "profile position mode":

- Subindex 01_h: PDO mapping of the control word, object `controlword` (6040_h).
- Subindex 02_h: target position of the travel command, object `target position` (607A_h).

9.3.2.27 1602_h 3rd receive PDO mapping

The object shows which objects are mapped in R_PDO3 and transmitted with the PDO. When reading the object subindex 00_h the number of mapped objects is given.

Object description

Index	1602 _h
Object name	3rd receive PDO mapping
Object code	RECORD
Data type	PDO Mapping

Value description

Subindex	00 _h , number of mapped application objects in PDO
Meaning	Number of values for the object
Access	read-only
PDO mapping	–
Value range	1...8
Default value	2
can be saved	–

Subindex	01 _h , PDO mapping for the first application object to be mapped (control word)
Meaning	First object for the mapping in R_PDO3
Access	read-only
PDO mapping	–
Value range	0...4294967295
Default value	6040 0010 _h
can be saved	–

Subindex	02 _h , PDO mapping for the second application object to be mapped (target velocity)
Meaning	Second object for the mapping in R_PDO3
Access	read-only
PDO mapping	–
Value range	0...4294967295
Default value	60FF 0020 _h
can be saved	–

The meaning of the bit states is described with the object `1st receive PDO-mapping` (1600_h).

Settings The PDO assignment for R_PDO3 cannot be modified. The following assignment is preset for speed mode in the "profile velocity mode":

- Subindex 01_h: PDO mapping of the control word, object `controlword` (6040_h).
- Byte 2..5: set speed of the travel command `Target velocity` (60FF_h).

9.3.2.28 1603_h 4th receive PDO mapping

The object shows which objects are mapped in R_PDO4 and transmitted with the PDO. When reading the object subindex 00_h the number of mapped objects is given.

Object description

Index	1603 _h
Object name	4th receive PDO mapping
Object code	RECORD
Data type	PDO Mapping

Value description

Subindex	00h, number of elements
Meaning	Number of values for the object
Access	read-write
PDO mapping	–
Value range	0...4
Default value	0
can be saved	Yes

The meaning of the bit states is described under object 1st receive PDO mapping (1600_h).

Settings The PDO assignment for R_PDO4 can be modified.

9.3.2.29 1800_h 1st transmit PDO parameter

The object saves settings for the first send PDO T_PDO1.

Object description

Index	1800 _h
Object name	1st transmit PDO parameter
Object code	RECORD
Data type	PDO Communication Parameter

Value description

Subindex	00 _h , number of entries
Meaning	Number of values for the object
Access	read-only
PDO mapping	–
Value range	–
Default value	5
can be saved	–

Subindex	01 _h , COB-ID used by PDO
Meaning	Identifier of the T_PDO1
Access	read-write
PDO mapping	–
Value range	0...4294967295
Default value	0180 _h + Node-ID
can be saved	Yes

Subindex	02 _h , transmission type = asynchronous
Meaning	Transmission type
Access	read-write
PDO mapping	–
Value range	0...255
Default value	255
can be saved	Yes

Subindex	03 _h , inhibit time
Meaning	Blocking period for bus access (1=100µs)
Access	read-write
PDO mapping	–
Value range	0...65535
Default value	0
can be saved	Yes

Subindex	04 _h , reserved
Meaning	Reserved
Access	–
PDO mapping	–
Value range	0...255
Default value	–
can be saved	–

Subindex	05 _h , event timer
Meaning	Time span for event triggering (1=1 ms)
Access	read-write
PDO mapping	–
Value range	0...65535
Default value	0
can be saved	Yes

The meaning of the bit states and subindex values is described with the object `1st receive PDO-parameters` (1400_h).

Settings T_PDO1 is sent asynchronously and event-controlled at every change of the PDO data.

The byte assignment of the T_PDO1 is specified via PDO mapping with the object `1st transmit PDO mapping` (1A00_h). The following assignment is the default:

- Byte 0..1: Status word `statusword` (6041_h).

The COB-Id of the object can be changed in the NMT "Pre-Operational" status.

9.3.2.30 1801_h 2nd transmit PDO parameter

The object saves settings for the second send PDO T_PDO2.

Object description

Index	1801 _h
Object name	2nd transmit PDO parameter
Object code	RECORD
Data type	PDO Communication Parameter

Value description

Subindex	00 _h , Largest subindex supported
Meaning	Maximum supported subindex
Access	read-only
PDO mapping	–
Value range	–
Default value	5
can be saved	–
Subindex	01 _h , COB-ID used by PDO
Meaning	Identifier of the T_PDO2
Access	read-write
PDO mapping	–
Value range	0...4294967295
Default value	C000 0280 _h + Node-ID
can be saved	Yes
Subindex	02 _h , transmission type
Meaning	Transmission type
Access	read-write
PDO mapping	–
Value range	0...255
Default value	255
can be saved	Yes
Subindex	03 _h , inhibit time
Meaning	Blocking period for bus access (1=100µs)
Access	read-write
PDO mapping	–
Value range	0...65535
Default value	0
can be saved	Yes

Subindex	04 _h , reserved
Meaning	Reserved
Access	–
PDO mapping	–
Value range	0...255
Default value	–
can be saved	–

Subindex	05 _h , event timer
Meaning	Time span for event triggering (1=1 ms)
Access	read-write
PDO mapping	–
Value range	0...65535
Default value	100
can be saved	Yes

The meaning of the bit states and subindex values is described with the object `1st receive PDO-parameters` (1400_h).

Settings T_PDO2 is sent synchronously and acyclically.

The byte assignment of the T_PDO2 is specified via PDO mapping with the object `2nd transmit PDO mapping` (1A01_h). The following assignment is preset in the "profile position mode":

- Byte 0..1: Status word `statusword` (6041_h).
- Byte 2..5: Current position `position actual value` (6064_h).

The COB-Id of the object can be changed in the NMT "Pre-Operational" status.

9.3.2.31 1802_h 3rd transmit PDO parameter

The object saves settings for the third send PDO T_PDO3.

Object description

Index	1802 _h
Object name	3rd transmit PDO parameter
Object code	RECORD
Data type	PDO Communication Parameter

Value description

Subindex	00 _h , Largest subindex supported
Meaning	Maximum supported subindex
Access	read-only
PDO mapping	–
Value range	–
Default value	5
can be saved	–
Subindex	01 _h , COB-ID used by PDO
Meaning	Identifier of the T_PDO3
Access	read-write
PDO mapping	–
Value range	0...4294967295
Default value	C000 0380 _h + Node-ID
can be saved	Yes
Subindex	02 _h , transmission type
Meaning	Transmission type
Access	read-write
PDO mapping	–
Value range	0...255
Default value	255
can be saved	Yes
Subindex	03 _h , inhibit time
Meaning	Blocking period for bus access (1=100µs)
Access	read-write
PDO mapping	–
Value range	0...65535
Default value	0
can be saved	Yes
Subindex	04 _h , reserved
Meaning	Reserved
Access	–
PDO mapping	–
Value range	0...255
Default value	–
can be saved	–

Subindex	05 _h , event timer
Meaning	Time span for event triggering (1=1 ms)
Access	read-write
PDO mapping	–
Value range	0...65535
Default value	100
can be saved	Yes

The meaning of the bit states and subindex values is described with the object `1st receive PDO-parameters` (1400_h).

Settings T_PDO3 is sent synchronously and acyclically.

The byte assignment of the T_PDO3 is specified via PDO mapping with the object `3rd transmit PDO mapping` (1A02_h). The following assignment is preset for speed mode in the "profile velocity mode":

- Byte 0..1: Status word `statusword` (6041_h).
- Byte 2..5: Current Speed `velocity actual value` (606C_h).

The COB-Id of the object can be changed in the NMT "Pre-Operational" status.

9.3.2.32 1803_h 4th transmit PDO parameter

The object saves settings for the fourth send PDO T_PDO4.

Object description

Index	1803 _h
Object name	4th transmit PDO parameter
Object code	RECORD
Data type	PDO Communication Parameter

Value description

Subindex	00 _h , Largest subindex supported
Meaning	Maximum supported subindex
Access	read-only
PDO mapping	–
Value range	–
Default value	5
can be saved	–

Subindex	01 _h , COB-ID used by PDO
Meaning	Identifier of the T_PDO4
Access	read-write
PDO mapping	–
Value range	0...4294967295
Default value	C000 0480 _h + Node-ID
can be saved	Yes

Subindex	02 _h , transmission type
Meaning	Transmission type
Access	read-only
PDO mapping	–
Value range	0...255
Default value	254
can be saved	Yes
Subindex	03 _h , inhibit time
Meaning	Blocking period for bus access (1=100µs)
Access	read-write
PDO mapping	–
Value range	0...65535
Default value	0
can be saved	Yes
Subindex	04 _h , reserved
Meaning	Reserved
Access	–
PDO mapping	–
Value range	0...255
Default value	–
can be saved	–
Subindex	05 _h , event timer
Meaning	Time span for event triggering (1=1 ms)
Access	read-write
PDO mapping	–
Value range	0...65535
Default value	0
can be saved	Yes

The meaning of the bit states and subindex values is described with the object 1st receive PDO-parameters (1400_h).

Settings

R_PDO4 is sent asynchronously and event-driven.

The COB-Id of the object can be changed in the NMT "Pre-Operational" status.

9.3.2.33 1A00_h 1st transmit PDO mapping

The object shows which objects are mapped in T_PDO1 and transmitted with the PDO. When reading the object subindex 00_h the number of mapped objects is given.

Object description

Index	1A00 _h
Object name	1st transmit PDO mapping
Object code	RECORD
Data type	PDO Mapping

Value description

Subindex	00 _h , number of mapped objects
Meaning	Number of values for the object
Access	read-only
PDO mapping	–
Value range	1...8
Default value	1
can be saved	–

Subindex	01 _h , ETA: status word
Meaning	First object for the mapping in T_PDO1
Access	read-only
PDO mapping	–
Value range	0...4294967295
Default value	6041 0010 _h
can be saved	–

The meaning of the bit states is described with the object 1st receive PDO mapping (1600_h).

Settings

The PDO assignment for T_PDO1 cannot be modified. The following assignment is the default:

- Subindex 1: PDO mapping of the status word, object `statusword` (6041_h)

9.3.2.34 1A01_h 2nd transmit PDO mapping

The object shows which objects are mapped in T_PDO2 and transmitted with the PDO. When reading the object subindex 00_h the number of mapped objects is given.

Object description

Index	1A01 _h
Object name	2nd transmit PDO mapping
Object code	RECORD
Data type	PDO Mapping

Value description

Subindex	00 _h , number of mapped application objects in PDO
Meaning	Number of values for the object
Access	read-only
PDO mapping	–
Value range	1...8
Default value	2
can be saved	–

Subindex	01 _h , PDO mapping for the first application object to be mapped (status word)
Meaning	First object for the mapping in T_PDO2
Access	read-only
PDO mapping	–
Value range	0...4294967295
Default value	6041 0010 _h
can be saved	–

Subindex	02 _h , PDO mapping for the second application object to be mapped (actual position)
Meaning	Second object for the mapping in T_PDO2
Access	read-only
PDO mapping	–
Value range	0...4294967295
Default value	6064 0020 _h
can be saved	–

The meaning of the bit states is described with the object 1st receive PDO-mapping (1600_h).

Settings

The PDO assignment for T_PDO2 cannot be modified. The following assignment is preset for point-to-point operation in the "profile position mode":

- Subindex 1: PDO mapping of the status word, object `statusword` (6041_h)
- Subindex 2: PDO mapping of the current position, object `position actual value` (6064_h).

9.3.2.35 1A02_h 3rd transmit PDO mapping

The object shows which objects are mapped in T_PDO3 and transmitted with the PDO. When reading the object subindex 00_h the number of mapped objects is given.

Object description

Index	1A02 _h
Object name	3rd transmit PDO mapping
Object code	RECORD
Data type	PDO Mapping

Value description

Subindex	00 _h , number of mapped application objects in PDO
Meaning	Number of values for the object
Access	read-only
PDO mapping	–
Value range	1...8
Default value	2
can be saved	–
Subindex	01 _h , PDO mapping for the first application object to be mapped (status word)
Meaning	First object for the mapping in T_PDO3
Access	read-only
PDO mapping	–
Value range	0...4294967295
Default value	6041 0010 _h
can be saved	–
Subindex	02 _h , PDO mapping for the second application object to be mapped (actual velocity)
Meaning	Second object for the mapping in T_PDO3
Access	read-only
PDO mapping	–
Value range	0...4294967295
Default value	606C 0020 _h
can be saved	–

The meaning of the bit states is described with the object `1st receive PDO-mapping` (1600_h).

Settings

The PDO assignment for T_PDO3 cannot be modified. The following assignment is preset for speed mode in the "profile velocity mode":

- Byte 0..1: Status word `statusword` (6041_h).
- Byte 2..5: Current Speed `velocity actual value` (606C_h).

9.3.2.36 1A03_h 4th transmit PDO mapping

The object shows which objects are mapped in T_PDO4 and transmitted with the PDO. When reading the object subindex 00_h the number of mapped objects is given.

Object description

Index	1A03 _h
Object name	4th transmit PDO mapping
Object code	RECORD
Data type	PDO Mapping

Value description

Subindex	00 _h , number of elements
Meaning	Number of values for the object
Access	read-write
PDO mapping	–
Value range	0...4
Default value	0
can be saved	Yes

The meaning of the bit states is described under object `1st receive PDO mapping (1600h)` .

Settings

The PDO assignment for T_PDO4 cannot be modified.

10 Diagnostics and troubleshooting

10.1 Error display

The last cause of interruption and the last 10 error messages are stored. You can display the last 10 error messages using the commissioning software and the fieldbus.

For a description of all error numbers, see chapter 10.3 "Table of error numbers".

Asynchronous errors Asynchronous errors are triggered by the internal monitoring (e.g. temperature) or by the external monitoring (e.g. limit switch). An error response is initiated if an asynchronous error occurs.

Asynchronous errors are displayed as follows:

- Change to operating status "Quick Stop" or "Fault"
- Addition of error number to parameter `StopFault`

synchronous errors Synchronous errors occur as direct errors in response to a fieldbus command. These include, for example:

- Error in executing an action or control command
- Parameter value outside the permissible value range
- Non-permissible action or control command during a running process
- Access to unknown parameter

For a detailed description of the synchronous errors, see chapter 10 "Diagnostics and troubleshooting".

10.1.1 State diagram

After switching on and at the start of an operating mode, a sequence of operating states is progressed through.

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

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

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

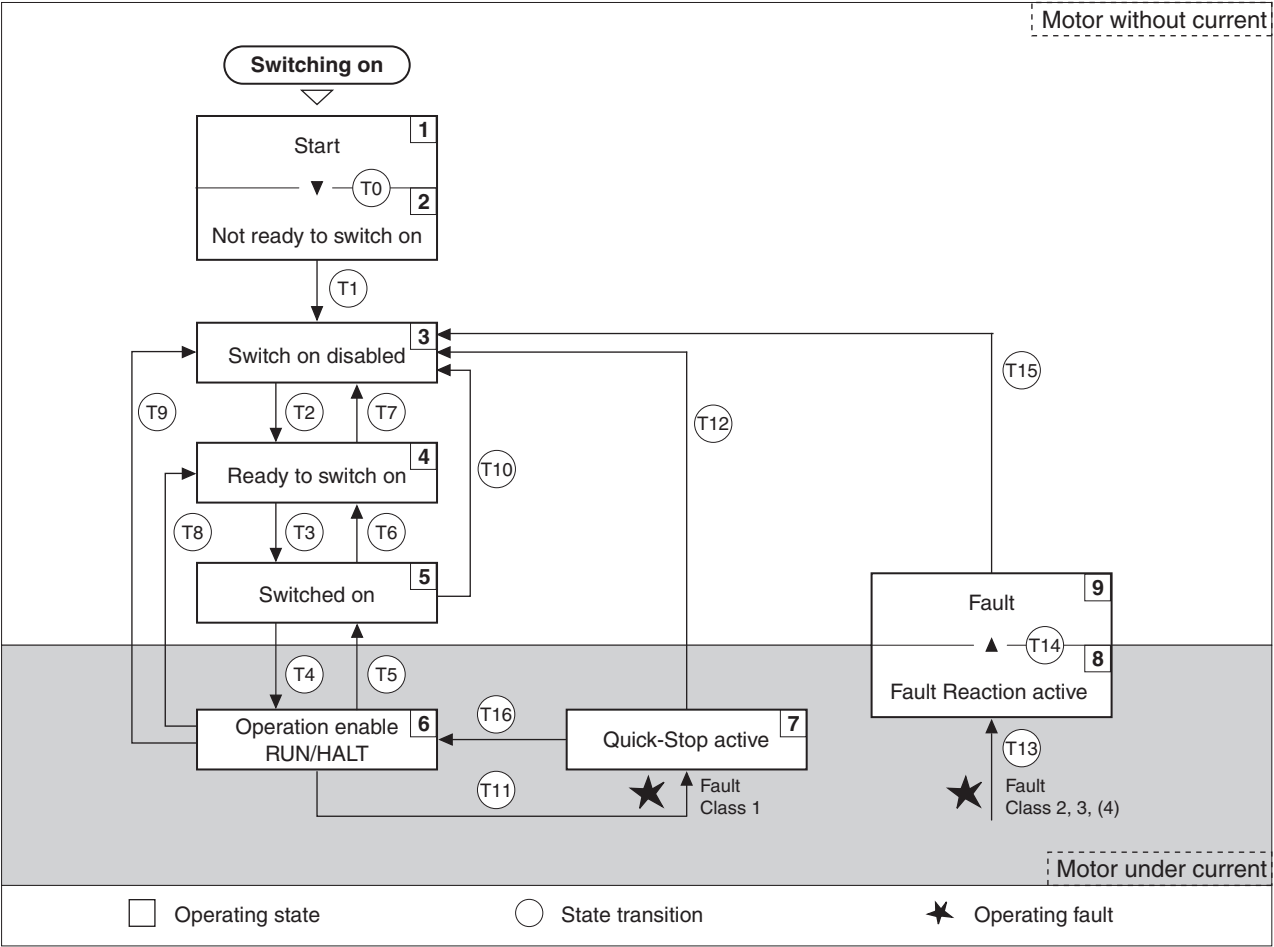


Figure 10.1 State diagram

Operating states You can display the operating statuses using the commissioning software.

Operating status	Description of operating status
1 Start	Controller supply voltage, electronics is initialized
2 Not ready to switch on	Power amplifier is not ready to switch on ¹⁾
3 Switch on disabled	Switching on the power amplifier is disabled
4 Ready to switch on	The power amplifier is ready to switch on
5 Switched on	Motor not under current Power amplifier ready No operating mode active
6 Operation enable	RUN: device running in the selected operating mode HALT: The motor is stopped with active power amplifier
7 Quick Stop active	"Quick Stop" is executed
8 Fault response active	Error detected, error response is enabled
9 Fault	device is in fault condition

1) The device must be switched off and then switched on again

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

Transition	Operating status	Condition / event ^{1) 2)}	Reaction
T0	1-> 2	• Device electronics successfully initialized	
T1	2-> 3	• Parameter successfully initialized	
T2	3-> 4	• no under-voltage Encoder successfully checked Actual speed: <1000 1/min $\overline{\text{STO_A}}$ and $\overline{\text{STO_B}}$ = +24V Fieldbus command: Shutdown ³⁾	
T3	4-> 5	• Call-up for activation of power amplifier • fieldbus command: Switch On	
T4	5-> 6	• Automatic transition • fieldbus command: Enable Operation (only if T3 via fieldbus command Switch On)	Power amplifier is activated User parameters are checked Holding brake is released (if present)
T5	6-> 5	• fieldbus command: Disable Operation	Travel command interrupted with "Halt" Brake is applied Power amplifier is deactivated.
T6	5-> 4	• fieldbus command: Shutdown	
T7	4-> 3	• Undervoltage • $\overline{\text{STO_A}}$ and $\overline{\text{STO_B}}$ = 0V • Actual speed: >1000 1/min (e.g. by remote drive) • Fieldbus command: Disable Voltage	-
T8	6-> 4	• fieldbus command: Shutdown	Power amplifier is immediately deactivated.

Transition	Operating status	Condition / event ^{1) 2)}	Reaction
T9	6-> 3	<ul style="list-style-type: none"> Call-up for deactivation of power amplifier fieldbus command: Disable Voltage 	Power amplifier is immediately deactivated.
T10	5-> 3	<ul style="list-style-type: none"> Call-up for deactivation of power amplifier fieldbus command: Disable Voltage 	
T11	6-> 7	<ul style="list-style-type: none"> Class 1 error fieldbus command: Quick Stop 	Interrupt travel command with "Quick Stop".
T12	7-> 3	<ul style="list-style-type: none"> Call-up for deactivation of power amplifier fieldbus command: Disable Voltage 	Power amplifier is deactivated immediately, even if "Quick Stop" is still active.
T13	x -> 8	<ul style="list-style-type: none"> Errors Class 2, 3 or 4 	Error response is carried out, see "Error response"
T14	8 -> 9	<ul style="list-style-type: none"> Error response terminated (error from class 2) Errors Class , 3 or 4 	
T15	9-> 3	<ul style="list-style-type: none"> Function: "Fault Reset" 	Error is reset (cause of error must be corrected).
T16	7-> 6	<ul style="list-style-type: none"> Function: "Fault Reset" fieldbus command: Enable Operation ⁴⁾ 	

1) In order to initiate status transition it is sufficient to fulfill just one point

2) fieldbus commands only with control mode fieldbus

3) Only required with fieldbus control mode, fieldbus CANopen and parameter DCOMcompatib= 1

4) Possible only if operating status was triggered through fieldbus

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

Error class	Response	Description
0	Warning	Message only, no interruption of movement mode.
1	"Quick Stop"	Motor stops with "Quick Stop", power amplifier and controller remain switched on and active.
2	"Quick Stop" with switch-off	Motor stops with "Quick Stop", power amplifier and controller switch off when at standstill.
3	Fatal error	Power amplifier and controller switch off immediately, without stopping the motor first.
4	Uncontrolled operation	Power amplifier and controller switch off immediately, without stopping the motor first. Error response can only be reset by switching the device off.

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

Error class	Status from -> to	Reaction
2	x -> 8	Braking with "Quick Stop" Brake is applied Power amplifier is switched off.
3,4 or Safety function STO	x -> 8 -> 9	Power amplifier is switched off immediately, even if "Quick Stop" is still active

An operating error can be indicated by a temperature sensor, for example. The device interrupts the travel command and carries out an error response e.g. braking and stopping with "Quick Stop" or switching off the power amplifier. Subsequently the operating status changes to "Fault".

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

10.1.2 Error display with LEDs

Overview The graph below shows an overview of the LEDs for the status display.

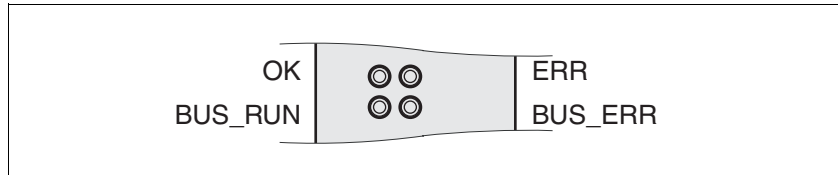


Figure 10.2 Overview LEDs for status display

Operating states The LEDs "OK" (green) and "ERR" (red) display error messages and warnings. They show the operating statuses in coded form.

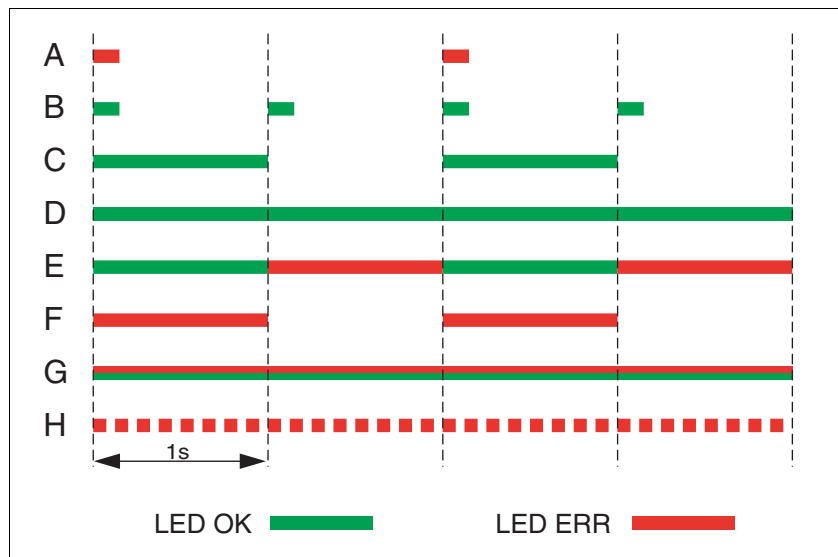


Figure 10.3 Operating states through LEDs

Operating states

- (A) **1** Start
- 2** Not ready to switch on
- (B) **3** Switch on disabled
- (C) **4** Ready to switch on
- 5** Switched on
- (D) **6** Operation enable
- (E) **7** Quick Stop active
- 8** Fault Reaction active
- (F) **9** Fault
- (G) Firmware not available
- (H) Internal error

Fieldbus communication The LEDs "BUS_RUN" (green) and "BUS_ERR" (red) show the NMT states of the fieldbus communication.

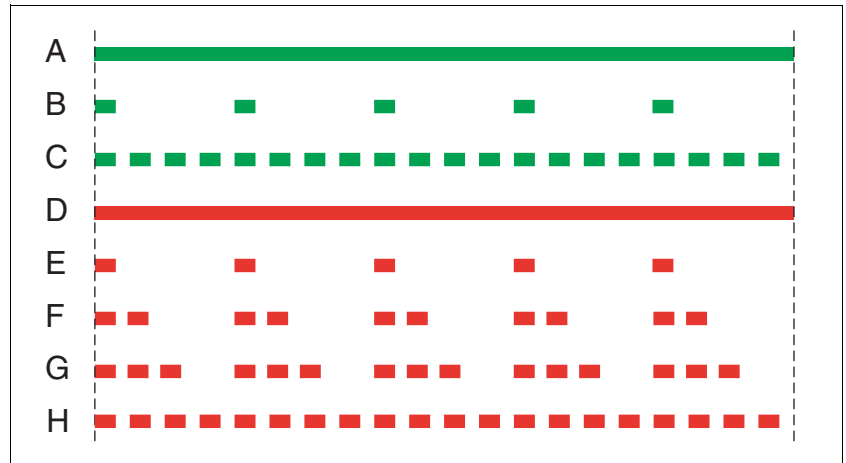


Figure 10.4 Fieldbus communication through LEDs

LED "BUS_RUN"

- (A) device is in the NMT state OPERATIONAL
- (B) device is in the NMT state STOPPED
- (C) device is in the NMT state PRE-OPERATIONAL

LED "BUS_ERR"

The

- (D) CAN is BUS-OFF, e.g. after 32 failed transmission attempts.
- (E) Warning limit reached e.g. after 16 failed transmission attempts
- (F) Monitoring result (node guarding) has occurred
- (G) SYNC message was not received within the configured period
- (H) Incorrect settings, e.g. invalid node address

10.1.3 Error display using commissioning software

- You will need a PC with the commissioning software and a functioning connection to the product.
- ▶ Select "Diagnosis - memory". A dialog box which displays the error messages appears.

The commissioning software shows a 4 digit error number in the list of the error memory with an "E" in front.

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

- ▶ Correct the error and reset the current error message with the "Reset" button in the command bar of the program.

10.1.4 Error display over the fieldbus

cause of last interruption The parameter `_StopFault` allows read out of the error number and the last cause of interruption. If there is no error, the value of the parameter is 0. If an error occurs, the error is written in the error memory together with other status information. In the case of subsequent errors, only the triggering cause of error is stored.

Error memory The error memory is an error history of the last 10 errors and is maintained even if the device is switched off. The following parameters allow the error memory to be controlled:

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
FLT_del_err	Clear error memory	-	UINT16	CANopen 303B:4 _h
-	1: Delete all entries in the error memory	0	UINT16	Modbus 15112
-	The clearing process is completed if a 0 is returned after a read access.	-	R/W	
-		1	-	-
FLT_MemReset	Reset error memory read pointer	-	UINT16	CANopen 303B:5 _h
-	1: Set error memory read pointer to oldest error entry.	0	UINT16	Modbus 15114
-		-	R/W	
-		1	-	-

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 moved on to the next entry, re-reading selects the next error entry. If the error number 0 is returned there is no error entry present.

Position of the entry	Meaning
1	1. Error entry, oldest message
2	2. Error entry, later message, if present
...	...
10	10. Error entry. In the case of 10 error entries the most current error value is shown here

An individual error entry consists of several pieces of information which are read out using various parameters. When reading out an error entry, the error number must always be read out first with the parameter FLT_err_num.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
FLT_err_num	Error number	-	UINT16	CANopen 303C:1 _h
-	Reading this parameter copies the entire error entry (error class, time of occurrence of error, ...) to an intermediate memory from which all elements of the error can then be read.	0	UINT16	Modbus 15362
-	In addition, the read pointer of the error memory is automatically set to the next error entry.	-	R/-	
-		65535	-	
FLT_class	Error class	-	UINT16	CANopen 303C:2 _h
-	0: Warning (no response)	0	UINT16	Modbus 15364
-	1: Error (Quick Stop -> status 7)	-	R/-	
-	2: Error (Quick Stop -> status 8, 9)	4	-	
	3: Fatal error (status 9, can be acknowledged)		-	
	4: Fatal error (status 9, cannot be acknowledged)			
FLT_Time	Error time	s	UINT32	CANopen 303C:3 _h
-	With reference to operating hours counter	0	UINT32	Modbus 15366
-		-	R/-	
-		536870911	-	
FLT_Qual	Error additional information	-	UINT16	CANopen 303C:4 _h
-	This entry contains additional information on the error, depending on the error number.	0	UINT16	Modbus 15368
-	Example: a parameter address	-	R/-	
-		65535	-	

10.1.4.1 Message objects

A number of objects provide information on the operating and error status:

- Object `Statusword` (6041_h)
Operating states, see product manual
- Object `EMCY` (80_h+ Node-ID)
Error message of a device with error status
- Object `Error register` (1001_h)
Error-state
- Object `Error code` (603F_h)
Error code of the most recent error that occurred
- Devices use the special SDO ABORT error message to report the failed message exchange via SDO (cancel)

10.1.4.2 Messages on the device status

A distinction is made between synchronous and asynchronous errors when evaluating and handling errors.

Synchronous error

The unit reports a synchronous error directly as a response to a message that cannot be evaluated. Possible causes can be faulty transmission or illegal data. For a list of synchronous errors see chapter 10.1.4.3 "error register".

Asynchronous errors

Asynchronous errors are reported by the monitoring devices of the unit as soon as a unit error occurs. An asynchronous error is reported via bit 3, "Fault", of the object `statusword` (6041_h). For errors that cause a movement interruption the unit sends an EMCY message.

Asynchronous errors are also reported via bits 5..7 of the object `driveStat` (2041_h).

10.1.4.3 error register

The object `Error register`(1001_h) shows the error status of a device in bit-coded form. The exact cause of error must be determined with the error code table. Bit 0 is set as soon as an error occurs.

Bit	Message	Description
0	generic error	An error has occurred
1	-	reserved
2	-	reserved
3	-	reserved
4	Communication	Error in network communications
5	Device profile-specific	Error in execution by device profile
6	-	reserved
7	Manufacturer-specific	Manufacturer-dependent error message

10.1.4.4 Error code table

The error code is evaluated with the object error code (603F_h), an object of the DSP 402 device profile, and output as a four-character hexadecimal number. The error code shows the cause of the last interruption of movement. The meaning of the error code can be found in the product manual in the section on error diagnosis and troubleshooting.

10.1.4.5 SDO error message ABORT

A SDO error message is output as a response to an error in a SDO transmission. The cause of error is shown in `error code`, byte 4 to byte 7.

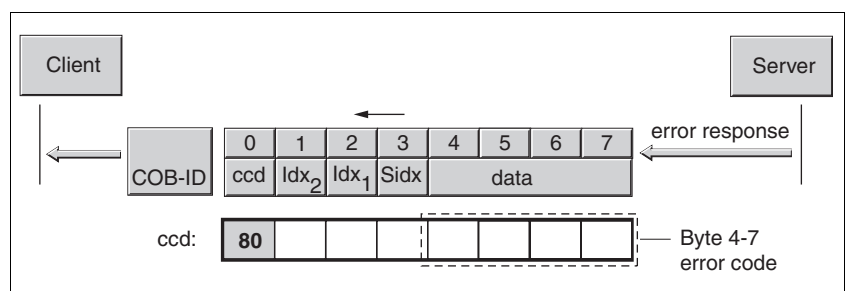


Figure 10.5 SDO error message as answer to a SDO message

The table below shows all error messages that may occur with the device during data exchange.

Error code	Description
0503 0000 _h	Inverse bit not inverted
0504 0000 _h	Time-out during SDO transfer
0504 0001 _h	Command specifier CS incorrect or unknown
0504 0005 _h	No free memory
0601 0000 _h	No access to object possible
0601 0001 _h	No read access, because write-only object (wo)
0601 0002 _h	No write access, because read object (ro)
0602 0000 _h	Object does not exist in object directory
0604 0041 _h	Object does not support PDO mapping
0604 0042 _h	PDO mapping: number or length of objects exceed the byte length of the PDO
0604 0043 _h	Parameters are not compatible
0604 0047 _h	Device detects internal incompatibility
0606 0000 _h	Hardware error, access denied
0607 0010 _h	Data type and parameter length do not match
0607 0012 _h	Data type does not match, parameter too long
0607 0013 _h	Data type does not match, parameter too short
0609 0011 _h	subindex not supported
0609 0030 _h	Value range of parameter too large (relevant only for write access)
0609 0031 _h	Parameter values too great

Error code	Description
0609 0032 _h	Parameter values too small
0609 0036 _h	Top value is less than bottom value
0800 0000 _h	General error
0800 0020 _h	Data cannot be uploaded or saved to the application.
0800 0021 _h	Device control is executed locally, data cannot be uploaded or saved.
0800 0022 _h	Device status prevent uploading and saving data.
0800 0023 _h	Object directory either not present or cannot be generated, e.g. if data error occurs when generating from file.
0800 xxxx _h	Manufacturer-specific error, xxxx corresponds to the error number of the device. It is listed in the error code table of the device manual.

10.2 Troubleshooting

10.2.1 Fieldbus communication

A correctly functioning fieldbus operation is essential for evaluating operational and error messages.

Checking connections

If the drive system cannot be addressed over the fieldbus, first check the connections.

Check the following connections:

- ▶ System power supply
- ▶ Power connections
- ▶ Fieldbus cable and wiring
- ▶ Fieldbus terminal

Check that the wiring is correct for the limit switch (if installed) and the terminating resistors.

Function test on the fieldbus

If the connections are correct, check the settings for the fieldbus addresses. After correct configuration of the transmission data test the fieldbus operation.

In addition to the master that knows the drive system by the EDS file and polling, a bus monitor that as a passive device displays messages should be installed.

- ▶ Switch the supply voltage of the drive system off and on.
- ▶ Observe the network messages shortly before switching on the drive system. A bus monitor can be used to record the elapsed time between message frames and the relevant information in the message frame during recording.

Possible errors: Polling, parameter setting, configuration

If the connection to a device cannot be established, check the following:

- Address: Every network device must have a unique address.
- Parameterization: The vendor ID and the product code of the device must conform to the values stored in the EDS file.

10.2.2 Error resolution sorted by error bit

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

Error bit	Meaning	Error class	Cause	Troubleshooting
0	General error	0		
1	Limit switch (LIMP/LIMN/REF)	1	Limit switch is or was activated, wire interrupted	Traverse drive into movement range, match positioning data to axis range, special message in error memory
2	Area of travel exceeded (software limit switch, tuning range)	1	Motor outside area of travel	Check area of travel, re-reference the drive
3	"Quick Stop" by fieldbus	1	fieldbus command	
4	Inputs <code>STO_A</code> and <code>STO_B</code> are "0"	3	STO safety function was triggered	Check safety guard, wiring
5	Reserved			
6	Error in fieldbus RS485, Modbus		Interruption of the fieldbus communication, only with RS485, e.g. Modbus	Check the communication cable, check the fieldbus, check the communication parameters.
8	Reserved			
9	Reference signals faulty (frequency too high)		frequency too high, error	EMC measures, maintain maximum frequency (Technical data)
10	Error in processing of the current operating mode	2	Processing error	Detailed information see under additional information in the error memory
11	Reserved			
13	Reserved			
14	DC Bus undervoltage	2	DC bus voltage under threshold value for "Quick Stop"	Check or increase mains voltage
		3	DC bus voltage under threshold value for switch-off of the drive	Check for power failure
15	DC bus overvoltage	3	DC bus overvoltage, braking too fast	Extend braking process, use external braking resistor
16	Power supply faulty (phase fault, ground fault)	par. ¹⁾	Short circuit or ground fault Power supply incorrectly connected (e.g. 1-phase instead of 3-phase)	Check fuse and installation
17	Connection to motor (motor phase interrupted, ground fault, commutation)	3	Short circuit or ground fault in the motor wiring or encoder wiring. Defective motor. External moment exceeds the motor moment (preset motor current too low).	Check connections, change motor cable or encoder cable. Change motor. Reduce external moment or increase the setting of the motor current.
18	Motor overload (phase current too high)	3	I ² t monitoring for motor	Reduce load, use a motor with a higher nominal power
19	Encoder in motor signals error or connection to encoder faulty	3-4	No signal from the motor encoder, encoder faulty	Check encoder cable and encoder, replace cable
20	Undervoltage from controller supply		Controller supply voltage has fallen below the minimum value	Secure control supply. Check short-term voltage failures during load changes

Error bit	Meaning	Error class	Cause	Troubleshooting
21	Temperature too high (power amplifier, braking resistor or motor)	3	The power amplifier is overheating Motor overheated Temperature sensor not connected	Ventilator faulty or blocked, switch on time for peak current, reduce load or peak torque Allow motor to cool down, reduce load, use motor with greater nominal power, temperature sensor faulty, check/change motor and encoder cables
22	SpeedError	par. ¹⁾ 1-3	SpeedError	Reduce external load or acceleration, error response is adjustable via "Flt_pDiff"
24	STO_A and STO_B inputs different	4	Interruption of the signal wiring	Signal cable/connection to be checked, check signal encoder or change
25..28	Reserved			
29	Error in EEPROM	3-4	Checksum in EEPROM incorrect	"Initial settings" to be carried out, user parameters to be stored in the EEPROM, consult your local sales partner
30	System start-up faulty (hardware or parameter fault)	3-4	Cause of error in accordance with error display	Resolution dependent upon error display
31	Internal system error (e. g. Watchdog)	4	Internal system error System error, e.g. division by 0 or time-out checks, inadequate EMC	Switch device off and on, replace device Comply with EMC protective measures, switch device off and on, contact your local service representative

1) par. = can be set by parameters

10.3 Table of error numbers

The cause of error for each error message is coded as an error number and stored in the parameter `FLT_err_num`. The following table shows all error numbers and their meaning. If "par." is shown under the error class, then the error class can be set as a parameter.

The error numbers are structured:

Error number	Error in area
E 1xxx	General errors
E 2xxx	Excess current error
E 3xxx	Voltage error
E 4xxx	Temperature error
E 5xxx	Hardware error
E 6xxx	Software error
E 7xxx	Interface error, wiring error
E 8xxx	Fieldbus error CANopen
E Axxx	Drive error, movement error
E Bxxx	Communication error

Information on error bits and measures for correcting errors can be found on page 302.

Error number	Class	Bit	Description, reason and correctives
E 1100	-	-	Parameter out of permissible range
E 1101	-	-	Parameter does not exist Fault signaled by parameter management: parameter (index) does not exist.
E 1102	-	-	Parameter does not exist Fault signaled by parameter management: parameter (subindex) does not exist.
E 1103	-	-	Parameter write not permissible (READ only) Write access to read only parameter.
E 1104	-	-	Write access denied (no access authorization) Parameter only accessible at expert level. The write access level expert is required.
E 1106	-	-	Command not allowed while power amplifier is active Command not allowed while the power amplifier is enabled (status "OperationEnable" or "QuickStopActive"). Disable the power amplifier and repeat the command.
E 1107	-	-	Access via other interface blocked Access occupied by another channel (e.g.: commissioning software is active and fieldbus access was tried at the same time). Check the channel that blocks the access.

Error number	Class	Bit	Description, reason and correctives
E 110B	3	30	<p>Initialization error (additional info=Modbus register address)</p> <p>Error detected at power enable parameter check e.g. reference speed value for profile position is greater than max. allowed speed of drive.#</p> <p>Value in additional error info shows the Modbus register address of the parameter where the initialization error was detected.</p>
E 110D	1	0	<p>Basic configuration of controller required after factory setting</p> <p>The "First Setup" (FSU) was not run at all or not completed.</p>
E 110E	-	-	<p>Parameter changed that requires a restart of the drive</p> <p>Only displayed by the commissioning software.</p> <p>A parameter modification requires the drive to be switched off and on.</p> <p>Restart the drive to activate the parameter functionality.</p> <p>Check the parameter chapter for the parameter that required a restart of the drive.</p>
E 1300	3	4	<p>Safety function STO activated (STO_A, STO_B)</p> <p>The safety function STO was activated in "Operation enable" status.</p> <p>Reset the fault; check the wiring of the STO inputs.</p>
E 1301	4	24	<p>STO_A and STO_B different level</p> <p>The levels of the input STO_A or STO_B were different for more than 1 second.</p> <p>The drive has to be switched off and the reason fixed (e.g.: check emergency stop active) before it is switched on.</p>
E 1310	3	9	<p>Reference signal frequency too high</p> <p>The frequency of the pulse signal (A/B, Pulse/Direction, CW/CCW) is higher than the allowed value.</p> <p>Adapt the output pulse frequency of the controller to fit the input specification of the drive. Take care to also adapt the electronic gear ratio for the application requirements (position accuracy and speed).</p>
E 1311	-	-	<p>The selected input or output function cannot be configured</p> <p>The function configured for an Input or Output cannot be used in the selected mode (e.g. enable positive movement input function cannot be configured in jog mode) .</p>
E 1312	-	-	<p>Limit or reference switch signal in I/O functions not defined</p> <p>Reference movements require limit switches. These limit switches are not assigned to inputs.</p> <p>Assign the LIMP, LIMN and ref functions to the inputs.</p>
E 160C	1	0	<p>Autotuning: moment of inertia outside permissible range</p> <p>The load inertia is too high.</p>
E 160D	1	0	<p>Autotuning: the value of parameter 'AT_n_tolerance' may be too low for the identified mechanical system</p> <p>First steps of Autotuning failed: oscillation is too high.</p>
E 160F	1	0	<p>Autotuning: power amplifier cannot be enabled</p> <p>Autotuning was started in "Fault" status.</p>
E 1610	1	0	<p>Autotuning: processing discontinued</p> <p>DC bus undervoltage, LIMP, LIMN, Stop button at remote terminal pressed, ..., but NOT caused by Autotuning process.</p>
E 1611	1	0	<p>System error: Autotuning internal write access</p> <p>HALT is active and an Autotuning parameter is written. Occurs when Autotuning is started.</p>

Error number	Class	Bit	Description, reason and correctives
E 1613	1	0	Autotuning: max. permissible positioning range exceeded The motor exceeded the adjusted position range during Autotuning. Increase the position range value or disable range check by setting 'AT_DIS' = 0.
E 1614	-	-	Autotuning: already active Autotuning has been started twice simultaneously OR an Autotuning parameter is modified during Autotuning ('AT_dis' and 'AT_dir').
E 1615	-	-	Autotuning: this parameter cannot be changed while Autotuning is active AT_gain' or 'AT_J' are written during Autotuning.
E 1616	1	0	Autotuning: static friction for selected speed jump height 'AT_n_ref' too high AT_n_ref' is too great regarding actual friction. Reduce 'AT_n_ref' or friction.
E 1617	1	0	Autotuning: friction torque or load torque too great The current limit has been reached ('CTRL_i_max').
E 1618	1	0	Autotuning: optimization aborted The internal Autotuning sequence has not been finished (following error?).
E 1619	-	-	Autotuning: the speed jump height 'AT_n_ref' is too small compared to 'AT_n_tolerance' $AT_n_ref < 2 * AT_n_tolerance$; checked only once at the first speed jump. Modify 'AT_n_ref' and/or 'AT_n_tolerance' to meet the desired condition.
E 1620	1	0	Autotuning: load torque too high Product dimensioning is not suitable for the machine load. Detected machine inertia is too high compared to the inertia of the motor. Reduce load, check dimensioning.
E 1A01	3	19	Motor has been changed Detected motor type is different from previously detected motor. Confirm the motor change.
E 1A02	3	19	Motor has been changed The motor type is the same, but the motor data structure has changed. Confirm the motor change.
E 1B04	3	30	ESIM resolution too high with selected 'n_max' Reduce the ESIM resolution or the maximum speed 'CTRL_n_max'.
E 2300	3	18	Power amplifier overcurrent Motor short circuit and deactivation of the power amplifier. Check the motor power connection.
E 2301	3	18	Braking resistor overcurrent Braking resistor short circuit.
E 3100	par.	16	Mains power supply phase fault Missing phase(s) for more than 50ms.
E 3200	3	15	DC bus overvoltage Energy recovery during braking too high. Check deceleration ramp, check dimensioning of drive and braking resistor.

Error number	Class	Bit	Description, reason and correctives
E 3201	3	14	DC bus undervoltage (switch-off threshold) Power supply loss, poor power supply.
E 3202	2	14	DC bus undervoltage (Quick Stop threshold) Power supply loss, poor power supply.
E 3203	4	19	Motor encoder supply voltage Encoder power supply voltage is not consistent because of a hardware problem. Replace the device.
E 3206	0	11	DC bus undervoltage, no mains phase (warning) Power supply loss, poor power supply.
E 4100	3	21	Power amplifier overtemperature Transistors overtemperature: ambient temperature is too high, fan is faulty, dust. Remove the protective foil, improve the heat dissipation in the cabinet.
E 4101	0	1	Warning power amplifier overtemperature Transistors overtemperature: ambient temperature is too high, fan is faulty, dust. Remove the protective foil, improve the heat dissipation in the cabinet.
E 4102	0	4	Power amplifier overload (I2t) warning The current has exceeded the nominal value for an extended period of time. Check dimensioning, reduce cycle time.
E 4200	3	21	Device overtemperature Control board overtemperature: ambient temperature is too high.
E 4300	3	21	Motor overtemperature Resistance of thermal sensor is too high; overload, ambient temp (see I2t); faulty encoder cable. Check motor installation: the heat must be dissipated via the mounting surface. Check encoder cable.
E 4301	0	2	Warning motor overtemperature Resistance of thermal sensor is too high; overload, ambient temp (see I2t). Check motor installation: the heat must be dissipated via the mounting surface.
E 4302	0	5	Motor overload (I2t) warning The current has exceeded the nominal value for an extended period of time.
E 4402	0	6	Braking resistor overload (I2t) warning The braking resistor is switched on for an excessively long period of time.
E 5200	4	19	Fault in connection to motor encoder Communication has not been established: encoder cable is faulty or not connected, EMC. Check the cable connection, shield.
E 5201	4	19	Errors in motor encoder communication Encoder error message: communication error detected by the encoder itself.
E 5202	4	19	Motor encoder is not supported Incompatible encoder type is connected.

Error number	Class	Bit	Description, reason and correctives
E 5204	3	19	Connection to motor encoder lost Encoder cable problems (communication has been interrupted). Check the cable connection.
E 5206	0	19	Communication error in encoder Communication disturbed, EMC. Check the connection, check the shielding on the EMC plate.
E 5600	3	17	Motor connection phase fault Motor phase(s) are not connected . Check connection of motor phases.
E 5601	4	19	Interruption or faulty encoder signals Encoder is not correctly connected (SinCos analog signals are missing). Check encoder connection.
E 5602	4	19	Interruption or faulty encoder signals Encoder is not correctly connected (SinCos analog signals are missing). Check encoder connection.
E 5603	4	17	Commutation error Motor phases are inverted; EMC; the load torque is greater than the motor torque; wrong motor data into the encoder EEPROM (encoder phase offset is wrong). Resize the motor so it can withstand the load torque; check motor data; contact technical support.
E 610D	-	-	Error in selection parameter Wrong parameter value selected. Check the value to be written.
E 7100	4	30	System error: invalid power amplifier data Amplifier data stored in device is corrupt (wrong CRC), error in internal memory data. Contact technical support or replace the device.
E 7120	4	19	Invalid motor data Motor data are corrupt (wrong CRC). Contact technical support or replace the motor.
E 7121	2	19	System error: errors in motor encoder communication EMC, detailed information is included in the fault buffer that contains the error code of the encoder. Contact technical support.
E 7122	4	30	Invalid motor data Motor data stored in motor encoder is corrupt, error in internal memory data. Contact technical support or replace the motor.
E 7123	4	30	Motor current offset outside permissible range Motor current measurement circuit is defective. Contact technical support or replace the device.
E 7124	4	19	System error: motor encoder faulty Encoder signals internal fault. Contact technical support or replace the motor.

Error number	Class	Bit	Description, reason and correctives
E 7328	4	19	Motor encoder sends: position capture errors Encoder signals internal position capturing fault. Contact technical support or replace the motor.
E 7329	0	8	Motor encoder sends: Warning EMC, encoder signals internal warning. Contact technical support or replace the motor.
E 7336	3	0	Offset with SinCos drift compensation too high HiFa analog signal offset during calibration procedure is out of range. Check encoder connection, replace device / motor.
E 7338	0	13	No valid motor absolute position Warning to inform you that absolute position has not yet been determined. Depending on application, fix the absolute position. Device still usable and all functions are OKAY.
E 7500	0	9	RS485/Modbus: overrun error EMC; cabling problem. Check cables.
E 7501	0	9	RS485/Modbus: framing error EMC; cabling problem. Check cables.
E 7502	0	9	RS485/Modbus: parity error EMC; cabling problem. Check cables.
E 7503	0	9	RS485/Modbus: receive error EMC; cabling problem. Check cables.
E 8120	0	7	CANopen: CAN Controller in Error Passive Too many error frames have been detected. Check CAN bus installation.
E 8130	2	7	CANopen: Heartbeat or Life Guard error The bus cycle time of the CANopen master is higher than the programmed heartbeat or nodeguard time. Check CANopen configuration, increase heartbeat or nodeguard time.
E 8140	-	-	CANopen: CAN controller was in Busoff, communication is possible again
E 8141	2	7	CANopen: CAN Controller in Busoff Too many error frames have been detected, CAN devices with different baudrates. Check CAN bus installation.
E 8201	0	7	CANopen: RxPDO1 could not be processed Error while processing Receive PDO1: PDO1 contains invalid value. Check RxPDO1 content (application).

Error number	Class	Bit	Description, reason and correctives
E 8202	0	7	CANopen: RxPDO2 could not be processed Error while processing Receive PDO2: PDO2 contains invalid value. Check RxPDO2 content (application).
E 8203	0	7	CANopen: RxPDO3 could not be processed Error while processing Receive PDO3: PDO3 contains invalid value. Check RxPDO3 content (application).
E 8204	0	7	CANopen: RxPDO4 could not be processed Error while processing Receive PDO4: PDO4 contains invalid value. Check RxPDO4 content (application)
E A060	2	10	Calculated speed in electronic gear/pulse control too high Gear ratio or speed reference value too high Reduce the gear ratio or speed reference value.
E A061	2	10	Position change in reference value with electronic gear/pulse control too high Position reference change is too high. Reference value input signal disturbance. Reduce the resolution of the master. Check reference value input signal.
E A300	-	-	Braking procedure after HALT request still active HALT was removed too soon. New command was sent before motor standstill was reached after a HALT request. Wait for complete stop before removing HALT signal. Wait until motor has come to a complete standstill.
E A301	-	-	Drive in status "Quick Stop active" Error with error class 1 occurred. Drive stopped with Quick Stop command.
E A302	1	1	Interruption by LIMP LIMP was activated because working range was exceeded, malfunction of limit switch or signal disturbance. Check application. Check limit switch function and connection.
E A303	1	1	Interruption by LIMN LIMN was activated because working range was exceeded, malfunction of limit switch or signal disturbance. Check application. Check limit switch function and connection.
E A305	-	-	Power amplifier cannot be activated in the current operating status (status diagram) Fieldbus: trying to enable the amplifier in status "Not ready to switch on". Refer to the status diagram in the operation chapter of the manual.
E A306	1	3	Interruption by user-initiated software stop Drive is in status "Quick Stop active" due to a software stop request. The activation of a new operating mode is not possible, the error code is sent as the response to the activation command. Clear break condition with command Fault Reset.

Error number	Class	Bit	Description, reason and correctives
E A307	-	-	<p>Interruption by internal software stop</p> <p>In homing and jog modes, the movement is internally interrupted using an internal software stop. The activation of a new operating mode is not possible, the error code is sent as the response to the activation command.</p> <p>Clear break condition with command Fault Reset.</p>
E A308	-	-	<p>Drive in "Fault" status</p> <p>Error with error class 2 or higher occurred.</p> <p>Check error code (HMI or PS2), remove error condition and clear error status with command Fault Reset.</p>
E A309	-	-	<p>Drive not in status "Operation Enable"</p> <p>A command which requires the status "Operation enable" was sent (e.g.: opmode change).</p> <p>Set drive to status "OperationEnable" and repeat the command.</p>
E A310	-	-	<p>Power amplifier not active</p> <p>Command is not possible because the power amplifier is not enabled (status "Operation Enabled" or "Quick Stop").</p> <p>Set drive to a status with the amplifier enabled, refer to the status diagram in the operation chapter of the manual.</p>
E A313	-	-	<p>Position overrun, reference point is therefore no longer defined (ref_ok=0)</p> <p>The position range limits were exceeded which resulted in a loss of the reference point. An absolute movement cannot be made until the definition of a new reference point.</p> <p>Define a new reference point by means of homing mode.</p>
E A314	-	-	<p>No reference position</p> <p>Command needs a defined reference point (ref_ok=1).</p> <p>Define a new reference point by means of homing mode.</p>
E A315	-	-	<p>Homing active</p> <p>Command not possible if homing status is active.</p> <p>Wait until homing movement is finished.</p>
E A317	-	-	<p>Drive is not at standstill</p> <p>Command send which is not allowed during the motor is not in standstill e.g.</p> <ul style="list-style-type: none"> - change of softwarelimits - change handling of supervision signals - set reference point - teach in of data set <p>Wait until drive has come to a standstimm (x_end = 1).</p>
E A318	-	-	<p>Operating mode active (x_end=0)</p> <p>Activation of a new operating mode is not possible while the current operating mode is still active.</p> <p>Wait until the command in the operating mode has finished (x_end=1) or terminate current operating mode with HALT command.</p>
E A319	1	2	<p>Manual/Autotuning: distance range overflow</p> <p>The motor exceeds the parameterized maximum allowed position range.</p> <p>Check allowed position range value and time interval.</p>

Error number	Class	Bit	Description, reason and correctives
E A31A	-	-	Manual/Autotuning: amplitude/offset set too high Amplitude plus offset for tuning exceed internal speed or current limitation. Choose lower amplitude and offset values.
E A31B	-	-	HALT requested Command not allowed while a HALT is requested. Clear HALT request and repeat command.
E A31C	-	-	Invalid position setting with software limit switch Value for negative (positive) software limit is greater (less) than value for positive (negative) software limit. Homing position value is set outside the range of the software limits. Set correct position values.
E A31D	-	-	Speed range overflow ('CTRL_n_max') The reference speed value was set to a value greater than the max. speed defined in 'CTRL_n_max'. Increase the value of 'CTRL_n_max' or reduce the reference speed value.
E A31E	1	2	Interruption by positive software limit switch Command not possible because of overrun of positive software limit switch. Move back to software limit range by means of manual movement.
E A31F	1	2	Interruption by negative software limit switch Command not possible because of overrun of negative software limit switch. Move back to software limit range by means of manual movement.
E A320	par.	22	Position tracking error External load or acceleration are too high . Reduce external load or acceleration, error response is adjustable via 'Flt_pDiff'.
E A321	-	-	RS422 position interface is not defined as input signal RS422 interface is defined as output (e.g. ESIM) at start of electronic gear mode. Define RS422 interface as input via 'IOposInterfac' parameter.
E A324	1	10	Error during homing (additional info = detailed error number) Homing movement was stopped by an error, the detailed reason is indicated by the additional info in the error buffer. Possible sub error codes: EA325 EA326 EA327 EA328 EA329
E A325	1	10	Limit switch to be approached not enabled Homing to LIMP or LIMN and limit switches are disabled. Enable limit switch via 'IOsigLimP' or 'IOsigLimN'.
E A326	1	10	REF switch not found between LIMP and LIMN REF input switch defective or not correctly connected. Check the function and wiring of the REF switch.

Error number	Class	Bit	Description, reason and correctives
E A327	1	10	<p>Reference movement to REF without direction reversal, improper enabling of limit switch LIM</p> <p>Search of REF without direction reversal in positive (negative) direction with LIMP (LIMN) activated.</p> <p>Check the function and wiring of the LIMP (LIMN) switch.</p>
E A328	1	10	<p>Reference movement to REF without direction reversal, overrun of LIM or REF not permissible</p> <p>Search of REF without direction reversal and REF or LIM overrun.</p> <p>Reduce homing speed ('HMn') or increase deceleration ('RAMPdecel').</p> <p>Check the function and wiring of LIMP, LIMN and REF switch.</p>
E A329	1	10	<p>More than one signal LIMP/LIMN/REF active</p> <p>REF or LIM not connected correctly or supply voltage for switches too low.</p> <p>Check the wiring and 24VDC supply voltage.</p>
E A32A	1	10	<p>Ext. monitoring signal LIMP with neg. direction of rotation</p> <p>Start reference movement with neg. direction of rotation (e.g. reference movement to LIMN) and activate the LIMP switch (switch in opposite direction of movement).</p> <p>Check correct connection and function of limit switch.</p> <p>Activate a jog movement with negative direction of rotation (target limit switch must be connected to the inputs LIMN).</p>
E A32B	1	10	<p>Ext. monitoring signal LIMN with pos. direction of rotation</p> <p>Start reference movement with pos. direction of rotation (e.g. reference movement to LIMP) and activate the LIMN switch (switch in opposite direction of movement).</p> <p>Check correct connection and function of limit switch.</p> <p>Activate a jog movement with positive rotation (target limit switch must be connected to the inputs LIMP).</p>
E A32C	1	10	<p>Error with REF (switch signal briefly enabled or switch overrun)</p> <p>Switch signal disturbance.</p> <p>Motor subjected to vibration or shock when stopped after activation of the switch signal.</p> <p>Check supply voltage, cabling and function of switch.</p> <p>Check motor reaction after stopping and optimize controller settings.</p>
E A32D	1	10	<p>Error with LIMP (switch signal briefly enabled or switch overrun)</p> <p>Switch signal disturbance.</p> <p>Motor subjected to vibration or shock when stopped after activation of the switch signal.</p> <p>Check supply voltage, cabling and function of switch.</p> <p>Check motor reaction after stopping and optimize controller settings.</p>
E A32E	1	10	<p>Error with LIMN (switch signal briefly enabled or switch overrun)</p> <p>Switch signal disturbance.</p> <p>Motor subjected to vibration or shock when stopped after activation of the switch signal.</p> <p>Check supply voltage, cabling and function of switch.</p> <p>Check motor reaction after stopping and optimize controller settings.</p>
E A330	-	-	<p>Reproducibility of the index pulse movement uncertain, index pulse too close to the switch</p> <p>The position difference between the change of the switch signal and the occurrence of the index pulse is too low.</p> <p>Change mounting point of limit switch (optim. to the point at half a motor revolution away from the current mechanical position, direction outside the working range).</p>

Error number	Class	Bit	Description, reason and correctives
E A332	1	10	Error with jog (additional info = detailed error number) Jog movement was stopped by error. For additional info, check the detailed error number in the error buffer.
E A334	2	0	Timeout at Standstill window monitor Position deviation after movement finished greater than standstill window, e.g. caused by an external load. Check load. Check settings for standstill window ('STANDp_win', 'STANDpwinTime' and 'STANDpwinTout'). Optimize controller settings.
E A335	1	10	Processing only possible in fieldbus mode Reference movement started in IODrive (homing not possible if 'DEVcmdinterf' is not set to fieldbus device, no limit switches). 'DEVcmdinterf' must be set to fieldbus device.
E A337	0	10	Operating mode cannot be continued Continuation of interrupted movement in profile position mode is not possible because another mode had been active in the meantime. In Motion Sequence mode, continuation is impossible if a motion blend was interrupted.
E A33A	-	-	Reference point is not defined (ref_ok=0) No homing done and no motor with absolute encoder connected. Homing position lost because the working position range was left. Start homing. Use motor with multiturn encoder if no homing is to be done.
E B100	0	9	RS485/Modbus: unknown service Unsupported Modbus service was received. Check application on the Modbus master.
E B200	0	9	RS485/Modbus: Protocol error Logical protocol error: wrong length or unsupported subfunction. Check application on the Modbus master.
E B201	2	6	RS485/Modbus: Nodeguard error Modbus is defined as command interface ('DEVcmdinterf'=modbus): connection monitoring parameter ('MBnode_guard') is <>0ms and a nodeguard event was detected. Check application on the Modbus master or change (set to 0ms or increase the parameter 'MBnode_guard' monitoring time).
E B202	0	9	RS485/Modbus: Nodeguard warning Modbus is not defined as command interface ('DEVcmdinterf' <>modbus): connection monitoring parameter ('MBnode_guard') is <>0ms and a nodeguard event was detected. Check application on the Modbus master or change (set to 0ms or increase the parameter 'MBnode_guard' monitoring time).
E B400	2	7	CANopen: NMT reset with power amplifier active CANopen is defined as command interface ('DEVcmdinterf'=CANopen): NMT Reset command is received while drive is in status "Enable". Always disable the drive before sending a NMT reset command.

Error number	Class	Bit	Description, reason and correctives
E B401	2	7	<p>CANopen: NMT reset with power amplifier active</p> <p>CANopen is defined as command interface ('DEVcmdinterf'=CANopen): NMT Stop command is received while drive is in status "Enable".</p> <p>Always disable the drive before sending a NMT Stop command.</p>
E B403	2	7	<p>Excessive Sync period deviation from ideal value</p> <p>The period time of the SYNC signals is not stable. The deviation is more than 100usec.</p> <p>The SYNC signals of the motion controller must be more accurate.</p>
E B404	2	7	<p>Sync signal failed</p> <p>SYNC signal was missing too often (more than twice).</p> <p>Check CAN connection, check motion controller.</p>
E B407	-	-	<p>Drive is not synchronous with master cycle</p> <p>The cyclic synchronous operating mode cannot be activated while the drive is not synchronized.</p> <p>Check motion controller. To be synchronized, the motion controller must cyclically send SYNC signals.</p>

11 Parameters

This chapter provides an overview of the parameters which can be addressed for the operation of the product.

⚠ WARNING

Unintentional behavior due to parameters

The behavior of the drive system is governed by numerous parameters. Improper parameter values can trigger unintentional movements or signals or deactivate monitoring functions.

- Change only parameters whose meaning you understand.
- Only start the system if there are no persons or materials in the danger zone and the system can be operated safely.
- When commissioning carefully run tests for all operating statuses and fault cases.

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

11.1 Representation of the parameters

The parameter display contains, on the one hand, information which is needed for positive identification of a parameter. On the other hand, the parameter display can also provide information on setting options, presets and parameter properties.



Observe that the parameters are input in the fieldbus without decimal character. All decimal places must always be input.

Input examples:

Maximum value	Commissioning software	fieldbus
2.0	2.0	20
23.57	23.57	2357
1,000	1,000	1000

11.1.1 Explanation of the parameter representation

A parameter display has the following features:

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Example_Name	Brief description (cross-reference) Selection values 1 / Selection value1: Explanation 1 2 / Selection value2: Explanation 2 Further description and details	A _{pk} 0.00 3.00 300.00	UINT32 R/W per. -	Fieldbus 1234

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

Parameter Name The parameter name clearly identifies a parameter.

Description Brief description (cross-reference)
The brief description contains some information on the parameter and refers the reader to the page on which the function of the parameter is described.

Selection values

In parameters offering a selection of settings, the value is specified using the fieldbus and designation of the values is specified during input with the commissioning software.

1 = Value via fieldbus

Selection value1 = Selection value via commissioning software

Further description and details

Contains further information on the parameter.

Unit The unit of the value.

Minimum value The lowest value which can be input.

Default value Factory setting.

Maximum value The highest value which can be input.

Data type The data type determines the valid range of values, especially when a parameter does not have explicit minimum and maximum values.

Data type	byte	Min value	Max value
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 Note for readability and writability of the values
"R/-" - Values can only be read
"R/W" - Values can be read and written.

- persistent* Designation of whether the value of the parameter is persistent, i.e. after switching off the device it is retained in the memory. When changing a value via commissioning software or fieldbus, the user must explicitly store the value change in the persistent memory.
- Parameter address* Each parameter has a unique parameter address. You can use the parameter address to access the parameter with the fieldbus.
- The address comprises:
- class.instance.attribute

11.2 List of all parameters

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_acc_pref	Acceleration of reference value generation	(1/min)/s	INT32	CANopen 301F:9 _h
-	Sign according to the changed speed value:	-	INT32	Modbus 7954
-	Increased speed: pos. sign	0	R/-	
-	Reduced speed: neg. sign	-	-	
_AccessInfo	Current access channel for action objects	-	UINT16	CANopen 3001:C _h
-	Low byte :	-	UINT16	Modbus 280
-	0 : Used by channel in high byte	0	R/-	
-	1 : Exclusively used by channel in high byte	-	-	
	High byte: Current assignment of access channel			
	0: reserved			
	1: IO			
	2: HMI			
	3: Modbus RS485			
	4: CANopen			
	5: CANopen via seconds SDO channel			
	6: Profibus			
	7: DeviceNet			
	8: reserved			
	9: Ethernet			
	10..15: Modbus TCP			
_actionStatus	Action word (173)	-	UINT16	CANopen 301C:4 _h
-	Signal status:	-	UINT16	Modbus 7176
-	0: not activated	0	R/-	
-	1: activated	-	-	
	Bit0: Error class 0			
	Bit1: Error class 1			
	Bit2: Error class 2			
	Bit3: Error class 3			
	Bit4: Error class 4			
	Bit5: Reserved			
	Bit6: Drive is at standstill			
	(Actual speed _n_act [1/min] < 9)			
	Bit7: Drive rotates clockwise			
	Bit8: Drive rotates counter-clockwise			
	Bit9: Reserved			
	Bit10: Reserved			
	Bit11: Profile generator idle			
	(reference speed is 0)			
	Bit12: Profile generator decelerates			
	Bit13: Profile generator accelerates			
	Bit14: Profile generator moves at constant speed			
	Bit15: Reserved			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_DCOMopmd_act	Active operating mode (120)	-	INT8	CANopen 6061:0 _h
-	See DCOMopmode for coding	-6	INT16	Modbus 6920
-		-	R/-	
-		6	-	-
_I2t_act_M	Current motor overload (170)	%	INT16	CANopen 301C:19 _h
-		-	INT16	Modbus 7218
-		0	R/-	
-		-	-	-
_I2t_mean_M	Motor load (170)	%	INT16	CANopen 301C:1A _h
STA- - i2TM		-	INT16	Modbus 7220
5tR- - , 2tR		0	R/-	
-		-	-	-
_Id_act	Actual motor current d-component	A _{pk}	INT16	CANopen 301E:2 _h
-	In increments of 0.01A _{pk}	-	INT16	Modbus 7684
-		0.00	R/-	
-		-	-	-
_Id_ref	Reference motor current d-component (weakening the field)	A _{pk}	INT16	CANopen 301E:11 _h
-		-	INT16	Modbus 7714
-	In increments of 0.01A _{pk}	0.00	R/-	
-		-	-	-
_Idq_act	Total motor current (vector sum d-components and q-components)	A _{pk}	INT16	CANopen 301E:3 _h
STA- - iACT		-	INT16	Modbus 7686
5tR- - , Rct	In increments of 0.01A _{pk}	0.00	R/-	
-		-	-	-
_IO_LI_act	Status of digital inputs (185)	-	UINT16	CANopen 3008:F _h
-	Coding of the individual signals:	-	UINT16	Modbus 2078
-	Bit0: LI1	0	R/-	
-	Bit1: LI2	-	-	-
	...			
	Bit8: XLI1			
	Bit9: XLI2			
	...			
_IO_LO_act	Status of digital outputs (185)	-	UINT16	CANopen 3008:10 _h
-	Coding of the individual signals:	-	UINT16	Modbus 2080
-	Bit0: LO1_OUT	0	R/-	
-	Bit1: LO2_OUT	-	-	-
	...			
	Bit8: XLO1_OUT			
	Bit9: XLO2_OUT			
	...			
_Iq_act	Actual motor current q-component	A _{pk}	INT16	CANopen 301E:1 _h
-	In increments of 0.01A _{pk}	-	INT16	Modbus 7682
-		0.00	R/-	
-		-	-	-

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_Iq_ref STA- - iQRF 5tR- - , q _{ref}	Reference motor current q-component (generating torque) In increments of 0.01A _{pk}	A _{pk} - 0.00 -	INT16 INT16 R/- -	CANopen 301E:10 _h Modbus 7712
_LastWarning - -	Last warning as number Number of the most recent warning. If the warning becomes inactive again, the number is memorised until the next fault reset. Value 0: No warning occurred	- - 0 -	UINT16 UINT16 R/- -	CANopen 301C:9 _h Modbus 7186
_n_act STA- - NACT 5tR- - n _{act}	Actual motor speed (135)	1/min - 0 -	INT32 INT16 R/- -	CANopen 606C:0 _h Modbus 7696
_n_actRAMP - -	Actual speed of motion profile generator (135)	1/min - 0 -	INT32 INT32 R/- -	CANopen 606B:0 _h Modbus 7948
_n_pref - -	Speed of reference value generation	1/min - 0 -	INT32 INT32 R/- -	CANopen 301F:7 _h Modbus 7950
_n_ref - -	Reference speed of speed controller	1/min - 0 -	INT16 INT16 R/- -	CANopen 301E:7 _h Modbus 7694
_n_targetRAMP - -	Reference speed of motion profile generator	1/min - 0 -	INT32 INT32 R/- -	CANopen 301F:5 _h Modbus 7946
_OpHours STA- - oPh 5tR- - oPh	Operating hours counter	s - 0 -	UINT32 UINT32 R/- -	CANopen 301C:A _h Modbus 7188

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_p_absENCusr	Motor position with reference to encoder range in user units	usr	UINT32	CANopen 301E:F _h
-	-	-	UINT32	Modbus 7710
-	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 (e.g. 4096 revolutions). IMPORTANT: 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	0	R/-	-
-	-	-	-	-
_p_absmodulo	Absolute pos. with ref. to 1 motor revolution in internal units	Inc	UINT32	CANopen 301E:E _h
-	-	-	UINT32	Modbus 7708
-	IMPORTANT: 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	0	R/-	-
-	-	-	-	-
_p_act	Actual position of motor in internal units	Inc	INT32	CANopen 6063:0 _h
-	-	-	INT32	Modbus 7700
-	-	0	R/-	-
-	-	-	-	-
_p_actRAMPusr	Actual position of motion profile generator (132)	usr	INT32	CANopen 301F:2 _h
-	-	-	INT32	Modbus 7940
-	In user units	0	R/-	-
-	-	-	-	-
_p_actusr	Actual motor position in user units (132)	usr	INT32	CANopen 6064:0 _h
STA- - PACu	-	-	INT32	Modbus 7706
5tR- - PR <u>u</u>	-	0	R/-	-
-	-	-	-	-
_p_dif	Current deviation between reference and actual position (171)	revolution	INT32	CANopen 60F4:0 _h
STA- - PDiF	-	-214748.3648	INT32	Modbus 7716
5tR- - Pd, F	Corresponds to the current control deviation of the position controller without consideration of any dynamic components. Please note the difference in terms of SPV_p_maxDiff.	-	R/-	-
-	-	214748.3647	-	-

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_p_DifPeak - -	Value of the maximum tracking error of the position controller (171) The tracking error is the current position control deviation minus the position control deviation caused by the speed. See SPV_p_maxDiff for more information. A write access resets this value.	revolution 0.0000 - 429496.7295	UINT32 UINT32 R/W -	CANopen 3011:F _h Modbus 4382
_p_ref - -	Reference position in internal units	Inc - 0 -	INT32 INT32 R/- -	CANopen 301E:9 _h Modbus 7698
_p_refusr - -	Reference position in user units (165)	usr - 0 -	INT32 INT32 R/- -	CANopen 301E:C _h Modbus 7704
_p_tarRAMPusr - -	Target position of motion profile generator Absolute position value of the profile generator, calculated on the basis of the relative and absolute position values received. In user units	usr - 0 -	INT32 INT32 R/- -	CANopen 301F:1 _h Modbus 7938
_prgNoDEV INF- - _PNR INF- - -P _{nr}	Firmware program number Example: PR840.1 The value is entered as a decimal value: 8401	- - 0.0 -	UINT16 UINT16 R/- -	CANopen 3001:1 _h Modbus 258
_prgVerDEV INF- - _PVR INF- - -P _{vr}	Firmware version number Example: V4.201 The value is entered as a decimal value: 4201	- - 0.000 -	UINT16 UINT16 R/- -	CANopen 3001:2 _h Modbus 260
_serialNoDEV - -	Device serial number Serial number: unique number for identification of the product	- 0 - 4294967295	UINT32 UINT32 R/- per. -	CANopen 3001:17 _h Modbus 302
_SigActive - -	Current status of monitoring signals (172) See _SigLatched for more details on the bit codes.	- - 0 -	UINT32 UINT32 R/- -	CANopen 301C:7 _h Modbus 7182

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_SigLatched	Saved status of monitoring signals (172)	-	UINT32	CANopen 301C:8 _h
STA- - SiGS	Signal status:	-	UINT32	Modbus 7184
5tR- - 5, 55	0: Not activated 1: Activated	0 -	R/- - -	
	Bit assignments: Bit0: General fault Bit1: Limit switches (LIMP/LIMN/REF) Bit2: Out of range (SW limit switches, tuning) Bit3: Quickstop via fieldbus Bit4: Inputs STO are 0 Bit6: RS485 fault Bit7: CAN fault Bit9: Frequency of reference signal too high Bit10: Fault current operating mode Bit12: Profibus fault Bit14: Low voltage DC bus Bit15: High voltage DC buss Bit16: Mains phase missing Bit17: Motor connection fault Bit18: Motor overcurrent/short circuit Bit19: Motor encoder fault Bit20: Undervoltage 24VDC Bit21: Overtemperature (power amplifier, motor) Bit22: Tracking error Bit23: Max. speed exceeded Bit24: Inputs STO different Bit29: EEPROM fault Bit30: System booting (Hardware fault or parameter error) Bit31: System error (e.g. watchdog)			
	Monitoring functions are product-dependent.			
_StopFault	Error number of last stop fault (173)	-	UINT16	CANopen 603F:0 _h
FLT- - STPF		-	UINT16	Modbus 7178
FLt- - 5tPF		0 -	R/- - -	
_Temp_act_PA	Power amplifier temperature (170)	°C	INT16	CANopen 301C:10 _h
STA- - TPA		-	INT16	Modbus 7200
5tR- - tPR		0 -	R/- - -	
_Ud_ref	Reference motor voltage d-component	V	INT16	CANopen 301E:5 _h
-	In increments of 0.1V	-	INT16	Modbus 7690
-		0.0 -	R/- - -	
_UDC_act	Voltage at DC bus	V	UINT16	CANopen 301C:F _h
STA- - uDCA	DC bus voltage	-	UINT16	Modbus 7198
5tR- - udLR	in increments of 0.1 V	0.0 -	R/- - -	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_Udq_ref	Total motor voltage (vector sum d-components and q-components)	V	INT16	CANopen 301E:6 _h
-	Square root of (_Uq_ref ² + _Ud_ref ²)	-	INT16	Modbus 7692
-	In increments of 0.1V	0.0	R/-	
-		-	-	
_Uq_ref	Reference motor voltage q-component	V	INT16	CANopen 301E:4 _h
-	In increments of 0.1V	-	INT16	Modbus 7688
-		0.0	R/-	
-		-	-	
_VoltUtil	Degree of utilization of DC bus voltage	%	INT16	CANopen 301E:13 _h
-	With a value of 100%, the drive operates at the voltage limit.	-	INT16	Modbus 7718
-		0	R/-	
-		-	-	
-	_VoltUtil = (_Udq_ref / _Udq_ref) * 100%		-	
_WarnActive	Active warnings, bit-coded (172)	-	UINT16	CANopen 301C:B _h
-	See _WarnLatched for more details on the bit codes.	-	UINT16	Modbus 7190
-		0	R/-	
-		-	-	
_WarnLatched	Saved warnings, bit-coded (173)	-	UINT16	CANopen 301C:C _h
STA - WRNS	Saved warning bits are deleted in the case of a FaultReset.	-	UINT16	Modbus 7192
5tR - Lrn5	Bits 10, 11, 13 are deleted automatically.	0	R/-	
-		-	-	
-	Signal status:			
-	0: Not activated			
-	1: Activated			
-	Bit assignments:			
-	Bit 0: General warning (see _LastWarning)			
-	Bit 1: Temperature of power amplifier high			
-	Bit 2: Temperature of motor high			
-	Bit 3: Reserved			
-	Bit 4: Power amplifier overload (I ² t)			
-	Bit 5: Motor overload (I ² t)			
-	Bit 6: Braking resistor overload (I ² t)			
-	Bit 7: CAN warning			
-	Bit 8: Motor encoder warning			
-	Bit 9: RS485 protocol warning			
-	Bit 10: STO_A and/or STO_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: Reserved			
-	Bit 15: Reserved			
-	Monitoring functions are product-dependent.			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
AbsHomeRequest - -	Absolute positioning only after homing (133) 0 / no: No 1 / yes: Yes	- 0 0 1	UINT16 UINT16 R/W per. -	CANopen 3006:16 _h Modbus 1580
AccessLock - -	Locking other access channels (108) 0: Release other access channels 1: Lock other access channels The fieldbus can lock active access to the device via the following access channels with this parameter: - Commissioning software - HMI - A second fieldbus Processing of the input signals (such as HALT) cannot be locked.	- 0 - 1	UINT16 UINT16 R/W - -	CANopen 3001:1E _h Modbus 316
ANA1_act STA- - A1AC SEt- - R iR	Voltage value analog input ANA1	mV -10000 - 10000	INT16 INT16 R/- - -	CANopen 3009:1 _h Modbus 2306
ANA1_I_scale SET- - A1iS SEt- - R i 5	Ref. value in op. mode current control at 10V at ANA1 By using a negative sign, you can invert the evaluation of the analog signal.	A _{pk} -300.00 3.00 300.00	INT16 INT16 R/W per. -	CANopen 3020:3 _h Modbus 8198
ANA1_n_scale SET- - A1NS SEt- - R i n 5	Reference value in operating mode speed control at 10V at ANA1 The internal maximum speed is limited to the current setting in CTRL_n_max. By using a negative sign, you can invert the evaluation of the analog signal.	1/min -30000 3000 30000	INT16 INT16 R/W per. -	CANopen 3021:3 _h Modbus 8454
ANA1_offset SET- - A1oF SEt- - R i oF	Offset at analog input ANA1 The analog input ANA1 is corrected/offset by the offset value. If you have defined a zero voltage window, this window is effective in the zero pass range of the corrected analog input ANA1.	mV -5000 0 5000	INT16 INT16 R/W per. -	CANopen 3009:B _h Modbus 2326
ANA1_win SET- - A1WN SEt- - R i L n	Zero voltage window at analog input ANA1 Threshold value up to which an input voltage value is treated as 0 V. Example: Value is set to 20mV -> range from -20 .. +20mV is treated as 0mV	mV 0 0 1000	UINT16 UINT16 R/W per. -	CANopen 3009:9 _h Modbus 2322

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
ANA2_l_max DRC- - A2iM drL - - R2iM	Current limitation at 10V at ANA2 The maximum limitation value is the smaller value from I _{maxM} and I _{maxPA}	A _{pk} 0.00 3.00 300.00	UINT16 UINT16 R/W per. -	CANopen 3012:C _h Modbus 4632
ANA2_n_max DRC- - A2NM drL - - R2nM	Speed limitation at 10V at ANA2 The minimum speed limitation value is set to 100 rpm, i.e. analog value which cause a lower speed have no effect. The maximum speed is also limited by the adjustable value in CTRL_n_max.	1/min 500 3000 30000	UINT16 UINT16 R/W per. -	CANopen 3012:D _h Modbus 4634
ANA2LimMode DRC- - A2Mo drL - - R2Mo	Selection of limitation via ANA2 0 / none / none : No limitation 1 / Current Limitation / Curr : Limitation of reference current value of current controller 2 / Speed Limitation / SPed : Limitation of reference speed value of speed controller (limitation value at 10V in ANA2_n_max)	- 0 0 2	UINT16 UINT16 R/W per. -	CANopen 3012:B _h Modbus 4630
ANAX1_act STA- - A3AC StR - - R3RL	Voltage value analog input XANA1	mV -10000 - 10000	INT16 INT16 R/- - -	CANopen 3009:C _h Modbus 2328
BRK_status - -	Status of holding brake 0: closed 1: open 2: not available	- 0 0 2	UINT16 UINT16 R/- - -	CANopen 3008:B _h Modbus 2070
BRK_tclose DRC- - BTCL drL - - btLL	Time delay during closing of holding brake	ms 0 0 1000	UINT16 UINT16 R/W per. -	CANopen 3005:8 _h Modbus 1296
BRK_trelease DRC- - BTRE drL - - btrE	Time delay during opening/releasing the holding brake	ms 0 0 1000	UINT16 UINT16 R/W per. -	CANopen 3005:7 _h Modbus 1294
CANadr COM- - CoAD Can - - CanAd	CANopen address (node number) (88) Valid addresses (node numbers): 1 to 127 Read access: Rotary switch (NodeID) = 0: NodeID = Parameter value Rotary switch (NodeID) = >0: NodeID = Value from rotary switch IMPORTANT: Changed settings do not become active until the unit is switched on the next time or until after an NMT reset.	- 1 127 127	UINT16 UINT16 R/W per. -	CANopen 3017:2 _h Modbus 5892

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CANbaud	CANopen Baud rate (88)	-	UINT16	CANopen 3017:3 _h
COM- - CoBD	50 / 50KB / 50 : 50 Kbaud	50	UINT16	Modbus 5894
Can- - Canbd	125 / 125KB / 125 : 125 Kbaud	125	R/W	
	250 / 250KB / 250 : 250 Kbaud	1000	per.	
	500 / 500KB / 500 : 500 Kbaud		-	
	1000 / 1MB / 1000 : 1 Mbaud			
	Read access: Rotary switch (Baud) = 0 -> Baud rate = value of user parameter Rotary switch (Baud) >0 -> Baud rate = value selected via rotary switch IMPORTANT: Changed settings do not become active until the unit is switched on the next time			
CanDiag	CANopen diagnosis word	-	UINT16	CANopen 3017:6 _h
-	0x0001 pms read error for TxPdo	-	UINT16	Modbus 5900
-	0x0002 pms write error for RxPdo1	0	R/-	
-	0x0004 pms write error for RxPdo2	-	-	
	0x0008 pms write error for RxPdo3		-	
	0x0010 pms write error for RxPdo4			
	0x0020 heartbeat or lifeguard error (timer expired)			
	0x0040 heartbeat msg with wrong state received			
	0x0080 CAN warning level set			
	0x0100 CAN message lost			
	0x0200 CAN in busoff			
	0x0400 software queue rx/tx overrun			
	0x0800 CPD error indication from stop fault			
CANpdo4Event	PDO4 event mask	-	UINT16	CANopen 3017:5 _h
-	Changes of values in the object trigger an event:	0	UINT16	Modbus 5898
-	Bit 0 = 1: first PDO4 object	15	R/W	
	Bit 1 = 1: second PDO4 object	15	-	
	Bit 2 = 1: third PDO4 object		-	
	Bit 3 = 1: fourth PDO4 object			
	Bit 4..15 : reserved			
CANrestore	CANopen Restore	-	UINT16	CANopen 3017:8 _h
COM- - CoRS	0 / on / on : CANopen Restore Default	0	UINT16	Modbus 5904
Can- - Canr5	Parameter supported	0	R/W	
	1 / off / off : CANopen Restore Default	1	per.	
	Parameter not supported		-	
	Defines the behavior of the CANopen object 1011 (Restore Default parameter). This value must be set to 'Off' for Telemeca- nique PLCs 'Twido' and 'Mirano'.			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_I_max SET- - iMAX SEt - - , nPAH	Current limitation (91) The value must not exceed the maximum permissible current of the motor or the power amplifier. Default: the smaller value of M_I_max and PA_I_max	A _{pk} 0.00 - 299.99	UINT16 UINT16 R/W per. -	CANopen 3012:1 _h Modbus 4610
CTRL_KFPp - -	Speed feed-forward control position controller Overshoot of up to 110% is possible.	% 0.0 100.0 110.0	UINT16 UINT16 R/W per. -	CANopen 3012:8 _h Modbus 4624
CTRL_KPid - -	Current controller longitudinal (d) P-term This value is calculated on the basis of the motor parameters. In increments of 0.1V/A	V/A 0.5 - 1270.0	UINT16 UINT16 R/- per. -	CANopen 3011:1 _h Modbus 4354
CTRL_KPiq - -	Current controller transverse (q) P-term This value is calculated on the basis of the motor parameters. In increments of 0.1V/A	V/A 0.5 - 1270.0	UINT16 UINT16 R/- per. -	CANopen 3011:3 _h Modbus 4358
CTRL_KPn - -	Speed controller P-term (97) The default value is calculated on the basis of the motor parameters.	A/(1/min) 0.0001 - 1.2700	UINT16 UINT16 R/W per. -	CANopen 3012:3 _h Modbus 4614
CTRL_KPp - -	Position controller P-term (103) The default value is calculated.	1/s 2.0 - 495.0	UINT16 UINT16 R/W per. -	CANopen 3012:6 _h Modbus 4620
CTRL_mode - -	Commutation mode 0 / sinusoidal commutation / 5: n: Sine commutation 1 / 120° block commutation / 120: 120° block commutation 2 / 180° block commutation / 180: 180° block commutation	- 0 0 2	UINT16 UINT16 R/W per. -	CANopen 3011:10 _h Modbus 4384
CTRL_n_max SET- - NMAX SEt - - nPAH	Speed limitation (91) The set value must not exceed the maximum motor speed. Default: maximum motor speed (see M_n_max)	1/min 0 - 13200	UINT16 UINT16 R/W per. -	CANopen 3012:2 _h Modbus 4612

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_Pcdamp	Damping Posicast filter speed	%	UINT16	CANopen 3012:14 _h
-	The filter is switched off at a value of 1000.	50.0	UINT16	Modbus 4648
-		100.0	R/W	
-		100.0	per. expert	
CTRL_Pcdelay	Time delay Posicast filter speed	ms	UINT16	CANopen 3012:15 _h
-	The filter is switched off at a value of 0.	0.00	UINT16	Modbus 4650
-		0.00	R/W	
-		25.00	per. expert	
CTRL_TAUnref	Filter time constant ref.value filter of the ref. speed value (98)	ms	UINT16	CANopen 3012:9 _h
-		0.00	UINT16	Modbus 4626
-		9.00	R/W	
-		327.67	per. -	
CTRL_TNid	Current controller longitudinal (d) setting time	ms	UINT16	CANopen 3011:2 _h
-		0.13	UINT16	Modbus 4356
-	This value is calculated on the basis of the motor parameters.	-	R/-	
-	In increments of 0.01ms	327.67	per. -	
CTRL_TNiq	Current controller transverse (d) setting time	ms	UINT16	CANopen 3011:4 _h
-	This value is calculated on the basis of the motor parameters.	0.13	UINT16	Modbus 4360
-		-	R/-	
-	In increments of 0.01ms	327.67	per. -	
CTRL_TNn	Speed controller setting time (97)	ms	UINT16	CANopen 3012:4 _h
-		0.00	UINT16	Modbus 4616
-		9.00	R/W	
-		327.67	per. -	
CUR_I_target	Reference current in operating mode current control (119)	A _{pk}	INT16	CANopen 3020:4 _h
-		-300.00	INT16	Modbus 8200
-		0.00	R/W	
-		300.00	- -	
CURreference	Selection of the ref. value source for op. mode current control (119)	-	UINT16	CANopen 301B:10 _h
-		0	UINT16	Modbus 6944
-		0	R/W	
-	0 / none: None	2	-	
-	1 / Analog Input: Reference value via +/- 10V interface ANA1		-	
-	2 / Parameter 'currTarg': Reference value via parameter CUR_I_target			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
DCOMcompatib - -	DriveCom state machine: status transition from 3 to 4 0 / Automatic: Automatic (state transition is performed automatically) 1 / Drivecom-conform: Standard-compliant (state transition must be controlled via the fieldbus) 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!	- 0 0 1	UINT16 UINT16 R/W per. -	CANopen 301B:13 _h Modbus 6950
DCOMcontrol - -	Drivecom control word (116) Refer to chapter Operation, Operating States, for bit coding information. Bit0: Switch on Bit1: Enable Voltage Bit2: Quick Stop Bit3: Enable Operation Bit4..6: Op. mode-specific Bit7: Fault Reset Bit8: Halt Bit9..15: Reserved (must be 0)	- - 0 -	UINT16 UINT16 R/W - -	CANopen 6040:0 _h Modbus 6914
DCOMopmode - -	Operating mode (119) DSP402 operating modes: 1: Profile position 3: Profile velocity 6: Homing ----- Manufacturer operating modes: -1: Jog -3: Current control -4: Speed control -8: Motion sequence	- -8 - 6	INT8 INT16 R/W - -	CANopen 6060:0 _h Modbus 6918
DCOMstatus - -	Drivecom status word (114) Refer to chapter Operation, State Machine for bit coding information. Bit0-3,5,6: Status bits Bit4: Voltage enabled Bit7: Warning Bit8: HALT request active Bit9: Remote Bit10: Target reached Bit11: Reserved Bit12: Op. mode-specific Bit13: x_err Bit14: x_end Bit15: ref_ok	- - 0 -	UINT16 UINT16 R/- - -	CANopen 6041:0 _h Modbus 6916

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
DEVcmdinterf	Specification of the control mode (85)	-	UINT16	CANopen 3005:1 _h
- - DEVC	0 / none / none : Undefined	0	UINT16	Modbus 1282
- - dEUE	1 / IODevice / Local : Local control type	0	R/W	
	2 / CANOpenDevice / CANopen	3	per.	
	3 / ModbusDevice / Modbus		-	
	IMPORTANT: Changed settings do not become active until the unit is switched on the next time (exception: change of value 0, for "Initial settings").			
FLT_class	Error class (297)	-	UINT16	CANopen 303C:2 _h
-	0: Warning (no response)	0	UINT16	Modbus 15364
-	1: Error (Quick Stop -> status 7)	-	R/-	
-	2: Error (Quick Stop -> status 8, 9)	4	-	
	3: Fatal error (status 9, can be acknowledged)		-	
	4: Fatal error (status 9, cannot be acknowledged)			
FLT_del_err	Clear error memory (296)	-	UINT16	CANopen 303B:4 _h
-	1: Delete all entries in the error memory	0	UINT16	Modbus 15112
-	The clearing process is completed if a 0 is returned after a read access.	1	R/W	
			-	
FLT_err_num	Error number (297)	-	UINT16	CANopen 303C:1 _h
-	Reading this parameter copies the entire error entry (error class, time of occurrence of error, ...) to an intermediate memory from which all elements of the error can then be read.	0	UINT16	Modbus 15362
-		-	R/-	
	In addition, the read pointer of the error memory is automatically set to the next error entry.	65535	-	
			-	
FLT_Idq	Motor current at error time	A	UINT16	CANopen 303C:9 _h
-	In increments of 10mA	-	UINT16	Modbus 15378
-		0.00	R/-	
		-	-	
			-	
FLT_MemReset	Reset error memory read pointer (296)	-	UINT16	CANopen 303B:5 _h
-	1: Set error memory read pointer to oldest error entry.	0	UINT16	Modbus 15114
-		-	R/W	
		1	-	
			-	
FLT_n	Speed at error time	1/min	INT16	CANopen 303C:8 _h
-		-	INT16	Modbus 15376
-		0	R/-	
		-	-	
			-	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
FLT_powerOn	Number of power on cycles	-	UINT32	CANopen 303B:2 _h
INF- - PoWo		0	UINT32	Modbus 15108
INF- - PoWo		-	R/-	
		4294967295	-	
FLT_Qual	Error additional information (297)	-	UINT16	CANopen 303C:4 _h
-	This entry contains additional information on the error, depending on the error number.	0	UINT16	Modbus 15368
-	Example: a parameter address	-	R/-	
		65535	-	
FLT_Temp_DEV	Temperature of device at error time	°C	INT16	CANopen 303C:B _h
-		-	INT16	Modbus 15382
-		0	R/-	
		-	-	
FLT_Temp_PA	Temperature of power amplifier at error time	°C	INT16	CANopen 303C:A _h
-		-	INT16	Modbus 15380
-		0	R/-	
		-	-	
FLT_Time	Error time (297)	s	UINT32	CANopen 303C:3 _h
-	With reference to operating hours counter	0	UINT32	Modbus 15366
-		-	R/-	
		536870911	-	
FLT_UDC	DC bus voltage at error time	V	UINT16	CANopen 303C:7 _h
-	In increments of 100mV	-	UINT16	Modbus 15374
-		0.0	R/-	
		-	-	
FLTAmpOnCyc	ENABLE cycles up to the time of error	-	UINT16	CANopen 303C:5 _h
-		-	UINT16	Modbus 15370
-	Number of power on cycles from the time the power supply (control voltage) was switched on to the time the error occurred.	0	R/-	
		-	-	
FLTAmpOnTime	Time of error after ENABLE	s	UINT16	CANopen 303C:6 _h
-		-	UINT16	Modbus 15372
-		0	R/-	
		-	-	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMdisREFtoIDX - -	Distance from switching edge to index pulse (161) This read value delivers the difference between the index pulse position and the position at the switching edge of the limit or reference switch. It allows to check the distance between the index pulse and the switching edge and serves as a criterion for determining whether the reference movement with index pulse processing can be safely reproduced. In increments of 1/10000 revolutions	revolution - 0.0000 -	INT32 INT32 R/- -	CANopen 3028:C _h Modbus 10264
HMdisusr - -	Distance from switching edge to reference point (158) After the drive 'leaves' the switch, it is positioned into the working area by a defined distance. This target point is defined as the reference point. The parameter is only effective during reference movements without index pulse search.	usr 1 200 2147483647	INT32 INT32 R/W per. -	CANopen 3028:7 _h Modbus 10254
HMIDispPara DRC- - SuPV drE - - 5uPU	HMI display when motor rotates 0 / DeviceStatus / 5tRLt : Device status (default) 1 / n_act / nRLt : Current speed (n_act) 2 / I_act / RLt : Current motor current	- 0 0 2	UINT16 UINT16 R/W per. -	CANopen 303A:2 _h Modbus 14852
HMIlocked - -	Lock HMI 0 / not locked / - : HMI not locked 1 / locked / - : HMI locked The following functions can no longer be started when the HMI is locked: - Parameter change - Jog - Fault reset	- 0 0 1	UINT16 UINT16 R/W per. -	CANopen 303A:1 _h Modbus 14850

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMmethod	Reference movement method (155)	-	INT8	CANopen 6098:0 _h
-	1: LIMN with index pulse	1	INT16	Modbus 6936
-	2: LIMP with index pulse	18	R/W	
-	7: REF+ with index pulse, inv., outside	35	-	
	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			
	Abbreviations: REF+: Search movement in pos. direction REF-: Search movement in pos. direction inv.: Invert direction in switch not inv.: Direction not inverted in switch outside: Index pulse / distance outside switch inside: Index pulse / distance inside switch			
HMn_out	Reference speed for moving away from switch (156)	1/min	UINT32	CANopen 6099:2 _h
-		1	UINT16	Modbus 10250
-	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	6 3000	R/W per. -	
HMn	Reference speed for searching the switch (156)	1/min	UINT32	CANopen 6099:1 _h
-		1	UINT16	Modbus 10248
-	The adjustable value is internally limited to the current parameter setting in RAMPn_max.	60 13200	R/W per. -	
HMoutdisusr	Maximum run-out distance (157)	usr	INT32	CANopen 3028:6 _h
-	0: Run-off check inactive	0	INT32	Modbus 10252
-	>0: Run-off in user-defined units	0 2147483647	R/W per. -	
	The switch must be disabled again inside this run-off, otherwise the reference movement is aborted.			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
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HMp_homeusr - -	Position at reference point (156) After a successful reference movement, this position is automatically set at the reference point.	usr -2147483648 0 2147483647	INT32 INT32 R/W per. -	CANopen 3028:B _h Modbus 10262
HMp_setpusr - -	Position for position setting (165) Position setting position for homing method 35	usr - 0 -	INT32 INT32 R/W - -	CANopen 301B:16 _h Modbus 6956
HMsrchdisusr - -	Max. search distance after overrun of switch (157) 0: Search distance processing disabled >0: Search distance in user units The switch must be activated again within this search distance, otherwise the reference movement is cancelled.	usr 0 0 2147483647	INT32 INT32 R/W per. -	CANopen 3028:D _h Modbus 10266
IO_AutoEnable DRC- - ioAE drC - - ioAE	Processing of power amplifier activation at PowerOn 0 / off / oFF : Active Enable during power on does not activate the power amplifier. 1 / on / oN : Active Enable during power on activates the power amplifier. 2 / AutoOn / RuLo : Power amplifier is always automatically activated at power on.	- 0 0 2	UINT16 UINT16 R/W per. -	CANopen 3005:6 _h Modbus 1292
IO_LO_set - -	Setting the digital outputs directly Write access to output bits is only active if the signal pin is available as an output and if the function of the output was set to 'Available as required'. Coding of the individual signals: Bit0: LO1_OUT Bit1: LO2_OUT ... Bit7: XLO1_OUT Bit8: XLO2_OUT ...	- - 0 -	UINT16 UINT16 R/W - -	CANopen 3008:11 _h Modbus 2082

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOdefaultMode DRC- - io-M drL - - , a-n	Start-up operating mode for 'Local control mode' (87) 0 / none / none : None 1 / CurrentControl / Curr : Current control (reference value from ANA1) 2 / SpeedControl / SPED : Speed control (reference value from ANA1) 5 / Jog / Jog : Jog 6 / MotionSequence / Mot5 : Motion sequence IMPORTANT: The operating mode is automatically activated as soon as the drive switches to the status 'OperationEnable' and 'IODevice / IO' is set in DEVcmdinterf.	- 0 0 6	UINT16 UINT16 R/W per. -	CANopen 3005:3 _h Modbus 1286
IOfuncn_LI1 I-O- - Li1 ,-a- - Li1	Function Input LI1 (190) 1 / Free available / none : Available as required 2 / Fault reset / FrES : Reset fault (local control mode only) 4 / Halt / hRLt : Halt 6 / Enable positive motor move / Posn : Enable positive motor movement (local control mode only) 7 / Enable negative motor move / negn : Enable negative motor movement (local control mode only) 9 / Jog positive / JogP : Jog right/positive 10 / Jog negative / Jogn : Jog left/negative 11 / Jog fast/slow / JogF : Jog fast/slow 13 / DataSet Start / dSEtR : Motion sequence: start request 14 / DataSet Select / dSEl : Motion sequence: data set selection 20 / Reference switch (REF) / rEF : Reference switch (REF) 21 / Positive limit switch (LIMP) / Li nP : Positive limit switch (LIMP) 22 / Negative limit switch (LIMN) / Li nN : Negative limit switch (LIMN)	- - 0 -	UINT16 UINT16 R/W per. -	CANopen 3007:1 _h Modbus 1794

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOfunct_LI2	Function Input LI2 (190)	-	UINT16	CANopen 3007:2 _h
I-O- - Li2	1 / Free available / none : Available as required	-	UINT16	Modbus 1796
I-O- - Li2	2 / Fault reset / FrES : Reset fault (local control mode only)	0	R/W	
	4 / Halt / hRLt : Halt	-	per.	
	6 / Enable positive motor move / PMSn : Enable positive motor movement (local control mode only)		-	
	7 / Enable negative motor move / nEGn : Enable negative motor movement (local control mode only)			
	9 / Jog positive / JoGP : Jog right/positive			
	10 / Jog negative / JoGn : Jog left/negative			
	11 / Jog fast/slow / JoGF : Jog fast/slow			
	13 / DataSet Start / dSEtR : Motion sequence: start request			
	14 / DataSet Select / dSEL : Motion sequence: data set selection			
	20 / Reference switch (REF) / rEF : Reference switch (REF)			
	21 / Positive limit switch (LIMP) / L, nP : Positive limit switch (LIMP)			
	22 / Negative limit switch (LIMN) / L, nN : Negative limit switch (LIMN)			
IOfunct_LI4	Function Input LI4 (191)	-	UINT16	CANopen 3007:4 _h
I-O- - Li4	1 / Free available / none : Available as required	-	UINT16	Modbus 1800
I-O- - Li4	2 / Fault reset / FrES : Reset fault (local control mode only)	0	R/W	
	4 / Halt / hRLt : Halt	-	per.	
	6 / Enable positive motor move / PMSn : Enable positive motor movement (local control mode only)		-	
	7 / Enable negative motor move / nEGn : Enable negative motor movement (local control mode only)			
	9 / Jog positive / JoGP : Jog right/positive			
	10 / Jog negative / JoGn : Jog left/negative			
	11 / Jog fast/slow / JoGF : Jog fast/slow			
	13 / DataSet Start / dSEtR : Motion sequence: start request			
	14 / DataSet Select / dSEL : Motion sequence: data set selection			
	20 / Reference switch (REF) / rEF : Reference switch (REF)			
	21 / Positive limit switch (LIMP) / L, nP : Positive limit switch (LIMP)			
	22 / Negative limit switch (LIMN) / L, nN : Negative limit switch (LIMN)			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
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IOfuncn_LO1	Function Output LO1_OUT (197)	-	UINT16	CANopen 3007:9 _h
I-O - - Lo1	1 / Free available / nonE : Available as required	-	UINT16	Modbus 1810
I - o - - Lo1	2 / No fault / nFLt : No fault	0	R/W	
	3 / Active / Rct : Ready	-	per.	
	4 / Motor move disable / Nd : 5: Direction of movement disabled		-	
	9 / Halt acknowledge / hRLt : Halt confirmation			
	10 / Brake release / brRH : Holding brake control			
	11 / DataSet start acknowledge / dSRc : Motion sequence: acknowledgement of start request			
	12 / DataSet trigger output / tRok : Motion sequence: trigger output			
	13 / Motor standstill / nStd : Motor standstill			
IOfuncn_LO2	Function Output LO2_OUT (197)	-	UINT16	CANopen 3007:A _h
I-O - - Lo2	1 / Free available / nonE : Available as required	-	UINT16	Modbus 1812
I - o - - Lo2	2 / No fault / nFLt : No fault	0	R/W	
	3 / Active / Rct : Ready	-	per.	
	4 / Motor move disable / Nd : 5: Direction of movement disabled		-	
	9 / Halt acknowledge / hRLt : Halt confirmation			
	10 / Brake release / brRH : Holding brake control			
	11 / DataSet start acknowledge / dSRc : Motion sequence: acknowledgement of start request			
	12 / DataSet trigger output / tRok : Motion sequence: trigger output			
	13 / Motor standstill / nStd : Motor standstill			
IOfuncn_XLI1	Function Module Input XLI1 (191)	-	UINT16	CANopen 3007:19 _h
I-O - - oLi1	1 / Free available / nonE : Available as required	-	UINT16	Modbus 1842
I - o - - oLi1	9 / Jog positive / JoGP : Jog right/positive	0	R/W	
	10 / Jog negative / JoGn : Jog left/negative	-	per.	
	11 / Jog fast/slow / JoGF : Jog fast/slow		-	
	13 / DataSet Start / dStR : Motion sequence: start request			
	14 / DataSet Select / dSEL : Motion sequence: data set selection			
	15 / DataSet Bit0 / dSb0 : Motion sequence: data set selection Bit0			
	16 / DataSet Bit1 / dSb1 : Motion sequence: data set selection Bit1			
	17 / DataSet Bit2 / dSb2 : Motion sequence: data set selection Bit2			
	18 / DataSet Bit3 / dSb3 : Motion sequence: data set selection Bit3			
	19 / Automatic/Manual / RuLo : Automatic/manual mode			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOfunc_XLI2	Function Module Input XLI2 (192)	-	UINT16	CANopen 3007:1A _h
I-O- - oLi2	1 / Free available / none : Available as required	-	UINT16	Modbus 1844
1 - o - oLi 2	9 / Jog positive / JoGP : Jog right/positive 10 / Jog negative / JoGN : Jog left/negative 11 / Jog fast/slow / JoGF : Jog fast/slow 13 / DataSet Start / dSEsR : Motion sequence: start request 14 / DataSet Select / dSEL : Motion sequence: data set selection 15 / DataSet Bit0 / d5b0 : Motion sequence: data set selection Bit0 16 / DataSet Bit1 / d5b1 : Motion sequence: data set selection Bit1 17 / DataSet Bit2 / d5b2 : Motion sequence: data set selection Bit2 18 / DataSet Bit3 / d5b3 : Motion sequence: data set selection Bit3 19 / Automatic/Manual / RuLo : Automatic/manual mode	0 -	R/W per. -	
IOfunc_XLI3	Function Module Input XLI3 (192)	-	UINT16	CANopen 3007:1B _h
I-O- - oLi3	1 / Free available / none : Available as required	-	UINT16	Modbus 1846
1 - o - oLi 3	9 / Jog positive / JoGP : Jog right/positive 10 / Jog negative / JoGN : Jog left/negative 11 / Jog fast/slow / JoGF : Jog fast/slow 13 / DataSet Start / dSEsR : Motion sequence: start request 14 / DataSet Select / dSEL : Motion sequence: data set selection 15 / DataSet Bit0 / d5b0 : Motion sequence: data set selection Bit0 16 / DataSet Bit1 / d5b1 : Motion sequence: data set selection Bit1 17 / DataSet Bit2 / d5b2 : Motion sequence: data set selection Bit2 18 / DataSet Bit3 / d5b3 : Motion sequence: data set selection Bit3 19 / Automatic/Manual / RuLo : Automatic/manual mode	0 -	R/W per. -	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOfuncn_XLI4	Function Module Input XLI4 (193)	-	UINT16	CANopen 3007:1C _h
I-O - oLi4	1 / Free available / none : Available as required	-	UINT16	Modbus 1848
1 - 0 - oLi, 4	9 / Jog positive / JoGP : Jog right/positive 10 / Jog negative / JoGN : Jog left/negative 11 / Jog fast/slow / JoGF : Jog fast/slow 13 / DataSet Start / dSEtR : Motion sequence: start request 14 / DataSet Select / dSEl : Motion sequence: data set selection 15 / DataSet Bit0 / dSb0 : Motion sequence: data set selection Bit0 16 / DataSet Bit1 / dSb1 : Motion sequence: data set selection Bit1 17 / DataSet Bit2 / dSb2 : Motion sequence: data set selection Bit2 18 / DataSet Bit3 / dSb3 : Motion sequence: data set selection Bit3 19 / Automatic/Manual / RuLo : Automatic/manual mode	0 -	R/W per. -	
IOfuncn_XLI5	Function Module Input XLI5 (193)	-	UINT16	CANopen 3007:1D _h
I-O - oLi5	1 / Free available / none : Available as required	-	UINT16	Modbus 1850
1 - 0 - oLi, 5	9 / Jog positive / JoGP : Jog right/positive 10 / Jog negative / JoGN : Jog left/negative 11 / Jog fast/slow / JoGF : Jog fast/slow 13 / DataSet Start / dSEtR : Motion sequence: start request 14 / DataSet Select / dSEl : Motion sequence: data set selection 15 / DataSet Bit0 / dSb0 : Motion sequence: data set selection Bit0 16 / DataSet Bit1 / dSb1 : Motion sequence: data set selection Bit1 17 / DataSet Bit2 / dSb2 : Motion sequence: data set selection Bit2 18 / DataSet Bit3 / dSb3 : Motion sequence: data set selection Bit3 19 / Automatic/Manual / RuLo : Automatic/manual mode	0 -	R/W per. -	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOfuncn_XLI6	Function Module Input XLI6 (194)	-	UINT16	CANopen 3007:1E _h
I-O- - oLi6	1 / Free available / none : Available as required	-	UINT16	Modbus 1852
1 - o - - oLi6	9 / Jog positive / JoGP : Jog right/positive 10 / Jog negative / JoGN : Jog left/negative 11 / Jog fast/slow / JoGF : Jog fast/slow 13 / DataSet Start / dSEtR : Motion sequence: start request 14 / DataSet Select / dSEtL : Motion sequence: data set selection 15 / DataSet Bit0 / dSEt0 : Motion sequence: data set selection Bit0 16 / DataSet Bit1 / dSEt1 : Motion sequence: data set selection Bit1 17 / DataSet Bit2 / dSEt2 : Motion sequence: data set selection Bit2 18 / DataSet Bit3 / dSEt3 : Motion sequence: data set selection Bit3 19 / Automatic/Manual / Auto : Automatic/manual mode	0 -	R/W per. -	
IOfuncn_XLO1	Function Module Output XLO1_OUT (197)	-	UINT16	CANopen 3007:21 _h
I-O- - oLo1	1 / Free available / none : Available as required	-	UINT16	Modbus 1858
1 - o - - oLo1	11 / DataSet start acknowledge / dSEtRc : Motion sequence: acknowledgement of start request 12 / DataSet trigger output / tRack : Motion sequence: trigger output	0 -	R/W per. -	
IOfuncn_XLO2	Function Module Output XLO2_OUT (197)	-	UINT16	CANopen 3007:22 _h
I-O- - oLo2	1 / Free available / none : Available as required	-	UINT16	Modbus 1860
1 - o - - oLo2	11 / DataSet start acknowledge / dSEtRc : Motion sequence: acknowledgement of start request 12 / DataSet trigger output / tRack : Motion sequence: trigger output	0 -	R/W per. -	
IOsigLimN	Signal evaluation LIMN (156)	-	UINT16	CANopen 3006:F _h
-	0 / inactive : Inactive	0	UINT16	Modbus 1566
-	1 / normally closed : Normally closed NC	1	R/W	
-	2 / normally open : Normally open NO	2	per. -	
IOsigLimP	Signal evaluation LIMP (156)	-	UINT16	CANopen 3006:10 _h
-	0 / inactive : Inactive	0	UINT16	Modbus 1568
-	1 / normally closed : Normally closed NC	1	R/W	
-	2 / normally open : Normally open NO	2	per. -	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOsigRef - -	Signal evaluation REF (156) 1 / normally closed: Normally closed NC 2 / normally open: Normally open NO The reference switch is only activated (to REF) while homing is processed.	- 1 1 2	UINT16 UINT16 R/W per. -	CANopen 3006:E _h Modbus 1564
JOGactivate - -	Activation of jog (123) Bit0: positive direction of rotation Bit1: negative direction of rotation Bit2: 0=slow 1=fast	- 0 0 7	UINT16 UINT16 R/W - -	CANopen 301B:9 _h Modbus 6930
JOGn_fast JOG- - NFST Jog - - nFSt	Speed for fast jog (123) The adjustable value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 180 13200	UINT16 UINT16 R/W per. -	CANopen 3029:5 _h Modbus 10506
JOGn_slow JOG- - NSLW Jog - - nSLW	Speed for slow jog (123) The adjustable value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 60 13200	UINT16 UINT16 R/W per. -	CANopen 3029:4 _h Modbus 10504
JOGstepusr - -	Jog distance prior to continuous run (123) 0: Direct activation of continuous run >0: Positioning distance per jog cycle	usr 0 20 -	INT32 INT32 R/W per. -	CANopen 3029:7 _h Modbus 10510
JOGtime - -	Wait time prior to continuous run (124) This time is only effective if you have set a jog distance not equal to 0, otherwise the drive immediately starts a continuous run.	ms 1 500 32767	UINT16 UINT16 R/W per. -	CANopen 3029:8 _h Modbus 10512
LIM_I_maxHalt SET- - LihA SEt - - L, hR	Current limitation for Halt (182) Max. current during braking after Halt or when an operating mode is terminated. Maximum and default settings depend on the motor and the power amplifier (settings M_I_max and PA_I_max) In increments of 0.01A _{pk}	A _{pk} - - -	UINT16 UINT16 R/W per. -	CANopen 3011:6 _h Modbus 4364
LIM_I_maxQSTP SET- - LiQS SEt - - L, qS	Current limitation for Quick Stop (181) Max. current during braking via torque ramp due to an error of error classes 1 or 2 and when a software stop is triggered. Maximum and default settings depend on the motor and the power amplifier (settings M_I_max and PA_I_max) In increments of 0.01A _{pk}	A _{pk} - - -	UINT16 UINT16 R/W per. -	CANopen 3011:5 _h Modbus 4362

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
M_currcomp DRC- - COMP drC - - C _{amp}	Current torque compensation	A 0.00 0.00 6.00	UINT16 UINT16 R/W per. -	CANopen 300D:1F _h Modbus 3390
M_hallpos DRC- - HALL drC - - h _{ALL}	Hall sensor position 0 / 120° / 120 : Position 120° 1 / 60° / 60 : Position 60°	- 0 0 1	UINT16 UINT16 R/- per. -	CANopen 300D:1E _h Modbus 3388
M_hallshift DRC- - SSHI drC - - 55h _i	Hall sensor shift 0 / direct / off : Without shift 1 / shifted / on : With shift	- - - -	UINT16 UINT16 R/- per. -	CANopen 300D:1D _h Modbus 3386
M_I_0 - -	Continuous motor current at standstill In increments of 0.01A _{pk}	A _{pk} - - -	UINT16 UINT16 R/- - -	CANopen 300D:13 _h Modbus 3366
M_I_max INF- - MiMA i _{nf} - - i _u i _{MA}	Maximum motor current In increments of 0.01A _{pk}	A _{pk} - - -	UINT16 UINT16 R/- - -	CANopen 300D:6 _h Modbus 3340
M_I_nom INF- - MiNo i _{nf} - - i _u i _{NO}	Nominal motor current In increments of 0.01A _{pk}	A _{pk} - - -	UINT16 UINT16 R/- - -	CANopen 300D:7 _h Modbus 3342
M_I2t - -	Maximum permissible time for M_I_max	ms - - -	UINT16 UINT16 R/- - -	CANopen 300D:11 _h Modbus 3362
M_kE_EC - -	Motor EMF constant kE Voltage constant in V _{pk} at 1000 1/min	- - -	UINT16 UINT16 R/W - expert	CANopen 300D:20 _h Modbus 3392
M_L_q_EC - -	Motor connection inductance In increments of 0.01 mH	mH - - -	UINT16 UINT16 R/- - -	CANopen 300D:21 _h Modbus 3394
M_n_max - -	Maximum permissible motor speed	1/min - - -	UINT16 UINT16 R/- - -	CANopen 300D:4 _h Modbus 3336

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
M_n_nom	Nominal motor speed	1/min	UINT16	CANopen 300D:5 _h
-		-	UINT16	Modbus 3338
-		-	R/-	
-		-	-	
M_Polepair	Number of pole pairs of motor	-	UINT16	CANopen 300D:14 _h
-		-	UINT16	Modbus 3368
-		-	R/-	
-		-	-	
M_R_UV	Motor connection resistance	Ω	UINT16	CANopen 300D:D _h
-	In increments of 10mOhm	-	UINT16	Modbus 3354
-		-	R/-	
-		-	-	
M_Sensor	Motor encoder type (87)	-	UINT16	CANopen 300D:3 _h
DRC- - SENS	0 / unknown / none : Unknown	-	UINT16	Modbus 3334
drC - - 5En5	16 / Hallsensor / hALL : Hall signals	0	R/-	
	17 / Hall and Incremental / hInc : Hall and increment signals	-	-	
M_SenssLine	Number of lines of motor encoder	-	UINT16	CANopen 300D:1B _h
-		-	UINT16	Modbus 3382
-		-	R/-	
-		-	-	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
M_Type	Motor type (86)	-	UINT32	CANopen 300D:2 _h
DRC- - MTYP	0 / none / none : No motor selected (default)	-	UINT32	Modbus 3332
<i>drC - - MTYP</i>	4334 / RECM343/3 24V / 4334 : RECM343/3 24V	-	R/-	
	4338 / RECM343/3 48V / 4338 : RECM343/3 48V		-	
	4344 / RECM343/4 24V / 4344 : RECM343/4 24V			
	4348 / RECM343/4 48V / 4348 : RECM343/4 48V			
	4534 / RECM345/3 24V / 4534 : RECM345/3 24V			
	4538 / RECM345/3 48V / 4538 : RECM345/3 48V			
	4544 / RECM345/4 24V / 4544 : RECM345/4 24V			
	4548 / RECM348/4 48V / 4548 : RECM345/4 48V			
	7224 / RECM372/2 24V / 7224 : RECM372/2 24V			
	7228 / RECM372/2 48V / 7228 : RECM372/2 48V			
	7244 / RECM372/4 24V / 7244 : RECM372/4 24V			
	7248 / RECM372/4 48V / 7248 : RECM372/4 48V			
	7424 / RECM374/2 24V / 7424 : RECM374/2 24V			
	7428 / RECM374/2 48V / 7428 : RECM374/2 48V			
	7444 / RECM374/4 24V / 7444 : RECM374/4 24V			
	7448 / RECM374/4 48V / 7448 : RECM374/4 48V			
	7528 / RECM375/2 48V / 7528 : RECM375/2 48V			
	7548 / RECM375/4 48V / 7548 : RECM375/4 48V			
	7728 / RECM377/2 48V / 7728 : RECM377/2 48V			
	7748 / RECM377/4 48V / 7748 : RECM377/4 48V			
	99999999 / user defined motor / 95Er : User-defined			
	<p>After selection of a motor type from the list, the motor-specific parameters are automatically set.</p> <p>When you select 'user-defined', you must set the motor-specific parameters via the commissioning software or the fieldbus.</p>			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
M_U_nom	Nominal motor voltage	V	UINT16	CANopen 300D:A _h
-	Voltage in increments of 100mV	-	UINT16	Modbus 3348
-		-	R/-	
-		-	-	
MBadr	Modbus address (89)	-	UINT16	CANopen 3016:4 _h
COM- - MBAD	Valid addresses: 1 to 247	1	UINT16	Modbus 5640
ЭобП- - ПбРд		1	R/W	
		247	per.	
			-	
MBbaud	Modbus Baud rate (89)	-	UINT16	CANopen 3016:3 _h
COM- - MBBD	9600 / 9.6KB / 96: 9600 Baud	9600	UINT16	Modbus 5638
ЭобП- - Пббд	19200 / 19.2KB / 192: 19200 Baud	19200	R/W	
	38400 / 38.4KB / 384: 34800 Baud	38400	per.	
			-	
	IMPORTANT: Changed settings do not become active until the unit is switched on the next time			
MBdword_order	Modbus word sequence for double words (32 bit values)	-	UINT16	CANopen 3016:7 _h
COM- - MBWo		0	UINT16	Modbus 5646
ЭобП- - ПбЛд	0 / HighLow / h, Lo: HighWord-LowWord	0	R/W	
	1 / LowHigh / Lah: LowWord-HighWord	1	per.	
	High word first or low word first		-	
	High word first -> Modicon Quantum			
	Low word first -> Premium, HMI (Telemecanique)			
MBformat	Modbus data format	-	UINT16	CANopen 3016:5 _h
COM- - MBFo	1 / 8Bit NoParity 1Stop / Bn1: 8 bits, no parity bit, 1 stop bit	1	UINT16	Modbus 5642
ЭобП- - ПбФд	2 / 8Bit EvenParity 1Stop / BE1: 8 bits, even parity bit, 1 stop bit	2	R/W	
	3 / 8Bit OddParity 1Stop / Bn1: 8 bits, odd parity bit, 1 stop bit	4	per.	
	4 / 8Bit NoParity 2Stop / Bn2: 8 bits, no parity bit, 2 stop bits		-	
	IMPORTANT: Changed settings do not become active until the unit is switched on the next time			
MBnode_guard	Modbus node guard	ms	UINT16	CANopen 3016:6 _h
-	Node guard	0	UINT16	Modbus 5644
-	0: Inactive (default)	0	R/W	
-	>0: Monitoring time	10000	-	
			-	
MSMactNum	Current data set number	-	INT16	CANopen 302D:4 _h
-	-1: Operating mode inactive or no data set triggered yet	-1	INT16	Modbus 11528
-	>0: Number of the currently started data set	-1	R/-	
		15	-	
			-	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MSMavailCnt	Number of available data sets	-	UINT16	CANopen 302D:F _h
-	Number of data sets that are available.	16	UINT16	Modbus 11550
-		16	R/-	
-		16	-	
MSMcurNextCond	Current transition condition	-	UINT16	CANopen 302D:9 _h
-	0 / rising edge: Rising edge	0	UINT16	Modbus 11538
-	1 / falling edge: Falling edge	4	R/-	
-	2 / 1-level: 1 level	7	-	
	3 / 0-level: 0 level		-	
	4 / global next condition: Global transition condition (see MSMglobalCond)			
	5 / auto: Auto			
	6 / blended move typ A: Blended movement a			
	7 / blended move typ B: Blended movement b			
	Shows the transition condition which must be met for the next data set to be triggered. Coding corresponds to the definition in the parameter 'MSMdataNextCond'			
MSMdataAcc	Acceleration (140)	(1/min)/s	UINT32	CANopen 302D:14 _h
-	0: Use of current acceleration, no change	0	UINT32	Modbus 11560
-	>0: Special acceleration value, see parameter RAMPacc for adjustment range	0	R/W	
		3000000	per.	
			-	
MSMdataDec	Deceleration (140)	(1/min)/s	UINT32	CANopen 302D:15 _h
-	0: Use of current deceleration, no change	0	UINT32	Modbus 11562
-	>0: Special deceleration value, see parameter RAMPdecel for adjustment range	0	R/W	
		3000000	per.	
			-	
MSMdataDelay	Wait time (140)	ms	UINT16	CANopen 302D:16 _h
-	Additional wait time in ms after termination of the movement.	0	UINT16	Modbus 11564
-		0	R/W	
-		30000	per.	
	This setting is only effective in the processing mode 'sequential selection'.		-	
MSMdataNext	Number of subsequent data set (140)	-	UINT16	CANopen 302D:18 _h
-	This setting is only effective in the processing mode 'sequential selection'.	0	UINT16	Modbus 11568
-		0	R/W	
-		15	per.	
			-	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MSMdataNextCond	Transition condition (142)	-	UINT16	CANopen 302D:17 _h
-	0 / rising edge: Rising edge	0	UINT16	Modbus 11566
-	1 / falling edge: Falling edge	4	R/W	
-	2 / 1-level: 1 level	7	per.	
	3 / 0-level: 0-Pegel		-	
	4 / global next condition: Global transition condition (see MSMglobalCond)			
	5 / auto: Auto			
	6 / blended move typ A: Blended movement a			
	7 / blended move typ B: Blended movement b			
	This setting is only effective in the processing mode 'sequential selection'.			
MSMdataOutEnd	Output processing when processing of a data set is finished	-	UINT16	CANopen 302D:1A _h
-		0	UINT16	Modbus 11572
-	0 / unchanged level: Unchanged level	0	R/W	
-	1 / 1-level: 1 level	3	per.	
	2 / 0-level: 0 level		-	
	3 / inverted level: Inverted level			
	This setting is only effective in the processing mode 'sequential selection'.			
MSMdataOutStrt	Output processing when a data set is started	-	UINT16	CANopen 302D:19 _h
-		0	UINT16	Modbus 11570
-	0 / unchanged level: Unchanged level	0	R/W	
-	1 / 1-level: 1 level	3	per.	
	2 / 0-level: 0 level		-	
	3 / inverted level: Inverted level			
	This setting is only effective in the processing mode 'sequential selection'.			
MSMdataSpeed	Speed (140)	1/min	UINT16	CANopen 302D:13 _h
-		0	UINT16	Modbus 11558
-	In the case of relative or absolute movements, this value corresponds to the reference speed, in the case of homing to the search speed.	0	R/W	
-		13200	per.	
			-	
MSMdataTarget	Target value of movement type (139)	-	INT32	CANopen 302D:12 _h
-	The value depends on the selected processing type (see MSMdataType for settings):	-2147483648	INT32	Modbus 11556
-	- None: no meaning	0	R/W	
-	- Absolute positioning: absolute position in usr	2147483647	per.	
	- Relative positioning: relative distance in usr		-	
	- Reference movement: type of reference movement (see HMmethod)			
	- Position setting: position setting position in usr			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MSMdataType	Selection of movement type (139)	-	UINT16	CANopen 302D:11 _h
-	0 / None: None	0	UINT16	Modbus 11554
-	1 / absolute positioning: Absolute positioning	0	R/W	
-	2 / relative positioning: Relative positioning	4	per.	
	3 / homing: Homing		-	
	4 / set position: Position setting			
	Sequential selection: Processing of wait time and transition condition only. Direct selection: Triggering of a data set without movement, but compliance with handshake mechanism.			
MSMfeature	Special setting	-	UINT16	CANopen 302D:B _h
-	Value 1:	0	UINT16	Modbus 11542
-	Only sequential selection:	0	R/W	
-	No automatic transition. When a data set is started, this value is used. The subsequent data set is triggered by a rising edge. If the movement is of type "Blended Movement", the complete blended movement is processed. After processing of the data set or in the case of a fault, the value is reset to 0.	1	-	
MSMglobalCond	Global transition condition (138)	-	UINT16	CANopen 302D:8 _h
-	0 / rising edge: Rising edge	0	UINT16	Modbus 11536
-	1 / falling edge: Falling edge	0	R/W	
-	2 / 1-level: 1 level	3	per.	
	3 / 0-level: 0 level		-	
	The global transition condition defines the way the start request is to be processed. This setting is used for the first start after activation of the operating mode. In addition, this setting can be used as transition condition in the individual data sets (default assignment).			
MSMnextNum	Next data set to be triggered	-	INT16	CANopen 302D:5 _h
-	-1: Operating mode inactive or no data set selected yet	-1	INT16	Modbus 11530
-	>0: Number of the next data set to be triggered	-1	R/-	
		15	-	
MSMprocMode	Processing mode (137)	-	UINT16	CANopen 302D:7 _h
-	0 / direct: Direct selection	0	UINT16	Modbus 11534
-	1 / sequential: Sequential selection	1	R/W	
		1	per.	
			-	
MSMselEntry	Selection of data set number in data set table	-	UINT16	CANopen 302D:10 _h
-		0	UINT16	Modbus 11552
-	Before an entry in the data set table can be read or written, the corresponding data set number must be selected.	0	R/W	
-		15	-	
			-	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MSMsetNum	Selection of a data set to be started	-	INT16	CANopen 302D:6 _h
-	Number of the next data set to be triggered.	-1	INT16	Modbus 11532
-	This setting can only be made if no data set is active and if processing of the current data set is complete (x_end = 1). A write access changes MSNnextNum.	-1 15	R/W	
	Special case for read access to parameter: -1: Operating mode inactive or no data set has yet been set via this parameter		-	
MSMstartReq	Start request for processing of a data set (143)	-	UINT16	CANopen 302D:3 _h
-		0	UINT16	Modbus 11526
-	Direct selection:	0	R/W	
-	The data set is always triggered by a rising edge. The number of the data set to be triggered must first adjusted via MSMsetNum.	1	-	
	Sequential selection: Triggering of a data set with start or transition condition. The start condition is defined with MSMglobalCond. The transition condition can be specially adjusted for each data set.		-	
MSMstartType	Activation type of operating mode motion sequence	-	UINT16	CANopen 301B:1A _h
-		0	UINT16	Modbus 6964
-	0 / Deactivate: Deactivate	0	R/W	
-	1 / Activate: Activate	2	-	
	2 / Continue halted movement: Continue a movement interrupted with HALT		-	
MSMteachIn	Take over current user position (TeachIn)	-	UINT16	CANopen 302D:A _h
-	Writes the current user position to the data set table.	0	UINT16	Modbus 11540
-	The parameter specifies the row in the table into which the position is to be written.	0	R/W	
	TeachIn is only allowed at standstill and if the drive is referenced (ref_ok=1). In addition, the data set type 'Absolute Positioning' must be entered in the selected table row. In the 'OperationEnable' status, '_p_refusr' is always used as position value. Otherwise, '_p_actusr' is used.	15	-	
MT_dismax	Max. permissible distance	revolution	UINT16	CANopen 302E:3 _h
-		0.0	UINT16	Modbus 11782
-	If the reference value is active and the maximum permissible distance is exceeded, an error of class 1 is generated.	1.0	R/W	
-		999.9	-	
	The value 0 switches off monitoring.		-	
PA_I_max	Maximum current of power amplifier	A _{pk}	UINT16	CANopen 3010:2 _h
INF- - PiMA	Current in increments of 10mA	-	UINT16	Modbus 4100
, nF- - P, nR		0.00	R/-	
		-	per.	
			-	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PA_I_nom	Nominal current of power amplifier	A _{pk}	UINT16	CANopen 3010:1 _h
INF- - PiNo	Current in increments of 10mA	-	UINT16	Modbus 4098
INF- - PiNo		0.00	R/-	
		-	per.	
		-	-	
PA_T_max	Maximum permissible power amplifier temperature (170)	°C	INT16	CANopen 3010:7 _h
-		-	INT16	Modbus 4110
-		0	R/-	
		-	per.	
		-	-	
PA_T_warn	Temperature warning threshold of power amplifier (170)	°C	INT16	CANopen 3010:6 _h
-		-	INT16	Modbus 4108
-		0	R/-	
		-	per.	
		-	-	
PA_U_maxDC	Maximum permissible DC bus voltage	V	UINT16	CANopen 3010:3 _h
-		-	UINT16	Modbus 4102
-	Voltage in increments of 100mV	-	R/-	
		-	per.	
		-	-	
PA_U_minDC	DC bus voltage low threshold for switching off the drive	V	UINT16	CANopen 3010:4 _h
-		-	UINT16	Modbus 4104
-	Voltage in increments of 100mV	-	R/-	
		-	per.	
		-	-	
PA_U_minStopDC	DC bus voltage low threshold for Quick Stop	V	UINT16	CANopen 3010:A _h
-		-	UINT16	Modbus 4116
-	If this threshold is reached, the drive performs a Quick Stop.	-	R/-	
	Voltage in increments of 100mV	-	per.	
		-	-	
PAR_CTRLreset	Reset controller parameters	-	UINT16	CANopen 3004:7 _h
TUN- - RES	0 / no / no: No	0	UINT16	Modbus 1038
tun- - rE5	1 / yes / YES: Yes	-	R/W	
		1	-	
	The controller parameters of the speed controller and the position controller are reset. The current controller is automatically adjusted under consideration of the connected motor.		-	
PAReeprSave	Save parameter values to EEPROM	-	UINT16	CANopen 3004:1 _h
-	Bit 0 = 1: Save all persistent parameters	-	UINT16	Modbus 1026
-		-	R/W	
	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.	-	-	
		-	-	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PARfactorySet DRC- - FCS drL - - FL5	<p>Restore factory settings (default values) (201)</p> <p>0 / No / na: No 1 / Yes / YES: Yes</p> <p>All parameters are set to their default values, these are saved to the EEPROM. Restoring the factory settings is possible via the HMI or the commissioning software. The saving process is complete when the parameter is read and 0 is returned.</p> <p>IMPORTANT: The default becomes active only when the unit is switched on the next time.</p>	- 0 - 3	R/W - -	
PARuserReset - -	<p>Reset user parameters (200)</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"> - Communication parameters - Device control - I/O functions - Type of encoder <p>IMPORTANT: The new settings are not saved to the EEPROM!</p>	- 0 - 7	UINT16 UINT16 R/W - -	CANopen 3004:8 _h Modbus 1040
POSdirOfRotat DRC- - PRoT drL - - ProL	<p>Definition of direction of rotation (198)</p> <p>0 / clockwise: Clockwise 1 / counter clockwise: Counter-clockwise</p> <p>Meaning: At positive speeds, the drive rotates clockwise (looking at the motor shaft at the flange).</p> <p>IMPORTANT: If you use limit switches, you must interchange the limit switch connections after changing the settings. The limit switch which is reached with a jog movement in positive direction must be connected to the LIMP input and vice versa.</p> <p>IMPORTANT: Changed settings do not become active until the unit is switched on the next time.</p>	- 0 0 1	UINT16 UINT16 R/W per. -	CANopen 3006:C _h Modbus 1560

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
POSScaleDenom	Denominator of position scaling (176)	usr	INT32	CANopen 3006:7 _h
-	Refer to numerator (POSScaleNum) for a description.	1	INT32	Modbus 1550
-	A new scaling is activated when the numerator value is supplied.	16384	R/W	
		2147483647	per.	
			-	
POSScaleNum	Numerator of position scaling (176)	revolution	INT32	CANopen 3006:8 _h
-	Specification of the scaling factor:	1	INT32	Modbus 1552
-	Motor revolutions [U]	1	R/W	
	-----	2147483647	per.	
	Change of user position [usr]		-	
	A new scaling is activated when the numerator value is supplied.			
	User limit values may be reduced due to the calculation of an internal factor.			
PPn_target	Reference speed in operating mode profile position (132)	1/min	UINT32	CANopen 6081:0 _h
-		1	UINT32	Modbus 6942
-	The adjusted value is internally limited to the current parameter value in RAMPn_max.	60	R/W	
		-	-	
PPoption	Options for operating mode profile position (133)	-	UINT16	CANopen 60F2:0 _h
-		0	UINT16	Modbus 6960
-	Determines the reference position for relative positioning:	0	R/W	
-	0: Relative with reference to the previous target position of the motion profile generator	2	-	
	1: Not supported			
	2: Relative with reference to the actual position of the motor			
PPp_targetusr	Target position in operating mode profile position (133)	usr	INT32	CANopen 607A:0 _h
-		-	INT32	Modbus 6940
-	Min./max values depend on:	0	R/W	
-	- Scaling factor	-	-	
	- Software limit switches (if they are activated)		-	
ProfileType	Motion profile	-	INT16	CANopen 6086:0 _h
-	0: Linear	0	INT16	Modbus 6954
-		0	R/W	
		0	-	
			-	
PVn_target	Reference speed in operating mode profile velocity (135)	1/min	INT32	CANopen 60FF:0 _h
-		-	INT32	Modbus 6938
-	The adjusted value is internally limited to the current parameter value in RAMPn_max.	0	R/W	
-		-	-	
			-	

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMP_TAUjerk	Jerk limitation (180)	ms	UINT16	CANopen 3006:D _h
-	0 / off: Off	0	UINT16	Modbus 1562
-	1 / 1: 1 ms	0	R/W	
-	2 / 2: 2 ms	128	per.	
-	4 / 4: 4 ms		-	
-	8 / 8: 8 ms			
-	16 / 16: 16 ms			
-	32 / 32: 32 ms			
-	64 / 64: 64 ms			
-	128 / 128: 128 ms			
	Limits the acceleration change (jerk) of the reference position generation during the positioning transitions: Standstill - acceleration Acceleration - constant speed Constant speed - deceleration Deceleration - standstill			
	Processing in the following operating modes: - Profile velocity - Profile position - Jog - Homing			
	Adjustments can only be made if the operating mode is inactive (x_end=1).			
RAMPacc	Acceleration of profile generator (178)	(1/min)/s	UINT32	CANopen 6083:0 _h
-		30	UINT32	Modbus 1556
-		600	R/W	
-		3000000	per.	
-			-	
RAMPdecel	Deceleration of profile generator (178)	(1/min)/s	UINT32	CANopen 6084:0 _h
-		750	UINT32	Modbus 1558
-		750	R/W	
-		3000000	per.	
-			-	
RAMPn_max	Limitation of ref. speed for op. modes with profile generation (179)	1/min	UINT32	CANopen 607F:0 _h
-		60	UINT16	Modbus 1554
-	The parameter is active in the following operating modes: - Profile position - Profile velocity - Homing - Jog	13200	R/W	
-		13200	per.	
-			-	
	If a greater reference speed is set in one of these operating modes, it is automatically limited to RAMPn_max. This way, commissioning at limited speed is easy to perform.			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMPsym	Symmetrical ramp	usr	UINT16	CANopen 3006:1 _h
-	Acceleration and deceleration of the profile generator (16 bit value) in 10 (1/min)/s	-	UINT16	Modbus 1538
-	Write access changes the values under RAMPacc and RAMPdecel. The limit values are checked on the basis of the values indicated for these parameters.	0	R/W	
-	Read access returns the greater value from RAMPacc/RAMPdecel. If the currently set value cannot be represented as 16 bit value, the max, UINT16 value is written.	-	-	
SPEEDn_target	Reference speed in operating mode speed control (129)	1/min -30000	INT16	CANopen 3021:4 _h
-	The internal maximum speed is limited to the current setting in CTRL_n_max.	0	INT16	Modbus 8456
-		30000	R/W	
SPEEDreference	Selection of the ref. value source for op. mode speed control (129)	-	UINT16	CANopen 301B:11 _h
-	0 / none: None	0	UINT16	Modbus 6946
-	1 / Analog Input: Reference value via +/- 10V interface ANA1	0	R/W	
-	2 / Parameter 'speedTarg': Reference value via parameter SPEEDn_target	2	-	
SPV_Flt_pDiff	Error response to tracking error (174)	-	UINT16	CANopen 3005:B _h
-	1 / ErrorClass1: Error class 1	1	UINT16	Modbus 1302
-	2 / ErrorClass2: Error class 2	3	R/W	
-	3 / ErrorClass3: Error class 3	3	per.	
SPV_p_maxDiff	Max. permissible tracking error of the position controller (171)	revolution 0.0001	UINT32	CANopen 6065:0 _h
-	The tracking error is the current position control deviation minus the position control deviation caused by the speed. Actually, only the position control deviation caused by the torque request is used for tracking error monitoring.	1.0000	UINT32	Modbus 4636
-		200.0000	R/W	
SPV_SW_Limits	Monitoring of software limit switches (168)	-	UINT16	CANopen 3006:3 _h
-	0 / none: None (default)	0	UINT16	Modbus 1542
-	1 / SWLIMP: Activation of software limit switches positive direction	0	R/W	
-	2 / SWLIMN: Activation of software limit switches negative direction	3	per.	
-	3 / SWLIMP+SWLIMN: Activation of software limit switches both directions		-	
	Monitoring of software limit switches only works in case of successful homing (ref_ok = 1).			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPV_t_block	Response time of blocking monitoring	ms	UINT16	CANopen 3005:18 _h
-	If, in spite of maximum current, the motor shaft does not move for the time set with this parameter, the monitoring system signal a blocking error.	0	UINT16	Modbus 1328
-		100	R/W	
-		10000	per.	
	A value of 0 deactivated blocking monitoring.		-	
SPVswLimNusr	Negative position limit for software limit switch (167)	usr	INT32	CANopen 607D:1 _h
-		-	INT32	Modbus 1546
-	Refer to description 'SPVswLimPusr'	-2147483648	R/W	
-		-	per.	
			-	
SPVswLimPusr	Positive position limit for software limit switch (167)	usr	INT32	CANopen 607D:2 _h
-		-	INT32	Modbus 1544
-	If a user value entered is outside of the permissible user range, the limit switch limits are automatically set to the max. user value.	2147483647	R/W	
-		-	per.	
			-	
STANDp_win	Standstill window, permissible control deviation (183)	revolution	UINT32	CANopen 6067:0 _h
-		0.0000	UINT16	Modbus 4370
-	The control deviation for the standstill window time must be within this range for a standstill of the drive to be detected.	0.0010	R/W	
-		3.2767	per.	
	Processing of the standstill window must be activated via the parameter 'STANDpwin-Time'.		-	
STANDpwinTime	Standstill window, time (183)	ms	UINT16	CANopen 6068:0 _h
-	0: Monitoring of standstill window deactivated	0	UINT16	Modbus 4372
-	>0: Time in ms during which the control deviation must be in the standstill window	0	R/W	
		32767	per.	
			-	
STANDpwinTout	Timeout time for standstill window monitoring (183)	ms	UINT16	CANopen 3011:B _h
-		0	UINT16	Modbus 4374
-	0 : Timeout monitoring deactivated	0	R/W	
-	>0 : Timeout time in ms	16000	per.	
			-	
	Standstill window processing values are set via STANDp_win und STANDpwinTime.			
	Time monitoring starts when the target position (reference position of position controller) is reached or when the profile generator has finished processing.			

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SuppDriveModes	Supported operating modes as per DSP402	-	UINT32	CANopen 6502:0 _h
-	Coding:	-	UINT32	Modbus 6952
-	Bit 0: Profile position	0	R/-	
-	Bit 2: Profile velocity	-	-	
	Bit 5: Homing		-	
	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 mode			
	The availability of the individual bits is product-dependent.			

11.3 Objects for PDO mapping

The table below shows an overview of objects that can be used for PDO mapping.

Index:Subindex	Object	PDO	Data type
3006:1 _h	RAMPsym	R_PDO	UINT16
3008:F _h	_IO_LI_act		
3008:10 _h	_IO_LO_act		
3009:1 _h	ANA1_act	T_PDO	INT16
301B:9 _h	JOGactivate	R_PDO	UINT16
301C:4 _h	_actionStatus	T_PDO	UINT16
301E:3 _h	_ldq_act	T_PDO	INT16
301F:2 _h	_p_actRAMPusr	T_PDO	INT32
3020:4 _h	CUR_I_target	R_PDO	INT16
3021:4 _h	SPEEDn_target	R_PDO	INT16
6040 _h	DCOMcontrol	R_PDO	UINT16
6041 _h	DCOMstatus	T_PDO	UINT16
6060 _h	DCOMopmode	R_PDO	INT16
6061 _h	_DCOMopomd_act	T_PDO	INT16
6063 _h	_p_act	T_PDO	INT32
6064 _h	_p_actusr	T_PDO	INT32
606C _h	_n_act	T_PDO	INT32
607A _h	PPp_targetusr	R_PDO	INT32
6081 _h	PPn_target	R_PDO	UINT32
6083 _h	RAMPacc	R_PDO	UINT32
6084 _h	RAMPdecel	R_PDO	UINT32
60FF _h	PVn_target	R_PDO	INT32

11.4 Arrangement of object group 6000_h



The product includes corresponding parameters for CANopen object groups 3000_h and 6000_h. The names of the parameters and the data type of the parameters may be different from the DS402 definition for object group 6000_h. In this case, the data type corresponding to DS402 must be input.

Index	DSP 402 object name	DSP 402 data type	Parameter name
603F:0 _h	Error code	UINT16	_StopFault
6040:0 _h	Controlword	UINT16	DCOMcontrol
6041:0 _h	Status word	UINT16	DCOMstatus
6060:0 _h	Modes of operation	INT8	DCOMopmode
6061:0 _h	Modes of operation display	INT8	_DCOMopmd_act
6063:0 _h	Position actual value int	INT32	_p_act
6064:0 _h	Position actual value	INT32	_p_actusr
6065:0 _h	Tracking error window	UINT32	SPV_p_maxDiff
6067:0 _h	Position window	UINT32	STANDp_win
6068:0 _h	Position window time	UINT16	STANDpwinTime
606B:0 _h	Velocity demand value	INT32	_n_actRAMP
606C:0 _h	Velocity actual value	INT32	_n_act
607A:0 _h	Target position	INT32	PPp_targetusr
607D:1 _h	Min position limit	INT32	SPVswLimNusr
607D:2 _h	Max position limit	INT32	SPVswLimPusr
607F:0 _h	Max profile velocity	UINT32	RAMPn_max
6081:0 _h	Profile velocity	UINT32	PPn_target
6083:0 _h	Profile acceleration	UINT32	RAMPacc
6084:0 _h	Profile deceleration	UINT32	RAMPdecel
6086:0 _h	Motion profile type	INT16	ProfileType
6098:0 _h	Homing method	INT8	HMmethod
6099:1 _h	Homing speed during search for switch	UINT32	HMn
6099:2 _h	Homing speed during search for zero	UINT32	HMn_out
60F02:00 _h	Position Option Code	UINT16	PPoption
60F04:00 _h	Tracking error actual value	INT32	_p_dif
60FF:0 _h	Target velocity	INT32	PVn_target
6502:0 _h	Supported drive modes	UINT32	SuppDriveModes

12 Accessories and spare parts

*Reference source of
commissioning software*

The current commissioning software is available for download from the internet.

<http://www.berger-lahr.com/download>

12.1 Accessories

Description	OrderNo.
Adapter plate for mounting on DIN rail	MNA3MFDINR1
Braking Resistor Controller UBC60	ACC3EA001
Remote control terminal (HMI)	VW3A31101
EMC kit	MNA3CS013
HBC Holding brake controller	VW3M3103
PC connection kit, converter RS485 to RS232	VW3A8106
Connector set BLP, CANopen/DeviceNet	MNA3CS111
Connector set BLP, CANopen/DeviceNet + I/O expansion	MNA3CS114

12.2 Plug

	Description	Type (Weidmüller)
Power supply	Socket board 2-pole 5.08, GOLD black	BLZF 5.08/02/180F AU BK
Modbus	RJ45	tyco/AMP
Signal interface	Socket B2L , 12-pole in black with tension spring	B2L 3.5/12 SN BK
CAN	Socket board, BL, 5.08 mm, 5-pole gray, printed, GOLD, flange	BLDZ DN5.08/5/180F GR BED
Motor	Socket board 4-pole 5.08, GOLD black	BLZF 5.08/04/180F AU BK
Hall sensors	Socket B2L , 6-pole in black with tension spring	B2L 3.5/6 SN BK
Encoder	Socket B2L , 8-pole in black with tension spring	B2L 3.5/8 SN BK
I/O expansion	Socket B2L, 10-pole in black with tension spring	B2L 3.5/10 SN BK

13 Service, maintenance and disposal

⚠ CAUTION

Destruction of system components and loss of control monitoring

Excessive currents can be created at the signal connections if the negative connection to the controller supply voltage is interrupted.

- Do not interrupt the negative connection between power supply unit and load with a fuse or switch
- Check for correct connection before switching on.
- Never connect the controller supply voltage or change its wiring while there is supply voltage present.

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



The repair should only be carried out by a certified customer service organization. No warranty or liability is accepted for repairs made by the customer.

13.1 Service address

If you cannot resolve the fault yourself please contact your appointed sales partner. Have the following details available:

- Type plate (Type, identification number, serial number, DOM, ...)
- Type of fault (possibly with flash code or fault number)
- Previous and concurrent conditions
- Your own ideas regarding the cause of the fault

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



If you have any questions please contact your local dealer. Your dealer will be happy to give you the name of a customer service outlet in your area.

<http://www.berger-lahr.com>

13.2 Maintenance

The product is maintenance free.

13.2.1 Operational duration of STO safety function

The operating life for the STO safety function is designed for 20 years. After this period correct function is no longer ensured. The expiry date of the device is determined by adding 20 years to the DOM shown on the name plate.

► This date must be included in the system maintenance schedule.

Example The DOM on the name plate of the device is quoted in the format DD.MM.YY, e.g. 31.12.06. (31 December 2006). This means that the safety function is guaranteed until 31 December 2026.

13.3 Replacing units

⚠ WARNING

Unexpected behavior

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

- Do not operate a drive system with unknown settings or data.
- Check the stored data or settings.
- When commissioning carefully run tests for all operating statuses and fault cases.
- Check 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 materials in the danger zone and the system can be operated safely.

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



Prepare a list with the parameters required for the functions in use.

Observe the following procedure when changing the devices.

- ▶ Save all parameter settings on your PC with the commissioning software, see chapter 6.3.2 "BLCT commissioning software".
- ▶ Switch off all power supplies. Make sure that power is no longer connected (safety instructions).
- ▶ Label all connections and remove the product.
- ▶ Note the identification number and the serial number from the product nameplate for later identification.
- ▶ Install the new product as specified in chapter 5 "Installation".
- ▶ Carry out commissioning in accordance with chapter 6 "Commissioning".

13.4 Changing the motor

- ▶ Switch off all power supplies. Make sure that power is no longer connected (safety instructions).
- ▶ Label all connections and remove the product.
- ▶ Note the identification number and the serial number from the product nameplate for later identification.
- ▶ Install the new product as specified in chapter 5 "Installation".
- ▶ Carry out commissioning as described in chapter 6 "Commissioning".

13.5 Shipping, storage, disposal

Refer to the ambient conditions in chapter 3.1 "Environmental conditions".

<i>Shipping</i>	The product must be protected against shocks during transport. Use the original packaging for this purpose.
<i>Storage</i>	Store the product only under the specified, approved environmental conditions for room temperature and humidity. Protect the product against dust and dirt.
<i>Disposal</i>	The product consists of various materials that can be recycled and must be disposed of separately. Dispose of the product in accordance with local regulations.

14 Extract

This extract does not replace the manual. It simply provides a brief overview of the device, but it is definitely not sufficient for correct commissioning. The manual must always be read carefully before commissioning to prevent errors in connection or installation.

14.1 Electromagnetic compatibility, EMC

Note the EMC specifications and instructions in the chapter on “Installation”. Make sure that all national regulations are observed.

14.2 Compact installation

⚠ WARNING

Loss of control

- Observe the accident prevention regulations. (For USA see also NEMA ICS1.1 and NEMA ICS7.1)
- The system manufacturer must take the potential error possibilities of the signals and the critical functions into account to ensure a safe status during and after errors. Examples are: Emergency stop, final position limitation, power failure and restart.
- The assessment of error possibilities must also include unexpected delays and the failure of signals or functions.
- Suitable redundant control paths must be in place for dangerous functions.
- Check that measures taken are effective.

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



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

14.2.1 Overview of all connections

The following diagram displays an overview of all connections:

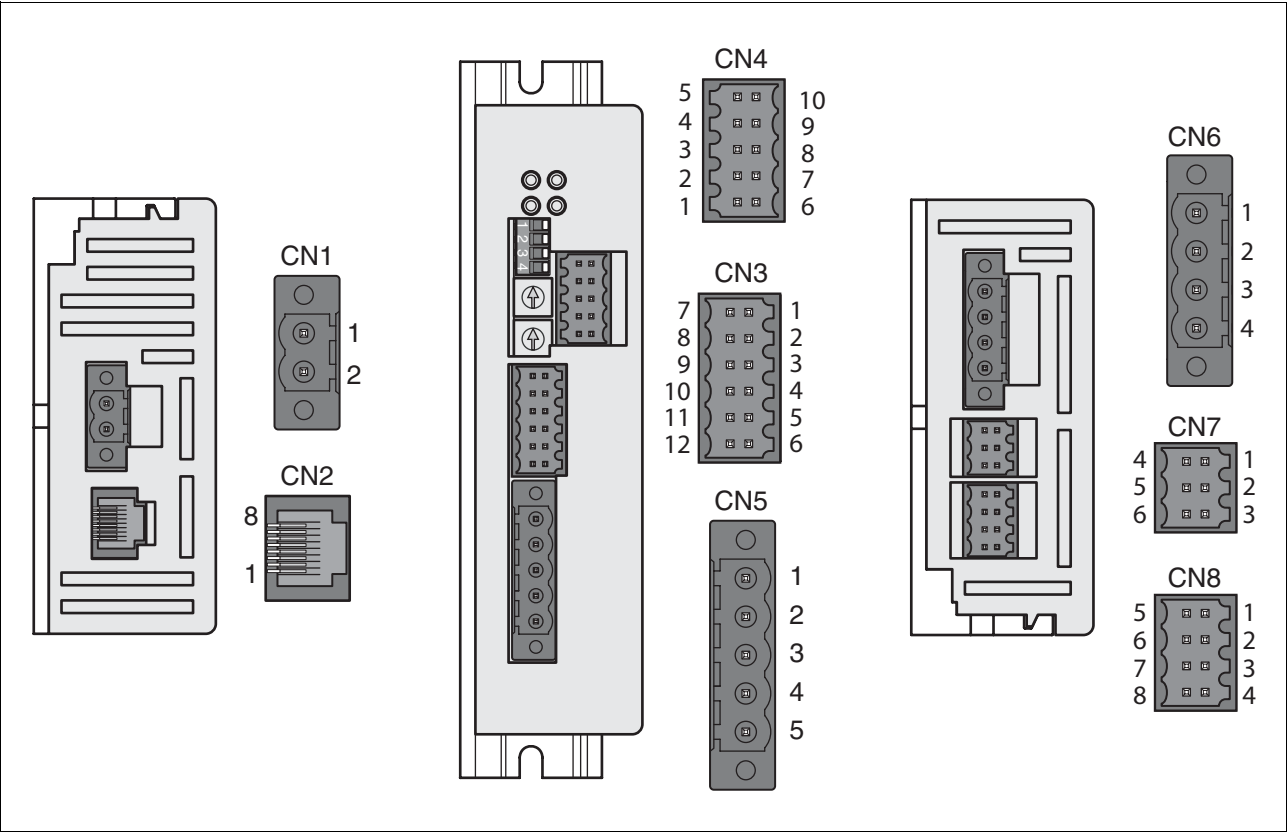


Figure 14.1 Overview of signal connections

Terminal	Configuration
CN1	Power supply
CN2	Commissioning interface
CN3	I/O signal interface
CN4	Expanded I/O signal interface (optional)
CN5	Fieldbus interface
CN6	Motor connection
CN7	Hall sensor interface
CN8	Motor encoder

Terminal	Pin	Signal	Meaning	I/O
CN1	1	VDC	Power supply ¹⁾	-
CN1	2	0VDC	Reference potential to VDC	-
CN2	4	MOD_D1	Bidirectional transmit/receive signal	RS485 level
CN2	5	MOD_D0	Bidirectional transmit/receive signal, inverted	RS485 level
CN2	7	MOD+10V_OUT	12 V power supply, max. 200 mA	O
CN2	8	MOD_0V	Reference potential to MOD+10V_OUT	O
CN3	1	ANA1-	Reference potential to ANA1+	I
CN3	2	LO2_OUT	Digital output 2	O
CN3	3	LI2	Digital input 2	I
CN3	4	LI4	Digital input 4	I
CN3	5	STO_B	Safety function STO	I
CN3	6	+24VDC ²⁾	24 V _{DC} supply voltage for the signal outputs	I
CN3	7	ANA1+	Analog input 1	I
CN3	8	LO1_OUT	Digital output 1	O
CN3	9	LI1	Digital input 1	I
CN3	10	LI3	Digital input 3	I
CN3	11	STO_A	Safety function STO	I
CN3	12	0VDC	Reference potential to +24VDC	I
CN4	1	XLO2_OUT	Digital output XLO2_OUT	O
CN4	2	XLI2	Digital input XLI2	I
CN4	3	XLI4	Digital input XLI4	I
CN4	4	XLI6	Digital input XLI6	I
CN4	5	XANA1-	Reference potential to XANA1+	I
CN4	6	XLO1_OUT	Digital output XLO1_OUT	O
CN4	7	XLI1	Digital input XLI1	I
CN4	8	XLI3	Digital input XLI3	I
CN4	9	XLI5	Digital input XLI5	I
CN4	10	XANA1+	Analog input XANA1	I
CN5	1	Reserved	Reserved	-
CN5	2	CAN_H	Data cable	CAN level
CN5	3	SHLD	Shield connection	-
CN5	4	CAN_L	data wire, inverted	CAN level
CN5	5	CAN_0V	Reference potential CAN	-
CN6	1	U	Motor line U	O
CN6	2	V	Motor line V	O
CN6	3	W	Motor line W	O
CN6	4	SHLD	Shield connection	-
CN7	1	HALL_U	Hall signal	I
CN7	2	HALL_V	Hall signal	I
CN7	3	HALL_W	Hall signal	I
CN7	4	SHLD	Shield connection	-

Terminal	Pin	Signal	Meaning	I/O
CN7	5	HALL_0V	Reference potential to HALL_5VOUT	O
CN7	6	HALL_5VOUT	5V _{DC} supply for hall sensors	O
CN8	1	ENC_A	Encoder signal channel A	I
CN8	2	ENC_B	Encoder signal channel B	I
CN8	3	ENC_I	Encoder signal channel I	I
CN8	4	ENC_5V	Encoder power supply 5V _{DC}	O
CN8	5	$\overline{\text{ENC_A}}$	Channel A, inverted	I
CN8	6	$\overline{\text{ENC_B}}$	Channel B, inverted	I
CN8	7	$\overline{\text{ENC_I}}$	Channel I, inverted	I
CN8	8	ENC_0V	Reference potential to ENC_5V	-

1) IMPORTANT: Please note the special requirements for the power supply parts. See 4.3 "External power supply units". (Energy recovery).

2) IMPORTANT: Do not bridge with supply voltage (recovery). See 4.3.2 "Signal power supply".

14.3 Wiring example

The following figure shows an example of wiring with electrical isolation.

- Fieldbus control mode
- Inputs and outputs with factory settings in the Fieldbus operating mode
- STO safety function with EMERGENCY OFF switch without emergency off module
- Motor with hall sensors and incremental encoder
- Braking Resistor Controller UBC60 (accessory)

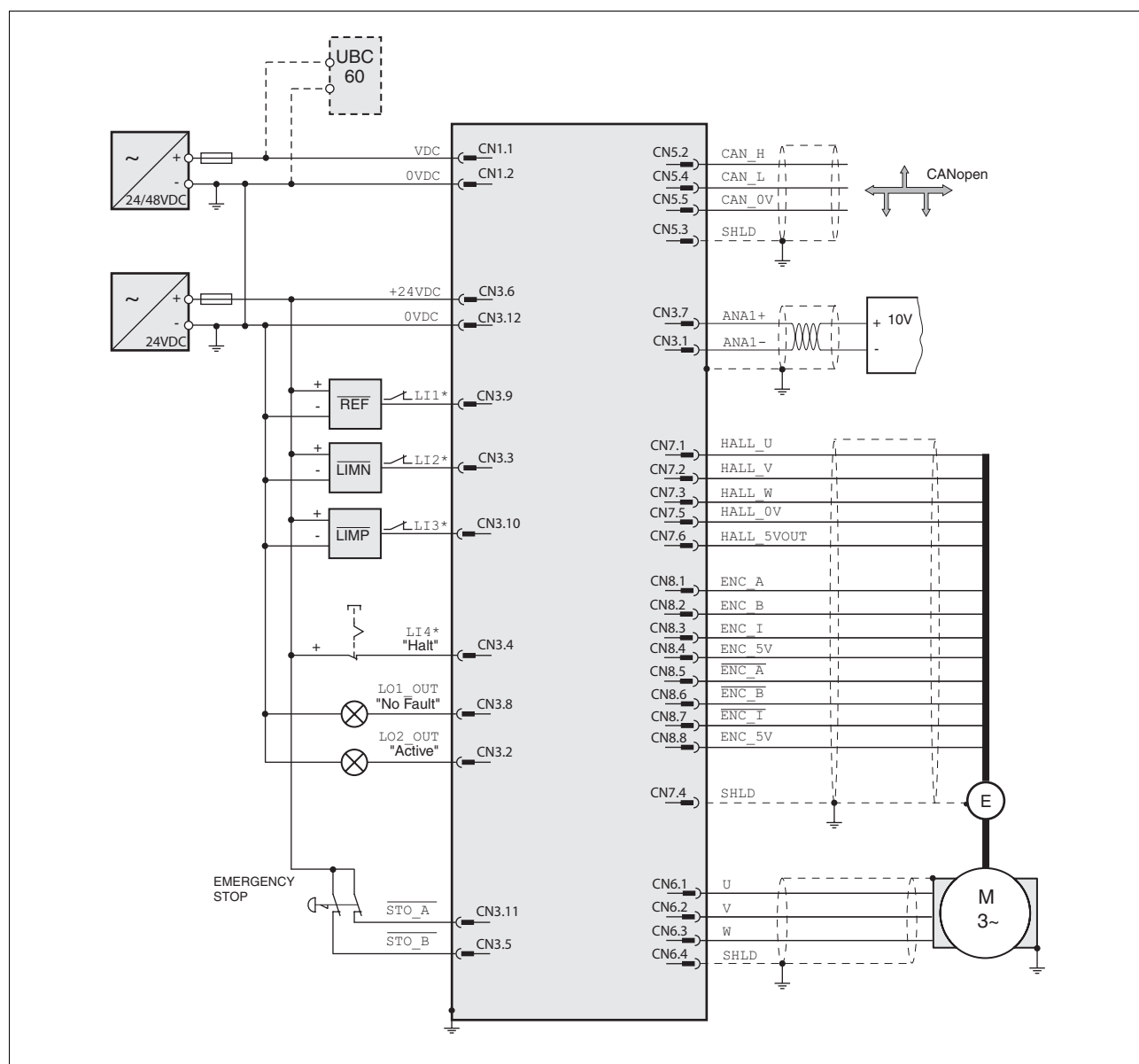


Figure 14.2 Wiring example in fieldbus control mode.

14.4 Compact commissioning

⚠ WARNING

Unexpected movement

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

- If possible, run the first test movement without coupled loads.
- Make sure that a functioning button for EMERGENCY STOP is within reach.
- Also anticipate a movement in the incorrect direction or oscillation of the drive.
- Make sure 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.

14.4.1 Setting the device address and baud rate

- Setting baud rate

The baud rate is set with parameter switch S1.
- ▶ Switch off all power supplies. Make sure that power is no longer connected (safety instructions).
 - ▶ Use parameter switches S1.1 to S1.3 to set the baud rate.

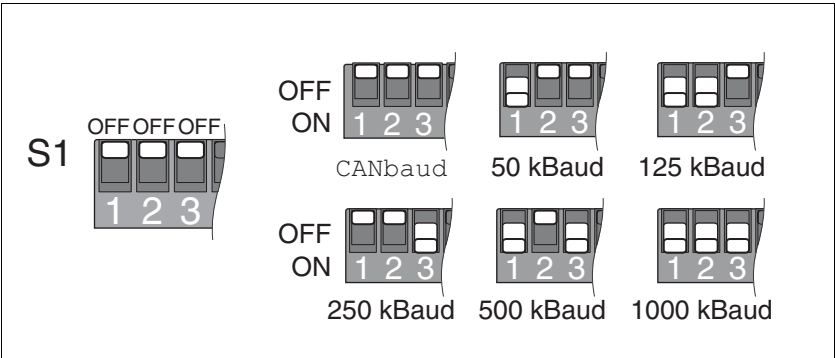


Figure 14.3 Parameter switch S1

With a switch setting of 01 ... 06 the selected switch setting corresponds with the baud rate.

With the switch setting 0, the baud rate will be set through the commissioning software.

Address setting Every device in the network is identified by a unique node address which can be set as desired.

The following diagram shows the factory setting for the device address.

- ▶ Switch off all power supplies. Make sure that power is no longer connected (safety instructions).
- ▶ Use parameter switches S2 and S3 to set the address.

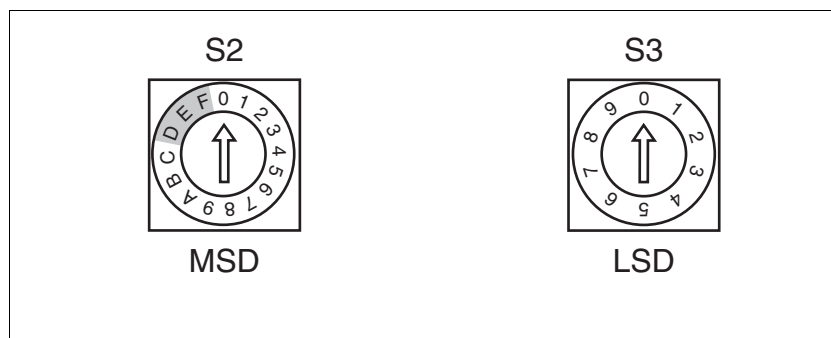


Figure 14.4 Rotary switch assignment

- (S2) MSD (most significant digit)
Determines the 10 position of the node address
- (S3) LSD (least significant digit)
Determines the 1 position of the node address

Example Parameter switch S2 = B
Parameter switch S3 = 8
Results in an address setting of 118.

With a switch setting of 01 ... 127, the selected switch setting corresponds with the address.

With switch setting 0, the address setting is made through the `CANadr` parameter.

Factory setting The factory setting for the device address is 0 in the parameter. Switch setting 0 will read it out. To operate the device, either the switch setting or parameter `CANadr` must be changed. This is designed to prevent that 2 devices in the network have the same device address.

14.4.2 "First Setup"

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

- Preparation*
- A PC with the commissioning software must be connected to the unit unless the commissioning is conducted exclusively through the HMI.
 - ▶ During commissioning disconnect the connection to the fieldbus to avoid conflicts caused by simultaneous access.
 - ▶ Switch on the controller power supply.

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

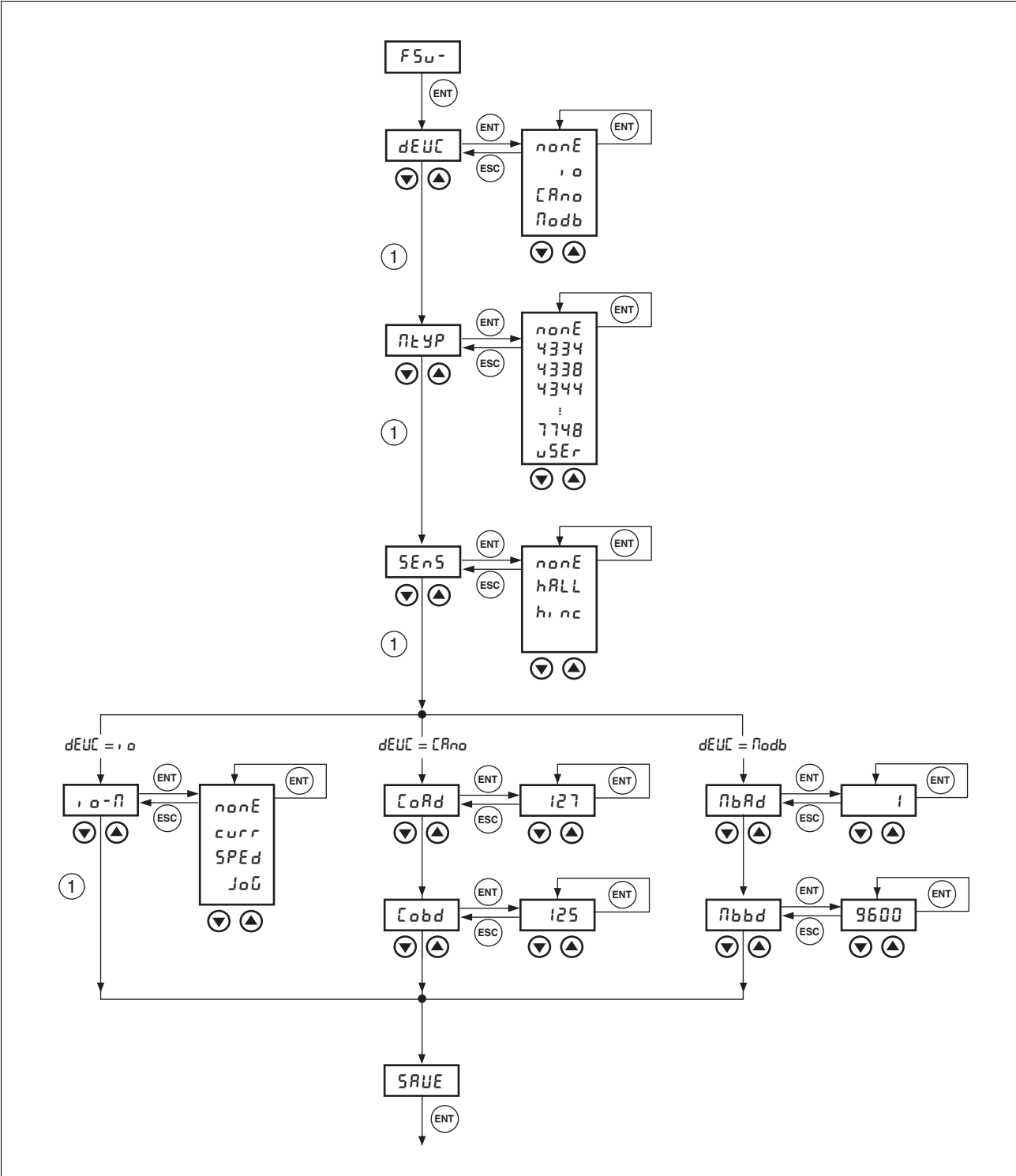


Figure 14.5 "First Setup" via HMI

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

Unit controller ► Specify how the unit will be controlled with the parameter DEVcmdinterf (dEUL).

- Motor type** ► Specify the motor that is connected to the device with the `M_Type` parameter (`P145P`).

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

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

`M_Sensor`, `M_n_max`, `M_n_nom`, `M_I_max`, `M_I_nom`, `M_U_nom`, `M_R_UV`, `M_I2t`, `M_I_0`, `M_Polepair`, `M_SenssLine`, `M_hallshift`, `M_hallpos`, `M_currcomp`, `M_kE_EC` and `M_L_q_EC`.

- Hall sensor / motor encoder** ► Specify whether a motor encoder is connected to the device and what its function will be with the `M_Sensor` parameter (`S5n5`).

If a motor encoder is not connected, select `none`. If `hALL` or `h_nC` is selected, a sensor must be connected for trouble-free operation.

- Start-up operating mode** ■ `DEVcmdinerf = IODevice`
(`dEUL = 10`)

- Use the `IOdefaultMode` parameter (`10-n`) to set the operating mode that is to enable the device every time it is started.

The operating modes are described from section 7.4 "Displaying, starting and changing operating modes".

Baud rate and address using parameter

- `DEVcmdinerf = CANOpenDevice`
Parameter switch `S1 = 0`
Parameter switch `S3` and `S3 = 0`

- Specify the node address with the `CANadr` parameter and the baud rate with the `CANbaud` parameter.



Every device must have its own unique node address, which must be assigned only once in the network.

Fieldbus Modbus

- `DEVcmdinerf = ModbusDevice`
(`dEUL = P0db`)

- Specify the node address with the `MBadr` parameter (`P1bPd`) and the baud rate with the `MBbaud` parameter (`P1bbd`).

*Data back-up***⚠ CAUTION****Damage to the product from failure of the supply voltage**

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

- Never switch off supply voltage during the update.
- Always carry out the update with a reliable supply voltage.

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

- Back up all inputs on completion.
Commissioning software: Save your settings with the menu path "Configuration - Save in EEPROM"

◁ The device will save all settings in the EEPROM.

A restart of the device is required to allow the changes to be accepted.

Further steps

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

Note that you can only return to the "First Setup" by restoring the factory settings, see 7.6.9.2 "Restore factory settings" page 201.

14.4.3 Duplicate existing device settings

- | | |
|----------------------------------|---|
| <i>Application and advantage</i> | <ul style="list-style-type: none">• Multiple devices should have the same settings, e.g. when devices are replaced.• "First setup" does not need to be carried out using the HMI. |
| <i>Requirements</i> | Device type, motor type and device firmware must be identical. The tool is the Windows-based commissioning software. The controller supply voltage must be switched on at the device. |
| <i>Export device settings</i> | <p>The commissioning software installed on a PC can apply the settings of a device as configuration.</p> <ul style="list-style-type: none">▶ Load the configuration of the device into the commissioning software with "Action - Transfer".▶ Highlight the configuration and select "File - Export". |
| <i>Import device settings</i> | <p>A stored configuration can be imported into a device of the same type. Please note that the fieldbus address is also copied with this information.</p> <ul style="list-style-type: none">▶ In the commissioning software select the menu item "File - Import" and load the desired configuration.▶ Highlight the configuration and select "Action - Configure". |

15 Glossary

15.1 Units and conversion tables

The value in the specified unit (left column) is calculated for the desired unit (top row) with the formula (in the field).

Example: conversion of 5 meters [m] to yards [yd]

5 m / 0.9144 = 5.468 yd

15.1.1 Length

	in	ft	yd	m	cm	mm
in	-	/ 12	/ 36	* 0.0254	* 2.54	* 25.4
ft	* 12	-	/ 3	* 0.30479	* 30.479	* 304.79
yd	* 36	* 3	-	* 0.9144	* 91.44	* 914.4
m	/ 0.0254	/ 0.30479	/ 0.9144	-	* 100	* 1000
cm	/ 2.54	/ 30.479	/ 91.44	/ 100	-	* 10
mm	/ 25.4	/ 304.79	/ 914.4	/ 1000	/ 10	-

15.1.2 Mass

	lb	oz	slug	kg	g
lb	-	* 16	* 0.03108095	* 0.4535924	* 453.5924
oz	/ 16	-	* 1.942559*10 ⁻³	* 0.02834952	* 28.34952
slug	/ 0.03108095	/ 1.942559*10 ⁻³	-	* 14.5939	* 14593.9
kg	/ 0.453592370	/ 0.02834952	/ 14.5939	-	* 1000
g	/ 453.592370	/ 28.34952	/ 14593.9	/ 1000	-

15.1.3 Force

	lb	oz	p	dyne	N
lb	-	* 16	* 453.55358	* 444822.2	* 4.448222
oz	/ 16	-	* 28.349524	* 27801	* 0.27801
p	/ 453.55358	/ 28.349524	-	* 980.7	* 9.807*10 ⁻³
dyne	/ 444822.2	/ 27801	/ 980.7	-	/ 100*10 ³
N	/ 4.448222	/ 0.27801	/ 9.807*10 ⁻³	* 100*10 ³	-

15.1.4 Power

	HP	W
HP	-	* 745.72218
W	/ 745.72218	-

15.1.5 Rotation

	1/min (RPM)	rad/s	deg./s
1/min (RPM) -		$\ast \pi / 30$	$\ast 6$
rad/s	$\ast 30 / \pi$	-	$\ast 57.295$
deg./s	/ 6	/ 57.295	-

15.1.6 Torque

	lb-in	lb-ft	oz-in	Nm	kp-m	kp-cm	dyne-cm
lb-in	-	/ 12	$\ast 16$	$\ast 0.112985$	$\ast 0.011521$	$\ast 1.1521$	$\ast 1.129 \ast 10^6$
lb-ft	$\ast 12$	-	$\ast 192$	$\ast 1.355822$	$\ast 0.138255$	$\ast 13.8255$	$\ast 13.558 \ast 10^6$
oz-in	/ 16	/ 192	-	$\ast 7.0616 \ast 10^{-3}$	$\ast 720.07 \ast 10^{-6}$	$\ast 72.007 \ast 10^{-3}$	$\ast 70615.5$
Nm	/ 0.112985	/ 1.355822	/ 7.0616 $\ast 10^{-3}$	-	$\ast 0.101972$	$\ast 10.1972$	$\ast 10 \ast 10^6$
kp-m	/ 0.011521	/ 0.138255	/ 720.07 $\ast 10^{-6}$	/ 0.101972	-	$\ast 100$	$\ast 98.066 \ast 10^6$
kp-cm	/ 1.1521	/ 13.8255	/ 72.007 $\ast 10^{-3}$	/ 10.1972	/ 100	-	$\ast 0.9806 \ast 10^6$
dyne-cm	/ 1.129 $\ast 10^6$	/ 13.558 $\ast 10^6$	/ 70615.5	/ 10 $\ast 10^6$	/ 98.066 $\ast 10^6$	/ 0.9806 $\ast 10^6$	-

15.1.7 Moment of inertia

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

15.1.8 Temperature

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

15.1.9 Conductor cross section

AWG	1	2	3	4	5	6	7	8	9	10	11	12	13
mm ²	42.4	33.6	26.7	21.2	16.8	13.3	10.5	8.4	6.6	5.3	4.2	3.3	2.6

AWG	14	15	16	17	18	19	20	21	22	23	24	25	26
mm ²	2.1	1.7	1.3	1.0	0.82	0.65	0.52	0.41	0.33	0.26	0.20	0.16	0.13

15.2 Terms and Abbreviations

<i>Drive system</i>	The drive system consists of the controller, power amplifier and motor.
<i>User-defined unit</i>	Unit whose reference to motor rotation can be determined by the user via parameters.
<i>CAN</i>	(C ontroller A rea N etwork), standardized open Fieldbus over which the drives and other devices from different manufacturers communicate with one another.
<i>Client</i>	First transmitter then receiver of fieldbus messages in the client-server relationship. The transmission is started with a transmission to the server; the reference point is the server object directory (client: customer)
<i>Default value</i>	Factory setting.
<i>DOM</i>	(D ate of m anufacturing), the nameplate of the device shows the date of manufacture in the format DD.MM.YY, e.g. 31.12.06 (31. December 2006).
<i>Direction of rotation</i>	Rotation of the motor shaft in a positive or negative direction of rotation. A positive direction of rotation is defined as the motor shaft rotating clockwise as the observer faces the end of the protruding shaft.
<i>I/O</i>	Inputs/Outputs
<i>EDS</i>	(E lectronic D ata S heet) electronic data sheet that contains specific features of a product.
<i>EMC</i>	Electromagnetic compatibility.
<i>ESD</i>	(e lectrostatic d ischarge) is the electrostatic discharge and describes the processes and effects during compensation of electrical charges.
<i>Encoder</i>	Sensor for recording the angular position of a rotating element. The encoder is mounted on the motor and signals the angular position of the rotor.
<i>Limit switch</i>	Switch that signals an overrun of the permissible travel range.
<i>Power amplifier</i>	A device that generates current for controlling the motor in accordance with the positioning signals from the controller.
<i>Error class</i>	Classification of operational faults into groups corresponding to the error responses
<i>RCD</i>	Residual current device
<i>Holding brake</i>	brake that only prevents the motor from rotating without power after it has stopped (e.g. a vertical-axis lowering). It must not be used as a service brake for braking motion.
<i>I²t-monitoring</i>	Predictive temperature monitoring. The expected temperature rise of unit components is calculated in advance on the basis of the motor current. If a limit value is exceeded, the drive system reduces the motor current.
<i>Inc</i>	Increment
<i>Index pulse</i>	Encoder signal for referencing the rotor position in the motor. The encoder sends one index pulse per revolution.

<i>Internal units</i>	Resolution of the power amplifier with which the motor is directed to the new setpoint. Internal units are given in increments.
<i>Actual position</i>	Current absolute or relative position of moving components in the drive system.
<i>IT mains</i>	Mains in which all active components are isolated from earth or are earthed by a high impedance. IT: isol�� terre (French), isolated earth. Opposite: earthed networks, see TT/TN network
<i>Consumer</i>	Network device that receives data packets, see also producer
<i>LED</i>	Light-Emitting Diode
<i>Master</i>	Active bus user that controls the data traffic in the network.
<i>NMT</i>	network management (NMT), component of the CANopen communications profile, tasks: initialising network and devices, starting, stopping, monitoring devices
<i>Node Guarding</i>	Monitoring function with slave at an interface for cyclic communication.
<i>NTC</i>	resistance with negative temperature coefficient. Resistance value is reduced as the temperature rises.
<i>Parameter</i>	Device functions and values that can be set and called by the user.
<i>PELV</i>	Protective Extra Low Voltage, functional low voltage with safe isolation.
<i>persistent</i>	Designation of whether the value of the parameter is persistent, i.e. after switching off the device it is retained in the memory. When changing a value via commissioning software or fieldbus, the user must explicitly store the value change in the persistent memory.
<i>Producer</i>	Network device that generates data packets, see also consumer
<i>Power Removal, PWRR</i>	see STO
<i>PTC</i>	resistance with positive temperature coefficient. Resistance value is increased as the temperature rises.
<i>Quick Stop</i>	Quick stop, function used to provide quick braking of the motor via a command or in the event of a fault.
<i>rms</i>	RMS value of a voltage (V_{rms}) or a current (A_{rms}); abbreviation of "Root Mean Square".
<i>RO , RW</i>	Read Only = parameter is read-only Read/Write = parameter is read and write
<i>Protection class</i>	The protection class is a standardized specification for electrical equipment that describes the protection against the ingress of foreign bodies and water (for example, IP20).
<i>Server</i>	First the transmitter, then the receiver of fieldbus messages in the client-server relationship responds to the request of a client; the reference point is the server object directory server
<i>Scaling factor</i>	This factor gives the relationship between an internal unit and the user unit.
<i>Slave</i>	Passive bus device that receives control commands and provides data to the master.
<i>Slave address</i>	Targeted communications between master and slave is only possible with the assignment of unique addresses.

<i>PLC</i>	Programmable Logic Controller
<i>STO</i>	Safety function "Safe Torque Off" STO according to IEC 61508.
<i>TT mains, TN mains</i>	Earthed mains, distinguished by the PE conductor connection. Opposite: unearthed networks, see IT mains
<i>Watchdog</i>	Equipment that monitors cyclic basic functions in the drive system. Power amplifier and outputs are switched off in the event of error.

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