BERGER LAHR

Technical Documentation

Product manual

Intelligent Compact Drive

IcIA IFAN DeviceNet

Document: 0098441113419

Edition: V1.02, 12.2007

Berger Lahr GmbH & Co. KG
Breslauer Str. 7
D-77933 Lahr

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 catalogue 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 promised characteristics.

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.

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1 Introduction

1.1 Unit overview

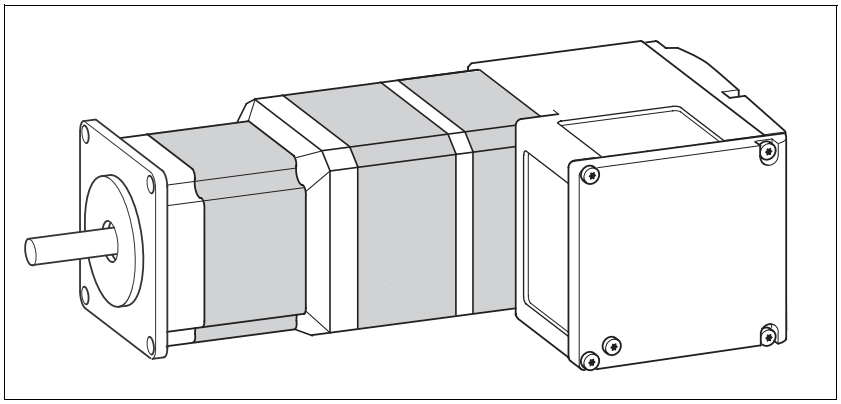

Figure 1.1 Device overview

The intelligent compact drives consist of a servomotor and integrated electronics. Interfaces, controller electronics, holding brake (optional) and the power amplifier are integrated into the drive system.

The "Intelligent Compact Drive" operates the motor in accordance with the defaults for a fieldbus master, such as a PLC or an industrial PC.

Safety function

The integrated safety function "Power Removal" (SIL2) enables a stop of category 0 or 1 as per EN60204-1 without external power contactors. It is not necessary to interrupt the supply voltage. This reduces the system costs and response times.

Drive profile

The product supports two different drive profiles:

- CIP "Position Controller Profile"
- Manufacturer-specific drive profile

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1.2 Components and interfaces

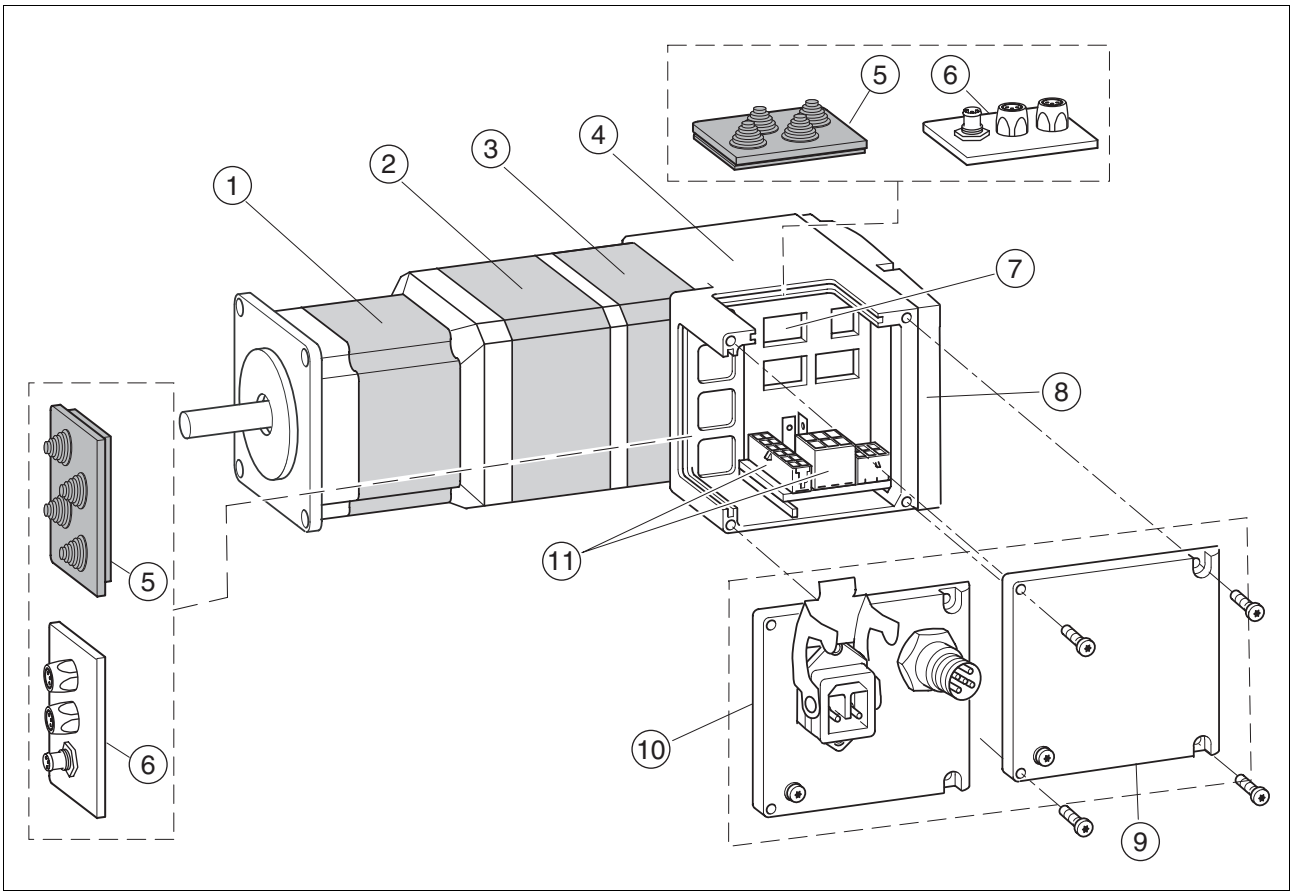

Figure 1.2 Components and interfaces

(1) Synchronous AC-servomotor
(2) Holding brake (optional)
(3) Encoder
(4) Electronics housing
(5) Plug-in unit cable entry (accessory)
(6) I/O plug-in unit with industrial connectors (accessory)
(7) Switches for making settings
(8) Electronics cover, must not be removed
(9) Plug cover, to be removed on installation
(10) Cover with industrial connectors for VDC supply voltage and IN/OUT fieldbus terminal (optional)
(11) Electrical terminals

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1.2.1 Components

Motor The motor is a brushless AC synchronous servomotor with 3-phase technology. The motor reaches a high power density with the use of the latest magnetic materials and an optimised design.

Gearing The motor can be operated with planetary gearing.

The following step-downs are available as standard equipment:

- single-stage step-down 3:1
- single-stage step-down 5:1
- single-stage step-down 8:1

The following sizes are available as standard equipment:

- PLE60 planetary gearing
- PLE80 planetary gearing
- PLS60 planetary gearing

Additional models on enquiry

Electronics The electronic system comprises control electronics and power amplifier. They have a common power supply and are not electrically isolated.

The drive system can be configured and actuated via the fieldbus interface.

Four digital 24V signals are also available. Every one of them can be used as an input or output.

Position sensor The drive system operates with a single turn absolute value encoder as standard equipment.

The single turn absolute value encoder has an internal resolution of 32768 increments per revolution.

Scaling of the drive is set to 16384 user-defined units per revolution.

The drive system can optionally operate with a multiturn absolute value encoder. The multiturn absolute value encoder covers a range of 4096 motor revolutions.

Holding brake The drive can also optionally be fitted with an integrated holding brake. The holding brake is actuated automatically.

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1.2.2 Interfaces

Supply voltage VDC The supply voltage VDC is the power supply to the control electronics and the power amplifier.

Fieldbus interface The drive is fitted with a DeviceNet fieldbus interface. This DeviceNet fieldbus interface is used for controlling and commissioning the drive.

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

You can also use the RS485 interface and the commissioning software to monitor the drive while in operation. It is not possible to establish a simultaneous connection with the fieldbus.

24V signal interface Four digital 24V signals are available. Every one of them can be used as an input or outputs.

The 24V signals are freely accessible to the master controller. However, special functions such as connections to limit switches can also be configured.

See the information in chapter 5.2 "External power supply units". Depending on the device version you will require a separate power supply unit for the sensor power supply.

Note that for drives with an internal 24V signal power supply different industrial connectors must be used from drives with an external 24V signal power supply.

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1.3 Name plate

The nameplate displays the most important data:

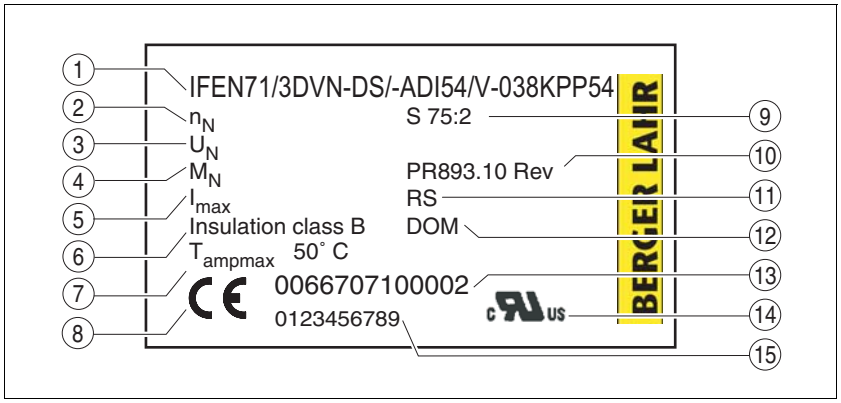

Figure 1.3 Nameplate

(1) Type code
(2) Nominal speed
(3) Nominal voltage
(4) Nominal torque
(5) max. current consumption
(6) Insulation class
(7) max. Ambient temperature
(8) CE mark
(9) Gearing type
(10) Firmware number
(11) Device revision
(12) Date of manufacture
(13) Material number
(14) UL Mark
(15) Serial number:

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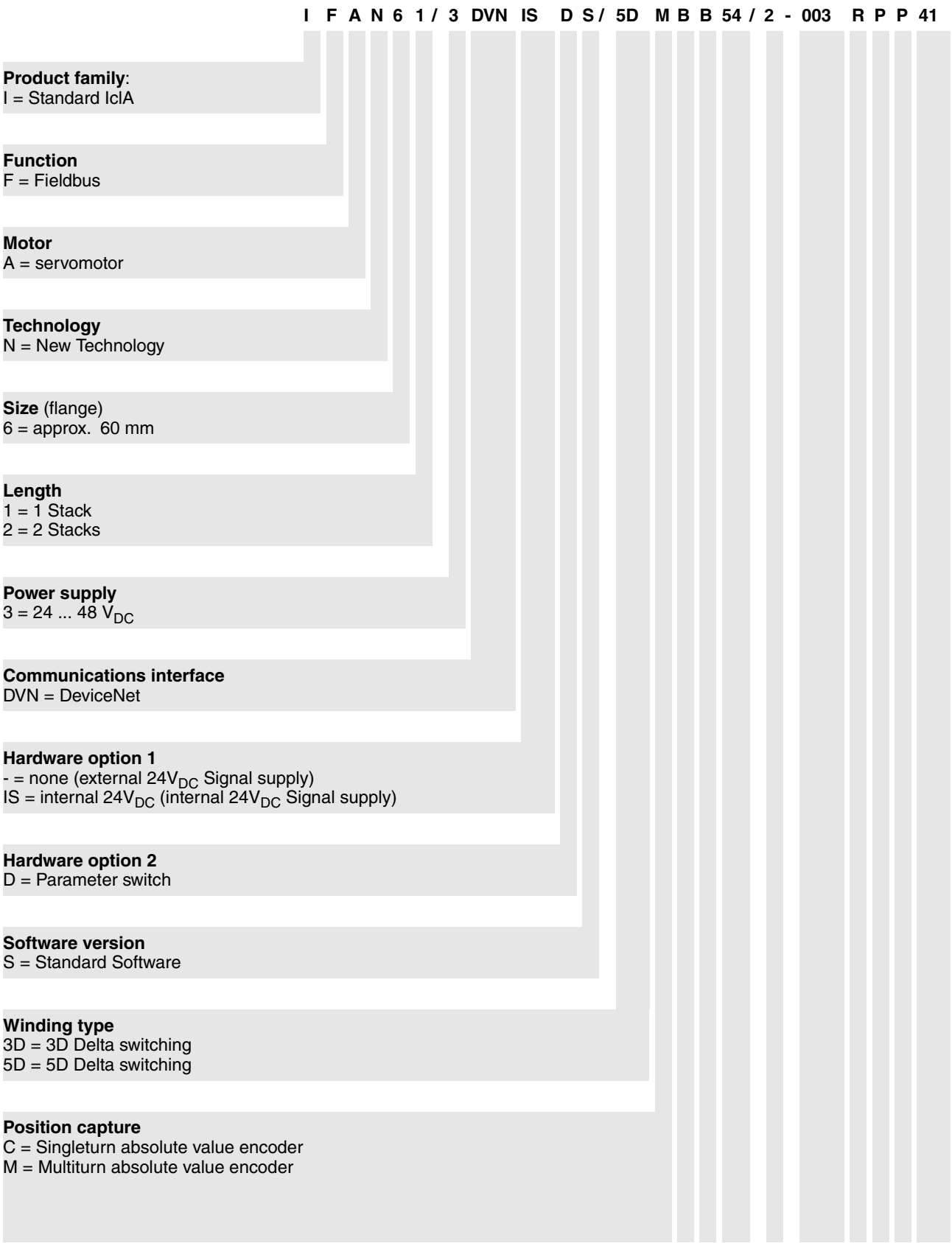
1.4 Type code



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I F A N 6 1 / 3 DVN IS D S / 5D M B B 54 / 2 - 003 R P P 41

Holding brake
- = without holding brake
B = holding brake

Connection type
B = printed circuit board plug connector
I = industrial connectors

Degree of protection except for shaft bushing
54 = IP54

Gearing type
2 = PLE 60
O = without gearing

Gear ratio
003 = 3:1
005 = 5:1
008 = 8:1

Shaft model front
R = round
K = parallel key

Centring collar
P = Standard

Shaft diameter
P = Standard

Shaft bushing degree of protection
41 = IP41

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1.5 Documentation and literature references

Source product manuals

The current product manuals are available for download from the Internet.
http://www.berger-lahr.com/download.

Source EPLAN Macros

For easier engineering, macro files and master article files are available for download from the Internet.
http://www.berger-lahr.com/download

Reference documents

- [1] The CIP Networks Library
  Volume 1
  Common Industrial Protocol
  Edition 3.1
- [2] The CIP Networks Library
  Volume 3
  DeviceNet Adaption of CIP
  Edition 1.3
- [3] DeviceNet terms of Usage Agreement
  ODVA: http://www.odva.org

DeviceNet User Association

Open **D**eviceNet **V**endor **A**ssociation (ODVA)

http://www.odva.org

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

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1.6 Directives and standards

CE mark

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.

EC Machine Directive

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.

The manufacturer must certify that the complete system conforms to the machine directive with the CE mark.

EC EMC Directive

The EC Electromagnetic Compatibility Directives applies to products that cause electromagnetic interference or whose operation may be be adversely affected by electromagnetic interference.

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.

EC Low-Voltage Directive

The EC Low-Voltage Directive lays down safety requirements for "electrical apparatus" as protection against the risks that can originate in such devices and can be created in response to external influences.

Declaration of conformity

The declaration of conformity certifies that the drive system complies with the specific EC directive.

Standards for safe operation

IEC 60204-1: Electrical equipment of machines, General requirements

IEC 60529: IP degrees of protection

IEC 61508: Functional safety of safety - related electric, electronic and programmable electronic systems

IEC 62061: Safety of machines - Functional safety of electrical, electronic and programmable controllers of machines

ISO 13849-1: Safety of machines - safety-related components of controllers, Part 1: General design requirements

Standards for compliance with EMC limit values

IEC 61800-3: Variable-speed electrical drives

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1.7 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.

EC Declaration of Conformity
Year 2007

BERGER LAHR

BERGER LAHR GmbH & Co.KG
Breslauer Str. 7
D-77933 Lahr

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

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

Designation:	Motors with integrated Control Electronics
Type:	IFAN, IFEN, IFSN
Product number:	0x66606xxxxxx, 0x66707xxxxxx, 0x6640xxxxxxx
Applied harmonized standards, especially:	EN 954-1:1997, Category 3 EN ISO 13849-1:2004, Performance Level "d" EN 61800-3:2001, second environment according to Berger Lahr EMC test conditions IEC 62061:2003, SIL 2
Applied national standards and technical specifications, especially:	IEC 61508, Part 1 – 7:2000, SIL 2 capability UL 508C Product documentation
Company stamp:	Berger Lahr GmbH & Co. KG Postfach 11 80 · D-77901 Lahr Breslauer Str. 7 · D-77933 Lahr
Date/ Signature:	13 November 2007
Name/ Department:	Wolfgang Brandstätter/Development

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1.8 TÜV certificate for functional safety

The certificate from the RWTÜV Systems GmbH certifying body for device safety and medical products is currently in the test phase and will be available shortly.

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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 recognise 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.

Changes and 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.

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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.

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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 $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ (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. Some 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.

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⚠ 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.

⚠ CAUTION

Unexpected behaviour and destruction of installation components

When working on the wiring and when inserting and removing plug connectors unexpected behaviour and destruction of installation components can be caused.

- Switch the power supply off before working on the wiring.

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 chapter5.4 "Safety function "Power Removal"" on page 63.

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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
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^2t Limit	Power limitation in event of overloading	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
Motor overload	Monitoring for excessively high current in the motor phases	Functional safety and device protection
Overtemperature	Monitoring device for overtemperature	Device protection

For the description of the monitoring function see 8.6.1 "Monitoring functions" from page 157.

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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 Testing agencies and certificates

This product or functions of this product have been certified by the following independent certifying bodies:

Testing agency	Assigned number	Validity
ODVA File Number	10547	
UL	File E153659	

3.2 Environmental conditions

When considering the ambient temperature a distinction is made between the permissible temperatures during operation and the permissible storage and transport temperature.

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.

Ambient temperature [1]	[°C]	0 ... 50
Ambient temperature with current reduction of 2% per Kelvin [1]	[°C]	50 ... 65

1) Limit values with flanged motor (e.g. steel plate 300x300x10 mm)

Ambient temperature for transport and storage

The environmental conditions must be dry and free of dust during transport and storage. The maximum oscillation and shock stress must be within the specified limits. The storage and transport temperature must remain within the specified range.

Temperature	[°C]	-25 ... +70

Temperature

max. Max. temperature of power amplifier [1]	[°C]	105
max. Temperature of motor [2]	[°C]	110

1) can be read out via parameters
2) measured on the surface

Pollution degree

Pollution degree	2

Relative humidity

The following relative humidity is permissible during operation:

Relative humidity	[%]	15 ... 85

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Installation height

Installation height without power reduction	[m]	< 1000 m above sea level

Oscillations and shocks

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

Wiring

Use UL-compliant wiring that is resistant to at least 60°C or 75°C.

EMC

Emission	IEC/EN 61800-3: Class C2 EN 61000-6-4 EN 55022: class A
Noise immunity	IEC/EN 61800-3: Second environment

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3.3 Mechanical data

3.3.1 Degree of protection

IP degree of protection

Degree of protection as per DIN EN 60529.

Degree of protection without gearing	IP41
Degree of protection with gearing	IP54

Overview of IP protection

First digit Protection against foreign bodies	Second digit Protection against water
0 no protection	0 no protection
1 foreign body > 50mm	1 vertically falling drops
2 foreign body > 12mm	2 diagonally falling drops (75° ... 90°)
3 foreign body > 2.5mm	3 spray water
4 foreign body > 1mm	4 splashing water
5 dust-protected	5 jet water
6 dust-proof	6 heavy sea
	7 immersion
	8 continuous immersion

Degree of protection when using "Power Removal"

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

3.3.2 Mounting position

Mounting position

The following mounting positions are defined and approved under EN 60034-7:

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

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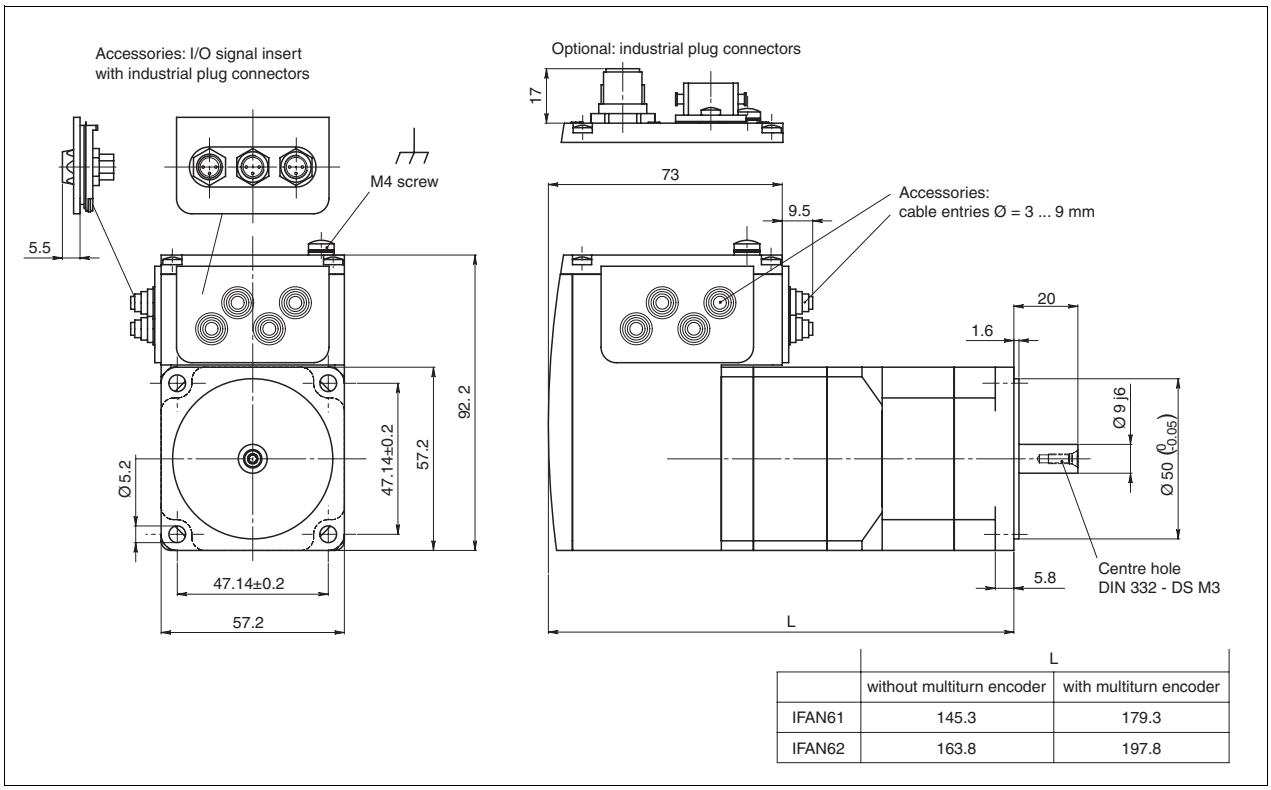
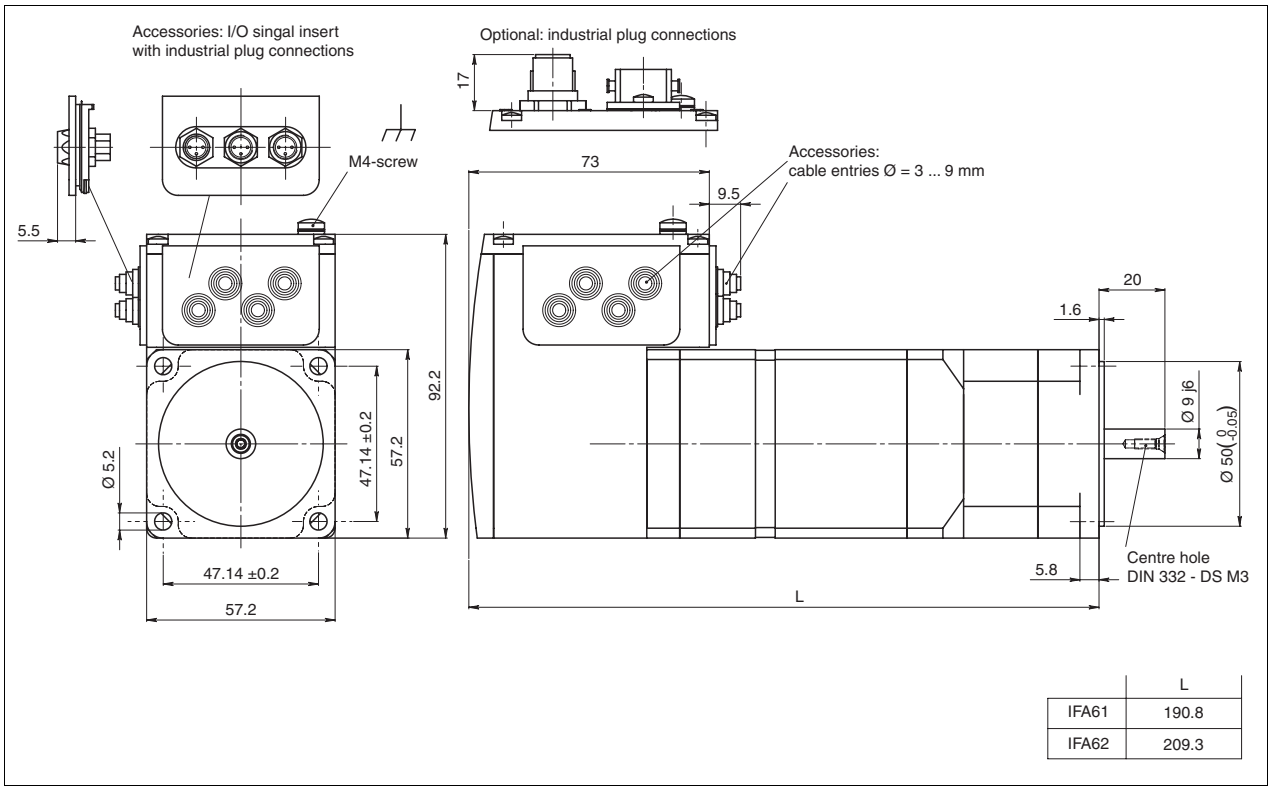
3.3.3 Dimensions



	L	
	without multiturn encoder	with multiturn encoder
IFAN61	145.3	179.3
IFAN62	163.8	197.8

Figure 3.1 IFAN without holding brake



	L
IFA61	190.8
IFA62	209.3

Figure 3.2 IFAN with holding brake

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3.4 Electrical Data

Overview of printed circuit board plug connectors

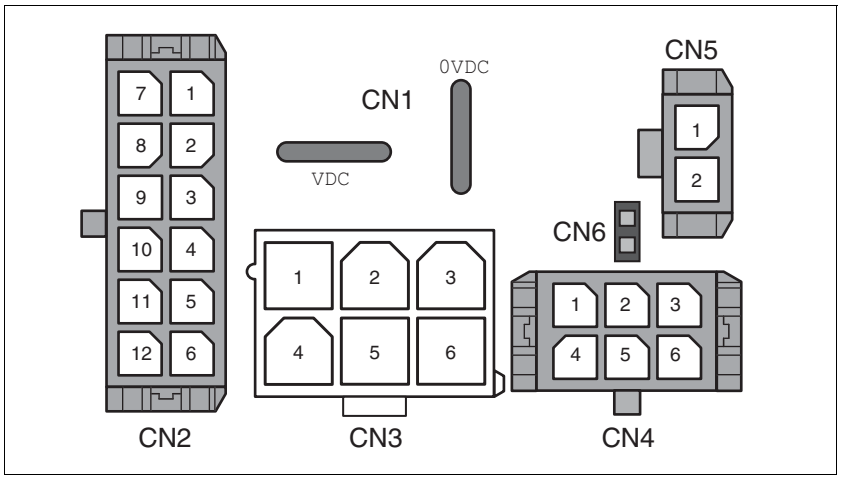

Figure 3.3 Overview of printed circuit board plug connectors

3.4.1 Supply voltage VDC to CN1

		IFAN61	IFAN62
Nominal voltage	[V_{DC}]	24 / 48	24 / 48
Limit values	[V_{DC}]	18 ... 55.2	18 ... 55.2
Ripple at nominal voltage	[V_{pp}]	≤ 3.6	≤ 3.6
max. Continuous power consumption [1)]	[A]		
Winding type 5D		5	7
Winding type 3D		7.5	7.5
Peak current consumption	[A]		
Winding type 5D		7	8.5
Winding type 3D		11	9
Fuses external [2)]	[A]	≤16	≤16

1) As not all the maximum possible torque is required for operating a system, the actual power requirement is distinctly lower..
2) see chapter 5.2.1 "Supply voltage"

Inrush current Charging current of capacitor C=1500 µF

3.4.2 Fieldbus on CN2

DeviceNet signals The DeviceNet signals conform to the DeviceNet standard and are electrically isolated.

Transmission rate	[kbaud]	125 / 250 / 500
Transmission protocol		DeviceNet

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3.4.3 Preset reference value to CN2

Pulse/direction, A/B/I input signals

The pulse/direction and A/B/I signals conform to the RS422 interface specifications

Symmetrical		In accordance with RS422
Input resistance	[kΩ]	5
Input frequency, pulse/direction	[kHz]	≤400
Input frequency, A/B	[kHz]	≤400

3.4.4 CN3 commissioning

RS485 signals

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

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

3.4.5 24V signals to CN4

Signal inputs

The signal inputs are electrically connected to 0VDC and a not reverse polarity protected.

Logical 0 (V_{low})	[V]	-3 ... +4.5
Logical 1 (V_{high})	[V]	+15 ...+30
Input current (typically at 24V)	[mA]	2
Debounce time LI01 ... LI04	[ms]	1.25 ... 1.5
Debounce time LI01 and LI02 [1)]	[ms]	0.01
Jitter LI01 and LI02 [1)]	[µs]	< 2

1) when using the function "Fast Position Capture"

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

Drives with external 24V signal power supply

Voltage range	[V]	10 ... 30 [1]
max. Switching current per output	[mA]	100
Inductively chargeable	[mH]	1000
voltage drop at 50 mA load	[V]	≤1

1) Height corresponding to the applied 24V signal power supply

Drives with internal 24V signal power supply

Nominal voltage	[V]	24
Voltage range	[V]	23 ... 25
max. Current per output [1]	[mA]	100
Inductively chargeable	[mH]	1000
voltage drop at 50 mA load	[V]	≤1

1) The max. current at all outputs depends on the max. current of the internal 24V-signal power supply.

Internal 24V signal power supply The internal 24V signal power supply is electrically connected to 0VDC and is short-circuit protected.

Voltage range	[V]	23 ... 25
max. Current	[mA]	200
Inductively chargeable	[mH]	1000

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3.4.6 Safety function "Power Removal" at CN5 and CN6

The signal inputs are electrically connected with 0VDC.

Logical 0 (V_{low})	[V]	-3 ... +4.5
Logical 1 (V_{high})	[V]	+15 ...+30
Input current (typically at 24V)	[mA]	10
Input current $\overline{\text{PWRR\_A}}$ (typically at 24V)	[mA]	≤10
Input current $\overline{\text{PWRR\_B}}$ (typically at 24V)	[mA]	≤3
Debounce time	[ms]	1 ... 5
max. Skew until detection of signal differences of $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ 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 be simultaneous for both inputs (skew <1s)

Data for maintenance schedule and safety calculations

IMPORTANT: The following technical data is provisional.

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

Service life corresponding to safety life cycle (IEC 61508)		20 years
SFF (Safe Failure Fraction) (IEC61508)	[%]	66
HFT (Hardware Fail Tolerance) (IEC61508) Type A subsystem		1
Safety integrity level (IEC61508 and IEC62061)		SIL2
Performance level (ISO 13849-1)		d (Category 3)

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4 Basics

4.1 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

IEC61508 standard

The IEC61508 standard "Functional safety of electrical/electronic/programmable electronic safety-related systems" covers the relevant safety-relevant 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 in this base.

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	$\geq 10^{-9}$ ... $<10^{-8}$
3	$\geq 10^{-8}$ ... $<10^{-7}$
2	$\geq 10^{-7}$ ... $<10^{-6}$
1	$\geq 10^{-6}$ ... $<10^{-5}$

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HFT and SFF

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 IEC61508 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.

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4.2 DeviceNet fieldbus

4.2.1 DeviceNet technology

The ODVA (**O**pen **D**eviceNet **V**endor **A**ssociation) administers the specifications for the DeviceNet network and DeviceNet terminal devices. For more information on the ODVA see: http://www.odva.org

Number of nodes Up to 64 nodes can be distinguished in a DeviceNet network (0 - 63).

Cable length The maximum cable length in the individual network segments depends on the baud rate and the wire diameter.

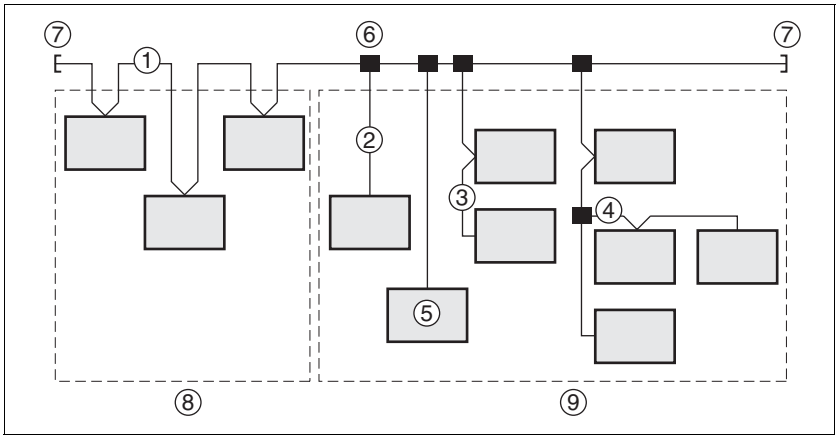

Figure 4.1 A possible DeviceNet structure

(1) Trunk Line
(2) Drop Line, 0 - 6 m
(3) Daisy Chain Drop-Off
(4) Branched Drop-Off
(5) Network Node
(6) Trunk Line Tap Junction
(7) Terminating Resistor
(8) Zero Drop
(9) Short Drops

Cable type	125 kbit/s	250 kbit/s	500 kbit/s
Total length of thick trunk line	500m	250 m	100m
Total length of thin trunk line	100m	100m	100m
Total length of flat trunk line	420 m	200m	75 m
max. length of a drop line	6 m	6 m	6 m
max. length of all drop lines	156 m	78 m	39 m

The "thick trunk" cable comprises two shielded, twisted cables containing a wire in the centre of the cable. The shielding is on the exterior. The cable is not branched.

The "thin trunk" cable has a more flexible design and is easier to lay. The cable is used as a drop line and can also be used as a trunk line for short distances.

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Drive profile

The product supports two different drive profiles:

- CIP "Position Controller Profile"
- Manufacturer-specific drive profile

The chapter 8 "Operation" describes the manufacturer-specific drive profile. Information on the "Position Controller Profile" drive profile is provided exclusively in Chapter 8.7 "Drive profile Position Controller Profile".

Characteristics

The product supports the following communications equipment from the DeviceNet specification:

- CIP "Position Controller" Profile (Device Type = 10_h)
- Group 2 Server
- UCCM-capable device
- Predefined master/Slave connections
  - Explicit Message
  - Polled I/O Connection
  - Full support for "fragmentation protocol"
  - Dynamic setup of two explicit messages and an I/O message
- Heartbeat message
- Shutdown message

Data Link Layer

The DeviceNet data link layer uses the transmission mechanism of the CAN specification. This makes it possible to implement a wide selection of available CAN controllers.

Physical Layer

The DeviceNet physical layer uses two twisted wire pairs. The data are transmitted over one wire pair. The second wire pair is connected to the supply voltage. This means that terminal devices with their own power supply and terminal devices that are powered by DeviceNet (e.g. I/O nodes) can be connected. The DeviceNet must be terminated at both ends by a 120Ω resistor.

Another feature of DeviceNet is that devices can be connected or disconnected during operation. It is not necessary to shut down the bus.

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Object model

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

Object class	Class ID	Instance ID
Identity Object	1	1
Message Router Object	2	1
DeviceNet Object	3	1
Assembly Object	4	101 Standard Output Assembly 111 Standard Input Assembly 102 Extended Output Assembly 112 Extended Input Assembly
Connection Object	5	1 = Explicit Message 2 = Poll Connection 5+6 = dyn. Explicit Connection 7 = dyn. I/O connection
Position Controller Supervisor Object	36	1
Position Controller Object	37	1
Acknowledge Handler Object	43	1
Manufacturer-specific objects	101 ... 199	1

The manufacturer-specific class IDs 101 to 199 correspond to the object directory (class ID = object group + 100). The attributes of a class correspond to the sub-index entry within the object group.

Communications model

DeviceNet uses the producer-consumer (producer-consumer) communications model. All nodes check the bus lines to check whether a data packet with their supported identifier is pending. Data packets that are sent by producers can only be received by the consumers for these packages.

Master-slave, multi-master and peer-to-peer topologies can be implemented in the DeviceNet.

Groups of connections

DeviceNet is a connection-oriented network. Connections must be established and administered between two nodes. The connection ID is in the 11-bit-long CAN identifier. A distinction is made among four differently prioritised connections:

Group 1	high-priority process data (highest priority)
Group 2	for single master-slave connections
Group 3	for explicit messages
Group 4	reserved group (lowest priority)

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Device profile

Device profiles are definitions for various types of nodes. The device profile of a node is described in Electronic Data Sheets (EDS). Predefined device profiles exist for:

- digital I/O nodes
- analogue I/O nodes
- Generic profile, adjustable and suitable for all DeviceNet slaves
- position profiles
- motor controllers

Electronic Data Sheet

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

4.2.2 Message types

DeviceNet defines multiple access methods for communications. The product described here uses the "Explicit Message" and "I/O Message" access methods.

Explicit Message

An access is a write or read access on a single parameter. Using an "Explicit Message" is only described as an example for some parameters. This is because this type of communication can be used consistently for all available parameters.

I/O Message

The "I/O Message" is used for positioning mode since it allows information to be transferred in a much more compact form. "I/O Messages"contain time-critical data that are compiled especially for an application case. "I/O Messages"have a high priority identifier and are therefore prioritised over the bus when transmitted. The parameters for configuring the DeviceNet communications are described in 7 "Commissioning". The practical application of the supported protocols is described in more detail in 9 "Examples".

Command processing: Transmitted data and received data

The master sends a command to the drive system (slave) to execute a travel command, enable operating functions or request information from the slaves. The slave executes the command and acknowledges it with a result message or an error message.

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

The master must then continuously monitor the conclusion of the process command by evaluating the slave's received data.

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4.2.3 Data structure

The data frame with transmission and received data and all byte, word and double-word values are output in hexadecimal form. Hexadecimal characters are indicated with an "h" after the numerical value, e.g. "31_h", decimal characters have no special identification. Note the different counting format of bit (0...7, right to left) and byte (0-xx, left to right).

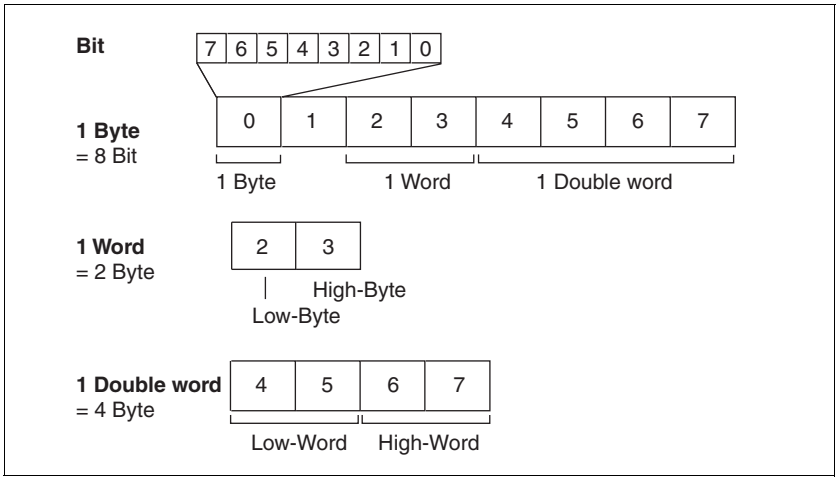

Figure 4.2 general data structure from the bit to the double word

The figure shows the bus view.

In the big-endian format the bytes are transmitted in sequence from 0 to 7.
In the little-endian format low-byte / high-byte and low-word / high-word are transmitted reversed.

Byte sequence

In the byte sequence a distinction is made between little-endian / Intel format and big-endian / Motorola format.

Unless explicitly specified otherwise, this manual describes the big-endian format from the view of the DeviceNet scanner.

The byte sequence is input in big-endian format (Motorola format) during input into the DeviceNet scanner, but is transmitted on the bus in little-endian format (Intel format). The display is therefore different on the DeviceNet scanner and on the fieldbus monitor!

The data are transmitted left-aligned on the bus in little-endian format, i.e. numerical values over one byte are transmitted with the lowest value byte first.

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4.2.4 Communication via "Explicit Message"

Only a single parameter (DeviceNet-specific or manufacturer-specific) is ever read or written using an explicit message. For an overview of all parameters, see Chapter 11 "Parameters".

Communication via explicit messages is described in this section only once as a write request and once as a read request. This type of communication is identical for all parameters.

4.2.4.1 Read parameter

Task

The master (MAC ID 2) should read the `n_act` parameter of the slave (MAC ID 10).

- Class.instance.attribute = 130.1.8 = 82_h.01_h.08_h

Transmitted data

Data 0	Data 1	Data 2	Data 3	Data 4
$0A_h$	$0E_h$	82_h	01_h	08_h

Data 0: $0A_h$ = Frag = 0, XID = 0, Destination MAC ID 0A
Data 1: $0E_h$ = Service Code = Get_Attribute_Single Request
Data 2: 82_h = Class 130
Data 3: 01_h = Instance 1
Data 4: 08_h = attribute 8

Received data

Data 0	Data 1	Data 2	Data 3
02_h	$8E_h$	02_h	58_h

Data 0: 02_h = Frag = 0, XID = 0, Destination MAC ID 2
Data 1: $8E_h$ = Get_Attribute_Single successful Response
Data 2+3: 0258_h = 600

4.2.4.2 Write parameter

Task

The master (MAC ID 2) should set the `RAMPsym` parameter of the slave (MAC ID 10) to the value 1000.

- Class.instance.attribute = 106.1.1 = $6A_h$.01_h.01_h
- Value = 1000 = $03E8_h$

Transmitted data

Data 0	Data 1	Data 2	Data 3	Data 4	Data 5	Data 6
$0A_h$	10_h	$6A_h$	01_h	01_h	03_h	$E8_h$

Data 0: $0A_h$ = Frag = 0, XID = 0, Source MAC ID 10
Data 1: 10_h = Service Code = Set_Attribute_Single
Data 2: $6A_h$ = Class 106
Data 3: 01_h = Instance 1
Data 4: 01_h = Attribute 1
Data 5+6: $03E8_h$ = value 1000

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Received data

Data 0	Data 1
02_h	90_h

Data 0: 02_h = Frag = 0, XID = 0, Destination MAC ID = 02
Data 1: 90_h = Set_Attribute_Single successful response

4.2.4.3 Synchronous errors

If a write or read command fails, the drive system responds with an error framework (Error Response). The transmitted error number shows information on the exact cause.

Task

The master (MAC ID 2) should set the `n_act` parameter of the slave (MAC ID 10) to any value required.

- Class.instance.attribute = 130.1.8 = $82_h.01_h.08_h$
- Value = any

Transmitted data

Data 0	Data 1	Data 2	Data 3	Data 4	Data 5	Data 6
$0A_h$	10_h	82_h	01_h	08_h	xx_h	xx_h

Data 0: $0A_h$ = Frag = 0, XID = 0, Source MAC ID 10
Data 1: 10_h = Service Code = Set_Attribute_Single
Data 2: 82_h = Class 130
Data 3: 01_h = Instance 1
Data 4: 08_h = attribute 8
Data 5+6: All positions

Received data

Data 0	Data 1	Data 2	Data 3
02_h	94_h	$0E_h$	FF_h

Data 0: 02_h = Frag = 0, XID = 0, Destination MAC D 2
Data 1: 94_h = Set_Attribute_Single Error Response
Data 2: $0E_h$ = Error Code
Data 3: FF_h = Additional Code (object specific)
Data 2+3: $0EFF_h$ = Attribute not settable

The synchronous error messages in data byte 2 are listed in Chapter 10 "Diagnostics and troubleshooting".

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4.2.5 Communication via "I/O Message"

An "I/O Message" is used for real-time exchange of process data. This type of connection is ideal for positioning mode. The transmission can be executed very fast, because it is sent without additional administration data and does not require a response from the recipient.

Using an "I/O Message", the master can control the operating statuses of the slave, e.g. enable and disable the power amplifier, trigger a "Quick Stop", reset faults and enable operating modes.

Changing the operating statuses and activating the operating modes must be executed separately. An operating mode can generally only be activated if the operating status is already "Operation enable".
A new operating mode is generally only imported with the motor at standstill.

Output - Input

Output and input represent the data direction from the master's perspective.

- Output: Commands from the master to the slave
- Input: Status messages from the slave to the master

Assembly

I/O messages contain a summary (assembly) of different parameters that are transferred with a single message.

The following assemblies are permanently defined:

- Standard Assemblies
  - Output Assembly 101
  - Input Assembly 111
- Extended Assemblies
  - Output Assembly 102
  - Input Assembly 112

Polled I/O Connection

The assemblies are used in a polled I/O connection. A polled I/O connection is initiated by the master with a poll command. The Slave responds with a poll response.

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

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4.2.5.1 Output Assemblies

Standard Output Assembly

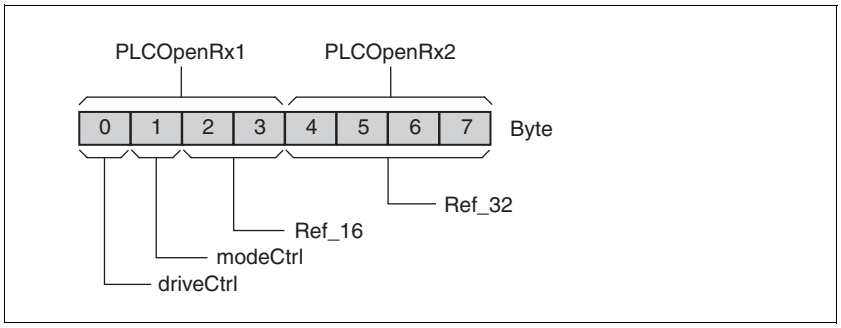

Figure 4.3 Output Assembly 101

Extended Output Assembly

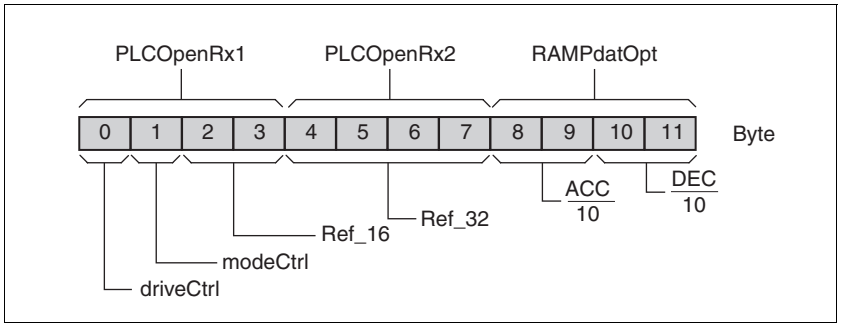

Figure 4.4 Output Assembly 102

driveCtrl The operating status is set using the "driveCtrl" byte.

For a detailed description of the bits, see Chapters 8.3.3 "Changing operating statuses".

modeCtrl The operating mode is set using the "modeCtrl" byte.

For a detailed description of the bits, see Chapter 8.4.2 "Starting and changing operating mode".

Ref_16 The reference value for speed is set using the "Ref_16" word. The reference value depends on the particular operating mode. See the section on the particular operating mode for a description.

Ref_32 The double word "Ref_32" is used to set the reference value for the target position. The reference value depends on the particular operating mode. See the section on the particular operating mode for a description.

ACC/DEC The double word "ACC/DEC" is used to set motor-optimised acceleration and deceleration. The value corresponds to the parameter `RAMPaccdec`.

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4.2.5.2 Input Assemblies

Standard Input Assembly

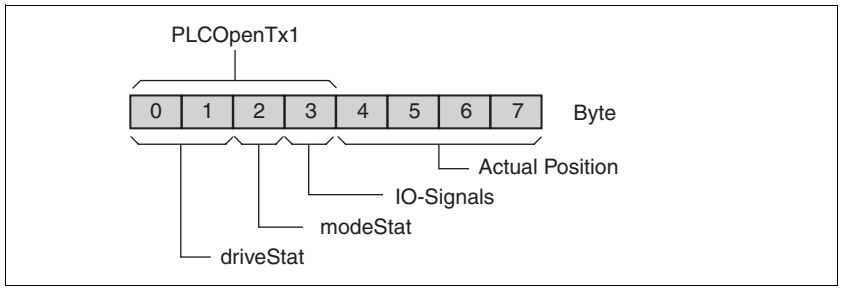

Figure 4.5 Input Assembly 111

Extended Input Assembly

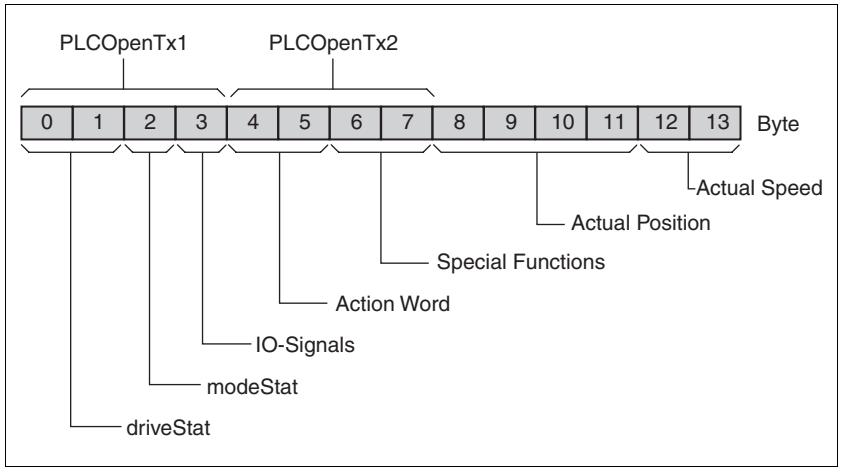

Figure 4.6 Input Assembly 112

driveStat The current operating status is displayed using the "driveStat" word.

For a detailed description of the bits, see Chapters 8.3.2 "Displaying the operating statuses".

modeStat The current operating mode is displayed using the "modeStat" byte.

For a detailed description of the bits, see Chapter 8.4.1 "Displaying and monitoring the operating mode".

I/O signals The "I/O signals" byte is used to display the status of the digital signal inputs or signal outputs.

Bit	Pin	Signal	Factory setting
0	CN4.3	LIO1	Positive limit switch (LIMP)
1	CN4.6	LIO2	Negative limit switch (LIMN)
2	CN4.2	LIO3	No function / free available
3	CN4.5	LIO4	Reference switch (REF)
4	CN5.1	$\overline{\text{PWRR\_A}}$	Safety function "Power Removal" 1)
5	CN5.2	$\overline{\text{PWRR\_B}}$	"Power Removal"safety function 1)
6	-	-	not connected
7	-	-	not connected

1) not adjustable

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Action Word

The "Action Word" is used to display information on the motor and profile generator.

Bit	Description
0 ... 4	Error class
5	reserved
6	MOTZ: Motor standstill, actual speed = 0
7	MOTP: Motor turns positively
8	MOTN: Motor turns negatively
9 ... 10	reserved
11	TAR0: profile generator at standstill, setpoint speed = 0
12	DEC: profile generator decelerated
13	ACC: profile generator accelerated
14	CONST: profile generator moves in constant mode
15	reserved

Special Functions

The "Special Functions" word is used to display the event counter of the "Fast Position Capture" function.

For a description of the function see Chapter 8.6.6 "Fast position capture".

Bit	Description
0 ... 1	Bit 0 and 1 of parameter `Cap1Count`
2 ... 3	Bit 0 and 1 of parameter `Cap2Count`
4 ... 15	reserved

Actual position

The current motor position is displayed using the double word "Actual Position". The value corresponds to the parameter `_p_actusr`.

Actual speed

The current (actual) speed is displayed using the word "Actual Speed". The value corresponds to the parameter `_n_act`.

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4.2.6 Handshake with Mode Toggle Bit

Mode Toggle

Synchronised processing can be carried out with the transmit data in byte "modeCtrl" bit "Mode Toggle" and the received data in byte "modeStat" bit "Mode Error" and bit "Mode Toggle". Synchronised processing means that the master waits for feedback messages from the slave and can respond appropriately.

Example 1: Positioning

The master starts positioning. The master checks the feedback from the slave at times t_1, t_2 etc. It waits for the end of positioning. The end is identified by bit "x_end" = 1.

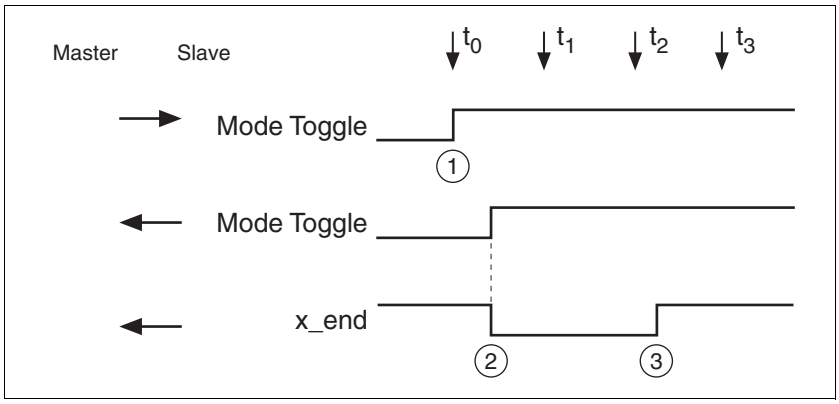

Figure 4.7 Mode Toggle Handshake

(1) Master starts positioning with "Mode Toggle" = 1
(2) Slave reports that positioning is running with "Mode Toggle" = 1 and "x_end" = 0 simultaneously
(3) Slave reports that positioning is ended with "x_end" = 1

Example 2: short movement

The master device starts a positioning movement that will only take a very short time. The duration is shorter than the query cycle of the master. The movement is already complete at time t_1. Using bit "x_end", the master cannot identify whether positioning has already finished or has not yet been started. However, it can identify this with bit "Mode Toggle".

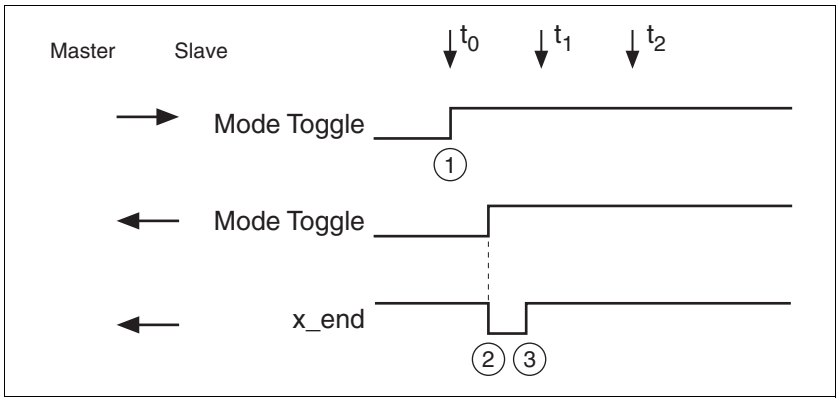

Figure 4.8 Mode Toggle Handshake, short movement

(1) Master starts positioning with "Mode Toggle" = 1
(2) Slave reports that positioning is running with "Mode Toggle" = 1 and "x_end" = 0 simultaneously
(3) Slave reports that positioning is ended with "x_end" = 1

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4.2.7 Communication parameters

This chapter describes the communication parameters supported by the product.

The following DeviceNet classes are supported:

- Identity
- Message Router
- DeviceNet
- Assembly
- DeviceNet Connection
- Acknowledge Handler
- Position Controller Supervisor
- Position Controller
- Manufacturer-specific objects

Acronyms

NV: non-volatile, persistent, not volatile
V: Volatile, non-persistent, volatile
RO: Read Only, only to be read
RW: Read Write

4.2.7.1 Identity object

Class ID 1 (01_h)

The Identity object contains the identification data of the product. The object defines an instance with ID 1.

Class attributes

ID	Access	Name	Data type	Description	Value
1	Get (NV-RO)	Revision	UINT	Revision	1
2	Get (NV-RO)	Max instance	UINT	current largest existing instance number of an object derived from this class	1

Instance attributes

ID	Access	Name	Data type	Description	Value
1	Get (NV-RO)	manufacturer ID [1)]	UINT	unique manufacturer number	348 ($15C_h$)
2	Get (NV-RO)	device families type [2)]	UINT	Unit series	10_h (Position Controller)
3	Get (NV-RO)	Product type	UINT	unique device type	xxxx
4	Get (NV-RO)	Revision MainRevison SubRevision	STRUCT of USINT USINT	Revision of device	xx.xx
5	Get (V-RO)	Status [3)]	WORD	summarised device status	

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ID	Access	Name	Data type	Description	Value
6	Get (NV-RO)	Serial number:	UDINT	Serial number:	
7	Get (NV-RO)	product name [4]	SHORT_ STRING	device name in text form	
8	Get (V-RO)	device status	USINT	current device status in status diagram	
10	Get/Set (NV-RW)	Heartbeat Interval	USINT	interval between two heartbeat messages (in sec)	Default value is 0 (no Heartbeat messages)

1) manufacturer number allocated by the ODVA
2) corresponds to the ODVA device profile
3) current device status; Bit 8...11 contain the error status
4) max. 32 characters

4.2.7.2 DeviceNet object

Class ID 3 (03_h)

The DeviceNet object contains the communications parameters for the DeviceNet interface. An instance with ID 1 exists.

Class attributes

ID	Access	Name	Data type	Description	Value
1	Get (NV-RO)	Revision	UINT	Revision	2
2	Get (NV-RO)	Max instance	UINT	current largest existing instance number of an object derived from this class	1

Instance attributes

ID	Access	Name	Data type	Description	Value
1	Get/Set (NV-RW)	MAC ID [1]	USINT	device address	0 ... 63
2	Get (V-RO)	Reading value baud rate [2]	USINT	Defined baud rate	0 = 125 kbaud 1 = 250 kbaud 2 = 500 kbaud
3	Get/Set (V-RW)	BOI	BOOL	Reaktion auf Bus Off Interrupt	0: CAN Controller stays in Bus Off (Default) 1: reset controller and then restart
4	Get/Set (V-RW)	Bus Off Counter	USINT	Counter how often the CAN Controller was in Bus Off Status Write access clears the counter	0...255
5	Get (V-RO)	Allocation Information	STRUCT of		
5	Get (V-RO)	Allocation selection byte [3]	BYTE		
5	Get (V-RO)	MAC ID from master	BYTE	detected master MAC ID	0 ... 63
6	Get (V-RO)	MAC ID switch changed	BOOL	Switch with device address has changed since it was last switched on	0 = no change 1 = change

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ID	Access	Name	Data type	Description	Value
8	Get (V-RO)	Status of MAC ID switch [1)]	USINT	Switch position for device address	0 ... 99
100	Get/Set (NV-RW)	Baud rate setting [2)]	USINT	Setting of baud rate	0 = 125 kbaud 1 = 250 kbaud 2 = 500 kbaud 3 = Autobaud (default)

1) MAC ID 0...63: Address is determined by the switch position; MAC ID 64...99: address is defined by attribute 1
2) The baud rate is automatically detected with Autobaud
3) see: The CIP Networks Library, Volume 3, DeviceNet Adaptation of CIP, Chapter 5-3

4.2.7.3 Assembly object

Class ID 4(04_h)

An Assembly object is a container that contains one or more attributes of other objects. It enables multiple attributes to be transmitted from or to a slave over one single connection.

In this context they are referred to as input and output data:

- Outputs are commands from the network to the device
- Inputs are status messages from the device to the network

The following instances of the assembly object are implemented in the device:

Instance ID	Type	Name	Number of bytes
101	Output Assembly	Manufacturer-specific standard profile	8
111	Input Assembly	Manufacturer-specific standard profile	8
102	Output Assembly	Manufacturer-dependent extended profile	12
112	Input Assembly	Manufacturer-dependent extended profile	14

Class attributes

ID	Access	Name	Data type	Description	Values
1	Get (NV-RO)	Revision	UINT	Revision	2
2	Get (NV-RO)	Max instance	UINT	current largest existing instance number of an object derived from this class	5

Common instance attributes

The assembly objects are all static. The mapping of the objects can be read with attributes 1 and 2 (read only).

Attribute 3 is the standard data attribute.

The instance attributes supported in the assembly class are described in the following table:

ID	Access	Name	Data type	Description	Value
1	Get (NV-RO)	Number of members in the list	UINT		see below

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ID	Access	Name	Data type	Description	Value
2	Get (NV-RO)	List of members [1]:	ARRAY of STRUCT	List of DeviceNet paths	see below
		Data type	UINT	Size in bits	see below
		Path size	UINT	Path size in bytes	see below
		Path	EPATH		see below
3	Get/Set (V-RW)	Contents of assembly [2]	ARRAY of BYTE	Data from/to device	
4	Get (NV-RO)	Size	UINT	Number of bytes in attribute 3	see below

1) list of all members with data type and DeviceNet path to the included attributes
2) attribute 3 contains the input assemblies or the output assemblies. "Set" access is only possible with the output assemblies

4.2.7.4 Connection object

Class ID 5(05_h)

The Connectionobject with class ID 5 administers access channels to or from the devices.

As a group 2 server in DeviceNet the drive supports the "Predefined Master/Slave Connection Set".

Class attributes

ID	Access	Name	Data type	Description	Value
1	Get (NV-RO)	Revision	UINT	Revision	1
2	Get (NV-RO)	Max instance	UINT	Number of instances	5

Explicit message connection object

Instance ID 1 = predefined Explicit Connection
Instance ID 5 and 6 = dynamic Explicit Connection

This instance acts as a profile position connection between two terminal devices. In an explicit message, an **individual** attribute of an object is either transferred to a terminal device or read from a terminal device.

ID	Access	Name	Data type	Description	Value
1	Get (NV-RO)	Status	USINT	Status of object	0 = non-existent 3 = built-up 5 = cancelled
2	Get (NV-RO)	Instance type	USINT	I/O or Explicit Message	0 = Explicit Message
3	Get (NV-RO)	Transport Class Trigger	BYTE	Retaining the connection	83_h = Class 3 Server
4	Get (NV-RO)	Produced Connection ID	UINT		11000xxxxxx xxxxxx = Node Address
5	Get (NV-RO)	Consumed Connection ID	UINT		11100xxxxxx xxxxxx = Node Address

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ID	Access	Name	Data type	Description	Value
6	Get (NV-RO)	Initial Comm Characteristics	BYTE		33_h Producer: Group 3 Sign. Consumer: gr. 3 mess.
7	Get (NV-RO)	Produced Connection Size	UINT	maximum number of bytes that are transmitted over this connection	44
8	Get (NV-RO)	Consumed Connection Size	UINT	maximum number of bytes that are transmitted over this connection	44
9	Get/Set (NV-RW)	Expected Paket Rate	UINT	Time characteristics of connection (ms)	2500
12	Get/Set (NV-RW)	Watchdog Timeout Action	USINT	Behaviour after timeout	1 = Auto Delete 3 = deferred Delete (Default = 1)
13	Get (NV-RO)	Produced Connection Path length	UINT	Length of attribute 14	0
14	Get/Set (NV-RW)	Produced Connection Path	EPATH		Zero
15	Get (NV-RO)	Consumed Connection Path length	UINT	Length of attribute 16	0
16	Get/Set (NV-RW)	Consumed Connection Path	EPATH		Zero
18	Get/Set (NV-RW)	Connection Timeout Multiplier	USINT	for Watchdog Timer for monitoring the Expected Paket Rate [1)]	0

1) see: The CIP Networks Library, Volume 1, Common Industrial Protocol, Chapter 3-4.4.18

Explicit messages must be confirmed. An error is confirmed with an error message.

Polled I/O Message Object

Instance ID 2 = predefined Poll Connection
Instance ID 7 = dynamic I/O Connection

A poll command message and a poll response message transmit multiple I/O data between a master and one or more slaves.

In a poll I/O connection a DeviceNet master acts as a client and a DeviceNet slave as a server. The client sends commands to the server in a poll command message, the server returns status data to the client in a poll response message.[1]

ID	Access	Name	Data type	Description	Value
1	Get (NV-RO)	Status	USINT	Status of object	0 = non-existent 3 = built-up 5 = cancelled
2	Get (NV-RO)	Instance type	USINT	I/O or Explicit Message	1 = I/O Message
3	Get (NV-RO)	Transport Class Trigger	BYTE	Behaviour of connection [1)]	83_h = Class 3 Server
4	Get (NV-RO)	Produced Connection ID	UINT		01111xxxxxx xxxxxx = Node Address

1. see: The CIP Networks Library, Volume 3, DeviceNet Adaption of CIP, Chapter 3-11

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ID	Access	Name	Data type	Description	Value
5	Get (NV-RO)	Consumed Connection ID	UINT		10xxxxxx101 xxxxxx = Node Address
6	Get (NV-RO)	Initial Comm Characteristics	BYTE		01_h Producer: Group 1 Sign. Consumer: gr. 2 mess.
7	Get (NV-RO)	Produced Connection Size	UINT	maximum number of bytes that can be transmitted unfragmented over this connection	8
8	Get (NV-RO)	Consumed Connection Size	UINT	maximum number of bytes that can be transmitted unfragmented over this connection	8
9	Get/Set (NV-RW)	Expected Paket Rate	UINT	Time characteristics of connection (ms) [2)]	1000
12	Get/Set (NV-RW)	Watchdog Timeout Action	USINT		0 = Transition to Timeout 1 = Auto Delete 2 = Auto Reset (Default = 0) [3)]
13	Get (NV-RO)	Produced Connection Path length	UINT	Length of attribute 14	6
14	Get/Set (NV-RW)	Produced Connection Path	EPATH	application objects whose data are produced over this connection. Factory setting: Position Controller	20 24 24 00 30 21_h
15	Get (NV-RO)	Consumed Connection Path length	UINT	Length of attribute 16	6
16	Get/Set (NV-RW)	Consumed Connection Path	EPATH	Application objects whose data are consumed via this connection Factory setting: Position Controller	20 24 24 00 30 20_h
18	Get/Set (NV-RW)	Connection Timeout Multiplier	USINT	for Watchdog Timer for monitoring the Expected Paket Rate [4)]	0
100	Get/Set (NV-RW)	Polled I/O Input	USINT	Input Position Controller Profil Input Assembly Instanz	110 111, 112
101	Get/Set (NV-RW)	Polled I/O Output	USINT	Output Position Controller Profil Output Assembly Instanz	100 101, 102

1) see: The CIP Networks Library, Volume 1, Common Industrial Protocol, Chapter 3-4.4.3
2) see: The CIP Networks Library, Volume 1, Common Industrial Protocol, Chapter 3-4.5
3) see: The CIP Networks Library, Volume 1, Common Industrial Protocol, Chapter 3-4.4.12
4) see: The CIP Networks Library, Volume 1, Common Industrial Protocol, Chapter 3-4.4.18

4.2.7.5 Acknowledge Handler Object

Class ID 43($2B_h$)

The Acknowledge Handler object administers the incoming messages over DeviceNet. It shows information on received validations, timeouts, repetitions etc.

The Acknowledge Handler object defines exactly one instance.

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Class attributes

ID	Access	Name	Data type	Description	Value
1	Get (NV-RO)	Revision	UINT	Revision	1
2	Get (NV-RO)	Max instance	UINT	current largest existing instance number of an object derived from this class	1

Instance attributes

ID	Access	Name	Data type	Description	Value
1	Get/Set (V-RW)	Acknowledge Timer	UINT	Time to wait for validation before a new transmission is required	1...65535 ms 0 = invalid 16 = Default
2	Get/Set (V-RW)	Retry Limit	USINT	Number of Ack timeouts before the application is informed of a "Retry_Limit_Reached" event	0...255 1=Default
3	Get/Set (V-RW)	COS Producing Connection Instance	UINT	Instance of connection that is informed via Ack handler events	Default: 4 (COS/Cyclic I/O Connection)
4	Get (V-RO)	Ack List Size	BYTE	max. Number of list items in Ack List	Default: 1
5	Get (V-RO)	Ack List	BYTE, ARRAY of UINT	List of active connections that receive validations	Default: $\{01\ 04\ 00\}_h$
6	Get (V-RO)	Data with Ack Path List Size	BYTE	max. number in attribute 7	Default: 1
7	Get (V-RO)	Data with Ack Path List	BYTE, ARRAY of - UINT - USINT - EPATH		Default: { 01 04 00 06 20 01 24 6D 30 03 $\}_h$

All attributes are saved in volatile memory. The application can set the values for Acknowledge Timer, Retry Limit and Producing Connection Instance to values different from those specified.

4.2.7.6 Manufacturer-specific objects

Class ID 101 - 199 (65_h - $C7_h$)

The device-specific parameters are defined from object class 101. For an exact description of individual parameters, see Chapter 11 "Parameters".

4.2.7.7 Network management

Device Heartbeat Message

The device supports the heartbeat protocol as per "The CIP Networks Library", Volume 3, DeviceNet Adaption of CIP, Chapter 2-12. The heartbeat message sends the device status cyclically with the device fault bit.

The cycle time is defined with identity object, attribute 10 "Heartbeat Interval".

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The following information is sent by the drive with the heartbeat message:

- device status (1 byte): attribute 8 of the identity object
- SF - System Fault (1 bit): error in bus communication
- UF - User Fault (1 bit): error by user commands
- DF - Device Fault (1 bit): device error

Device Shutdown Message

The device supports the shutdown protocol as per "The CIP Networks Library", Volume 3, DeviceNet Adaption of CIP, Chapter 2-13. This message is generated if the device switches to offline status.

Two bytes in the shutdown message are reserved for the shutdown code. This code is manufacturer-specific and is shown for the device in the following table:

Class ID	Instance ID	Shutdown Code	Description
1	1	4	Remote request: reset service for the identity object (service code 5)
2	1	4	Remote request: set the MAC ID with attribute 1 of the DeviceNet object
3	0	5	Internal Diagnostic Fault: the device went into shutdown status as a result of one of the following causes: 1. CAN Transmit Queue Overrun 2. CAN Receive Queue Overrun 3. CAN Receive Buffer

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5 Engineering

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

5.1 Configurable inputs and outputs

This product has digital inputs and outputs that can be configured. This standard assignment can be adapted to the requirements of the customer's installation. For more information see chapter 8.6.9 "Configurable inputs and outputs".

5.2 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.

5.2.1 Supply voltage

General

The power supply unit must be designed to meet the power requirements of the drive. The current 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).

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Energy recovery

Note the following if the drive is operated highly dynamically or with large external mass moments of inertia:

During deceleration (depending on the external mass moment of inertia and the set deceleration ramp) or in braking mode the drive can generate power. The external power supply unit must be able to accept the generated energy. If it cannot (e.g. output capacitor in power supply unit too small), an overvoltage condition may occur on the power line. The drive detects the overvoltage and triggers an overvoltage error if the voltage is too high. This prevents the voltage from increasing further.

If energy recovery is expected in an application, the power supply unit must be appropriately designed. In many cases the overvoltage can be reduced during energy recovery by switching higher capacities. Pay attention to the higher load currents when switching on the power supply.

Because of these considerations only chopper-type power supplies that have a sufficiently high output capacity can be recommended.

Transformers with appropriate rectifier circuits are available on the market and with their high output capacity (e.g. 10,000 µF) they provide good results.

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 VDC supply voltage by an unexpected degree. Parts that are not designed for this voltage may be destroyed or malfunction.

- Check that all consumers on VDC 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.

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5.2.2 Signal power supply

External 24V signal power supply

The supply voltage of the VDC drive must not be bridged to the supply voltage of the +24VDC sensors. A separate power supply unit must be used for the 24V signal power supply. Otherwise the sensors may be destroyed on feedback.

Internal 24V signal power supply

A constant 24V signal power supply is available for the sensor power supply on drives with internal 24V signal power supply.

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

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5.3 Ground design

The earth connections of all interfaces, including the earth for the supply voltage, are directly interlinked VDC.

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

- The voltage drop on the VDC supply voltage lines must be kept as low as possible (less than 1 V). At higher frame potential differences between different drives the communications and control signals may be affected in some cases.
- At greater distances between the system components decentralised power supply units for the VDC supply voltage close to the drives are the better alternative. However, the individual power supply units must be bonded with largest possible conductor cross section.
- In the case of drives with internal 24V signal power supply they must not be connected in parallel with the internal 24V signal power supply of a different drive.
- If the master controller (e.g. PLC, IPC etc.) does not have electrically isolated outputs for the drives, it is necessary to ensure that the current for the VDC supply voltage has no path back to the power supply unit via the master controller. The master controller earth must therefore be connected to the VDC supply voltage earth at one point only. This is generally the case in the control cabinet. The earth contacts of the various signal connectors in the compact drive are therefore not connected; there is already a connection via the VDC supply voltage earth.
- If the controller has, for example, an electrically isolated RS485 interface for communication with the drives, the electrically isolated earth of this interface should be connected with the corresponding signal earth of the first drive. This earth can only be connected to a drive to prevent earth loops. The same applies for an electrically isolated CAN connection.

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 over 100 m are approved, the following applies: up to 200 m length a cable cross section of 16 mm^2 is sufficient, for greater lengths a cable cross section of 20 mm^2 is required.

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5.4 Safety function "Power Removal"

For some general information on the application of IEC 61508 see page 37.

5.4.1 Definitions

Power Removal The "Power Removal" safety function shuts off the motor torque safely. The supply voltage must not be interrupted. There is no monitoring at standstill.

Category 0 stop (EN60204-1) Standstill by immediate power shutdown to the machine drive elements (i.e. an uncontrolled stop).

Category 1 stop (EN60204-1) A controlled stop in which the machine drive elements are retained to effect the standstill. Power feed is only interrupted when everything has come to a standstill.

5.4.2 Function

The "Power Removal" 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.

Function The "Power Removal" safety function can be triggered with the two redundant inputs $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$. The circuits of the two inputs must be separated from each other to retain the two channels.

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".

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.

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5.4.3 Requirements for safe application

⚠ 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.

Stop of category 0

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.

Stop of category 1

In a stop of category 1 a controlled stop must be triggered. The controlled stop 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 $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ inputs. This is generally controlled by a standard Emergency Stop module with safe time delay.

Vertical axes, external forces

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.

Prevention of unexpected restart

To prevent an unexpected restart after restoration of power (e.g. after power failure), the parameter `IO_AutoEnable` must be set to "off". Note that a higher level controller must not trigger a dangerous restart.

Degree of protection when using "Power Removal"

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

Protected cable installation

If short circuits and cross connections can be expected on the wiring of the $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ signals and they are not detected by upstream devices, a protected cable installation is required.

In the case of an unprotected cable installation the $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ signals may be connected to interference voltage if a cable is damaged. If both signals are connected to interference voltage the "Power Removal" safety function will not operate.

A protected cable installation can be achieved as follows:

- Layout of $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ 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 earthed shield protects the signals against interference voltage if the cable is damaged and can trip the fuse.
- Use of separate earthed shielding. If there are other wires in the cable, the $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ signals must be isolated from these wires by a separate earthed shield.

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Data for maintenance schedule and safety calculations

IMPORTANT: The following technical data is provisional.

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

Service life corresponding to safety life cycle (IEC 61508)		20 years
SFF (Safe Failure Fraction) (IEC61508)	[%]	66
HFT (Hardware Fail Tolerance) (IEC61508) Type A subsystem		1
Safety integrity level (IEC61508 and IEC62061)		SIL2
Performance level (ISO 13849-1)		d (Category 3)

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 "Power Removal" 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.

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5.4.4 Application examples

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

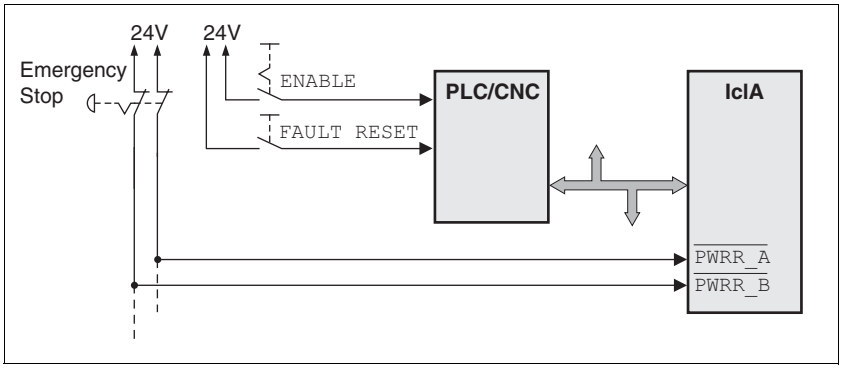

Figure 5.1 Example: category 0 stop

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, Stop category 1,

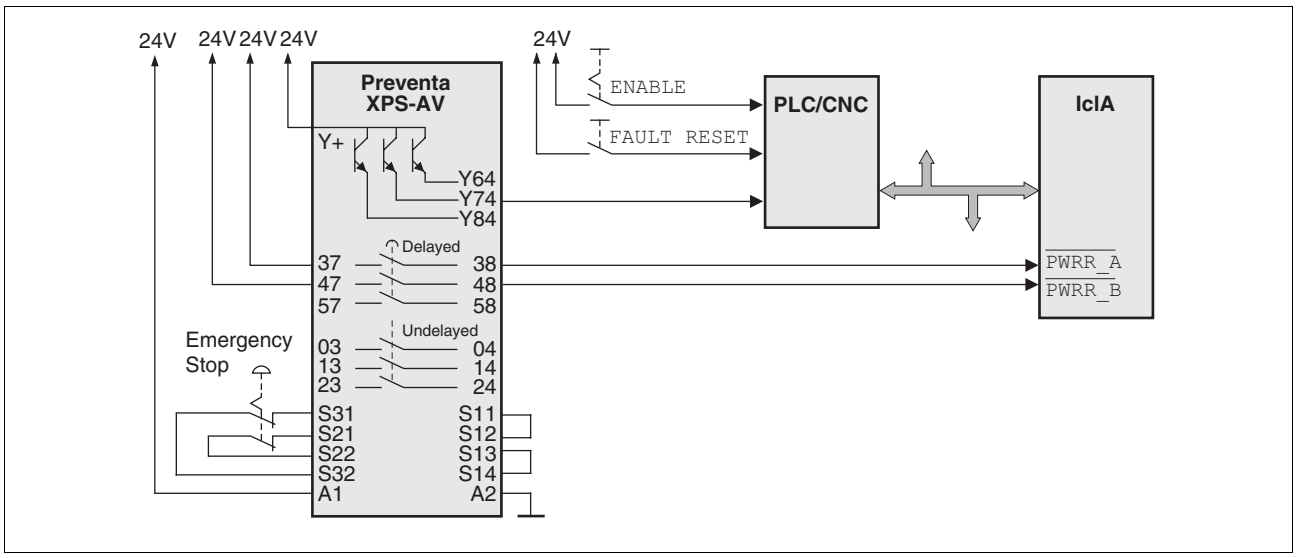

Figure 5.2 Example: category 1 stop

Please note:

- The master controller must immediately trigger a controlled stop, e.g. with the "Quick Stop" function.
- The $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ inputs are shut down in accordance with 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.

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6 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. Some 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

Risk of injury when removing circuit board plugs

- When removing them note that the connectors must be unlocked.
  - Supply voltage VDC:
    unlock by pulling at the connector shell
  - Miscellaneous:
    unlock by pressing the locking lever
- Always hold the connector to remove it (not the cable).

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

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

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6.1 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 lines and system parts and adversely affect the operating reliability of the system.

Before operation the electromagnetic compatibility of the system must be checked and assured. The drive system conforms to the requirements of the EC directives on EMC immunity to interference under IEC 61800-3 for the second environment where the following actions are taken into account during installation.

To maintain the limit values for the EMC interference resistance and interference radiation the drive must be earthed. 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 earthed machine component for sufficient earthing of the drive.

EMC measures	Effect
Cable as short as possible. No ground loops.	Prevent capacitive and inductive fault interference
The electronics case is electrically connected to the motor. Earthing drive through the motor flange. If this is not possible, provide additional earth wire connected to the plug cover lid or with a cable clip to the flange. Note that in this case the drive will not be earthed when the cover is removed.	Reduce emissions, increase noise immunity
Earth shields on digital signal lines over a wide area at both ends or via conductive plug housing.	Preventing interference on control cables, reduction of emissions
Connect large surface areas of cable shields, use cable clamps and tapes	Reduction of emissions.

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Shielding

The following cables must be shielded:

- Fieldbus cable
- "Power Removal" safety function
  See the requirements in chapter 5.4.3 "Requirements for safe application".

The following cables can be left unshielded:

- Supply voltage VDC
- 24V 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 over 100 m are approved, the following applies: up to 200 m length a cable cross section of 16 mm^2 is sufficient, for greater lengths a cable cross section of 20 mm^2 is required.

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6.2 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

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.

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⚠ WARNING

Wear or high temperature will cause loss of braking power.

Setting the holding brake when the motor is running will cause fast wear and loss of braking force. Heat reduces the braking force.

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

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

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.

Heat dissipation

The motor may become very hot, e.g. in the case of incorrect arrangement of multiple drives. The surface temperature of the motor must not exceed 110 °C in continuous operation.

- Make sure that the maximum temperature is not exceeded by maintaining sufficient distance or good ventilation for every single drive.
- If the drive is operated to the limits of its performance, adequate heat dissipation via the motor flange is essential

Fixing

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

Painted surfaces have an insulating effect. During mounting make sure that the motor flange is mounted to ensure good conductivity (electrical and thermal).

Installation clearances

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

Note the bending radii of the cables used.

Ambient conditions

Note the permissible environmental conditions.

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6.3 Electrical installation

⚠ WARNING

Unexpected behaviour due to external objects

External objects, deposits or humidity can cause unexpected behaviour.

- Prevent any external objects from entering the terminal unit.
- Do not remove the electronic case cover. Only remove the connector shell cover.
- Check that seals and cable entries are correctly seated.

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

⚠ WARNING

Danger of loss of safety function by external objects

The safety function may fail because of conductive external objects, dust or liquids.

- The "Power Removal" safety function must only be used if the system is protected against conductive dirt.

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

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

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6.3.1 Wiring examples

The following figure shows an example of wiring for drives with internal 24V signal power supply. The limit switches and the reference switch are powered by the internal 24V signal power supply.

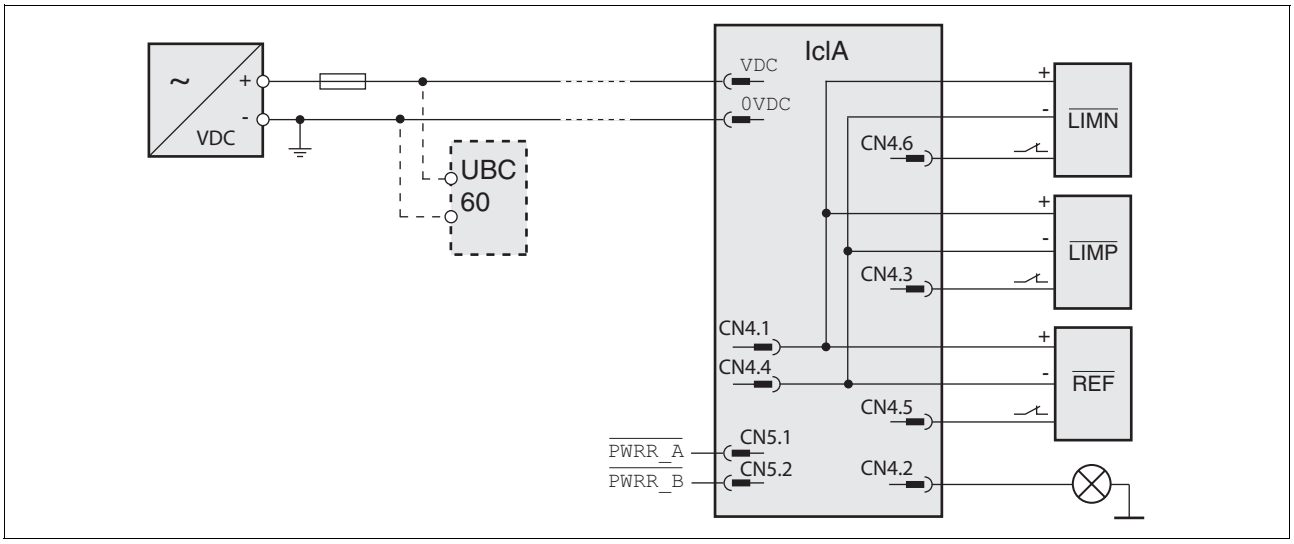

Figure 6.1 Wiring example with internal 24V signal power supply

The following figure shows an example of wiring for drives with external 24V signal power supply. The limit switches and the reference switch are powered by a separate $24V_{DC}$ power supply unit.

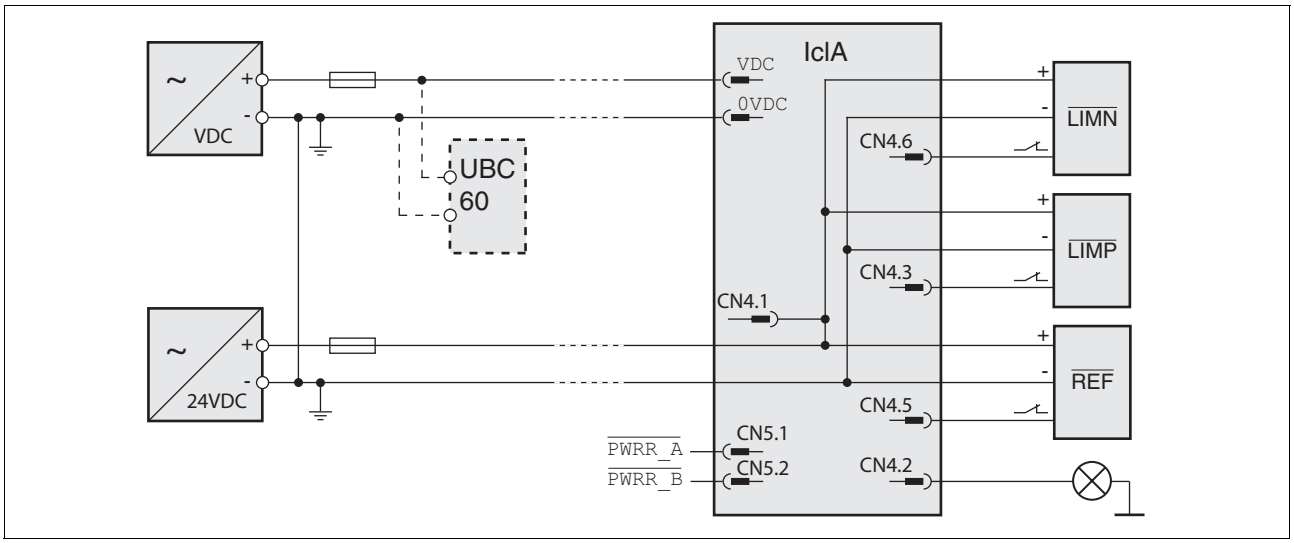

Figure 6.2 Wiring example with external 24V signal power supply

VDC power supply units and the UBC braking resistor controller are available as accessories, see chapter 12 "Accessories and spare parts".

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6.3.2 Overview of all connections

Overview of printed circuit board plug connectors

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

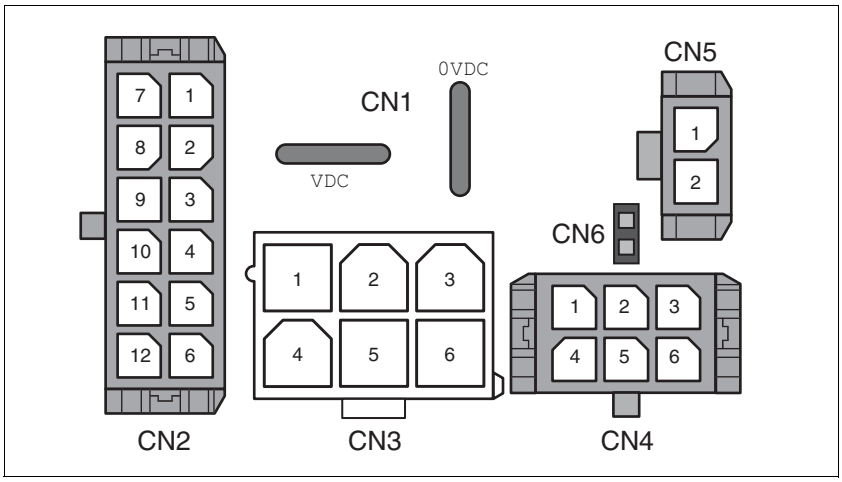

Figure 6.3 Overview of all connections

Terminal	Assignments
CN1	Supply voltage VDC
CN2	Fieldbus interface and preset reference value (for electronic gear operating mode)
CN3	Commissioning interface
CN4	24V signals
CN5	"Power Removal" safety function
CN6	Jumper for disabling "Power Removal" safety function

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

For connection via cable entry see page 75.
For connection via industrial connectors see page 78.

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6.3.3 Connection with cable bushing

The wiring specifications and pin assignment can be found in the chapters that describe the connections.

Preparing and fastening wiring

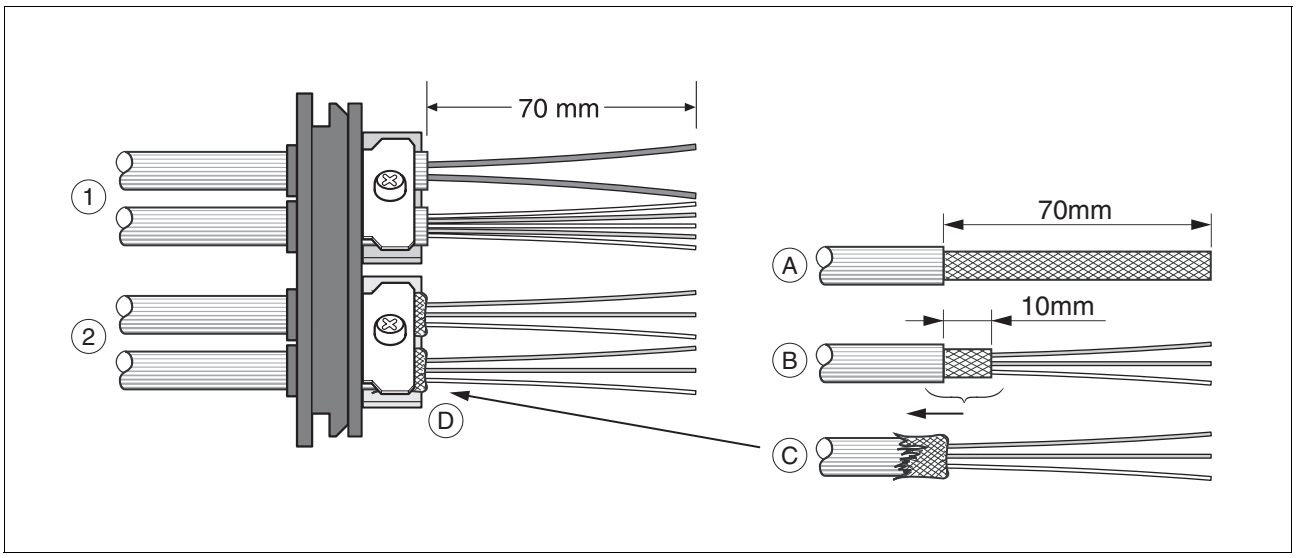

Figure 6.4 Fasten cable in bushing

(1) unshielded cable
(2) shielded cable

- ▶ Select the correct cable cross section to ensure that the drive remains sealed.

  CAUTION: The specified degree of protection IP54 can only be achieved with correctly sized cable bushes.
- ▶ (A) Sheath all cables over a length of 70 mm.
- ▶ (B) Shorten the shield to a remaining length of 10 mm.
- ▶ (C) Slide the shield braiding back over the cable sheath.
- ▶ (D) Loosen the strain relief.
- ▶ Push the cable though the strain relief.
- ▶ Glue EMC shielding foil around the shield.
- ▶ Pull the cable back to the strain relief.
- ▶ Fasten the strain relief.

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Attach connector

The required parts and data for preparation are listed in the following table. Plug housing and crimp contacts are included in the accessory set. See also chapter 12 "Accessories and spare parts"

Terminal	Wire cross section of the crimp contact [mm²]	Stripped length [mm]	Crimp contact manufacturer no.	Crimp pliers	Plug manufacturer	Plug type
CN1	0.5 ... 1.5 2.5 ... 4.0	5 ... 6	160773-6 341001-6	654174-1	AMP	Positive Lock 1-926 522-1
CN2	0.14 ... 0.6	2.5 ... 3.0	43030-0007	69008-0982	Molex	Micro-Fit 3.0 43025-1200
CN3	0.25 ... 1.0	3.0 ... 3.5	39-00-0060	69008-0724	Molex	Mini-Fit Jr. 39-01-2065
CN4	0.14 ... 0.6	2.5 ... 3.0	43030-0007	69008-0982	Molex	Micro-Fit 3.0 43025-0600
CN5	0.14 ... 0.6	2.5 ... 3.0	43030-0007	69008-0982	Molex	Micro-Fit 3.0 43645-0200

Prepare the cable for connection as follows:

- ▶ Strip the ends of the cable.
- ▶ Attach terminal ends and crimp contacts. Make sure you have the correct crimp contacts and the matching crimping pliers.
- ▶ Slide the terminal end and crimp contacts straight on until they click into the connector.

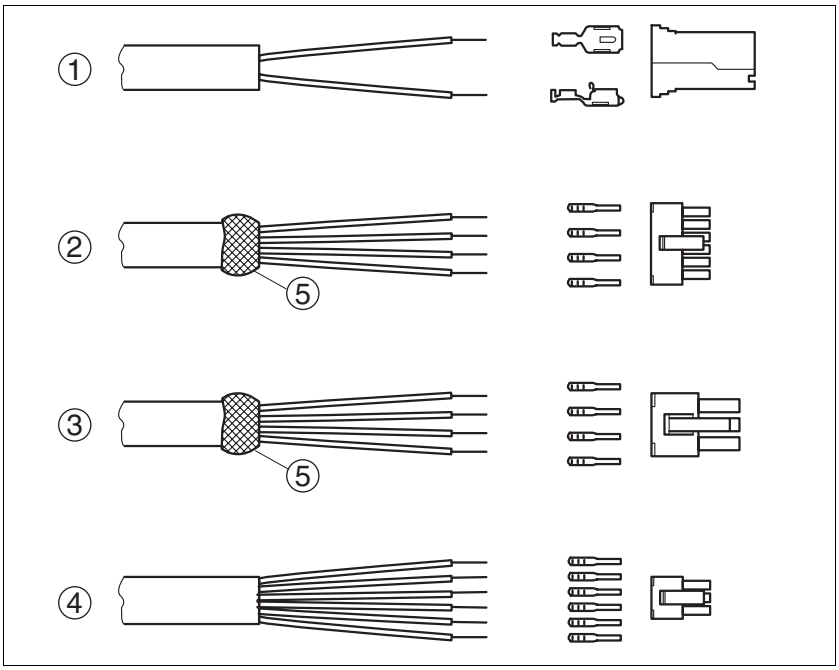

Figure 6.5 Connector, cable lugs and crimp contacts

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

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

Installing cable entry

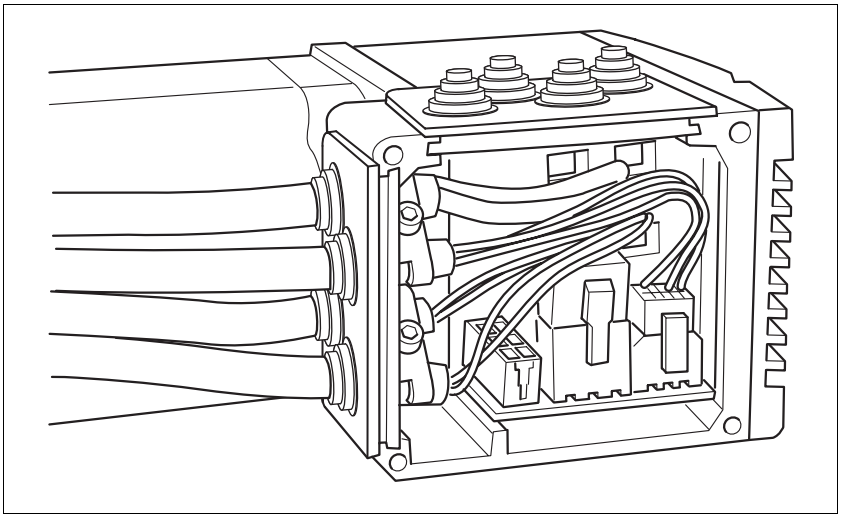


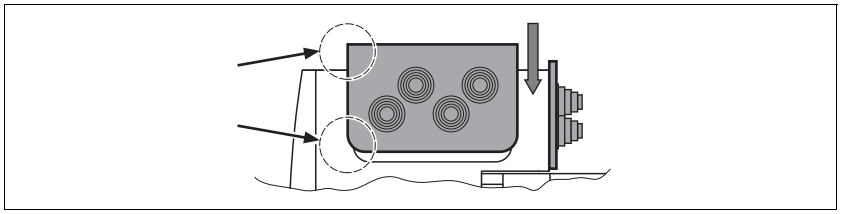
Figure 6.6 Inserting cable entries

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

  For a description of the parameter switches, see the relevant chapters describing the connections.
- ▶ Connect the plug on the prepared cable to the matching socket. Plugs cannot be confused and must click into place when plugged in.

  Always hold the plug to remove it (not the cable).
- ▶ Position the cable bushing in one of the two openings provided. The space available in your system will decide which side the cable is led out from.

  Note: The sharp corners of the cable entry must point in the direction of the plug housing cover. Degree of protection IP54 is not assured if the cable bushing is mounted reversed.



- ▶ Close the opening that is not used with a blank cover.

  CAUTION: do not use the transport clips.
- ▶ Finally, screw the plug case cover back into place.

  If screws are lost use M3x12 only.

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6.3.4 Connection with industrial connectors

Interface	Connector used
Supply voltage VDC	Hirschmann STASEI 200
DeviceNet fieldbus	Circular plug-in connector M12 , 5-pin, A-coded
24V signal inputs and outputs	Circular plug-in connector M8, 3-pin
Safety function "Power Removal"	Circular plug-in connector M8, 4-pin

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

All specifications for the prepared cables, connector sets and recommended suppliers can be found in 12 "Accessories and spare parts".

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6.3.5 Supply voltage connection VDC

⚠ 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.

⚠ CAUTION

Loss of control by regeneration condition

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

- Check that all consumers on VDC 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.

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⚠ 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.

Cable specifications

- Cross section 2 x 0.75 ... 4.0 mm²

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

▶ Use prefabricated cables to minimise the risk of a wiring error.

▶ Make sure that the wiring, the cables and the connected interfaces meet the requirements for PELV.

Connecting cable

▶ Follow the relevant technical data.

▶ See chapter 5.2 "External power supply units" and 5.3 "Ground design".

▶ Install fuses for the power supply line in accordance with the selected cross section (note the starting currents).

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Pin assignment for printed circuit board plug connector

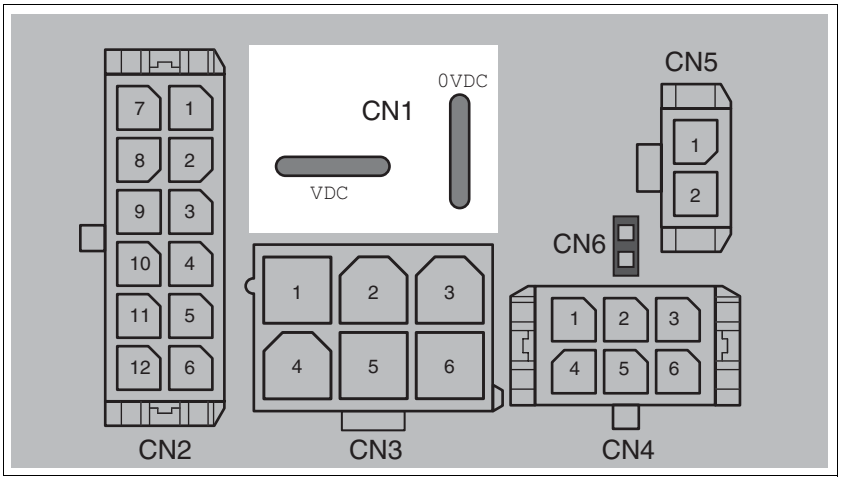

Figure 6.7 Pin assignment for supply voltage

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

1) Information refers to pre-assembled cables

You can crimp two braided wires together to supply multiple drives over one DC bus. Two different crimp contacts are available for different wire diameters, see 6.3.3 "Connection with cable bushing".

Pin assignment of industrial connectors

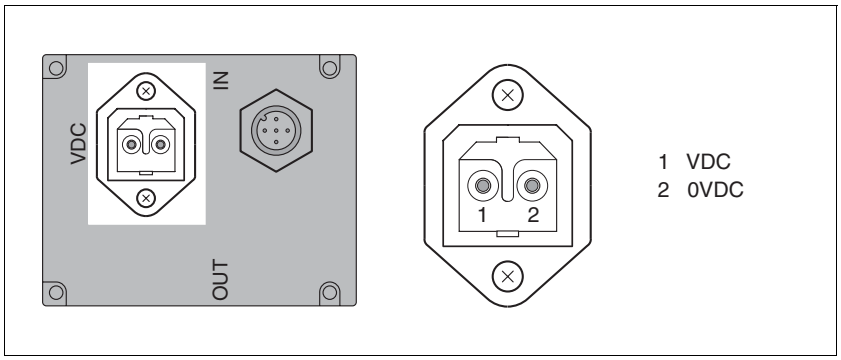

Figure 6.8 Pin assignment for supply voltage

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

1) Information refers to pre-assembled cables

6.3.6 DeviceNet-fieldbus interface connection

Function

Using the DeviceNet interface, you can connect the drive system as a slave to a DeviceNet network.

The fieldbus interface is galvanically isolated from the power supply VDC.

The presence of the Bus supply voltage is monitored internally. The monitoring function can be activated and deactivated using the commissioning software.

Cable specifications

For details of the cable specification, see chapter 4.2 "DeviceNet fieldbus".

- ▶ Use equipotential bonding conductors, see page 69.
- ▶ Use pre-assembled cables to minimise the risk of a wiring error.
- ▶ Make sure that the wiring, the cables and the connected interfaces meet the requirements for PELV.

Terminating resistor

The two ends of the entire Bus system must, in each case, be fitted with a terminator of 120 Ω between CAN_H and CAN_L.

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.

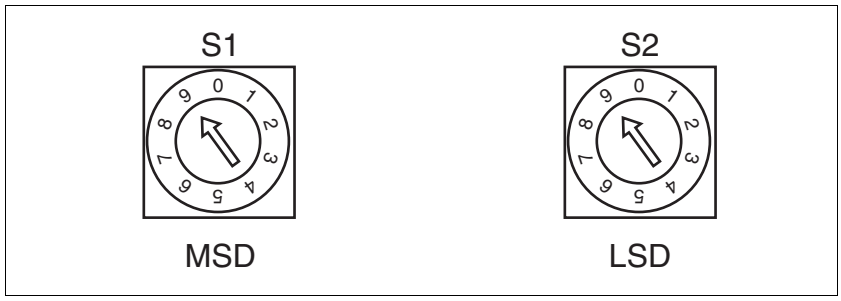

Figure 6.9 Rotary switch assignment

(S1) MSD (most significant digit)
Determines the 10 position of the node address
(S2) LSD (least significant digit)
Determines the 1 position of the node address

With a switch setting of 01 ... 63, the selected switch setting is the same as the MAC-ID.

With a switch setting of 64 ... 99, the MAC-ID setting is performed using the RSNetWorx configuration software.

- ▶ Before changing the settings on the switches switch all supply voltage off.
- ▶ Adjust the rotary switches according to your requirements.

Factory setting

Rotary switch: MAC-ID 99 (MSD = 9, LSD = 9)

Parameter: MAC-ID 63

Baud rate setting

The baud rate is identified automatically. However, it can be defined permanently using the parameter DVNbaud.

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Pin assignment for printed circuit board plug connector

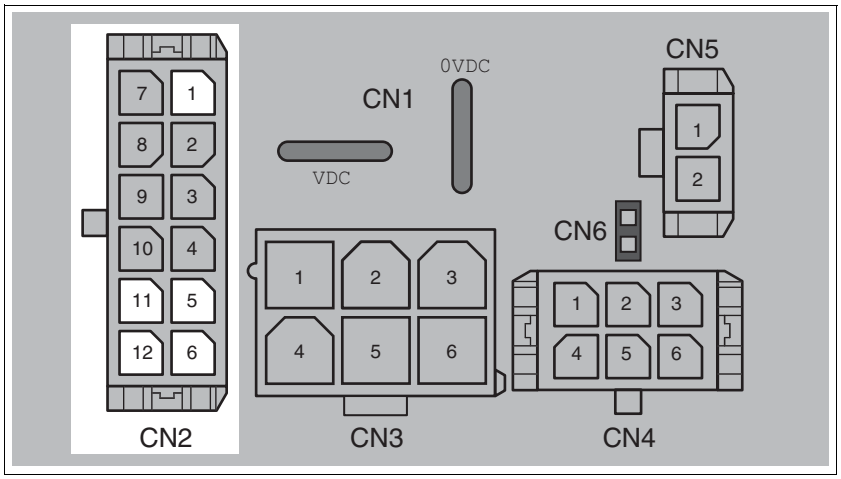

Figure 6.10 Pin assignment for printed circuit board plug connector

Pin	Signal	Description
CN2.1	SHLD	Shield connection
CN2.5	V+	Bus supply voltage
CN2.11	V-	Reference potential to V+
CN2.6	CAN_H	fieldbus
CN2.12	CAN_L	fieldbus

Pin assignment of industrial connectors

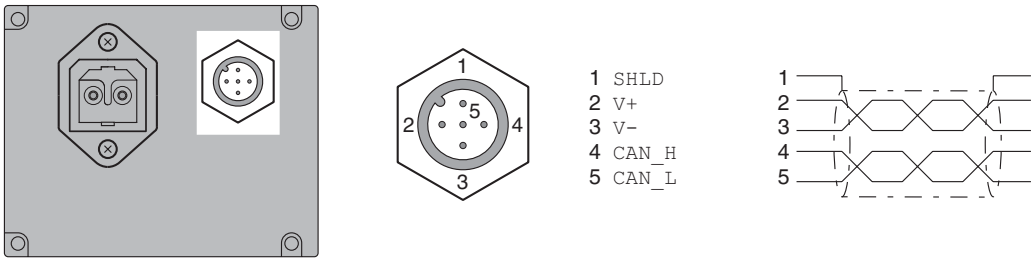

Figure 6.11 Pin assignment of industrial connectors

Pin	Signal	Description
1	SHLD	Shield connection (internally connected with CN2.1)
2	V+	Bus supply voltage (internally connected with CN2.5)
3	V-	Reference potential for V+ (internally connected with CN2.11)
4	CAN_H	Fieldbus (internally connected with CN2.6)
5	CAN_L	Fieldbus (internally connected with CN2.12)

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6.3.7 RS485 interface connection

Function

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

You can also use the RS485 interface and the commissioning software to monitor the drive while in operation. It is not possible to establish a simultaneous connection with the fieldbus.

Cable specifications

- Shielded cable
- Minimum cross section of signal wires: 0.25 mm²
- Twisted-pair lines
- Earthing of the screen at both ends
- Maximum cable length: 400 m
- ▶ Use equipotential bonding lines, see page 69.
- ▶ Use prefabricated cables to minimise the risk of a wiring error.
- ▶ Make sure that the wiring, the cables and the connected interfaces meet the requirements for PELV.

Address setting

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

Factory setting:

- Node address: 1
- Baud rate: 19200
- Data format: 8Bit EvenParity 1Stop

Pin assignment for printed circuit board plug connector

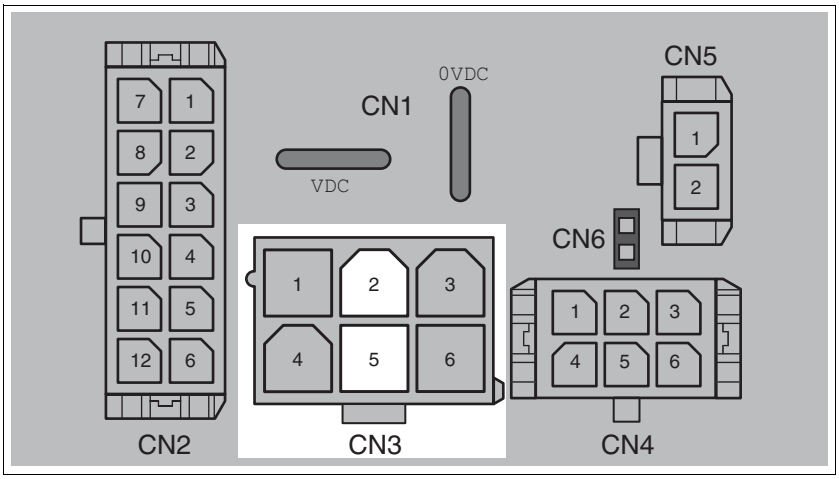

Figure 6.12 Pin assignment for printed circuit board plug connector

Pin	Signal	Description
2	+RS485	RS485 interface
5	–RS485	RS485 interface

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6.3.8 24V signal interface connection

External 24V signal power supply

In the case of drives without internal 24V signal power supply the VDC supply voltage must not be bridged at +24VDC. A separate power supply unit must be used for the 24V signal power supply.

⚠ 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.

Internal 24V signal power supply

A constant 24V signal power supply is available for the sensor power supply on drives with internal 24V signal power supply.

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

Note that for drives with an internal 24V signal power supply different accessories must be used from drives with an external 24V signal power supply.

Cable specifications

- Cross section: 0.2 .. 0.6 mm²

▶ Use prefabricated cables to minimise the risk of a wiring error.

▶ Make sure that the wiring, the cables and the connected interfaces meet the requirements for PELV.

Configuration

The digital signal inputs or signal outputs can be assigned various functions. For a detailed description, see Chapter 8.6.9 "Configurable inputs and outputs".

Factory settings

The following table provides an overview of the factory settings.

Pin	Signal	Factory setting	I/O
CN4.3	LI01	Input Positive limit switch (LIMP)	I
CN4.6	LI02	Input Negative limit switch (LIMN)	I
CN4.2	LI03	Input Free available	I
CN4.5	LI04	Input Reference switch (REF)	I

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⚠ CAUTION

Loss of control

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

- Use $\overline{\texttt{LIMP}}$ and $\overline{\texttt{LIMN}}$ 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 $\overline{\texttt{LIMP}}$ and $\overline{\texttt{LIMN}}$.
- 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 $\overline{\texttt{LIMP}}$ and $\overline{\texttt{LIMN}}$. If the drive moves to a limit switch, the motor stops. The triggering of the limit switch is signalled.

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Pin assignment for printed circuit board plug connector

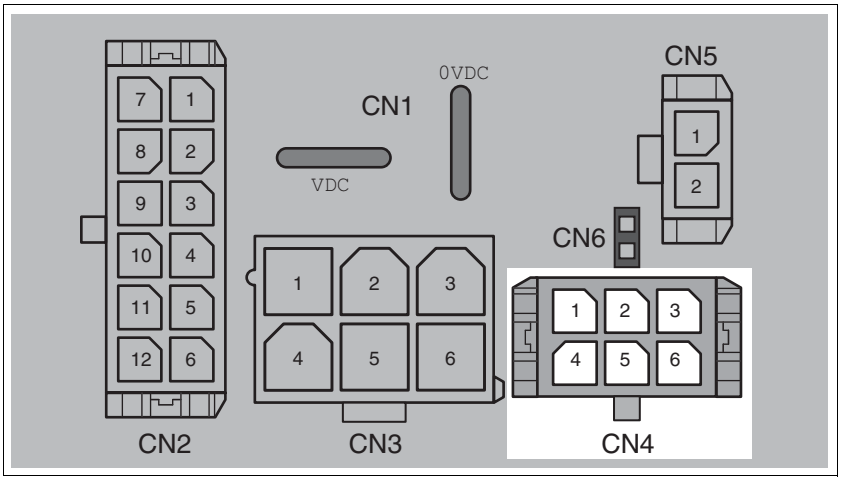

Figure 6.13 Pin assignment for printed circuit board plug connector

Pin	Signal	Description	I/O
1 [1)]	+24VDC	An external 24V signal power supply is required if outputs are to be used	I
1 [2)]	+24VDC_OUT	The internal 24V signal power supply may be used for the power supply of the sensors (e.g. limit switches)	O
2	LIO3	freely usable input or Output	I/O
3	LIO1	freely usable input or Output	I/O
4	0VDC	internally connected with CN1.0VDC	
5	LIO4	freely usable input or Output	I/O
6	LIO2	freely usable input or Output	I/O

1) for drives with external 24V signal power supply.
2) drives with internal 24V signal power supply

Pin assignment of industrial connectors

Pin assignment of the "Insert 3I/O 24V" accessory on drives with 24V signal power supply.

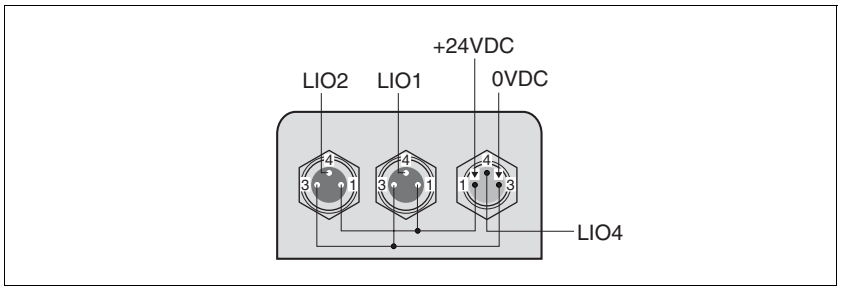

Figure 6.14 Pin assignment " Insert 3I/O 24V"

An external 24V signal power supply must be created if you are to use LIO1, LIO2 or LIO4 as the output.

Sensors (e.g. limit switches) can also be powered by this power supply.

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Pin assignment of industrial connectors

Pin assignment of the "Insert 4I/O 24V" accessory on drives with 24V signal power supply.

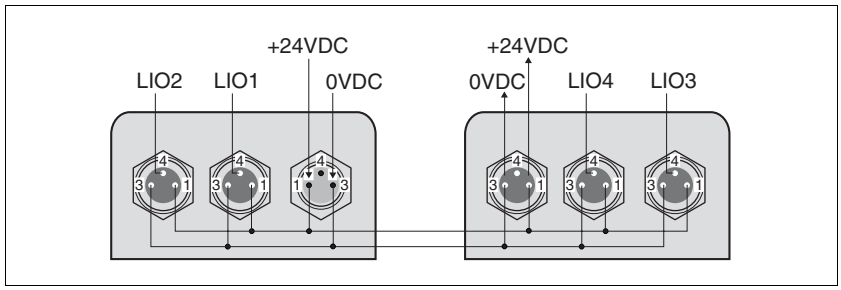

Figure 6.15 Pin assignment " Insert 4I/O 24V"

An external 24V signal power supply must be created if you are to use LIO1, LIO2, LIO3 or LIO4 as the output.

Sensors (e.g. limit switches) or an additional drive can also be powered by this power supply.

Pin assignment of industrial connectors

Pin assignment of the "Insert 3I/O" accessory on drives with internal 24V signal power supply.

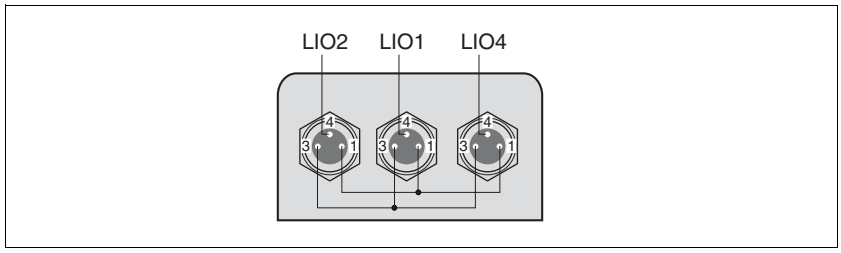

Figure 6.16 Pin assignment"Insert 3I/O"

Pin 1 is internally connected with +24VDC_OUT of the internal 24V signal power supply, pin 3 is connected with 0VDC.

The internal 24V signal power supply may be used for the power supply of connected sensors (e.g. limit switches)

Pin assignment of industrial connectors

Pin assignment of the "Insert 4I/O" accessory on drives with internal 24V signal power supply.

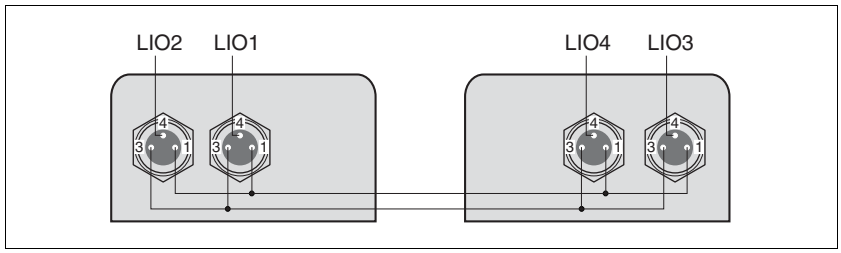

Figure 6.17 Pin assignment "Insert 4I/O"

Pin 1 is internally connected with +24VDC_OUT of the internal 24V signal power supply, pin 3 is connected with 0VDC.

The internal 24V signal power supply may be used for the power supply of connected sensors (e.g. limit switches)

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6.3.9 Connection of "Power Removal" safety function

⚠ 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.

Requirements

For information and requirements on the "Power Removal" safety function see 5.4 "Safety function "Power Removal"".

Cable specifications

- Shielded cable corresponding to the requirements for protected cable installation
- Minimum cross section of signal wires: 0.34 mm^2

▶ Use equipotential bonding conductors, see page 69.

▶ Use pre-assembled cables to minimise the risk of a wiring error.

▶ Make sure that the wiring, the cables and the connected interfaces meet the requirements for PELV.

The cable available as an accessory is a special cable and is only available with a connector. The shield of the cable is connected to the earthed housing of the drive by the metal connector. A one-sided connection of the shield to the earthed housing is sufficient.

Pin assignment for printed circuit board plug connector

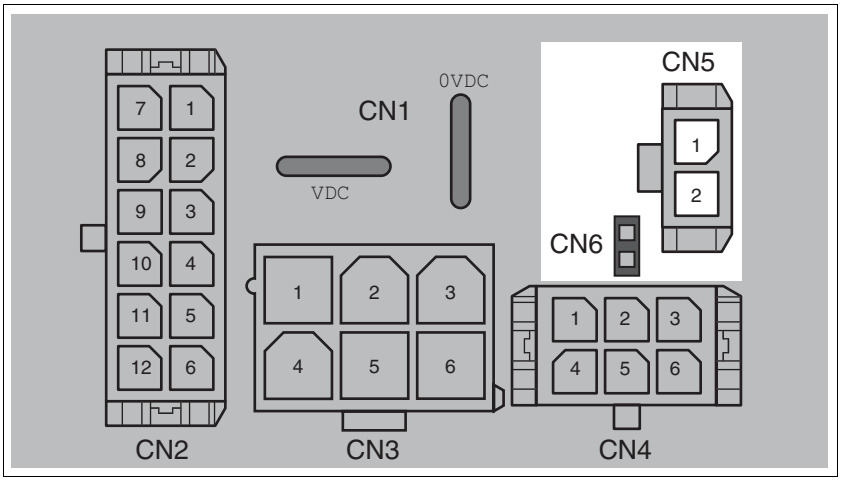

Figure 6.18 Pin assignment for printed circuit board plug connector

Pin	Signal	Description
CN6 [1)]		Jumper plugged in: "Power Removal" disabled Jumper removed: "Power Removal" activated
CN5.1	$\overline{\text{PWRR\_A}}$	"Power Removal" safety function
CN5.2	$\overline{\text{PWRR\_B}}$	"Power Removal" safety function

1) CN5 cannot be connected if jumper CN6 is still connected (mechanical lock).

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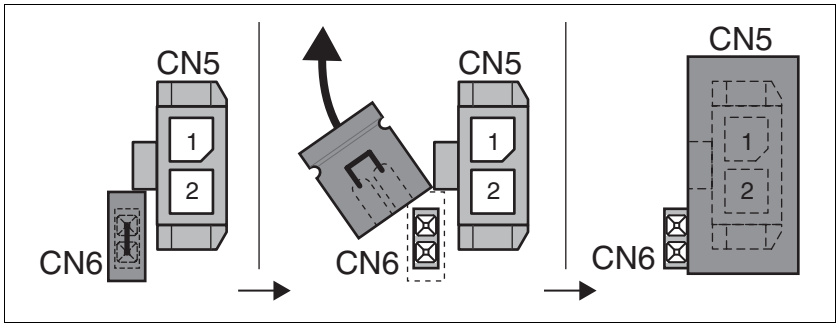
Connecting "Power Removal" safety function



- ▶ Remove jumper CN6.
- ▶ Attach the connector to CN5.

Pin assignment of industrial connectors

Pin assignment of "Insert 2I/O 1PWRR" accessory.

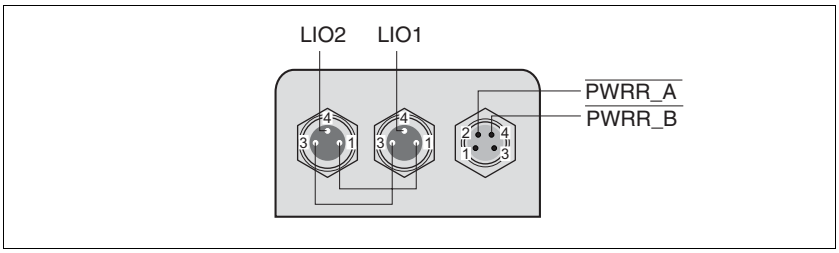


Figure 6.19 Pin assignment "Insert 2I/O 1PWRR"

Pin 1 is internally connected with +24VDC_OUT of the internal 24V signal power supply, pin 3 is connected with 0VDC.

The internal 24V signal power supply may be used for the power supply of connected sensors (e.g. limit switches)

Pin assignment of industrial connectors

Pin assignment of "Insert 4I/O 2PWRR" accessory.

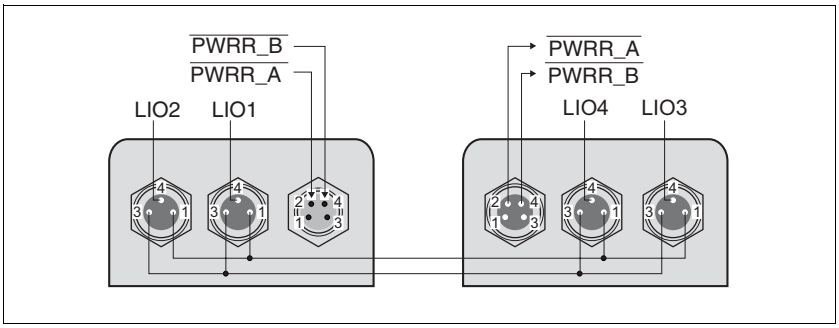


Figure 6.20 Pin assignment "Insert 4I/O 2PWRR"

Pin 1 is internally connected with +24VDC_OUT of the internal 24V signal power supply, pin 3 is connected with 0VDC.

The internal 24V signal power supply may be used for the power supply of connected sensors (e.g. limit switches)

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6.3.10 Preset reference value connection

Function

External reference signals can be connected at CN2 for the "electronic gear" operating mode.

The signal inputs PULSE/DIR and A/B are used in combination:

- "PULSE/DIR" interface mode

  Pulse direction signals

- "A/B" interface mode

  AB encoder signals

Cable specifications

- Shielded cable
- Cross section 0.14 … 0.6 mm²
- Twisted-pair lines
- Earthing of the screen at both ends
- Maximum length: ca. 100 m

  The maximum possible length depends on the cross section and the driver circuit used.

▶ Use equipotential bonding lines, see page 69.

▶ Use prefabricated cables to minimise the risk of a wiring error.

▶ Make sure that the wiring, the cables and the connected interfaces meet the requirements for PELV.

Signal level

The inputs operate at the RS422 level and are not electrically isolated.

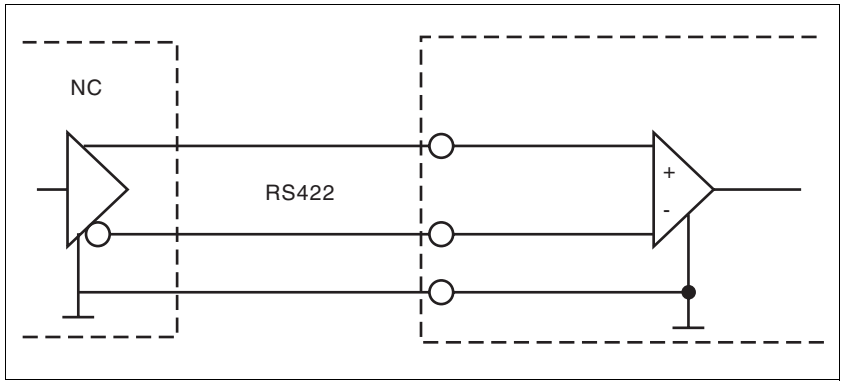

Figure 6.21 Circuit of the signal inputs

- Logical 0
  - 0-level at input "+"
  - 1-level at input "-"
- Logical 1
  - 1-level at input "+"
  - 0-level at input "-"

Open inputs are logical 0.

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"PULSE/DIR" interface mode

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

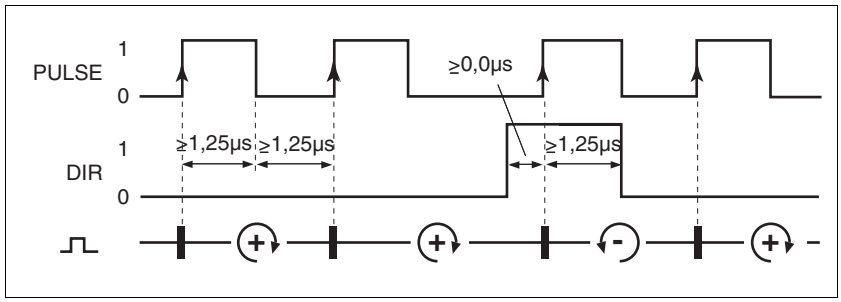

Figure 6.22 Pulse direction signals

Signal	Signal value	Description
PULSE	0 -> 1	Angular step
DIR	0 / open 1	Clockwise rotation Counterclockwise rotation

"A/B" interface mode

A/B encoder signals can be fed as a reference value selection via the "A/B" interface mode.

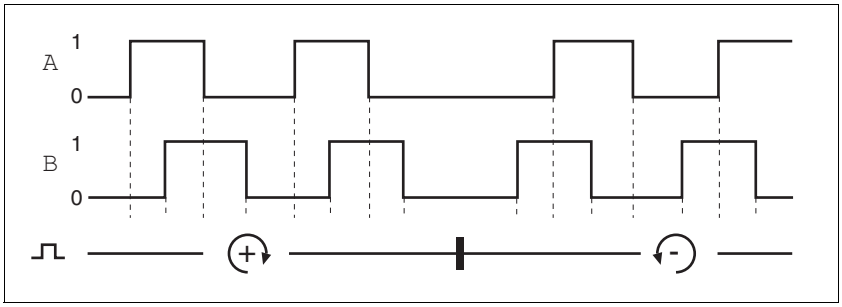

Figure 6.23 AB encoder signals

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Pin assignment for printed circuit board plug connector

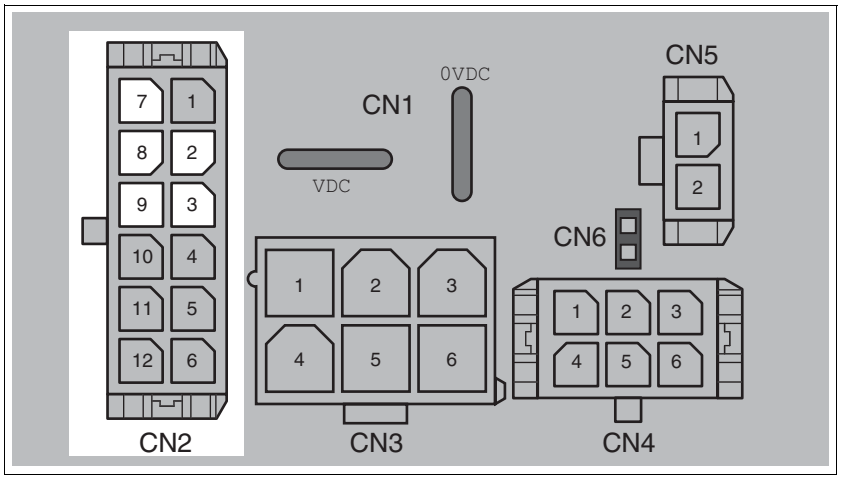

Figure 6.24 Pin assignment of pulse/direction or A/B interface

Pin	Signal	Description
7	POS_0V	internally connected with 0VDC
2	+DIR or +B	Direction of rotation "DIR" or B-channel of AB encoder signals
8	-DIR or -B	Direction of rotation "DIR" or B-channel of AB encoder signals
3	+PULSE or +A	Motor step "PULSE" or A-channel of AB encoder signals
9	-PULSE or -A	Motor step "PULSE" or A-channel of AB encoder signals

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6.4 Checking wiring

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 seals installed and is degree of protection IP54 specified? (only with use of the "Power Removal" safety function)

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7 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.*

7.1 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.

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⚠ WARNING

Unexpected behaviour

The behaviour 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

Rotating parts

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

- After mounting check all rotating parts (parallel keys, coupling, ..).
- Use a cover as protection against rotating parts.

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

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⚠ 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.

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7.2 Overview

This chapter describes the commissioning procedure for the drive.

The following components are required for commissioning:

- EDS file (www.berger-lahr.com/download)
- RSNetWorx configuration software
- Basic knowledge of RSNetWorx configuration software
- BLCT commissioning software (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
6.4 "Checking wiring"	94
7.3.1 "Setting the device address"	99
7.3.2 "Adding product to fieldbus"	100
7.3.3 "BLCT commissioning software"	102

▶ Carry out the following steps using the commissioning software.

What you need to do...	Page
7.3.4 "Setting basic parameters and limit values"	103
7.3.5 "Digital inputs/outputs"	105
7.3.6 "Checking the signals of limit switches"	106
7.3.7 "Testing safety functions"	107
7.3.8 "Releasing holding brake manually"	108
7.3.9 "Check direction of rotation"	109
7.3.10 "Setting parameters for encoder"	110

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7.3 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.

7.3.1 Setting the device address

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.

Figure 7.1 Rotary switch assignment

(S1) MSD (most significant digit)
Determines the 10 position of the node address
(S2) LSD (least significant digit)
Determines the 1 position of the node address

With a switch setting of 01 ... 63, the selected switch setting is the same as the MAC-ID.

With a switch setting of 64 ... 99, the MAC-ID setting is performed using the RSNetWorx configuration software.

▶ Before changing the settings on the switches switch all supply voltage off.

▶ Adjust the rotary switches according to your requirements.

Factory setting

Rotary switch: MAC-ID 99 (MSD = 9, LSD = 9)

Parameter: MAC-ID 63

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7.3.2 Adding product to fieldbus

The product is added to the fieldbus using the RSNetWorx configuration software.

Configuring the product

- ▶ Add the product to the PLC using a network scan.
- ▶ In the "General" tab, change the MAC-ID to a free address if no fixed MAC ID was selected with the rotary switch.
- ▶ Switch to the "Parameters" tab and load all parameters from the product.
- ▶ In the parameter `Polled I/O Input` and `Polled I/O Output`, select the required "Connection Object".

  For the relevant description, see Chapter 4.2.5 "Communication via "I/O Message"" and 8.7 "Drive profile Position Controller Profile".

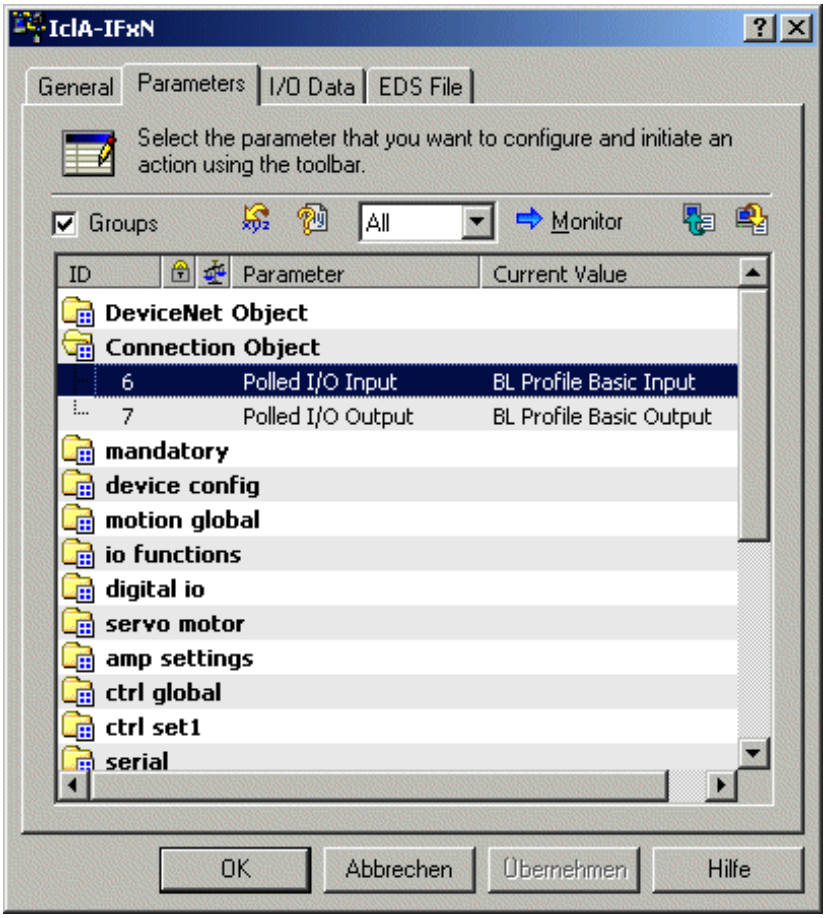

Figure 7.2 Configuring connection object in the device

If you want to use extended input/output assemblies, you must adjust the reserved bytes in the DeviceNet-Scanner configuration.

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Configuring the DeviceNet scanner

▶ In the DeviceNet Scanner configuration in the "Scanlist" tab, add the product for "Scanlist".

▶ Adjust the bytes as follows in the "Scanlist" tab using the "Edit I/O Parameters"button.

- Position Controller Profile 100 -> 8 Bytes

  Standard Output Assembly 101 -> 8 Bytes

  Extended Output Assembly 102 -> 12 Bytes

- Position Controller Profile 110 -> 8 Bytes

  Standard Input Assembly 111 -> 8 Bytes

  Extended Input Assembly 112 -> 14 Bytes

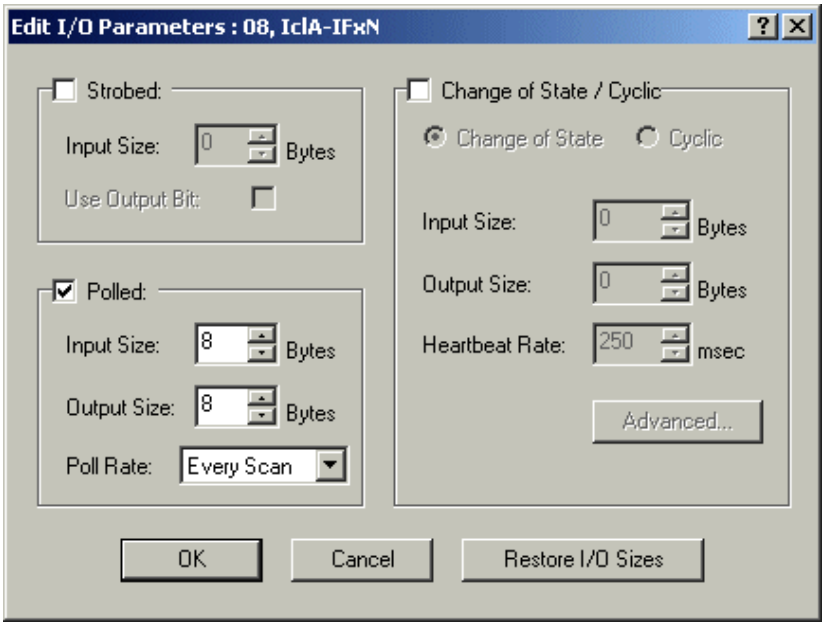

Figure 7.3 Reserve data range

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7.3.3 BLCT commissioning software

Features

The commissioning software simplifies commissioning, parameterisation, simulation and diagnostics.

It provides extensive options such as:

- Graphic interface for parameter setting and status display
- Extensive diagnostic tools for optimisation and maintenance
- Long-term recording as an aid to assessing operating behaviour
- Testing input and output signals
- Tracking signal sequences on the monitor
- Archiving all device settings and recordings with export functions for data processing

Requirements

- PC or laptop with Windows 2000 or later
- Converter for fieldbus connection to PC
- Product manual: BLCT commissioning software

Converter

You require a converter to connect the product to the PC. This allows you to perform the connection using the commissioning interface or the fieldbus interface.

The commissioning interface mainly differs from the fieldbus interface as follows:

- Commissioning interface:
  - Converter for RS485 is required.
  - Connection possible while operation is in process.
  - Master must not be deactivated.
  - 24V fieldbus supply must not be activated.
- Fieldbus interface:
  - Converter for DeviceNet is required.
    "USB-to-CAN compact", www.ixxat.com
  - Connection not possible while operation is in process.
  - Master must be deactivated.
  - 24V fieldbus supply must be activated.

Online help

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

Reference source of commissioning software

The current commissioning software is available for download from the internet.
http://www.berger-lahr.com/download

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7.3.4 Setting basic parameters and limit values

⚠ WARNING

Unexpected behaviour

The behaviour 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`.

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_I_max	Current limiting The value cannot exceed the max. allowable current of the drive M_I_max. Default is M_I_max	A_{pk} 0.00 - 299.99	UINT16 UINT16 R/W per. -	Modbus 4610 DeviceNet 118.1.1
LIM_I_maxQSTP	Current limiting for Quick Stop max. Current at braking via torque ramp due to error with error class 1 or 2, and on triggering of a software stop. Maximum and default value setting depend on M_I_max. in 0.01 Apk steps	A_{pk} - - -	UINT16 UINT16 R/W per. -	Modbus 4362 DeviceNet 117.1.5
LIM_I_maxHalt	Current limiting for Stop max. Current during braking after Halt or termination of an operating mode. Maximum and default value setting depend on M_I_max. in 0.01 Apk steps	A_{pk} - - -	UINT16 UINT16 R/W per. -	Modbus 4364 DeviceNet 117.1.6

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 limiter Setting value must not exceed Do not exceed speed of motor. Default is maximum speed of motor (see M_n_max)	1/min 0 - 13200	UINT16 UINT16 R/W per. -	Modbus 4612 DeviceNet 118.1.2

Type of preset reference value

▶ Using the `IOposInterfac` parameter, define the type of preset reference value for use with the "electronic gear"operating mode.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOposInterfac	Signal selection at position interface **0 / ABinput**: Input ENC_A, ENC_B 4x evaluation **1 / PDinput**: input PULSE, DIR RS422 IO interface (Pos) IMPORTANT: A change of the setting is not activated until the unit is switched on again	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 1284 DeviceNet 105.1.2

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7.3.5 Digital inputs/outputs

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

Configuration of the 24V signals is described in Chapter 8.6.9 "Configurable inputs and outputs".

Factory settings

The following table provides an overview of the factory settings.

Pin	Signal	Factory setting	I/O
CN4.3	LI01	Input Positive limit switch (LIMP)	I
CN4.6	LI02	Input Negative limit switch (LIMN)	I
CN4.2	LI03	Input Free available	I
CN4.5	LI04	Input Reference switch (REF)	I

Signal level

Using the parameter _IO_LIO_act, you can display the current signal level of the 24V signals.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_IO_LIO_act	Status of digital inputs/outputs Coding of the individual signals: Bit0: LIO1 Bit1: LIO2 ...	- - 0 -	UINT16 UINT16 R/- - -	Modbus 2090 DeviceNet 108.1.21

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7.3.6 Checking the signals of limit switches

⚠ CAUTION

Loss of control

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

- Use LIMP and 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 LIMP and 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 8.6.9 "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 8.6.1 "Monitoring functions".

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

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7.3.7 Testing safety functions

Operation with "Power Removal"

You must perform the following steps if you want to use the "Power Removal" safety function.

- Supply voltage switched off.
- ▶ Check that the inputs PWRR_A and PWRR_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. PWRR_A and PWRR_B must be disconnected simultaneously (skew <1s).
- ◁ The power amplifier is deactivated and error message 1300 is displayed. (CAUTION: error message 1301 displays a wiring error.)
- ▶ Check if the parameter IO_AutoEnable is set to "off" to prevent unexpected restart.
- ▶ Check the behaviour of the drive in error states.
- ▶ Record all tests of the safety function in the acceptance record.

Operation without "Power Removal"

If you do not want to use the "Power Removal" safety function, follow the steps below.

- ▶ Check whether the jumper CN6 is connected.

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7.3.8 Releasing holding brake manually

The drive takes control of the integrated holding brake and it is released automatically. However, for commissioning it may be necessary to release the holding brake manually.

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

⚠ WARNING

Unexpected movement

Releasing the holding brake manually or an error may cause an unexpected movement in the system.

- Disable the inputs PWRR_A and PWRR_B (status 0) to prevent an unwanted startup.
- Make sure that no damage will be caused by the load dropping.
- Run the test only if there are no persons or materials in the danger zone of the moving system components.

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

Power amplifier deactivated

The holding brake can be released without activating the power amplifier with the parameter BRK_release and the commissioning software.

The power amplifier cannot be activated with a manually released holding brake.

Power amplifier activated

When the power amplifier is activated the holding brake is automatically controlled. If the holding brake is manually released an error message is generated.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
BRK_release	Processing of holding brake 0: automatic processing (default) 1: manual brake release Activation of the brake output is only possible in 'Switch on disabled' or 'Ready to switch on' status if the power amplifier is activated the value 0 is automatically set.	- 0 0 1	UINT16 UINT16 R/W - -	Modbus 2068 DeviceNet 108.1.10

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7.3.9 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 the 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 8.6.10 "Reversal of direction of rotation".

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7.3.10 Setting parameters for encoder

Setting an encoder absolute position

When starting up the device reads the absolute position of the motor from the encoder. The current absolute position can be displayed by the parameter _p_absENCusr.

At motor standstill the new absolute position of the motor can be defined as the current mechanical position with the parameter ENC_pabsusr. The value can be transferred with the power amplifier active and inactive. Setting the absolute position also shifts the position of the index pulse of the encoder and the index pulse of the encoder simulation.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_p_absENCusr	Motor position rel. to encoder work stroke in user-def. units Value range is defined by encoder type On singleturn motor encoders, the value is supplied relative to one motor revolution, on multiturn motor encoders it is relative to the entire work stroke of the encoder (e.g. 4096 revs.) IMPORTANT: Position is only valid after determination of the motor absolute position. With invalid motor absolute position: _WarnLatched _WarnActive Bit 13=1: absolute position of motor not yet detected	usr - 0 -	UINT32 UINT32 R/- - -	Modbus 7710 DeviceNet 130.1.15
ENC_pabsusr	Setting position of the motor sensor directly Value range depends on the sensor type. Singleturn encoder: 0..max_pos_usr/rev. - 1 Multiturn encoder: 0 .. (4096 * max_pos_usr/rev.) -1 max_pos_usr/rev.: maximum user position for one motor revolution, with default position scaling this value is 16384. IMPORTANT: * If processing is to be carried out with direction inversion, this must be set before setting the motor encoder position * The set value does not become active until the next time the controller is switched on. After the write access a wait of at least 1 second is required until the controller is switched off. * Changing the value also changes the position of the virtual index pulse and the index pulse displaced at ESIM function.	usr 0 - 2147483647	UINT32 UINT32 R/W - -	Modbus 1324 DeviceNet 105.1.22

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Singleturn encoder

With the Singleturn encoder the position of the index pulse of the encoder can be moved by setting a new absolute position. At position value 0 the index pulse is defined at the current mechanical motor position.

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

Multiturn encoder

With the Multiturn encoder the mechanical work stroke of the motor can be shifted to the continuous range of the sensor by setting a new absolute position.

If the motor is moved counterclockwise from the absolute position 0, the Multiturn encoder receives an underrun of its absolute position. In contrast, the internal actual position counts mathematically forward and sends a negative position value. After switching off and on the internal actual position would no longer show the counterclockwise position value but the absolute position of the encoder.

An overflow or underrun are discontinuous positions in the area of travel. To prevent these jumps the absolute position in the sensor must be set so the mechanical limits are within the continuous range of the encoder.

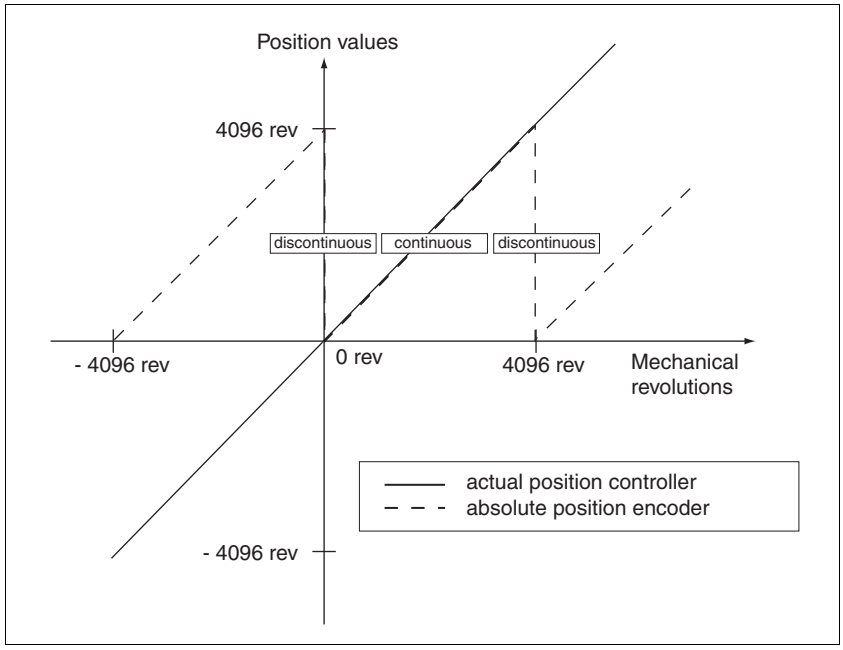

Figure 7.4 Position values of multiturn encoder

▶ When setting the absolute position at the mechanical limit set a position value >0. This ensures that when the drive is moved within the mechanical limits of the system the resulting encoder position is always within the continuous range of the encoder.

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7.4 Controller optimisation with step response

7.4.1 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.

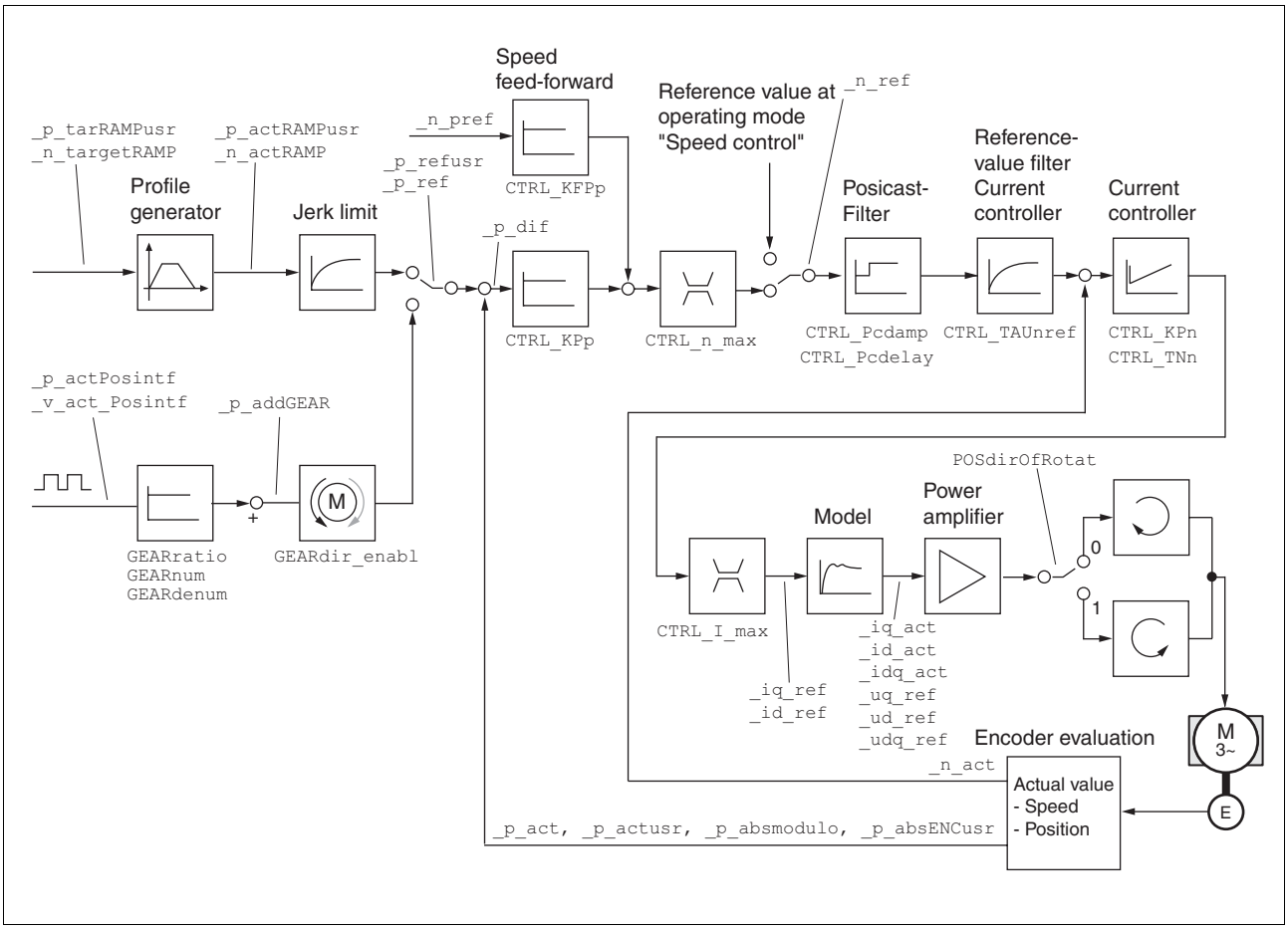

Figure 7.5 Controller structure

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

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

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

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

A requirement for good amplification of the position controller is an optimised speed control loop.

7.4.2 Optimisation

The drive optimisation 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 behaviour on the monitor with the commissioning software.

Setting reference signals

▶ Start controller optimisation with the commissioning software using the menu path "Functions - Recording/optimisation...".

▶ Switch to the "Tune" tab.

▶ Set the following values for the reference signal:

- Amplitude: 100 1/min
- Period: 100 ms
- Signal: positive jump
- Number of repetitions: 1

▶ Also note additional settings in the "Display - Specific Displays" menu.

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The total dynamic behaviour 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 optimisation 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 optimisation in the parameters window in the "Control" group.

7.4.3 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 optimised 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-factor Default value is calculated from motor parameters	A/(1/min) 0.0001 - 1.2700	UINT16 UINT16 R/W per. -	Modbus 4614 DeviceNet 118.1.3
CTRL_TNn	Speed controller correction time	ms 0.00 - 327.67	UINT16 UINT16 R/W per. -	Modbus 4616 DeviceNet 118.1.4

Check and optimise the calculated values in a second step, as described from page 118.

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Determining the mechanics of the system

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

- System with rigid mechanism
- System with less rigid mechanism

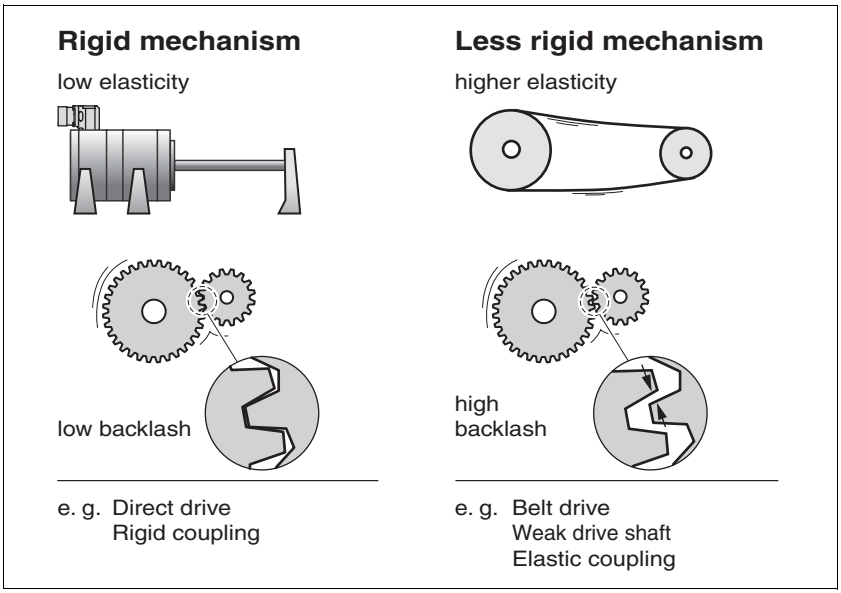

Figure 7.6 Mechanical systems with rigid and less rigid mechanisms

▶ 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 behaviour under optimised 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_TAUnref` 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_TAUnref	Filter time constant reference value filter of the setpoint speed value	ms 0.00 0.00 327.67	UINT16 UINT16 R/W per. -	Modbus 4626 DeviceNet 118.1.9

The procedure for optimisation 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.

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Determining controller values with rigid mechanics

Requirements for setting the control behaviour 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 7.1:

	$J_L = J_M$		$J_L = 5 * J_M$		$J_L = 10 * J_M$	
J_L[kgcm^2]	KPn	TNn	KPn	TNn	KPn	TNn
1	0.0125	8	0.008	12	0.007	16
2	0.0250	8	0.015	12	0.014	16
5	0.0625	8	0.038	12	0.034	16
10	0.125	8	0.075	12	0.069	16
20	0.250	8	0.150	12	0.138	16

Table 7.1 Determining controller values

Determining controller values with less rigid mechanics

For optimisation 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 optimisation 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.

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- ▶ 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".

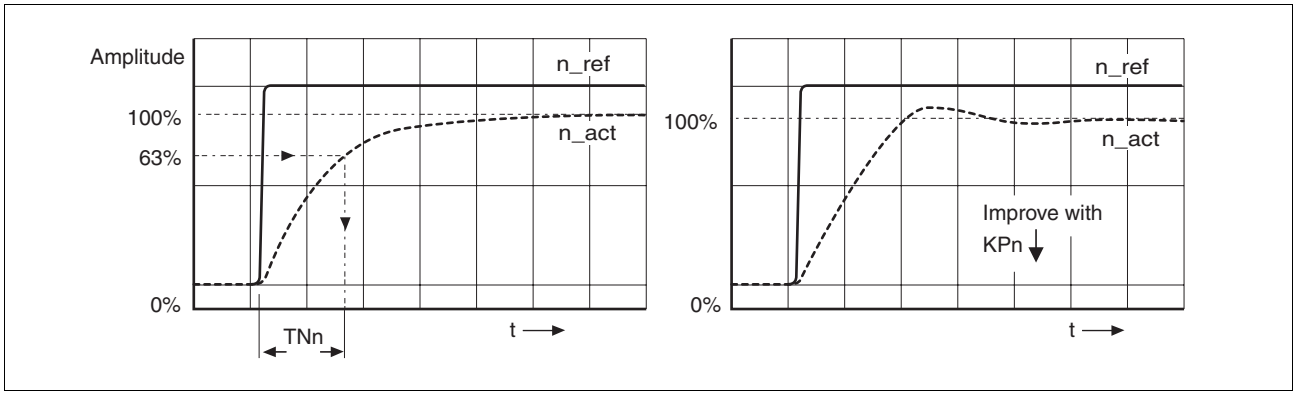

Figure 7.7 Determining 'TNn' in the aperiodic limiting case

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 optimisation

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

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7.4.4 Checking and optimising default settings

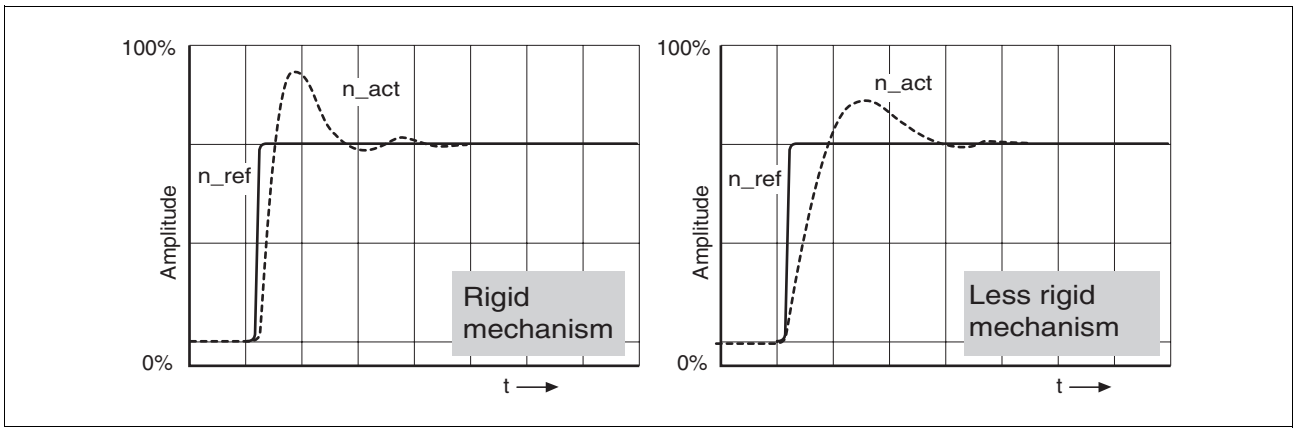

Figure 7.8 Step responses with good control behaviour

The controller is properly set when the jump response is approximately identical to the signal path shown. Good control response can be recognised 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 recognise an oscillation by the motor continuously accelerating and decelerating.

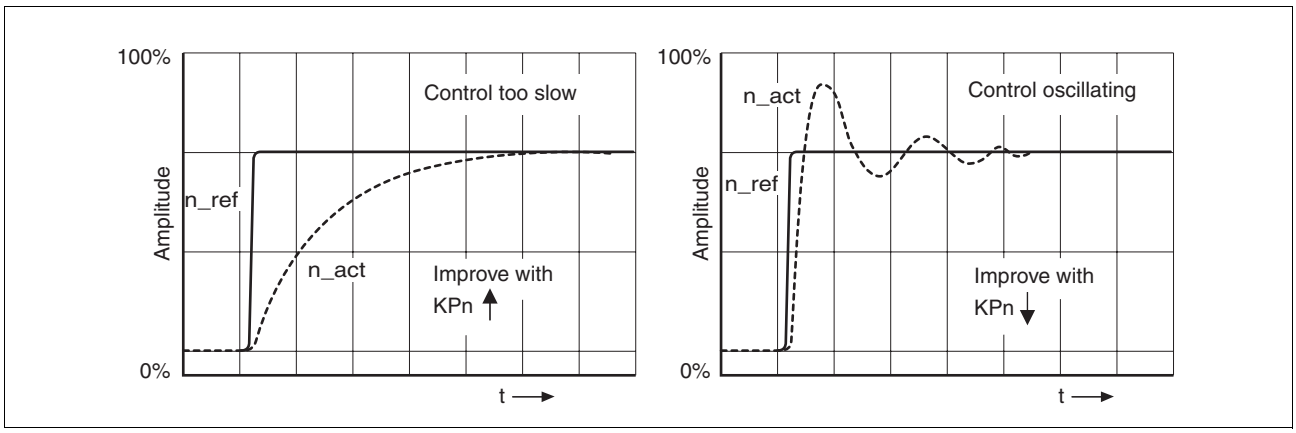

Figure 7.9 Optimise inadequate settings of the speed controller

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

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7.4.5 Optimising the position controller

Optimisation 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 optimised 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-factor Default value is calculated	1/s 2.0 - 495.0	UINT16 UINT16 R/W per. -	Modbus 4620 DeviceNet 118.1.6

⚠ 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.

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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.

Optimising 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.

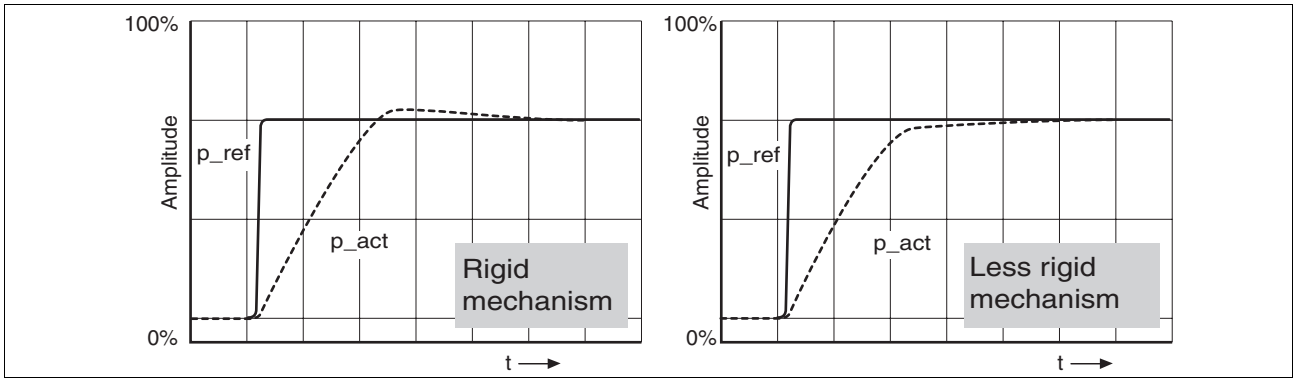

Figure 7.10 Step responses of a position controller with a good control behaviour

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 behaviour 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.

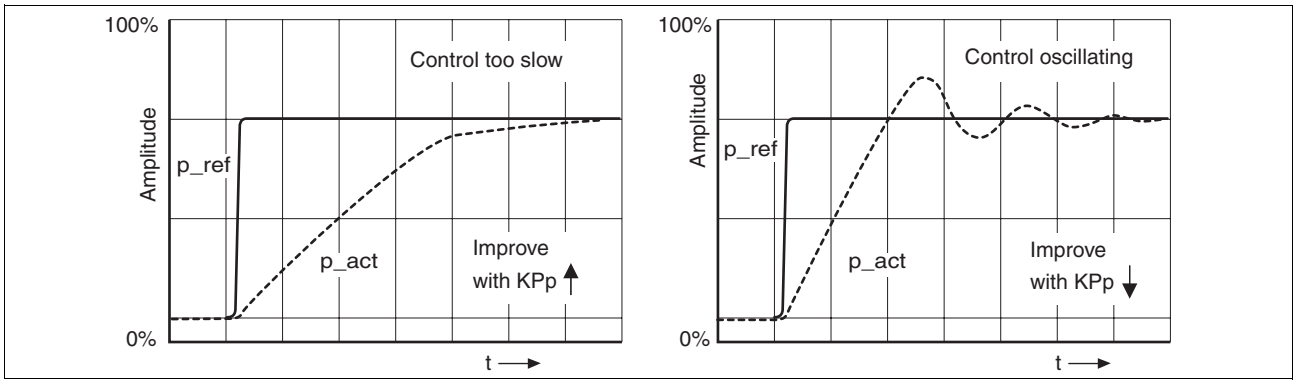

Figure 7.11 Optimising improper settings of the position controller

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8 Operation

The "Operation" section describes the basic operating statuses, 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.*

8.1 Overview of operating modes

The following table shows an overview of the operating modes and the type of reference value preselection.

Operating mode	Setpoint default	Description
Jog	Fieldbus commands	Page 131
Speed control	Fieldbus commands	Page 134
Electronic gear	P/D or A/B	Page 135
Profile position	Fieldbus commands	Page 139
Profile velocity	Fieldbus commands	Page 142
Homing	Fieldbus commands	Page 144

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 loop	Profile generator
Jog	Position controller	X
Speed control	Speed controller	-
Electronic gear	Position controller	-
Profile position	Position controller	X
Profile velocity	Position controller	X
Homing	Position controller	X

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8.2 Access control

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

8.2.1 via fieldbus

You can use the parameter AccessLockto restrict access control to the fieldbus. Control using another access channel is then not possible.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
AccessLock	Locking of other access channels 0: Other access channels enabled 1: Other access channels locked With this parameter, the fieldbus can lock active access to the device for the following access channels: - input signals - commissioning software The processing of the HALT input signal cannot be locked.	- 0 - 1	UINT16 UINT16 R/W - -	Modbus 316 DeviceNet 101.1.30

8.2.2 via commissioning software

Using the "Access" field, you can restrict access control to the commissioning software. Control using another access channel is then not possible.

8.2.3 via signal inputs

You can control the device using the functions of the signal inputs LI01 ... LI04. Control is not possible while another access channel has exclusive access control.

Exceptions:

- The digital signal inputs with the functions "Halt", "Positive limit switch (LIMP)", "Negative limit switch (LIMN)" and "Reference switch (REF)" still work.
- The digital signal inputs $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ still work.

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8.3 Operating statuses

8.3.1 Status 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 status diagram is shown graphically as a flow chart.

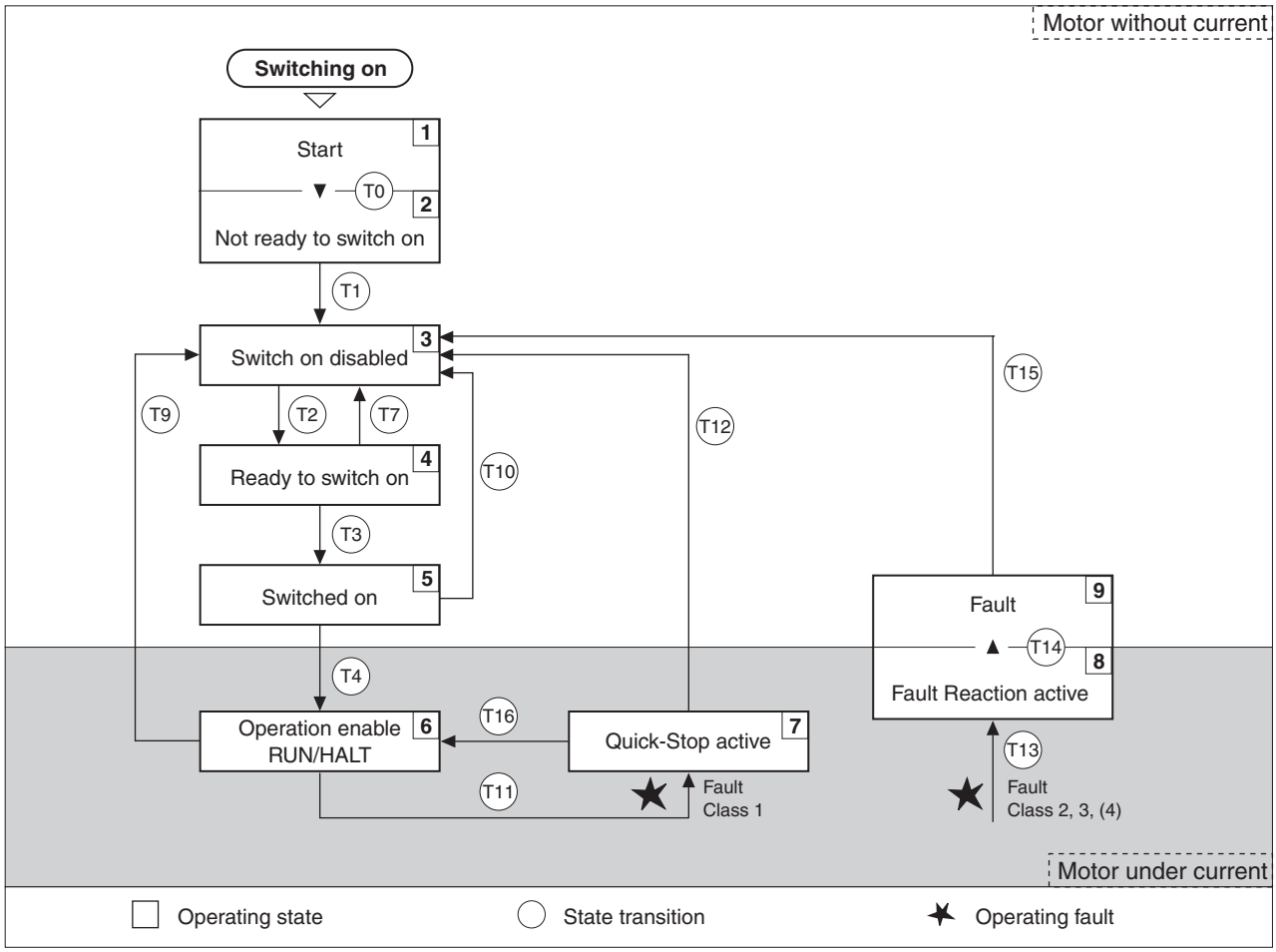

Figure 8.1 Status diagram

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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 initialised
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

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 initiates an error response as soon as an internal occurrence indicates a breakdown to which the device must react.

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

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An operating error can be indicated by, for example, a temperature sensor. The device aborts the running 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 state 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**.*

Status transitions

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

Transition	Operating state	Condition / event [1) 2)]	Response
T0	**1**-> **2**	• Device electronics successfully initialised	
T1	**2**-> **3**	• Parameter successfully initialised	
T2	**3**-> **4**	• no under-voltage Motor encoder successfully checked, Actual speed: <1000 1/min $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ = +24V, (or plug bridge CN6 inserted)	
T3	**4**-> **5**	• Call-up for activation of power amplifier	
T4	**5**-> **6**	• Automatic transition	Power amplifier is activated User parameters are checked Holding brake is released (if present)
T7	**4**-> **3**	• Undervoltage • $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ = 0V • Actual speed: >1000 1/min (e.g. by remote drive)	-
T9	**6**-> **3**	• Call-up for deactivation of power amplifier	Power amplifier is immediately deactivated.
T10	**5**-> **3**	• Call-up for deactivation of power amplifier	
T11	**6**-> **7**	• Class 1 error	Interrupt travel command with "Quick Stop".
T12	**7**-> **3**	• Call-up for deactivation of power amplifier	Power amplifier is deactivated immediately, even if "Quick Stop" is still active.
T13	**x** -> **8**	• Errors Class 2, 3 or 4	Error response is carried out, see "Error response"
T14	**8** -> **9**	• Error response terminated (error from class 2) • Errors Class , 3 or 4	
T15	**9**-> **3**	• Function: "Fault Reset"	Error is reset (cause of error must be corrected).
T16	**7**-> **6**	• Function: "Fault Reset"	

1) In order to initiate status transition it is sufficient to fulfil just one point
2) fieldbus commands only with control mode fieldbus

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8.3.2 Displaying the operating statuses

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

Signal outputs

You must configure the operating statuses with the signal outputs, see chapter 8.6.9 "Configurable inputs and outputs".

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

Commissioning software

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

fieldbus

The current operating status is displayed using the "driveStat" word.

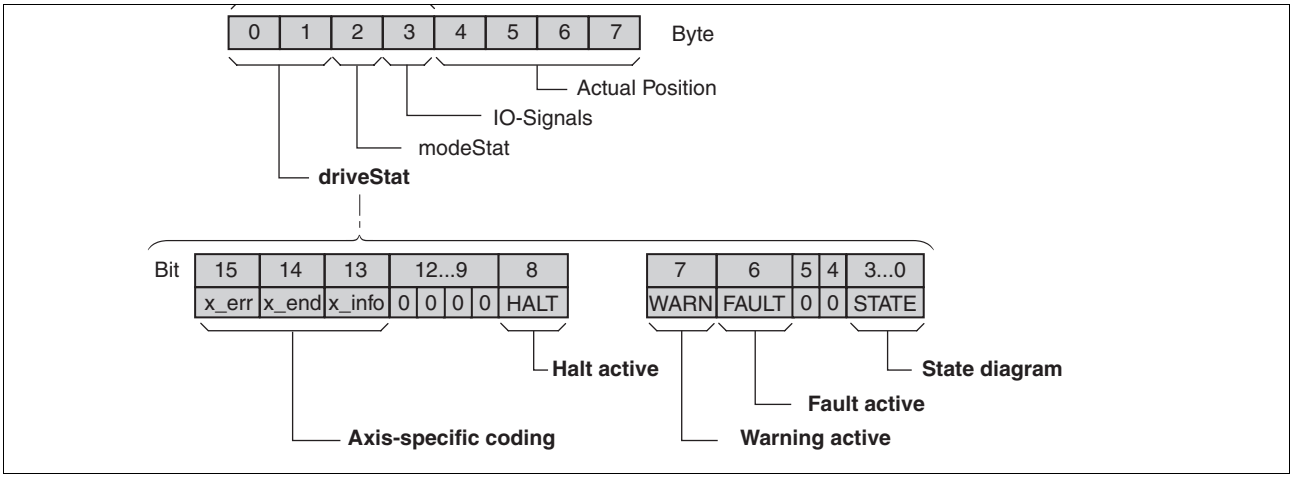

Figure 8.2 driveStat structure

Bit	Name	Signifi-cance	Description
0 ... 3	STATE	$000F_h$	Current operating status
6	FAULT	0040_h	An error has occurred
7	WARN	0080_h	A warning was generated
8	HALT	0100_h	"Halt" function is active
9 ... 12	-	-	reserved
13	x_info	2000_h	Additional information on operating mode
14	x_end	4000_h	End label of operating mode
15	x_err	8000_h	error identifier of operating mode

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8.3.3 Changing operating statuses

You can switch the operating status using the commissioning software or the fieldbus.

Commissioning software

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

fieldbus

The operating status is set using the "driveCtrl" byte.

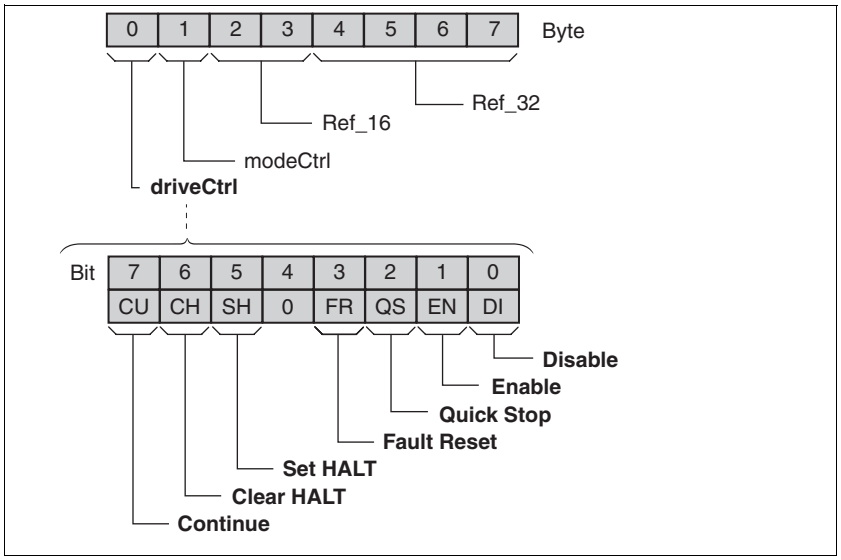

Figure 8.3 driveCtrl structure

Bit	Name	Signifi-cance	Description
0	DI	01_h	Deactivate power amplifier
1	EN	02_h	Activate power amplifier
2	QS	04_h	Execute the "Quick Stop" function
3	FR	08_h	Execute the "Fault Reset" function
4	-	10_h	reserved
5	SH	20_h	Execute the "Halt" function
6	CH	40_h	Clear the "Halt" function
7	CU	80_h	Resume operating mode interrupted by "Halt"

During the access operation, these bits are edge-selective: the relevant function is triggered with a 0->1 edge.

If a request for changing the operating status cannot be implemented, this request is ignored. There is no error response.

Non-unique bit combinations are treated in accordance with the following priority list:

- Bit 0 (Disable) before Bit 1 (Enable)
- Bit 2 (Quick Stop) before Bit 3 (Fault Reset)
- Bit 5 (Set HALT) before Bit 6 (Clear HALT) and Bit 7 (Continue)

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8.4 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 initialised.

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 statuses and activating the operating modes must be executed separately. An operating mode can generally only be activated if the operating status is already "Operation enable".

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8.4.1 Displaying and monitoring the operating mode

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

Commissioning software

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

fieldbus

The current operating mode is displayed using the "modeStat" byte.

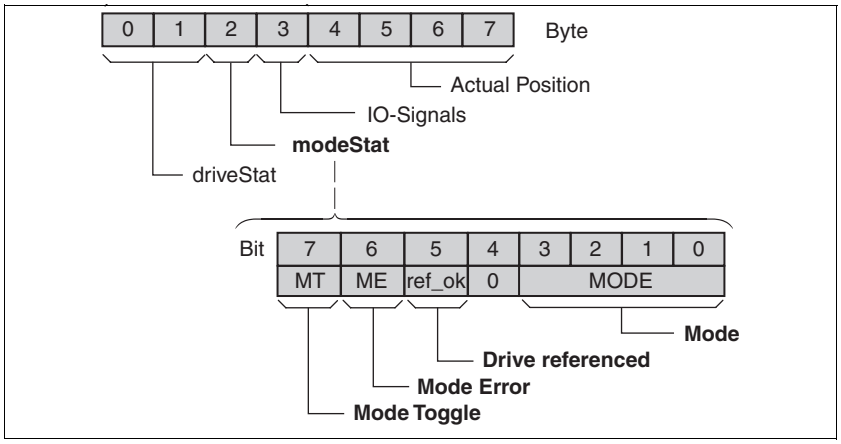

Figure 8.4 modeStat structure

Bit	Name	Description
0 ... 3	MODE	displays the current defined operating mode : 1: Jog 2: Homing 3: Profile position 4: Profile velocity 5: Electronic gear 7: Speed control
4	-	reserved
5	ref_ok	set if operating mode homing was successfully completed
6	ME	set if a master request was rejected
7	MT	Handshake via "Mode Toggle", see chapter 4.2.6 "Handshake with Mode Toggle Bit"

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8.4.2 Starting and changing operating mode

You can start and change an operating mode using the commissioning software or the fieldbus.

Commissioning software

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

fieldbus

The operating mode is set using the "modeCtrl" byte.

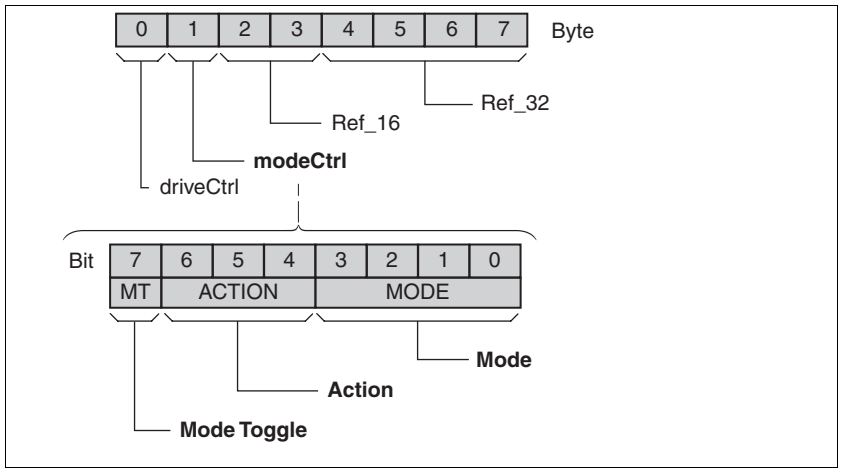

Figure 8.5 modeCtrl structure

Bit	Name	Description
0 ... 3	MODE	displays the current defined operating mode : 1: Jog 2: Homing 3: Profile position 4: Profile velocity 5: Electronic gear 7: Speed control
4 ... 6	ACTION	Operating mode-dependent action
7	MT	Handshake via Mode Toggle (see chapter 4.2.6 "Handshake with Mode Toggle Bit"

The operating modes can be changed whilst the operation is in process. For this purpose, the current process must be completed or explicitly discontinued. The drive must be at a standstill.

Fault processing

When the status of the "Mode Toggle" bit is changed, this is considered as a request to start an operating mode or to change data of the current operating mode.

If the request cannot be processed, the "Mode Error" bit is set in the "modeStat" byte. This has no effect on the defined operating mode. Use the parameter `ModeError` to read out the corresponding error number.

The "Mode Error" bit remains set until a new command is issued.

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8.5 Operating modes

8.5.1 Operating mode Jog

⚠ DANGER

Unexpected movement

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

- Check the behaviour of the system during application of the power supply.
- Male 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.

⚠ 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 is started with an output assembly. The value in byte "modeCtrl" is "Mode Toggle" without the set bit.

modeCtrl	reference value ref_16	reference value ref_32
01_h	as `JOGactivate`	-

Status information

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

Bit	Name	Description
13	x_info	reserved
14	x_end	0: Operating mode active 1: Operating mode finished
15	x_err	0: no error 1: Error arisen

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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 cancelled.

The graph below shows an overview.

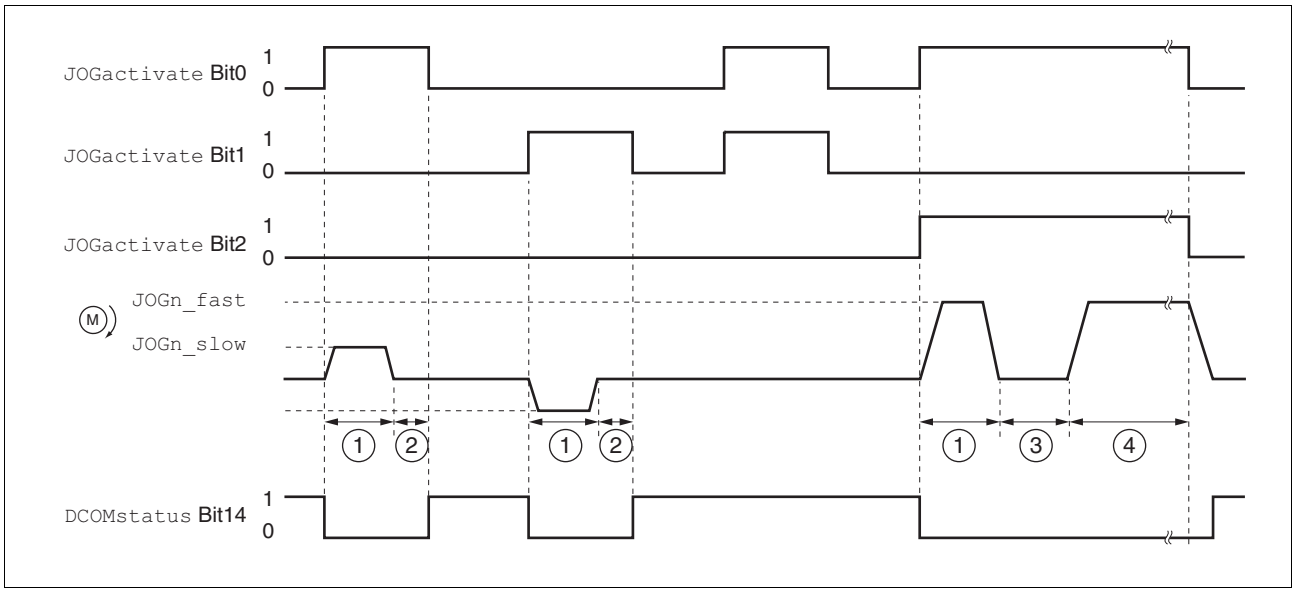

Figure 8.6 Jog, slow and fast

(1) Path unit
(2) t < wait time
(3) t > 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 Bit0: clockwise rotation Bit1: counterclockwise rotation Bit2: 0=slow 1=fast If both direction bits are activated simultaneously, no movement is initiated. In the case of an ongoing jog, the simultaneous activation of the rotation direction bits has no effect.	- 0 0 7	R/W - -	
JOGn_slow	Speed for slow jog The set value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 60 13200	UINT16 UINT16 R/W per. -	Modbus 10504 DeviceNet 141.1.4

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
JOGn_fast	Speed for fast jog The set value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 180 13200	UINT16 UINT16 R/W per. -	Modbus 10506 DeviceNet 141.1.5
JOGstepusr	inching movement before continuous operation 0: direct activation of continuous operation >0: positioning section per inching cycle	usr 0 20 -	INT32 INT32 R/W per. -	Modbus 10510 DeviceNet 141.1.7
JOGtime	Waiting time before continuous operation Time is only effective if an inching section not equal to 0 has been set, otherwise direct transition to continuous operation.	ms 1 500 32767	UINT16 UINT16 R/W per. -	Modbus 10512 DeviceNet 141.1.8

End operating mode

Jog is finished when the motor has stopped and

- the direction signal is disabled,
- 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 157.

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8.5.2 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.

Start operating mode

The operating mode is started with an output assembly. The value in byte "modeCtrl" is "Mode Toggle" without the set bit.

modeCtrl	reference value ref_16	reference value ref_32
17_h	as SPEEDn_target	-

Status information

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

Bit	Name	Description
13	x_info	0: Motor turns 1: Motor standstill
14	x_end	0: Operating mode active 1: Operating mode finished
15	x_err	0: no error 1: Error arisen

Setting thresholds

For setting current limiting and speed limiting see 7.3.4 "Setting basic parameters and limit values".

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPEEDn_target	Set speed in operating mode speed control The internal maximum speed is limited by the current setting in CTRL_n_max	1/min -30000 0 30000	INT16 INT16 R/W - -	Modbus 8456 DeviceNet 133.1.4

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.

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8.5.3 Operating mode Electronic gear

⚠ 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.

Description In the electronic gear operating mode reference signals are fed in as A/B signals or as pulse/direction signals. They are offset to a new position preset with an adjustable gear ratio.

The parameter `IOposInterfac` specifies the type of preset reference value.

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

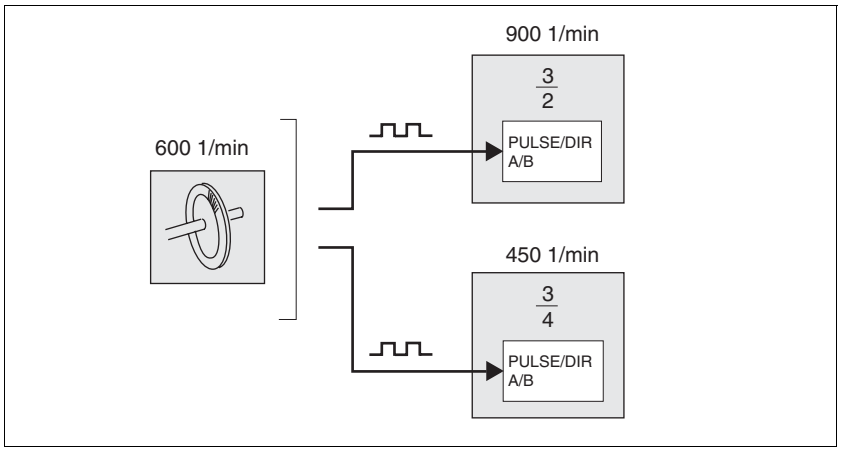

Figure 8.7 Preset default via NC controller

Start operating mode The operating mode is started with an output assembly. The value in byte "modeCtrl" is "Mode Toggle" without the set bit.

Description	modeCtrl	reference value ref_16	reference value ref_32
Immediate synchronisation:	05_h	as `GEARdenom`	as `GEARnum`
Synchronisation with compensation movement:	15_h	as `GEARdenom`	as `GEARnum`

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Status information

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

Bit	Name	Description
13	x_info	reserved
14	x_end	0: Operating mode active 1: Operating mode finished
15	x_err	0: no error 1: Error arisen

End operating mode

The process is ended by:

- disabling the operating mode and motor at standstill
- motor standstill by "Halt" or by an error

8.5.3.1 Parameterisation

Overview

The following overview shows the mode of action of the parameters that can be set for the operating mode electronic gear.

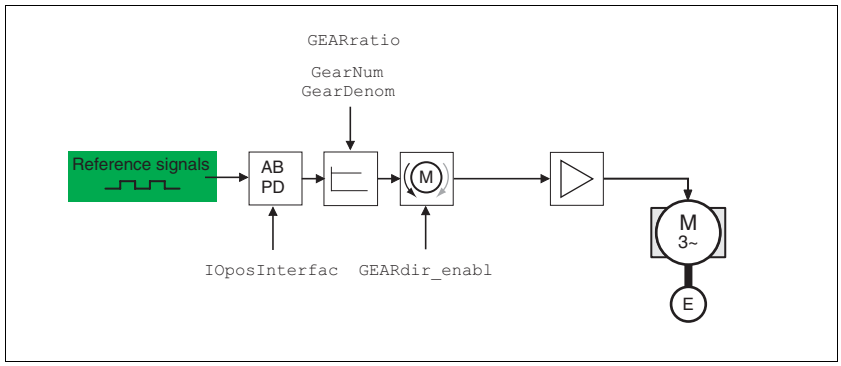

Figure 8.8 Operating mode electronic gear, effect of settable parameters

The resulting positioning path is dependent upon the current motor resolution. It amounts to 32768 motor increments per revolution.

The setting values, independent of the type of synchronisation, are:

- Gear factor (predefined value or intrinsic gear factor)
- size of following error
- Release of the direction of rotation

Setting thresholds

For setting current limiting and speed limiting see 7.3.4 "Setting basic parameters and limit values".

Synchronisation

The device operates synchronously interconnected, e.g. with other drives. If the device leaves the processing for a short period of time, then the synchronous run with other drives is lost. However, position changes that occur at the reference signals are internally counted during the interruption.

You can either equalise or ignore the position changes when restarting gear processing. This depends on when the operating mode is started.

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Gear ratio The gear ratio is the relationship between the motor increments and the externally inputted guide increments for the movement of the motor.

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

The parameter GEARratio serves to set the predefined gear ratio. Alternatively, an intrinsic gear ratio can be selected.

The intrinsic gear ratio is determined with the parameters count and name. A negative numerator value reverses the motor's direction of rotation. The gear ratio is preset to 1:1.

▶ Using the GEARratio parameter, specify whether you want to use a particular gear ratio or your own factor from numerator/denominator.

If you use the counter/denominator, the required factor is defined with the output assembly.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
GEARratio	Selection of special gear ratios 0: Use of the specified gear ratio from GEARnum/GEARdenom 1: 200 2: 400 3: 500 4: 1000 5: 2000 6: 4000 7: 5000 8: 10000 9: 4096 10: 8192 11: 16384 Changing the reference value by the stated value results in one motor rotation.	- 0 0 11	UINT16 UINT16 R/W per. -	Modbus 9740 DeviceNet 138.1.6
GEARnum	Gear ratio numerator $\text{Gear ratio} = \frac{\text{GEARnum}}{\text{GEARdenom}}$ The new gear ratio is implemented when the numerator value is transferred.	- -2147483648 1 2147483647	INT32 INT32 R/W per. -	Modbus 9736 DeviceNet 138.1.4
GEARdenom	Gear ratio denominator see description GEARnum	- 1 1 2147483647	INT32 INT32 R/W per. -	Modbus 9734 DeviceNet 138.1.3

Example At a setting of 1000 reference increments the motor should rotate 2000 motor increments. This yields a gear ratio of 2.

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Direction enabling The direction enabling allows restriction of the movement to positive or negative direction of rotation. Direction enabling is set with the parameter `GEARdir_enabl`.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
GEARdir_enabl	Enabled direction of motion of the gear processing **1 / positive :** pos. direction **2 / negative**: neg. direction **3 / both**: both directions This can be used to activate a reverse interlock.	- 1 3 3	UINT16 UINT16 R/W per. -	Modbus 9738 DeviceNet 138.1.5

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8.5.4 Operating mode Profile position

⚠ 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.

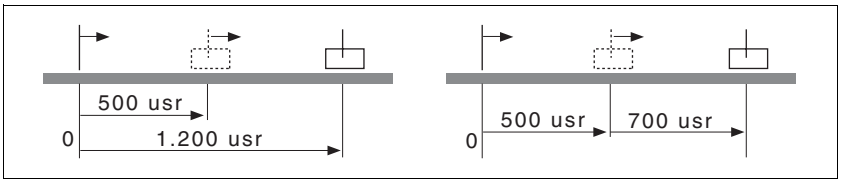

Figure 8.9 Absolute positioning (left) and relative positioning (right)

Start operating mode

The operating mode is started with an output assembly. The value in byte "modeCtrl" is "Mode Toggle" without the set bit.

Description	modeCtrl	reference value ref_16	reference value ref_32
absolute	03_h	as `PPn_target`	as `PPp_absusr`
Relative to the target position currently defined	13_h	as `PPn_target`	as `PPp_relprefusr`
Relative to the current motor position	23_h	as `PPn_target`	as `PPp_relpactusr`

Status information

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

Bit	Name	Description
13	x_info	0: Target position not reached : 1: Target position reached
14	x_end	0: Operating mode active 1: Operating mode finished
15	x_err	0: no error 1: Error arisen

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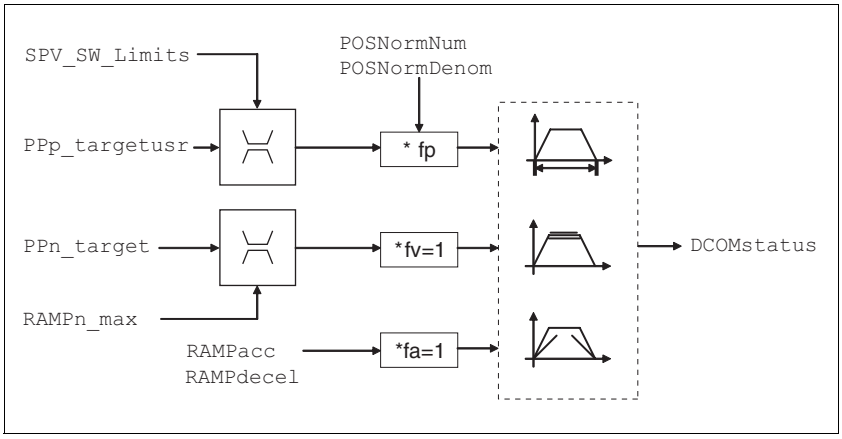

Figure 8.10 Profile position operating mode, effect of settable parameters

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
_p_actusr	Actual position of the motor in user units	usr - 0 -	INT32 INT32 R/- - -	Modbus 7706 DeviceNet 130.1.13
_p_actRAMPusr	Actual position of the movement profile encoder in user-defined units	usr - 0 -	INT32 INT32 R/- - -	Modbus 7940 DeviceNet 131.1.2

Target position A new position value is transferred with the parameter `PPp_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.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PPn_target	Speed setpoint for profile position Maximum value is limited to the current setting in CTRL_n_max. The set value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 60 13200	R/W - -	
AbsHomeRequest	Absolute positioning only after homing **0 / no**: No **1 / yes**: yes	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 1580 DeviceNet 106.1.22

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PPp_absusr	Absolute target position of profile position operating mode Min/Max values are dependent upon: - scaling factor - software limit switch (if activated)	usr - 0 -	R/W - -	
PPp_relpactusr	Target position relative to curent motor position Min/max value : depending on: - position scaling factor - software limit switch (if activated) During running positioning in profile position mode, the relative positioning refers to the current motor position. An overrun of the absolute user-defined position limits is possible only if the drive is at standstill when starting the movement (x_end=1). In this case an implicit setting dimensions to position 0 is run.	usr - 0 -	R/W - -	
PPp_relprefusr	Target position rel. to current profile position target pos. Min/max value : depending on: - position scaling factor - software limit switch (if activated) During running positioning in profile position mode, the relative positioning refers to the target position of the current movement. An overrun of the absolute user-defined position limits is possible only if the drive is at standstill when starting the movement (x_end=1). In this case an implicit setting of the dimensions to position 0 is run.	usr - 0 -	R/W - -	

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8.5.5 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

The operating mode is started with an output assembly. The value in byte "modeCtrl" is "Mode Toggle" without the set bit.

modeCtrl	reference value ref_16	reference value ref_32
04h	as PVn_target	-

Status information

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

Bit	Name	Description
13	x_info	0: Reference speed not reached 1: Reference speed reached
14	x_end	0: Operating mode active 1: Operating mode finished
15	x_err	0: no error 1: Error occurred

Overview

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

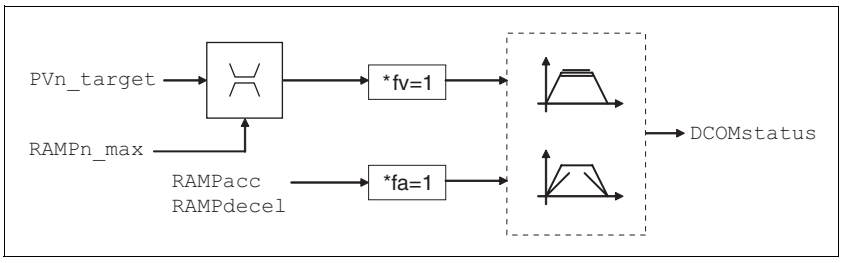

Figure 8.11 Profile velocity operating mode, effect of settable parameters

Reference speed

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.

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PVn_target	Setpoint velocity profile velocity operating mode Maximum value is limited to the current setting in CTRL_n_max. The set value is internally limited to the current parameter setting in RAMPn_max.	1/min -13200 - 13200	R/W - -	

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_n_act	Actual speed of motor	1/min - 0 -	INT16 INT16 R/- - -	Modbus 7696 DeviceNet 130.1.8
_n_actRAMP	Actual speed of the movement profile encoder	1/min - 0 -	INT32 INT32 R/- - -	Modbus 7948 DeviceNet 131.1.6

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8.5.6 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.

Homing is not required for a motor with Multiturn encoder because it sends a valid absolute position after startup.

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Types of reference movements

4 standard reference movements are available

- Movement to negative limit switch LIMN
- Movement to positive limit switch LIMP
- Movement to reference switch REF with movement in counter-clockwise rotation
- Movement to reference switch 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

The operating mode is started with an output assembly. The value in byte "modeCtrl" is "Mode Toggle" without the set bit.

Description	modeCtrl	reference value ref_16	reference value ref_32
Position setting	02h	-	as HMp_setpusr
Reference movement	12h	as HMmethod	-

Status information

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

Bit	Name	Description
13	x_info	reserved
14	x_end	0: Operating mode active 1: Operating mode finished
15	x_err	0: no error 1: Error arisen

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.

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMmethod	Reference movement method 0: disabled 1: LIMN with index pulse 2: LIMP with index pulse 7: REF+ with index pulse, inv., outside 8: REF+ with index pulse, inv., inside 9: REF+ with index pulse, not inv., inside 10: REF+ with index pulse, not inv., outside 11: REF- with index pulse, inv., outside 12: REF- with index pulse, inv., inside 13: REF- with index pulse, not inv., inside 14: REF- with index pulse, not inv., outside 17: LIMN 18: LIMP 23: REF+, inv., outside 24: REF+, inv., inside 25: REF+, not inv., inside 26: REF+, not inv., outside 27: REF-, inv., outside 28: REF-, inv., inside 29: REF-, not inv., inside 30: REF-, not inv., outside 33: index pulse, neg. direction of rotation 34: index pulse, pos. direction of rotation Abbreviations: REF+: search movement in pos. direction REF-: search movement in neg. direction inv.: Invert direction of rotation in switch not inv.: direction of rotation in switch not inverted. outside: Index pulse/distance outside switch. inside: index pulse/distance inside switch.	- 0 - 35	R/W - -	

The evaluation active 0 or active 1 of the reference switch`IOsigREF` is set via parameter $\overline{\texttt{REF}}$. A release of the switch is not required.

The parameters `IOsigLimP` and `IOsigLimN` are used to release the input signals $\overline{\texttt{LIMP}}$ and $\overline{\texttt{LIMN}}$ 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 breakage.

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOsigRef	REF signal evaluation **1 / normally closed:** normally closed contact **2 / normally open**: normally-open switch The reference switch is only activated while processing the reference movement to REF.	- 1 1 2	UINT16 UINT16 R/W per. -	Modbus 1564 DeviceNet 106.1.14

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOsigLimN	LIMN signal evaluation **0 / inactive:** inactive **1 / normally closed:** normally closed contact **2 / normally open**: normally-open switch	- 0 1 2	UINT16 UINT16 R/W per. -	Modbus 1566 DeviceNet 106.1.15
IOsigLimP	LIMP signal evaluation **0 / inactive:** inactive **1 / normally closed:** normally closed contact **2 / normally open**: normally-open switch	- 0 1 2	UINT16 UINT16 R/W per. -	Modbus 1568 DeviceNet 106.1.16

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 search for the switch The set value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 60 13200	UINT16 UINT16 R/W per. -	Modbus 10248 DeviceNet 140.1.4
HMn_out	Set speed for release movement from switch The set value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 6 3000	UINT16 UINT16 R/W per. -	Modbus 10250 DeviceNet 140.1.5

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMp_homeusr	Position on reference point After successful reference movement this position value is automatically set at the reference point.	usr -2147483648 0 2147483647	INT32 INT32 R/W per. -	Modbus 10262 DeviceNet 140.1.11

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

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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 0: Run-off check inactive >0: Run-off in user-defined units The switch must be disabled again inside this run-off, otherwise the reference movement is aborted	usr 0 0 2147483647	INT32 INT32 R/W per. -	Modbus 10252 DeviceNet 140.1.6
HMsrchdisusr	max. search distance after traversing over the switch 0: Search distance processing inactive >0: Search distance in user-defined units The switch must be enabled again inside this run-off, otherwise the reference movement is aborted	usr 0 0 2147483647	INT32 INT32 R/W per. -	Modbus 10266 DeviceNet 140.1.13

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8.5.6.1 Reference movement without index pulse

Description

The defined limit switch or reference switch is first approached. 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 between the switching point and the reference point After leaving the switch, the drive is still positioned in the working range for a defined path and this position is defined as a reference point. The parameters are only effective with reference movements without index pulse searching.	usr 1 200 2147483647	INT32 INT32 R/W per. -	Modbus 10254 DeviceNet 140.1.7

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).

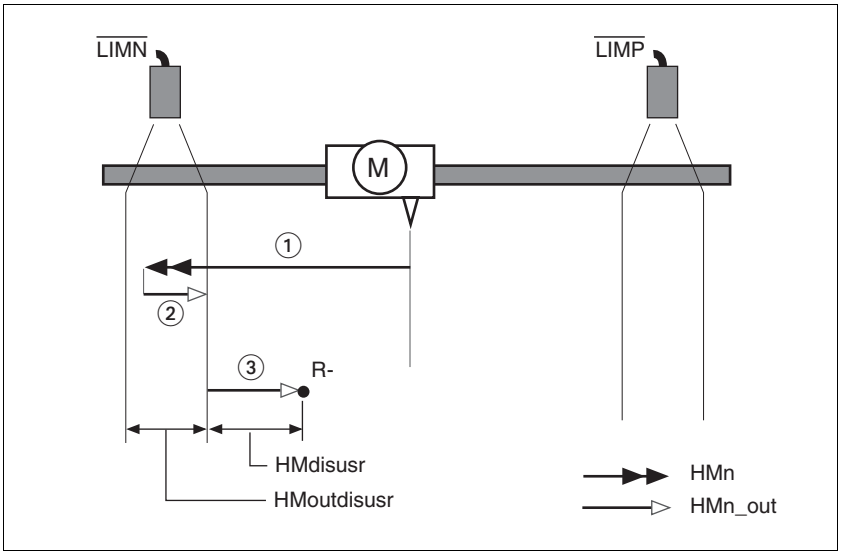

Figure 8.12 Reference movement to the negative limit switch

(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

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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).

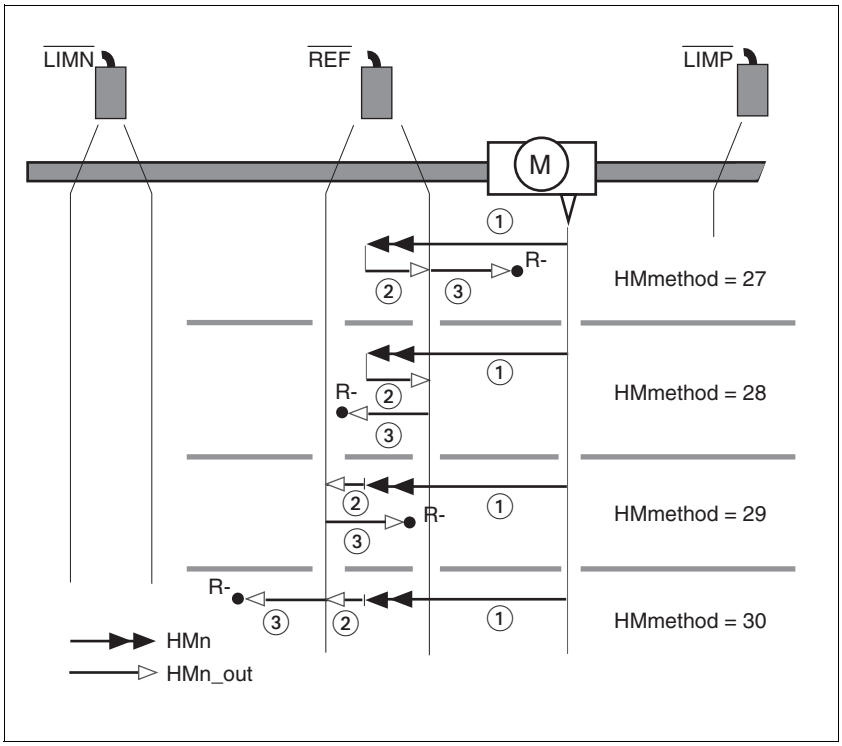

Figure 8.13 Reference movements to the reference switch

(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

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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).

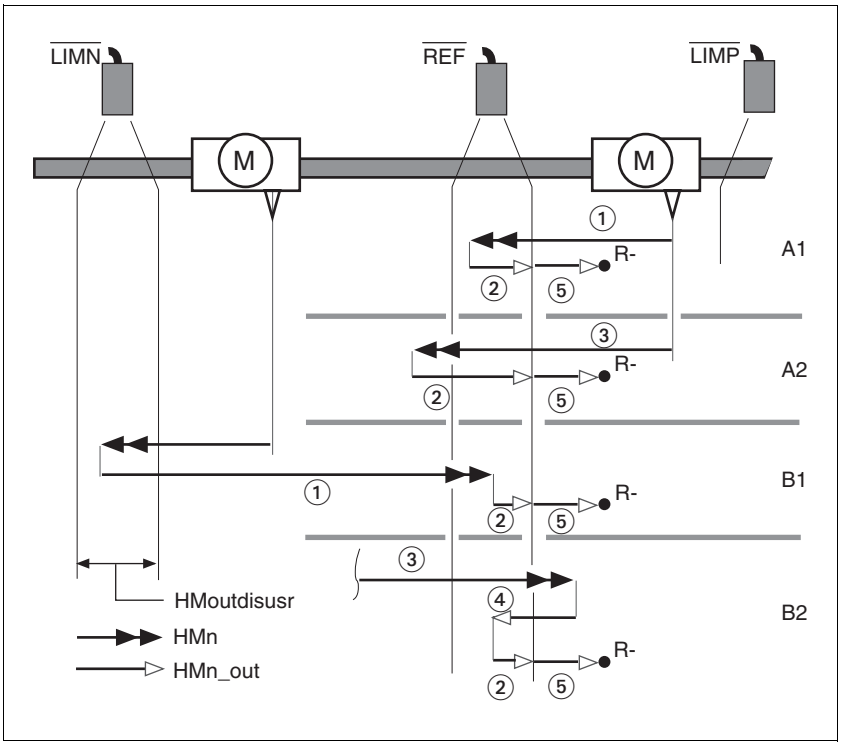

Figure 8.14 Reference movements to the reference switch

(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

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8.5.6.2 Reference movement with index pulse

Description The defined limit switch or reference switch is first approached. 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 7.3.10 "Setting parameters for encoder".

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMdisREFtoIDX	Distance of switch - index pulse after reference movement Reading value provides the value of the difference between the index pulse position and the position on the switching flank of the limit or reference switch. Serves to monitor how far the index pulse is from the switching flank and serves to provide the criterion whether the reference movement with index pulse processing can be safely reproduced. in steps of 1/10000 revolutions	revolution - 0.0000 -	INT32 INT32 R/- - -	Modbus 10264 DeviceNet 140.1.12

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

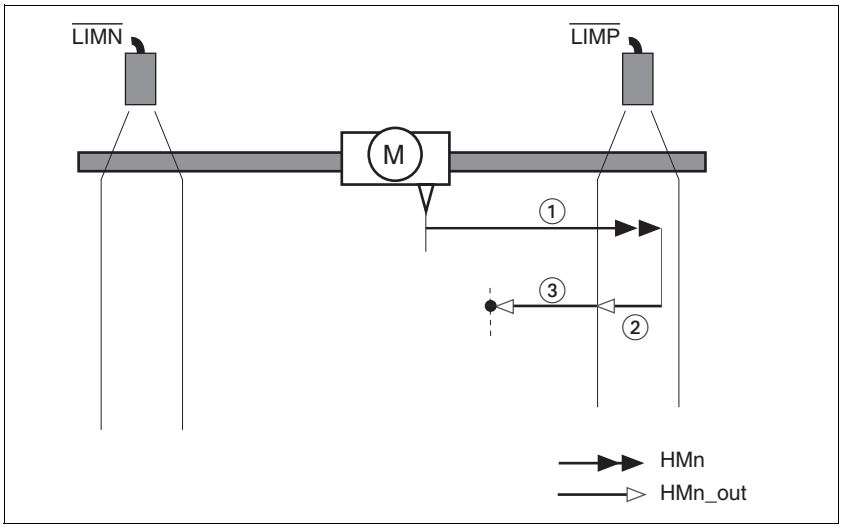

Figure 8.15 Reference movement to the positive limit switch

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

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Reference movement to reference switch

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

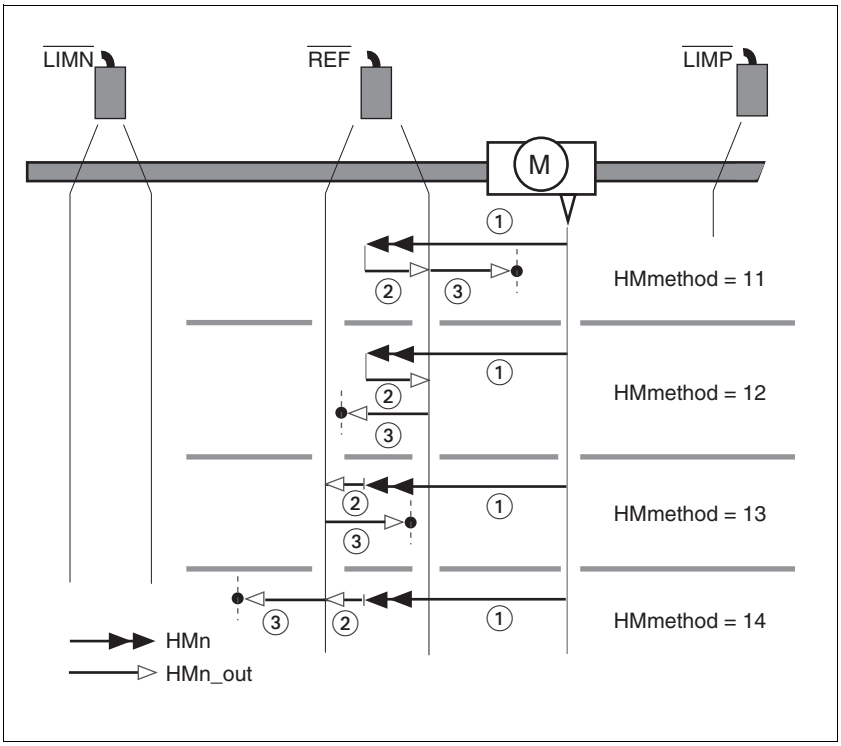

Figure 8.16 Reference movements to the reference switch

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

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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).

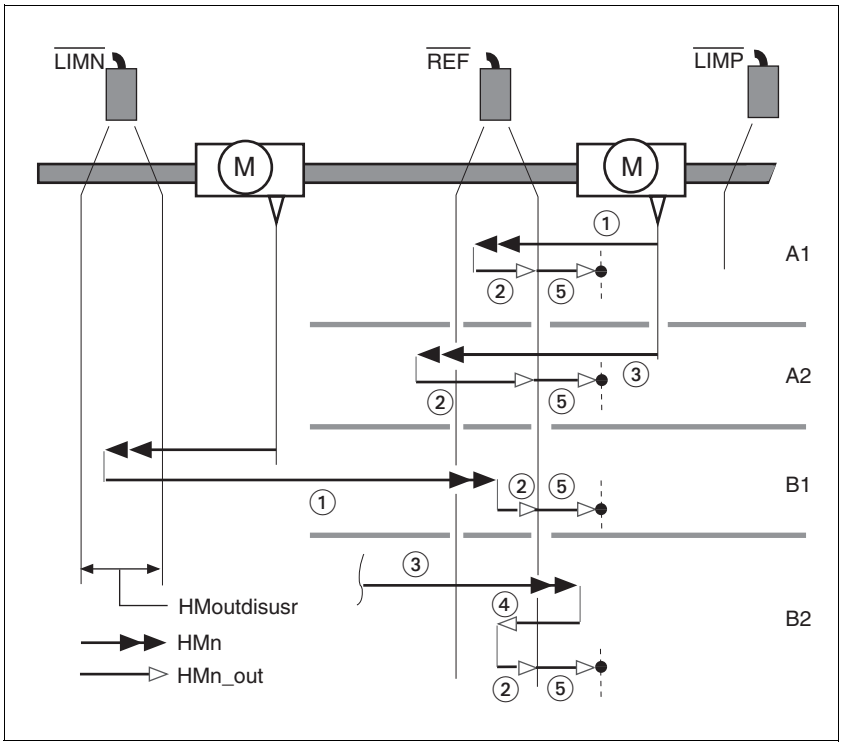

Figure 8.17 Reference movements to the reference switch

(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

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8.5.6.3 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).

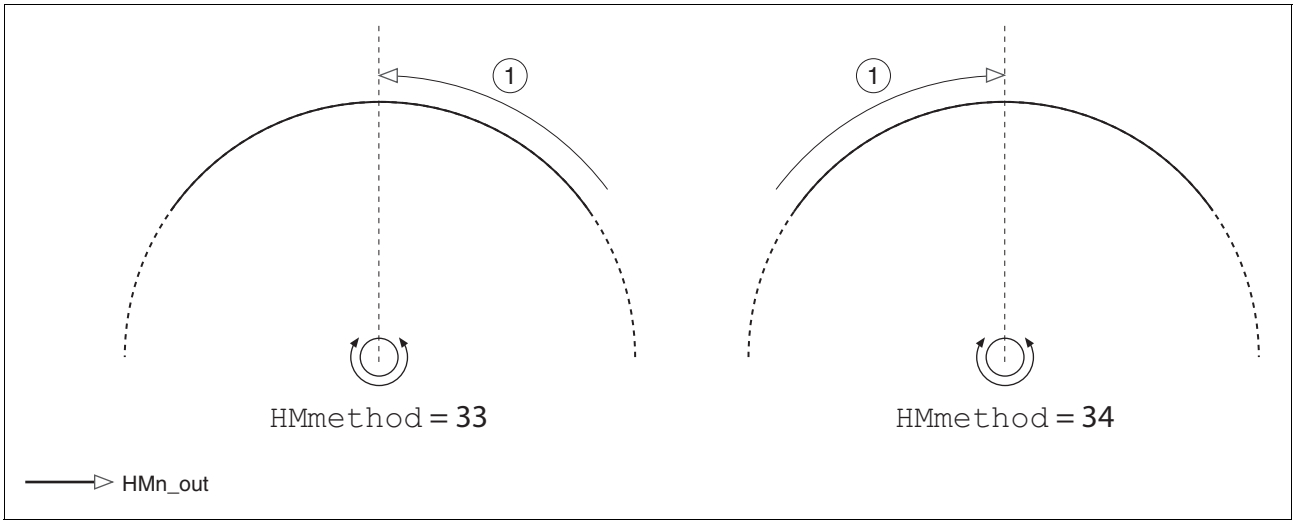

Figure 8.18 Reference movement on index pulse

(1) Movement on index pulse with clearance speed

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8.5.6.4 Homing by position setting

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

Homing by position setting can only be carried out when the motor is at a standstill. Any active position deviation is retained and can still be compensated by the position controller after position setting 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	Set dimensions to dimension setting position Action object: Write access triggers dimension setting Only possible with motor standing still. Position standardisation is taken into account.	usr -2147483648 - 2147483647	R/W - -	

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

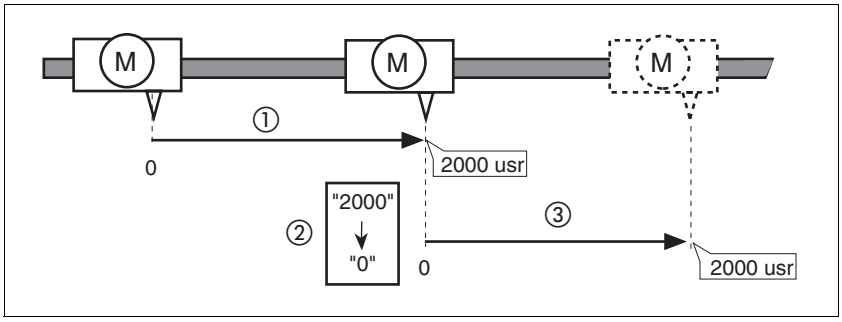

Figure 8.19 Positioning by 4000 usr units with dimension setting

(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 reference position 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-defined units Value represents the reference position of the position controller	usr - 0 -	INT32 INT32 R/- - -	Modbus 7704 DeviceNet 130.1.12

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8.6 Functions

8.6.1 Monitoring functions

8.6.1.1 Status monitoring in movement mode

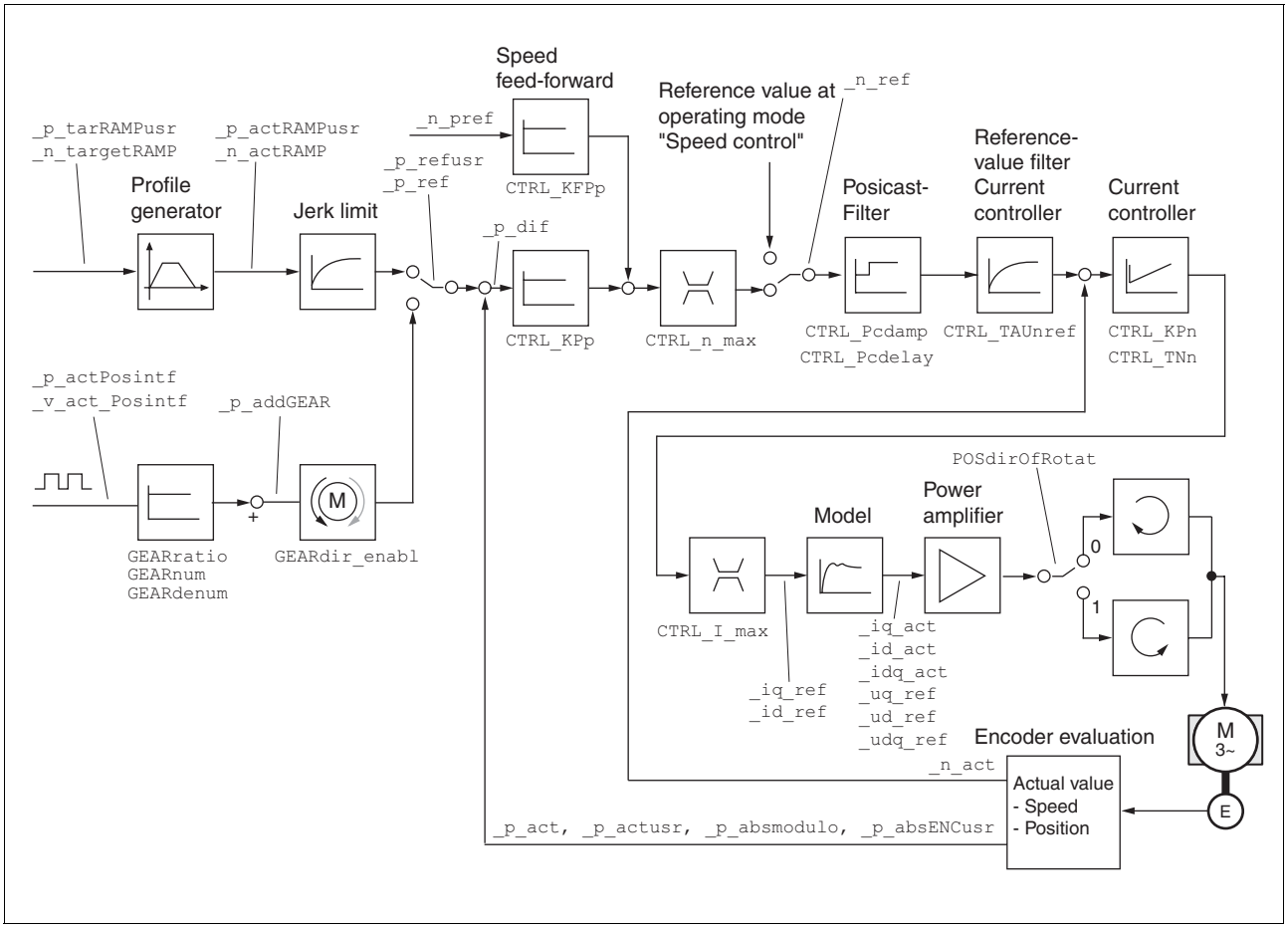

Figure 8.20 Status monitoring of the control loops

8.6.1.2 Positioning range

Positioning range

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

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

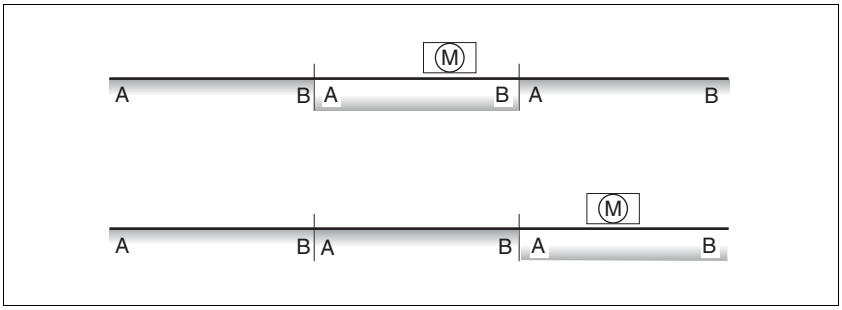

Figure 8.21 Positioning range

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 overshot 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 SW-limit switch If a user-defined value outside the permissible user-defined area is set, the limit switch limits are automatically limited internally to the maximum user-defined value.	usr - 2147483647 -	INT32 INT32 R/W per. -	Modbus 1544 DeviceNet 106.1.4
SPVswLimNusr	negative position limit for SW-limit switch see description of 'SPVswLimPusr'	usr - -2147483648 -	INT32 INT32 R/W per. -	Modbus 1546 DeviceNet 106.1.5

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPV_SW_Limits	Monitoring the SW-limit switch **0 / none:** none (default) **1 / SWLIMP**: activating SW limit switch pos. direction **2 / SWLIMN**: activating SW limit switch neg. direction **3 / SWLIMP+SWLIMN**: activating SW limit switch both. directions The software limit switch is only monitored after a successful homing (ref_ok = 1)	- 0 0 3	UINT16 UINT16 R/W per. -	Modbus 1542 DeviceNet 106.1.3

Limit switch

⚠ CAUTION

Loss of control

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

- Use $\overline{\texttt{LIMP}}$ and $\overline{\texttt{LIMN}}$ 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 $\overline{\texttt{LIMP}}$ and $\overline{\texttt{LIMN}}$.
- 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 $\overline{\texttt{LIMP}}$ and $\overline{\texttt{LIMN}}$. If the drive moves to a limit switch, the motor stops. The triggering of the limit switch is signalled.

The parameters `IOsigLimP` and `IOsigLimN` are used to release the input signals $\overline{\texttt{LIMP}}$ and $\overline{\texttt{LIMN}}$ 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 breakage.

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOsigLimN	LIMN signal evaluation **0 / inactive:** inactive **1 / normally closed:** normally closed contact **2 / normally open**: normally-open switch	- 0 1 2	UINT16 UINT16 R/W per. -	Modbus 1566 DeviceNet 106.1.15
IOsigLimP	LIMP signal evaluation **0 / inactive:** inactive **1 / normally closed:** normally closed contact **2 / normally open**: normally-open switch	- 0 1 2	UINT16 UINT16 R/W per. -	Modbus 1568 DeviceNet 106.1.16
IOsigRef	REF signal evaluation **1 / normally closed:** normally closed contact **2 / normally open**: normally-open switch The reference switch is only activated while processing the reference movement to REF.	- 1 1 2	UINT16 UINT16 R/W per. -	Modbus 1564 DeviceNet 106.1.14

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.

8.6.1.3 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	Temperature of the power amplifier	°C - 0 -	INT16 INT16 R/- - -	Modbus 7200 DeviceNet 128.1.16
PA_T_max	maximum permissible temperature of the power amplifier	°C - 0 -	INT16 INT16 R/- per. -	Modbus 4110 DeviceNet 116.1.7

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PA_T_warn	Temperature limit of the power amplifier	°C - 0 -	INT16 INT16 R/- per. -	Modbus 4108 DeviceNet 116.1.6

I^2t monitoring

If the device operates with high peak currents, then temperature monitoring with sensors can be too sluggish. With the ^{2}monitoring, the closed-loop control anticipates a rise in temperature in time and if the^{2}t 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	Overload motor current	% - 0 -	INT16 INT16 R/- - -	Modbus 7218 DeviceNet 128.1.25
_I2t_mean_M	Motor load	% - 0 -	INT16 INT16 R/- - -	Modbus 7220 DeviceNet 128.1.26

Tracking error monitoring

The drive monitors the following error at 1ms intervals. The tracking error is the difference between the current setpoint and the actual position. If the difference exceeds the limit value set by the parameter SPV_P_maxDiff, it will immediately cause an interruption of movement (tracking error) with configurable error class.

Select the limit value in parameter SPV_P_maxDiff significantly higher than the maximum possible following error in 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_DifPeakand compared with the maximum permissible following error. 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 also8.6.1 "Monitoring functions".

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_p_DifPeak	Value of max. reached tracking errors of the position controller The tracking error is the current position regulation offset minus the speed-dependent position regulation offset. Further information see SPV_p_maxDiff. A write operation resets the value again.	revolution 0.0000 - 429496.7295	UINT32 UINT32 R/W - -	Modbus 4382 DeviceNet 117.1.15
_p_dif	Current variation between reference and actual position Corresponds to the current control deviation of the position controller	revolution -214748.3648 - 214748.3647	INT32 INT32 R/- - -	Modbus 7716 DeviceNet 130.1.18
SPV_p_maxDiff	Max. permissible tracking error of the position controller The tracking error is the current position regulation offset minus the speed-dependent position regulation offset. Actually, only the position offset caused by the moment requirements is still referred to for tracking error monitoring.	revolution 0.0001 1.0000 200.0000	UINT32 UINT32 R/W per. -	Modbus 4636 DeviceNet 118.1.14

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 state of the monitoring signals Meaning see _SigLatched	- - 0 -	UINT32 UINT32 R/- - -	Modbus 7182 DeviceNet 128.1.7

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_SigLatched	Stored state of the monitoring signals Signal state: 0: not enabled 1: enabled Bit assignment: Bit0: General error Bit1: Limit switch (LIMP/LIMN/REF) Bit2: Range exceeded (software limit switch, tuning) Bit3: Quickstop via fieldbus Bit4: Inputs PWRR are 0 Bit6: Error RS485 Bit7: Error CAN Bit9: Frequency of reference signal too high Bit10: Error current operating mode Bit12: Profibus error Bit14: DC bus undervoltage Bit15: DC bus overvoltage Bit16: No mains phase Bit17: Connection to motor faulty Bit18: Motor overcurrent/short-circuit Bit19: Motor encoder error Bit20: 24VDC undervoltage Bit21: Overtemperature (power amplifier, motor) Bit22: Tracking error Bit23: max. speed exceeded Bit24: PWRR inputs different Bit29: error in EEPROM Bit30: System run-up (hardware or parameter fault) Bit31: System error (e. g. Watchdog) Monitors are product-dependent	- - 0 -	UINT32 UINT32 R/- - -	Modbus 7184 DeviceNet 128.1.8
_WarnActive	Active warnings bit-coded Meaning of Bits see _WarnLatched	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7190 DeviceNet 128.1.11

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_WarnLatched	Stored warnings bit-coded Stored warning bits are erased in the event of a FaultReset. Bits 10,11,13 are automatically deleted. Signal state: 0: not enabled 1: enabled Bit assignment: Bit 0: General warning (see _LastWarning) Bit 1: Temperature of power amplifier high Bit 2: Temperature of motor high Bit 3: reserved Bit 4: Overload (I^2t) power amplifier Bit 5: Overload (I^2t) motor Bit 6: Overload (I^2t) braking resistor Bit 7: CAN warning Bit 8: Motor encoder warning Bit 9: RS485 protocol warning Bit 10: PWRR_A and/or PWRR_B Bit 11: DC Bus undervoltage, no mains phase Bit 12: Profibus warning Bit 13: Position not yet valid (position detection continuing) Bit 14: reserved Bit 15: reserved Monitors are product-dependent	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7192 DeviceNet 128.1.12
_actionStatus	Action word Signal state: 0: not enabled 1: enabled Bit0: Error class 0 Bit1: Error class 1 Bit2: Error class 2 Bit3: Error class 3 Bit4: Error class 4 Bit5: reserved Bit6: Drive stopped (Actual speed _n_act [1/min] < 9) Bit7: drive is rotating in a positive direction Bit8: drive is rotating in a negative direction Bit9: reserved Bit10: reserved Bit11: Profile generator at a standstill (reference speed is 0) Bit12: profile generator decelerated Bit13: profile generator accelerated Bit14: profile generator moves in constant mode Bit15: reserved	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7176 DeviceNet 128.1.4
_StopFault	Fault number of the last interruption cause	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7178 DeviceNet 128.1.5

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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 **1 / ErrorClass1:** Error class 1 **2 / ErrorClass2**: error class 2 **3 / ErrorClass3**: error class 3	- 1 3 3	UINT16 UINT16 R/W per. -	Modbus 1302 DeviceNet 105.1.11

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8.6.2 Scaling

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

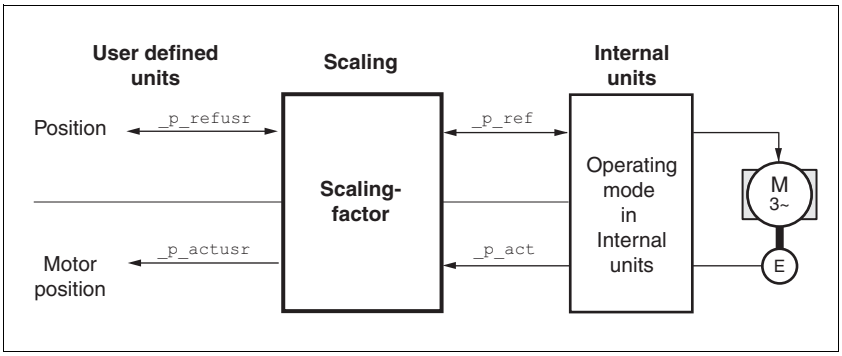

Figure 8.22 Scaling

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 8.23 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.

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
POSscaleNum	Numerator of the position scaling factor :Definition of scaling factor Motor revolutions [U] ---------- Change of user position [usr] The new scaling is used when the numerator value is transferred. User limit values may be reduced due to calculation of a system-internal factor	revolution 1 1 2147483647	INT32 INT32 R/W per. -	Modbus 1552 DeviceNet 106.1.8
POSscaleDenom	Denominator of the position scaling factor For a description, see numerator (POSscaleNum) The new scaling is used when the numerator value is transferred.	usr 1 16384 2147483647	INT32 INT32 R/W per. -	Modbus 1550 DeviceNet 106.1.7

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 2nd motor position can be approached.

- Scaling corresponds to motor resolution (minimum scaling)
  1 motor revolution = 32768 user-defined units

  => every motor position can be approached.

- Scaling is lower than the default scaling
  1 motor revolution = 4096 user-defined units

  => every 4th motor position can be approached.

In order to keep the same positioning movement of the motor after changing the scaling factor, the following persistent parameters must be matched, in addition to the user values of the application `HMoutdisusr`, `HMdisusr`, `HMp_homeusr`, `HMsrchdisusr`, `JOGstepusr`, `SPVswLimPusr` and `SPVswLimNusr`.

If the parameters are not adjusted, this can cause problems such an error during the reference movement, because the distance to the switching edge of the limit or reference switch is no longer sufficient for safely leaving the switching range.

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Example 1 Positioning of 1111 user-defined units is to correspond to 3 motor revolutions. This gives:

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

If you carry out a relative positioning operation of 900 user-defined units now, the motor will move 900 usr * 3/1111 rev/usr = 2.4302 motor revolutions.

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

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

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

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

User value = 1 usr

device value = 1/(2*π*1000) U

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

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

Ramp steepness

The steepness of the ramp determines the speed changes of the motor per unit time. It can be specified for the acceleration ramp via parameter RAMPacc for the deceleration ramp via RAMPdecel.

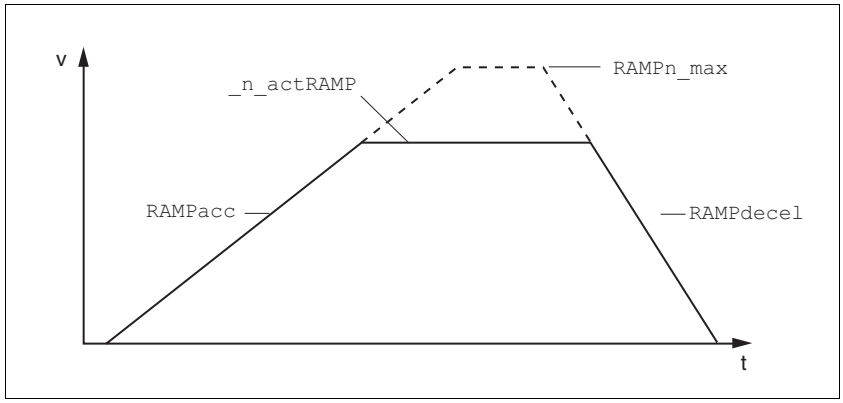

Figure 8.24 Acceleration and deceleration ramps

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMPacc	Profile generator acceleration	(1/min)/s 1 600 3000000	UINT32 UINT32 R/W per. -	Modbus 1556 DeviceNet 106.1.10
RAMPdecel	Deceleration of the profile generator	(1/min)/s 750 750 3000000	UINT32 UINT32 R/W per. -	Modbus 1558 DeviceNet 106.1.11
RAMPn_max	Limiting set speed with operating modes with profile generation The parameters are effective in the following operating modes: - Profile position - Profile velocity - Homing - Jog If a higher target speed is set in one of these operating modes, the limit is automatically set to RAMPn_max. This makes it simple to conduct a commissioning with limited speed.	1/min 60 13200 13200	UINT16 UINT16 R/W per. -	Modbus 1554 DeviceNet 106.1.9

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Jolt limiting

The jolt limiting removes the jump-like acceleration changes to create a smooth, soft virtually jolt-free speed change.

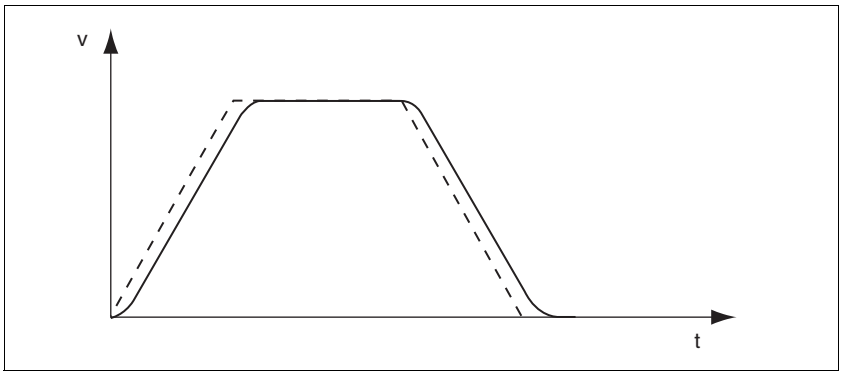

Figure 8.25 Speed curve with and dotted without jolt limitation

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	Jolt limiting **0 / off:** inactive **1 / 1**: 1 ms **2 / 2**: 2 ms **4 / 4**: 4 ms **8 / 8**: 8 ms **16 / 16**: 16 ms **32 / 32**: 32 ms **64 / 64**: 64 ms **128 / 128**: 128 ms Limits the acceleration changes (jerk) of the setpoint position generation during the positioning transitions: standstill - acceleration acceleration - constant movement constant movement - deceleration deceleration - standstill Processing in the following operating modes: - Profile velocity - Profile position - Jog - Homing Setting is only possible with inactive operating mode (x_end=1).	ms 0 0 128	UINT16 UINT16 R/W per. -	Modbus 1562 DeviceNet 106.1.13

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8.6.4 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.

Maximum current

The unit absorbs the excess braking energy. If the DC bus voltage exceeds the permissible limit the output stage switches off and the unit signals "DC bus overvoltage". The motor runs down without braking.

The current for the moment ramp should be set so that the drive comes to a standstill with the required delay.

"Quick Stop" ramp

The "Quick Stop" ramp must be set so the drive comes to a standstill when the fast-braking function is triggered with the desired deceleration.

The device absorbs excess braking energy during braking. 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
LIM_QStopReact	Type of deceleration with Quick Stop **6 / Deceleration ramp:** Deceleration ramp **7 / Torque ramp**: Torque ramp Setting for deceleration ramp via parameter RAMPquickstop. Setting for torque ramp via parameter LIM_I_maxQSTP. The deceleration ramp is only possible in operating modes with profile generator. The torque ramp is always used in operating modes without a profile generator.	- 6 7 7	INT16 INT16 R/W per. -	Modbus 1584 DeviceNet 106.1.24
RAMPquickstop	Deceleration ramp at Quick Stop Deceleration of drive when a software stop is triggered or if an error of error class 1 occurs	(1/min)/s 200 6000 3000000	UINT32 UINT32 R/W per. -	Modbus 1572 DeviceNet 106.1.18

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
LIM_I_maxQSTP	Current limiting for Quick Stop max. Current at braking via torque ramp due to error with error class 1 or 2, and on triggering of a software stop Maximum and default value setting depend on motor and power amplifier (Setting M_I_max and PA_I_max) in 0.01 Apk steps	A_{pk} - - -	UINT16 UINT16 R/W per. -	Modbus 4362 DeviceNet 117.1.5

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8.6.5 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.

The interrupted movement is continued when all "Halt" requests are cancelled. If the "Halt" request is already cancelled 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).

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.

Maximum current

The unit absorbs the excess braking energy. If the DC bus voltage exceeds the permissible limit the output stage switches off and the unit signals "DC bus overvoltage". The motor runs down without braking.

The current for the moment ramp should be set so that the drive comes to a standstill with the required delay.

"Halt" ramp

The "Halt" ramp must be set so the drive comes to a standstill with the desired deceleration on a "Halt" request.

The device absorbs excess braking energy during braking. If the DC bus voltage exceeds the permissible limit value, the power amplifier switches off and the device indicates "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
LIM_HaltReaction	Type of deceleration with Halt **1 / Deceleration ramp:** Deceleration ramp **3 / Torque ramp**: Torque ramp Setting the deceleration ramp using the RAMPdecel parameter. Setting of torque ramp via parameter LIM_I_maxHalt. The deceleration ramp is only possible in operating modes with profile generator. The torque ramp is always used in operating modes without a profile generator.	- 1 3 3	INT16 INT16 R/W per. -	Modbus 1582 DeviceNet 106.1.23

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMPdecel	Deceleration of the profile generator	(1/min)/s 750 750 3000000	UINT32 UINT32 R/W per. -	Modbus 1558 DeviceNet 106.1.11
LIM_I_maxHalt	Current limiting for Stop max. Current during braking after Halt or termination of an operating mode. Maximum and default value setting depend on motor and power amplifier (Setting M_I_max and PA_I_max) in 0.01 Apk steps	A_{pk} - - -	UINT16 UINT16 R/W per. -	Modbus 4364 DeviceNet 117.1.6

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8.6.6 Fast position capture

The "fast position capture" function captures the current motor position at the time of receipt of a digital 24V signal at one of the two capture inputs. The operating function can, for example, be used for detection of a print mark.

Setting options

Two independent capture inputs are available for the "Fast Position Capture" function.

- `LI01` (CAP1)
- `LI02` (CAP2)

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

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

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

The CAP1 and CAP2 capture inputs have a time constant of t = 10 µs.

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

Enable fast position capture

Enable single position capture

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

Activate continuous position capture

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

End position capture

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

With continuous position capture or no signal edge the capture can be terminated writing the parameter`Cap1Activate`, value 0 or `Cap2Activate`, value 0.

Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Cap1Activate	Capture unit 1 Start/Stop **0 / Capture stop**: Abort capture function **1 / Capture once**: Start once-off capture **2 / Capture continuous**: Start continuous capture function In the case of a once-off capture, the function is terminated with the first captured value. The capture continues endlessly with continuous capture.	- 0 - 2	UINT16 UINT16 R/W - -	Modbus 2568 DeviceNet 110.1.4

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Parameter Name HMI menu	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Cap1Config	Configuration of capture unit 1 **0 / 1->0**: position capture with 1->0 switch **1 / 0->1**: position capture with 0->1 switch	- 0 0 1	UINT16 UINT16 R/W - -	Modbus 2564 DeviceNet 110.1.2
Cap1Count	Capture unit 1 event counter Counts the capture events. Numerator is reset when the capture unit 1 is activated.	- - 0 -	UINT16 UINT16 R/- - -	Modbus 2576 DeviceNet 110.1.8
Cap1Pos	Capture unit 1 captured position Captured position at the time of the "capture signal". The captured position is recalculated after "set dimensions" or after a "homing".	usr - 0 -	INT32 INT32 R/- - -	Modbus 2572 DeviceNet 110.1.6
Cap2Activate	Capture unit 2 Start/Stop **0 / Capture stop**: Abort capture function **1 / Capture once**: Start once-off capture **2 / Capture continuous**: Start continuous capture function In the case of a once-off capture, the function is terminated with the first captured value. The capture continues endlessly with continuous capture.	- 0 - 2	UINT16 UINT16 R/W - -	Modbus 2570 DeviceNet 110.1.5
Cap2Config	Configuration of capture unit 2 **0 / 1->0**: position capture with 1->0 switch **1 / 0->1**: position capture with 0->1 switch	- 0 0 1	UINT16 UINT16 R/W - -	Modbus 2566 DeviceNet 110.1.3
Cap2Count	Capture unit 2 event counter Counts the capture events. Numerator is reset when the capture unit 2 is activated.	- - 0 -	UINT16 UINT16 R/- - -	Modbus 2578 DeviceNet 110.1.9
Cap2Pos	Capture unit 2 captured position Captured position at the time of the "capture signal". The captured position is recalculated after "set dimensions" or after a "homing".	usr - 0 -	INT32 INT32 R/- - -	Modbus 2574 DeviceNet 110.1.7
CapStatus	Status of capture units Read access: Bit 0: Position captured via input CAP1 Bit 1: Position captured via input CAP2	- - 0 -	UINT16 UINT16 R/- - -	Modbus 2562 DeviceNet 110.1.1

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8.6.7 Standstill window

The standstill window can be used to check whether the drive has reached the reference 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).

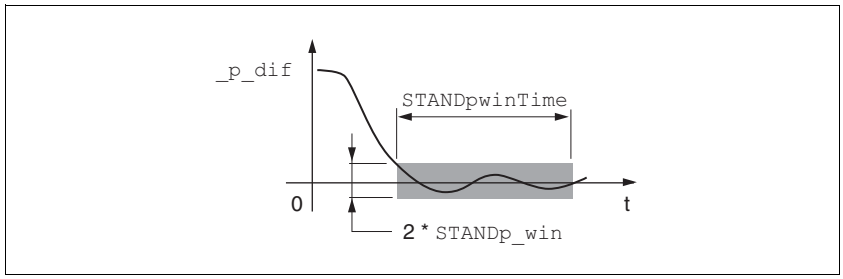

Figure 8.26 Standstill window

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 offset The offset for the standstill window time must lie in this range of values to allow recognition of the standstill of the drive. The processing of the standstill window must be activated via the STANDpwinTime parameter.	revolution 0.0000 0.0010 3.2767	UINT16 UINT16 R/W per. -	Modbus 4370 DeviceNet 117.1.9
STANDpwinTime	Standstill window, time 0: Standstill window monitoring deactivated >0 : Time in ms within which the control deviation must lie in the standstill window	ms 0 0 32767	UINT16 UINT16 R/W per. -	Modbus 4372 DeviceNet 117.1.10
STANDpwinTout	Timeout for the standstill window monitor 0: Timeout monitor deactivated >0 : Timeout time in ms Processing of the standstill window is set via STANDp_win and STANDpwinTime Time monitoring begins when the target position is reached (position controller reference position) or. at the end of the profile generator processing.	ms 0 0 16000	UINT16 UINT16 R/W per. -	Modbus 4374 DeviceNet 117.1.11

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8.6.8 Braking function

Inadvertent movement of the motor without current is prevented by the use of motors with a holding brake.

The holding brake is not available with all product types.

⚠ WARNING

Wear or high temperature will cause loss of braking power.

Setting the holding brake when the motor is running will cause fast wear and loss of braking force. Heat reduces the braking force.

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

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

Control The integrated holding brake is automatically actuated.

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

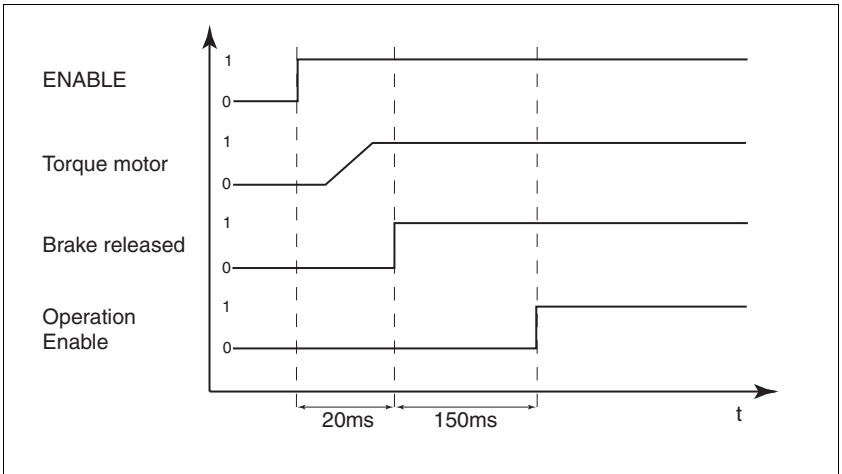

Figure 8.27 Releasing the holding brake

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Applying the holding brake

When the power amplifier is disabled and in the event of an error of error class 2 the holding brake is automatically closed. The motor is without current only after a delay time to ensure that the holding brake can close safely.

In the event of an error of error class 3 or 4 the holding brake is automatically closed and the motor is immediately without power.

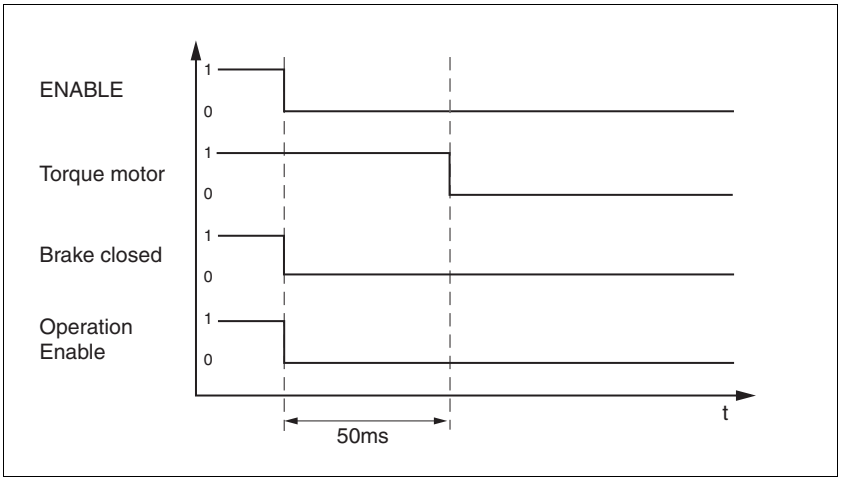

Figure 8.28 Applying the holding brake

The delay time is not effective if the power amplifier is deactivated via the "Power Removal" safety function. It is important, especially in the case of vertical axes, to check whether additional measures are required to prevent lowering of the load.

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8.6.9 Configurable inputs and outputs

⚠ WARNING

Unforeseen behaviour 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 or signal outputs can be assigned various functions.

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

Factory settings

The following table provides an overview of the factory settings.

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

Current status

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_IO_LIO_act	Status of digital inputs/outputs Coding of the individual signals: Bit0: LIO1 Bit1: LIO2 ...	- - 0 -	UINT16 UINT16 R/- - -	Modbus 2090 DeviceNet 108.1.21

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8.6.9.1 Description of functions for signal inputs

Input Free available	The function has no unit-internal functionality. The signal input which is freely available can be read via parameter `_IO_LIO_act`.
Input Fault reset	An error message is reset with the function, see chapter 8.3 "Operating statuses".
Input Enable	The power amplifier is activated with the function, see chapter 8.3 "Operating statuses".
Input Halt	A "Halt" is triggered with this function, see chapter8.6.5 "Halt".
Input Jog positive	A jog movement in clockwise rotation is executed with the function, see chapter 8.5.1 "Operating mode Jog".
Input Jog negative	A jog movement in counterclockwise rotation is executed with the function, see chapter 8.5.1 "Operating mode Jog".
Input Jog fast/slow	The device switches between slow and fast jog with the function, see chapter 8.5.1 "Operating mode Jog".
Input Reference switch (REF)	The operation of the reference switch is set with the function. See chapter 8.5.6 "Operating mode Homing".
Input Positiv limit switch (LIMP)	The operation of the positive limit switch is set with the function. See chapter 8.5.6 "Operating mode Homing" and chapter 8.6.1.2 "Positioning range".
Input Negative limit switch (LIMN)	The operation of the negative limit switch is set with the function. See chapter 8.5.6 "Operating mode Homing" and chapter 8.6.1.2 "Positioning range".

8.6.9.2 Description of functions for signal outputs

Output Free available	The function permits direct setting of an output via the parameter `IO_LO_set`.
Output No fault	The function shows the error status, see chapter 8.3.2 "Displaying the operating statuses".
Output Active	The function shows the operating status "Operation enable", see chapter 8.3.2 "Displaying the operating statuses".

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IO_LO_set	Setting digital outputs directly Write access to output bits is only effective if the signal pin exists as output and the function of the output was set to 'freely available'. Coding of the individual signals: Bit0: LO1_OUT Bit1: LO2_OUT ...	- - 0 -	UINT16 UINT16 R/W - -	Modbus 2082 DeviceNet 108.1.17

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8.6.9.3 Configuration of signal inputs or signal outputs.

The following table provides an overview of which signal inputs or outputs can be assigned a function.

Functions for signal inputs

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

Functions for signal outputs

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

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOfunct_LIO1	Function input/output LIO1 **1 / Input Free available**: Freely available : **2 / Input Fault reset**: Reset error message **3 / Input Enable**: Enable **4 / Input Halt**: Halt **9 / Input Jog positive**: jog right **10 / Input Jog negative**: jog left **11 / Input Jog fast/slow**: Manual movement fast/slow : **20 / Input Reference switch (REF)**: Reference switch (REF) **21 / Input Positive limit switch (LIMP)**: Positive limit switch (LIMP) **101 / Output Free available**: Freely available : **102 / Output No fault**: No error **103 / Output Active**: Operating readiness	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1826 DeviceNet 107.1.17

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOfunct_LIO2	Function input/output LIO2 **1 / Input Free available**: Freely available : **2 / Input Fault reset**: Reset error message **3 / Input Enable**: Enable **4 / Input Halt**: Halt **9 / Input Jog positive**: jog right **10 / Input Jog negative**: jog left **11 / Input Jog fast/slow**: Manual movement fast/slow : **20 / Input Reference switch (REF)**: Reference switch (REF) **22 / Input Negative limit switch (LIMN)**: Negative limit switch (LIMN) **101 / Output Free available**: Freely available : **102 / Output No fault**: No error **103 / Output Active**: Operating readiness	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1828 DeviceNet 107.1.18
IOfunct_LIO3	Function input/output LIO3 **1 / Input Free available**: Freely available : **2 / Input Fault reset**: Reset error message **3 / Input Enable**: Enable **4 / Input Halt**: Halt **9 / Input Jog positive**: jog right **10 / Input Jog negative**: jog left **11 / Input Jog fast/slow**: Manual movement fast/slow : **20 / Input Reference switch (REF)**: Reference switch (REF) **101 / Output Free available**: Freely available : **102 / Output No fault**: No error **103 / Output Active**: Operating readiness	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1830 DeviceNet 107.1.19
IOfunct_LIO4	Function input/output LIO4 **1 / Input Free available**: Freely available : **2 / Input Fault reset**: Reset error message **3 / Input Enable**: Enable **4 / Input Halt**: Halt **9 / Input Jog positive**: jog right **10 / Input Jog negative**: jog left **11 / Input Jog fast/slow**: Manual movement fast/slow : **20 / Input Reference switch (REF)**: Reference switch (REF) **101 / Output Free available**: Freely available : **102 / Output No fault**: No error **103 / Output Active**: Operating readiness	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1832 DeviceNet 107.1.20

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8.6.10 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 stroke with clockwise rotation must be connected to LIMP. The limit switch that limits the work stroke 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
POSdirOfRotat	Definition of the direction of rotation **0 / clockwise:** Clockwise **1 / counter clockwise**: counterclockwise Meaning:1 The drive rotates clockwise with positive speeds, looking onto the motor shaft at the flange. IMPORTANT: When using limit switches, after changing the setting, the limit switch connections must be changed over. The limit switch which is actuated by moving in jog mode in a positive direction must be connected to the input LIMP, and vice versa. IMPORTANT: A change of the setting is not activated until the device is switched on again.	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 1560 DeviceNet 106.1.12

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8.6.11 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.

8.6.11.1 Reset 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	Resetting the user parameters Bit 0=1: Set persistent parameters to default values. All parameters are reset, with the exception of: - Communication parameter - Definition of the direction of rotation - Signal selection at position interface - IO functions IMPORTANT: The new settings are not backed up to the EEPROM!	- 0 - 7	UINT16 UINT16 R/W - -	Modbus 1040 DeviceNet 104.1.8

8.6.11.2 Restore factory settings

Factory settings via commissioning software

The factory settings are set via the menu items 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.

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

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8.7 Drive profile Position Controller Profile

The drive supports the "Position Controller Profile" drive profile.

Device type: 10_h.

Reference documents

- [1] The CIP Networks Library
  Volume 1
  Common Industrial Protocol
  Edition 3.1
- [2] The CIP Networks Library
  Volume 3
  DeviceNet Adaption of CIP
  Edition 1.3
- [3] DeviceNet terms of Usage Agreement
  ODVA: http://www.odva.org

For more detailed information on the "Position Controller Profile" drive profile, see "The CIP Networks Library, Volume 1", the "Position Controller Profile" chapter.

Object model

The following object classes from the CIP object model are available for the "Position Controller Profile" drive profile:

Object class	Class ID	Instance ID
Position Controller Supervisor Object	36	1
Position Controller Object	37	1
Manufacturer-specific objects	101 ... 199	1

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8.7.1 Communication via an "IO Message"

The "Position Controller Profile" supports the following formats:

Command Message

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	Enable	-	Hard Stop	Smooth Stop	Direction	Incre-mental	-	LoadData/ StartProfile
Byte 1	Command Data 1							
Byte 2	Command Axis Number			Command Message Type				
Byte 3	Command Data 2							
Byte 4	Command Data 3							
Byte 5	Command Data 4							
Byte 6	Command Data 5							
Byte 7	Command Data 6							

Figure 8.29 Command Message

The following table displays the structure of byte 0:

Bit	Name	Function
0	LoadData / Start-Profile	Handshake for a "Command Message" To execute a "Command Message", you require a rising edge on the "LoadData / StartProfile" bit. To obtain data via a "Response message", you do not require a rising edge on the "LoadData / StartProfile" bit.
1	Start Block	No function
2	Incremental	0: Absolute positioning 1: Relative positioning
3	DIR	0: Counterclockwise rotation 1: Clockwise direction of rotation
4	Smooth Stop	0: Reset "Halt" : 1: Set "Halt"
5	Hard Stop	0->1: "Quick Stop" setting 1->0: Reset "Quick Stop" 1)
6	RegArm	No function
7	Enable	Activate and deactivate the power amplifier

1) Only possible when motor is at a standstill and if "Quick Stop was initiated by 0->1 edge."

The following table shows the types of "Command Message" available:

Type	Command Message
01_h	Target position
02_h	Target velocity
03_h	Acceleration
04_h	Deceleration
$1A_h$	Position Controller Supervisor Attribute
$1B_h$	Position Controller Attribute

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Response Message

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	Enable	-	-	Current Direction	General Fault	On Target Position	-	Profile in Progress
Byte 1	Response Data 1							
Byte 2	Load Complete	-	FE Fault	Negative Limit	Positive Limit	-	-	-
Byte 3	Response Axis Number			Response Message Type				
Byte 4	Response Data 2							
Byte 5	Response Data 3							
Byte 6	Response Data 4							
Byte 7	Response Data 5							

Figure 8.30 Response Message

The following table displays the structure of byte 0:

Bit	Bit	Function
0	ProfileInProgress	1: Operating mode active (x_end = 0)
1	BlockInExecution	No function
2	OnTargetPosition	1: Target position reached
3	General Fault	Set in operating statuses 2, 3, 7 [1], 8 and 9 [2].
4	Current Direction	0: Counterclockwise rotation 1: Clockwise direction of rotation
5	HomeLevel	No function
6	RegLevel	No function
7	Enable	1: Power amplifier activated

1) Not when "Quick Stop is initiated with the fieldbus."
2) The operating statuses are described in Chapter 8.3 "Operating statuses".

The following table displays the structure of byte 1:

Bit	Name	Function
0	LoadData / Start-Profile	No function
1	FwdLimit	No function
2	RevLimit	No function
3	PositiveLimit	1: error, positive limit switch (LIMP)
4	NegativeLimit	1: error, negative limit switch (LIMN)
5	FE Fault	1: tracking error
6	BlockFault	No function
7	LoadComplete	Handshake

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The following table shows the types of "Response Message" available:

Type	Response Message
01_h	Actual position
03_h	Actual Velocity
14_h	Command/Response Error
$1A_h$	Position Controller Supervisor Attribute
$1B_h$	Position Controller Attribute

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8.7.2 Operating statuses

For an overview of the operating statuses, see Chapter 8.3.1 "Status diagram".

The following section describes how you can change and display the operating statuses in the "Position Controller Profile" drive profile.

Displaying the operating statuses

The operating statuses are displayed using the "Response Message" byte 0 bit 3 and bit 7.

Operating state	Bit 7 Enable	Bit 3 General Fault
2: Not ready to switch on	0	0
3: Switch on disabled	0	0
4: Ready to switch on	0	0
5: Switched on	0	0
6: Operation enable	1	0
7: Quick Stop activ	1	1
8: Fault Reaction active	0	1
9: Fault	0	1

Changing operating statuses

You can change the operating status with the "Command Message" byte 0 bit 5 and bit 7.

byte0	Operating statuses
Bit 7 Enable	0->1: Activate power amplifier [1)] Drive switches to operating status **6** Operation enable.
	1->0: deactivate power amplifier and reset error Drive switches to operating status **4** Ready to switch on.
Bit 5 Hard Stop	0->1: "Quick Stop" activation Drive switches to operating status **7** Quick Stop activ
	1->0: "Quick Stop" reset Drive switches to operating status **6** Operation enable

1) Drive must be in operating mode **4** Ready to switch on

A fault is reset using the manufacturer-specific attribute 103 of the "Position Controller 25_h" object value =1.

Operating status when fault occurs	Switch to operating status
7: Quick Stop activ	**6**: Operation enable
9: Fault	**4**: Ready to switch on

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8.7.3 Operating modes

The following operating modes are supported:

- Profile position (CIP: Position mode)
- Profile velocity (CIP: Velocity mode)
- Homing (manufacturer-specific)

Displaying operating modes

You can display the current operating mode using attribute 3 and attribute 100 of the "Position Controller 25_h" object.

Changing the operating modes

Use attribute 3 of the "Position Controller 25_h" object to set the profile position operating mode (CIP: Position mode) or profile velocity operating mode (CIP: Velocity mode).

In addition, you can use attribute 100 of the "Position Controller 25_h" object to set the homing operating mode specific to the manufacturer.

Two separate values are saved internally for the speed for the profile position and profile velocity operating mode. The value for speed is thus retained when the operating mode is changed.

You can switch between operating modes as soon as one operating mode has ended.

Profile position

A movement is triggered when you transfer a target position.

New values entered for speed, acceleration and deceleration do not take effect while a movement is in process. These values only apply when a target position is transferred again.

Profile velocity

The operating mode is started when you transfer the target speed.

Homing

The manufacturer-specific operating mode is described in Chapter 8.5.6 "Operating mode Homing".

Use the manufacturer-specific attribute 100 to set the operating mode.

Use the manufacturer-specific attribute 101 to select the type of reference movement and start the operating mode.

Homing by position setting

To perform homing by position setting, use attribute 13 of the "Position Controller 25_h" object (see chapter 8.5.6.4 "Homing by position setting". The homing operating mode must not be set when you do this.

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8.7.4 "Position Controller Supervisor 24_h" object

Attribute	ro/rw	CIP Name	Data type	Description	Comments
1	ro	Number of Attributes	USINT	Number of supported attributes	
3	ro	Axis Number	USINT	Axis Number	Value is always 1
5	ro	General Fault	BOOL	General fault that can be cleared by using "Fault Reset".	Set in operating statuses 2, 3, 7 [1], 8 and 9 [2].
6	rw	Command Message Type	USINT	Configuration "Command Message Type".	
7	rw	Response Message Type	USINT	Configuration "Response Message Type".	
100	rw	Vendor specific error information	UINT	Manufacturer-specific error number of last faulty "I/O Message"	High-Word: Error Message Type [3] Low-Word: Manufacturer-specific error number.

1) Not when "Quick Stop is initiated with the fieldbus."
2) The operating statuses are described in Chapter 8.3 "Operating statuses".
3) Value 0 if byte 0 contains an error

8.7.5 "Position Controller 25_h" object

Attribute	ro/rw	CIP Name	Data type	Description	Comments
1	ro	Number of Attributes	USINT	Number of supported attributes	
2	ro	Attribute List	Array of USINT	List of supported attributes	
3	rw	Mode	USINT	Operating mode 0: Profile position 1: Profile velocity	You can set other operating modes using attribute 100.
6	rw	Target position	DINT	Target position of profile position operating mode Unit: [usr]	
7	rw	Target velocity	DINT	Reference speed Unit: [1/min]	Negative figures not permitted. See also attribute 23.
8	rw	Acceleration	DINT	Acceleration Unit: [(1/min)/s]	A new value only comes into effect with the next movement.
9	rw	Deceleration	DINT	Deceleration Unit: [(1/min)/s]	A new value only comes into effect with the next movement.
10	rw	Incremental Position Flag	BOOL	Positioning 0: Absolute positioning 1: Relative positioning	Relative positioning with reference to the last end position.
11	rw	Load Data/Profile Handshake	BOOL	Used to transfer data from an "IO Message" in the drive and to start a movement.	The bits "Load Data/Profile Handshake" and "Load Data Complete" are used as a handshake for the "IO Message".
12	ro	On Target Position	BOOL	Target position reached	In profile position operating mode

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Attribute	ro/rw	CIP Name	Data type	Description	Comments
13	rw	Actual position	DINT	Current Position Unit: [usr]	The current position of the motor is displayed during the read operation. The position setting function for the homing operating mode is executed during the write operation.
14	ro	Actual Velocity	DINT	Current speed Unit: [1/min]	Value is always positive. See also attribute 23.
17	rw	Enable	BOOL	0: Deactivate power amplifier 1: Activate power amplifier	0 -> 1: Fault reset
20	rw	Smooth Stop	BOOL	"Halt" function	
21	rw	Hard Stop	BOOL	"Quick Stop" function	
23	rw	Direction	BOOL	Direction of rotation 0: Counterclockwise rotation 1: Clockwise direction of rotation	The current direction of rotation of the motor is displayed during the read operation. The direction of rotation for the "profile velocity" operating mode is defined during the write operation.
29	ro	Wrap Around	BOOL	Position overrun 1: Position overrun exists	
45	rw	Max Dynamic Following Error	DINT	Maximum permissible conveyance distance	corresponds to parameter-`SPV_p_maxDiff`
47	rw	Following Error	BOOL	tracking error 1: Maximum permissible conveyance distance exceeded	
48	ro	Actual Following Error	DINT	Current conveyance distance	corresponds to parameter-`_p_dif`
56	ro	Positive Limit Triggered	BOOL	Positive limit switch tripped	
57	ro	Negative Limit Triggered	BOOL	Negative limit switch triggered	
58	ro	Load Data Complete	BOOL	Indicates that the data from the "IO Message" have been transferred in the drive	The bits "Load Data/Profile Handshake" and "Load Data Complete" are used as a handshake for the "IO Message".
100	rw	ModeExt	USINT	Enhanced operating mode 0: Profile position 1: Profile velocity 100: Homing	
101	rw	Homing method	USINT	Type of reference movement	corresponds to parameter-`HMmethod`
102	ro	Drive State	UDINT	Manufacturer-specific status word	corresponds to parameter-`_xStatus`
103	rw	Fault Reset	BOOL	1: Fault reset	

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9 Examples

9.1 Wiring examples

The following figure shows an example of wiring for drives with internal 24V signal power supply. The limit switches and the reference switch are powered by the internal 24V signal power supply.

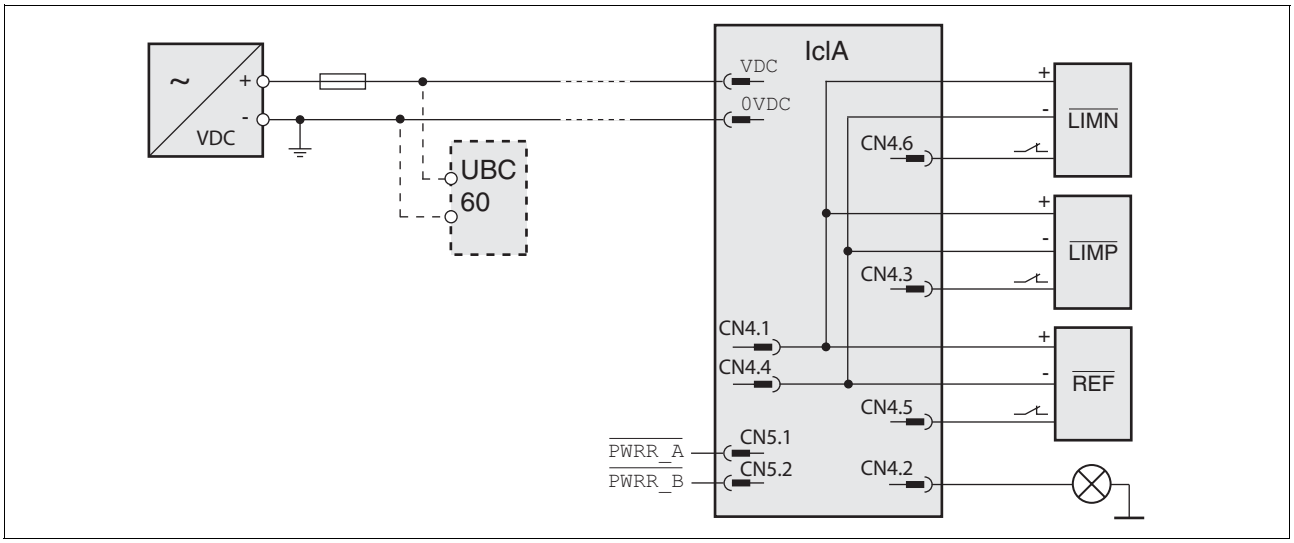

Figure 9.1 Wiring example with internal 24V signal power supply

The following figure shows an example of wiring for drives with external 24V signal power supply. The limit switches and the reference switch are powered by a separate $24V_{DC}$ power supply unit.

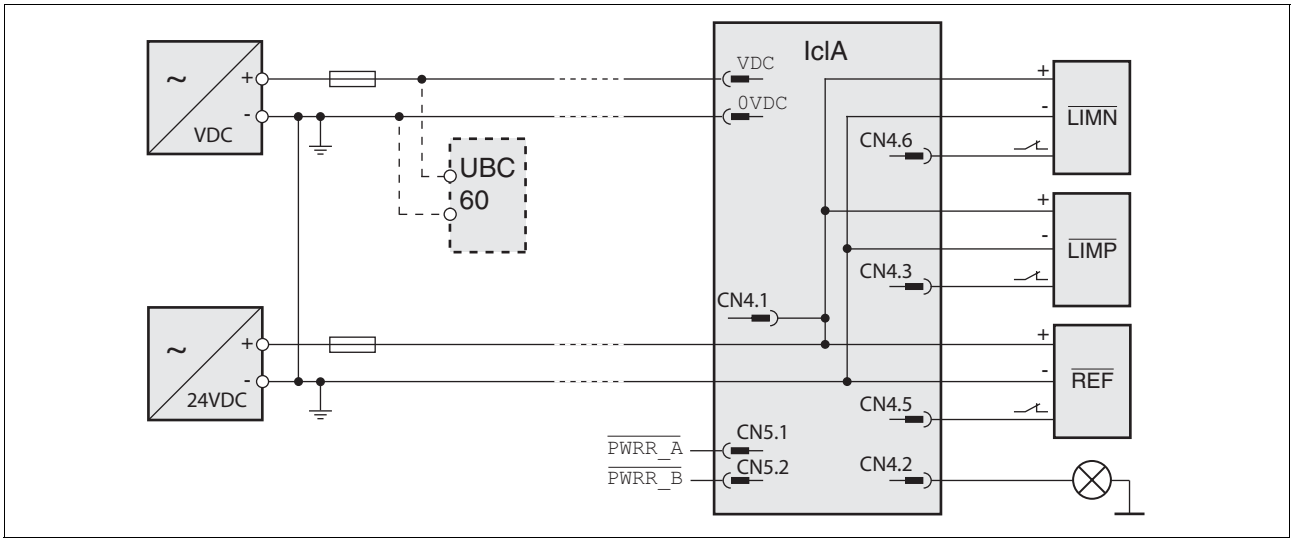

Figure 9.2 Wiring example with external 24V signal power supply

VDC power supply units and the UBC braking resistor controller are available as accessories, see chapter 12 "Accessories and spare parts".

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9.2 "Power Removal " wiring

Using the safety functions integrated in this product requires careful planning. For more information see chapter5.4 "Safety function "Power Removal"" on page 63.

9.3 Settings as examples

The byte sequence is input in big-endian format (Motorola format) during input into the DeviceNet scanner, but is transmitted on the bus in little-endian format (Intel format). The display is therefore different on the DeviceNet scanner and on the fieldbus monitor!

The examples are shown in big-endian format. They can be input directly into the DeviceNet scanner. The bus monitor displays the data in little-endian format.

9.3.1 Overview of examples

The program examples demonstrate practical applications for network operation. All examples are shown based on an I/O message with output assembly 101 and input assembly 111.

All examples show only the data field of the message without the CAN identifier field.

Structure of the examples

The examples cover the following topics:

- description of task
- Initial conditions
- required entries in the output assembly 101
- response in input assembly 111
- possible restrictions for command execution
- display in big-endian format (DeviceNet scanner view)

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Output Assembly 101

Operating modes can be set and movements started with output assembly 101. Target presets can be changed during processing.

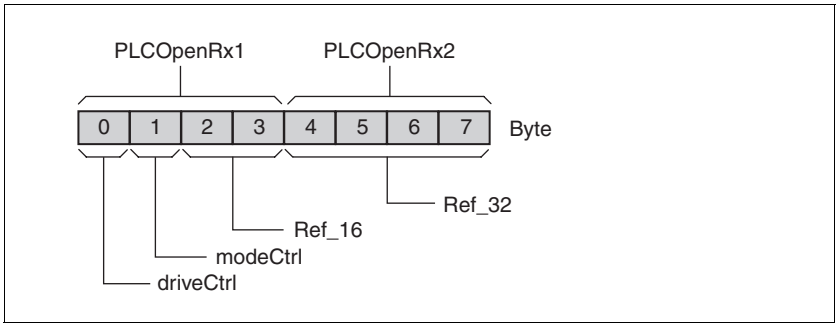

Figure 9.3 Output Assembly 101

The following fields are available in the assembly:

- Byte "driveCtrl": Manage operating status
- Byte "modeCtrl": Start and change operating mode
- "Ref_16" word: depends on operating mode, e.g. setpoint speed
- "Ref_32" double word: depends on operating mode, e.g. setpoint position

The default values for these fields are not transferred until the status in byte "modeCtrl" bit "ModeToggle" was changed.

Input Assembly 111

You can use input assembly 111 to monitor the operating status and travel commands.

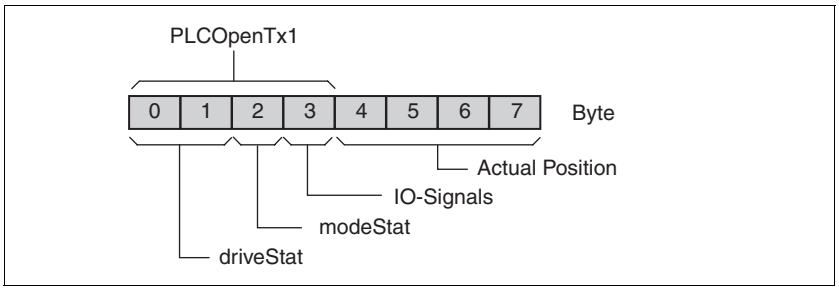

Figure 9.4 Input Assembly 111

The following fields are available:

- "driveStat" word: Displays the current operating status, warning and error bits and the status of the current operating mode.
- Byte "modeStat": displays the current defined operating mode :
- Byte "IO-Signals": Status of input signals
- "Actual Position" double word: Current motor position

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9.3.2 Operating statuses via an I/O message

⚠ 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.

9.3.2.1 Activating and deactivating the power amplifier

Activate power amplifier

■ Operating status "Ready to Switch On"

▶ "driveCtrl" Bit "Disable": 0

▶ "driveCtrl" Bit "Enable": 0 -> 1

	Master <---> Slave	
Disable is requested	---> Output	driveCtrl 01_h
Drive system reports operating status 4	<--- Input	driveStat $xxx4_h$
Request Enable	---> Output	driveCtrl 02_h
Drive system reports operating status 5	<--- Input	driveStat $xxx5_h$
Drive system reports operating status 6	<--- Input	driveStat $xxx6_h$

Deactivate power amplifier

■ Operating status "Operation enable" or "Quick Stop active"

▶ "driveCtrl" Bit "Enable": 0

▶ "driveCtrl" Bit "Disable": 0 -> 1

	Master <---> Slave	
Enable is requested	---> Output	driveCtrl 02_h
Drive system reports operating status 6	<--- Input	driveStat $xxx6_h$
Request disable	---> Output	driveCtrl 01_h
Drive system reports operating status 4	<--- Input	driveStat $xxx4_h$

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9.3.2.2 Execute the "Quick Stop" function

A running travel command can be interrupted at any time using the function "Quick Stop".

Execute the "Quick Stop" function

- Operating status "Operation Enable"
- ▶ "driveCtrl" Bit "Enable": 0 -> 1
- ▶ "driveCtrl" Bit "Quick Stop": 0 -> 1

	Master <---> Slave	
Request Enable	---> Output	driveCtrl 02_h
Drive system reports operating status 6	<--- Input	driveStat xxx6_h
Request Quick Stop (+ Enable)	---> Output	driveCtrl 06_h
Drive system reports operating status 7	<--- Input	driveStat xxx7_h
Wait until drive system is at standstill		
Drive system remains in operating status 7	<--- Input	driveStat xxx7_h

"Quick Stop" reset

- Operating mode "Quick Stop active"
- ▶ "driveCtrl" Bit "Quick Stop": 0
  "driveCtrl" Bit "Fault Reset": 1
- ▶ "driveCtrl" Bit "Fault Reset": 0

	Master <---> Slave	
Drive system must start again: Clear Quick Stop request, apply Fault Reset	---> Output	driveCtrl $0A_h$
Drive system reports operating status 6	<--- Input	driveStat xxx6_h
Clear Fault Reset	---> Output	driveCtrl 02_h
Drive system reports operating status 6	<--- Input	driveStat xxx6_h

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10 Diagnostics and troubleshooting

10.1 Service

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.

10.2 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 10.4 "Table of error numbers".

Asynchronous error

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"
- Information in "driveStat" byte
- 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 10.2.5 "Errors:Synchronous".

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10.2.1 Status 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 status diagram is shown graphically as a flow chart.

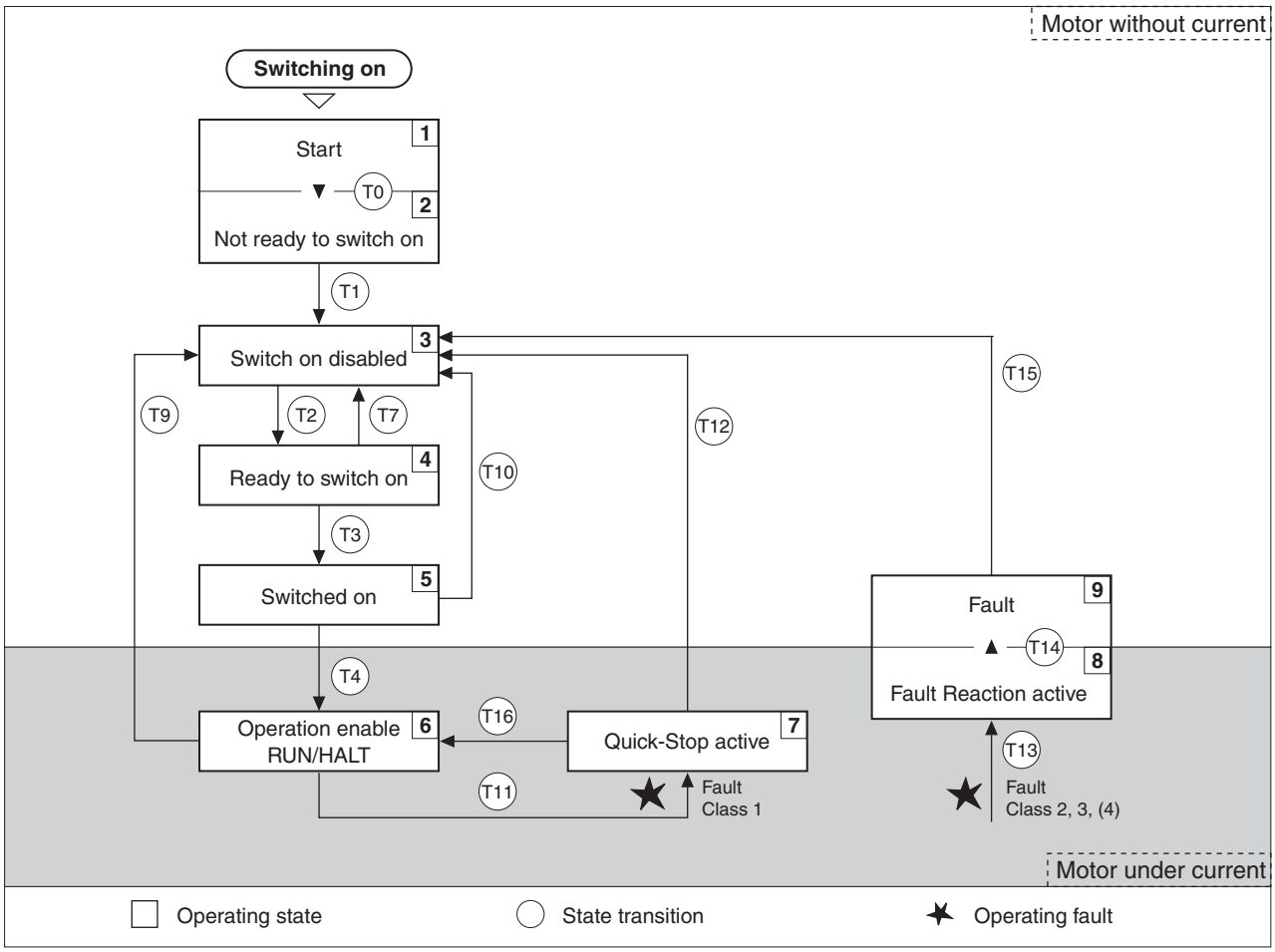

Figure 10.1 Status diagram

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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 initialised
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

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

Transition	Operating state	Condition / event [1) 2)]	Response
T0	**1**-> **2**	• Device electronics successfully initialised	
T1	**2**-> **3**	• Parameter successfully initialised	
T2	**3**-> **4**	• no under-voltage Motor encoder successfully checked, Actual speed: <1000 1/min $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ = +24V, (or plug bridge CN6 inserted)	
T3	**4**-> **5**	• Call-up for activation of power amplifier	
T4	**5**-> **6**	• Automatic transition	Power amplifier is activated User parameters are checked Holding brake is released (if present)
T7	**4**-> **3**	• Undervoltage • $\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ = 0V • Actual speed: >1000 1/min (e.g. by remote drive)	-
T9	**6**-> **3**	• Call-up for deactivation of power amplifier	Power amplifier is immediately deactivated.
T10	**5**-> **3**	• Call-up for deactivation of power amplifier	
T11	**6**-> **7**	• Class 1 error	Interrupt travel command with "Quick Stop".
T12	**7**-> **3**	• Call-up for deactivation of power amplifier	Power amplifier is deactivated immediately, even if "Quick Stop" is still active.
T13	**x** -> **8**	• Errors Class 2, 3 or 4	Error response is carried out, see "Error response"
T14	**8** -> **9**	• Error response terminated (error from class 2) • Errors Class , 3 or 4	
T15	**9**-> **3**	• Function: "Fault Reset"	Error is reset (cause of error must be corrected).
T16	**7**-> **6**	• Function: "Fault Reset"	

1) In order to initiate status transition it is sufficient to fulfil just one point
2) fieldbus commands only with control mode fieldbus

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10.2.2 Error display with LEDs

Status display The LEDs display error messages and warnings. They show the operating statuses in coded form.

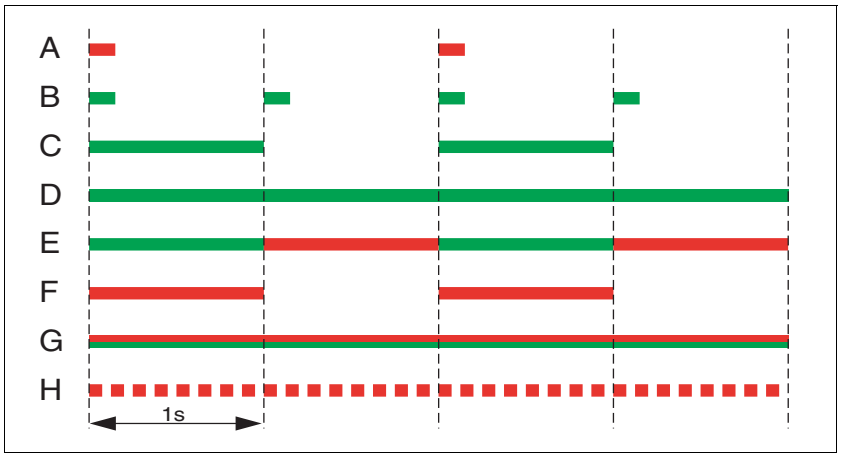

Figure 10.2 Error display with LEDs

Operating statuses

(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 response active
(F)	**9** Fault
(G)	Firmware not available
(H)	internal error

10.2.3 Error display using commissioning software

- You will need a PC with the commissioning software and a functioning connection to the product.

▶ Select “Diagnosis error memory“. A dialogue 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 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.
In the case of class 4 errors, you will need to switch off the controller supply voltage and switch it on again.

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10.2.4 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. As long as there is no error present, the value of this parameter will be 0. If an error occurs, the error, together with the further status information, is written to the error memory. 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	Erase error memory 1: Deletion of all entries in error memory The process is completed if, when reading the parameters, a 0 is sent back.	- 0 - 1	UINT16 UINT16 R/W - -	Modbus 15112 DeviceNet 159.1.4
FLT_MemReset	Reset the error memory read pointer 1: Set error memory read pointer to oldest error entry.	- 0 - 1	UINT16 UINT16 R/W - -	Modbus 15114 DeviceNet 159.1.5

The error memory can only be read sequentially. The parameter `FLT_MemReset` must be used to reset the read pointer. Then the first error entry can be read. The read pointer is automatically 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	Description
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`.

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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 Reading this parameter brings the complete error entry (error class, time of error ...) into an intermediate memory from which all components of the error can be read. In addition, the read indicator of the error memory is automatically switched forward to the next error entry.	- 0 - 65535	UINT16 UINT16 R/- - -	Modbus 15362 DeviceNet 160.1.1
FLT_class	Error class 0: Warning (no reaction) 1: Error (Quick Stop -> status 7) 2: Error (Quick Stop -> status 8,9) 3: Fatal error (state 9, resettable) 4: Fatal error (state 9, not resettable)	- 0 - 4	UINT16 UINT16 R/- - -	Modbus 15364 DeviceNet 160.1.2
FLT_Time	Error time referenced to the operating hours counter	s 0 - 536870911	UINT32 UINT32 R/- - -	Modbus 15366 DeviceNet 160.1.3
FLT_Qual	Error additional information This entry contains additional information about the error, depending on the error number. Example: a parameter address	- 0 - 65535	UINT16 UINT16 R/- - -	Modbus 15368 DeviceNet 160.1.4

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10.2.5 Errors:Synchronous

Explicit Error Response

If an explicit request message from the slave cannot be processed, the master receives an error message in the associated explicit response. This response message contains 2 bytes:

- General Error Code
- Additional Error Code

All errors can be read out with object 100.1.1. If the general error code has the value =1F$_h$, manufacturer-specific error numbers are shown in the "additional error code" field.

Response in I/O connection

The slave reacts to an I/O command with errors in the next I/O response by setting bit 6 (`ME, ModeError`) in byte `modeStat`. This does not interrupt the current process. To find the cause of the error the master can read the error number with the object 100.1.1 with an explicit access.

This error display is reset when the next valid data protocol is transmitted.

Table of general error codes

The error codes that can be displayed in the "General Error Code" field are listed in the following table:

Error code	Name	Description
00$_h$	Success	The service was successfully executed by the specified object.
01$_h$	Connection failure	A connection-specific service has failed along the connection path.
02$_h$	Resource unavailable	Resources that the object required to execute the requested service were not available.
03$_h$	Invalid parameter value	See status code 0x20, which is the preferred value for this condition.
04$_h$	Path segment error	The path segment identifier or segment syntax could not be interpreted by the processing node. The path processing ends when a path segment error is detected.
05$_h$	Path destination unknown	The path refers to an object class, an instance or a structure element that is unknown or not included in the processing node. The path processing ends if an error is detected based on an unknown path target.
06$_h$	Partial transfer	Only part of the expected data was transmitted.
07$_h$	Connection lost	The connection to the message transmission was interrupted.
08$_h$	Service not supported	The requested service was not implemented or was not defined for this object class or this instance.
09$_h$	Invalid attribute value	Invalid attribute data were detected
0Ah	Attribute list error	An attribute in the response "Get_Attribute_List" (call attribute list) or "Set_Attribute_List" (set attribute list) indicates a status that is not zero.
0B$_h$	Already in requested mode/ state	The object is already in the mode/status that was requested by the service
0C$_h$	Object state conflict	The object cannot execute the requested service in its current mode/status
0D$_h$	Object already exists	The requested instance of the object that is to be created already exists.
0E$_h$	Attribute not settable	A request to change an attribute that cannot be set was received.
0F$_h$	Privilege violation	The check of an authorisation/privilege has failed
10$_h$	Device state conflict	The current mode/status of the device prevents execution of the requested service.
11$_h$	Reply data too large	The data volume for transmission in the response buffer is larger than the allocated response buffer

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Error code	Name	Description
12_h	Fragmentation of a primitive value	The service has input an operation that results in fragmentation of the original data value, i.e. half a REAL data type.
13_h	Not enough data	The service does not return enough data to execute the specified operation.
14_h	Attribute not supported	The attribute specified in the request is not supported
15_h	Too much data	The service returned more data than expected
16_h	Object does not exist	The specified object does not exist in the device.
17_h	Service fragmentation sequence not in progress	The fragmentation sequence for this service is not currently activated for these data.
18_h	No stored attribute data	The attribute data of this object were not saved before the requested service.
19_h	Store operation failure	The attribute data of this object were not saved, because an error occurred during the attempt.
$1A_h$	Routing failure, request packet too large	The request packet of the service was too large to be transmitted to the target on a network in the path. The routing device was forced to cancel the service.
$1B_h$	Routing failure, response packet too large	The response packet of the service was too large to be transmitted from the target on a network in the path. The routing device was forced to cancel the service.
$1C_h$	Missing attribute list entry data	The service did not provide an attribute in an attribute list that was required to allow the service to carry out the required behaviour.
$1D_h$	Invalid attribute value list	The service returns the list with the status information provided for the specified attributes for the invalid attributes.
$1E_h$	Embedded service error	An embedded service results in an error.
$1F_h$	Vendor specific error	A manufacturer-specific error was detected. The "Additional Code" field (additional error code) of the response message defines the detected error. If "Additional Code" contains the value "FE", the synchronous error code must be read with the object 100.1.1. If "Additional Code" contains a value not equal to "FE", the error number can also be displayed for reading with object 100.1.1 by placing "A3" in front, e.g.: error code = 1Fh, additional code = 08h -> error code = A308h: Drive in Fault status
20_h	Invalid parameter	A parameter allocated to the request was invalid. This code is used if a parameter does not meet the requirements of this specification and/or the requirements defined in an application object specification are not met.
21_h	Write-once value or medium already written	An attempt was made either to write data again to a data carrier that was writable (e. g. WORM drive, PROM) and that already contained written data, or to change a specified value that cannot be changed.
22_h	Invalid Reply Received	An invalid reply was received (e. g. the service reply code is not the same as the request code or the reply is shorter than the expected minimum length of the reply). This status code may also be used for other causes of invalid responses.
23_h - 24_h		Reserved by CIP for future extensions
25_h	Key Failure in path	The key segment that was inserted in the path as the first segment does not match the target module. The object-specific status indicates which part of the key test has failed.
26_h	Path Size Invalid	The size of the path that was sent with the service request is either not larger enough to allow routing of the request, or it contained too much routing data.
27_h	Unexpected attribute in list	An attempt was made to set an attribute that cannot be set at this time.
28_h	Invalid Member ID	The member ID specified in the request does not exist in the specified class/instance/attribute
29_h	Member not settable	A request to change a member that cannot be changed was received.
$2A_h$	Group 2 only server general failure	This error code can only be reported by the servers of DeviceNet group 2 with 4 KB or less code memory space (and only if the service or an attribute is not supported or an attribute cannot be set.

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Error code	Name	Description
$2B_h$ - CF_h	-	Reserved by CIP for future extensions
$D0_h$ -FF_h	Reserved for Object Class and service errors	This error code range is used to display errors related to object classes. Use this range only if none of the error codes listed in this table represent the detected error exactly.

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10.3 Troubleshooting

10.3.1 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.

In DeviceNet the two ends of the network (at the devices most distant from each other) must be terminated with a 120 Ohm resistor.

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, parameterisation, configuration

If the connection to a device cannot be established, check the following:

- Polling: Every network device must have a unique address.
- Parameterisation: the vendor ID and the product code of the device must conform to the values stored in the EDS file.

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10.3.2 Error resolution sorted by error bit

To provide improved visibility when troubleshooting, all error numbers are categorised 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	Description	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 zone, 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" via field bus	1	fieldbus command	
4	$\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ inputs are "0"	3	"Power Removal" has been triggered	Check safety guard, cabling
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.
9	Reference signals faulty (frequency too high)		frequency too high, malfunction	EMC measures, observe max. 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
14	DC bus undervoltage	2	DC bus voltage under threshold value for "Quick Stop"	Check DC-Bus voltage
		3	DC bus voltage under threshold value for switch-off of the drive	
15	DC bus overvoltage	3	DC bus overvoltage, braking too fast	Extend braking, apply external brake resistor
18	Motor overload	3	Phase current too high	Reduce loading
20	Undervoltage from controller supply voltage		Controller supply voltage has fallen below the minimum value	Secure controller supply voltage. Check short-term voltage failures during load changes
21	Temperature of power amplifier too high	3	The power amplifier is overheating	Reduce loading
22	tracking error	par. 10.3 .2	tracking error	Reduce external load or acceleration, error response is adjustable via "Flt_pDiff“
24	$\overline{\text{PWRR\_A}}$ and $\overline{\text{PWRR\_B}}$ inputs are different	4	Interruption of the signal wiring	Signal cable/connection to be checked, check signal encoder or change
29	error in EEPROM	3-4	Checksum in EEPROM incorrect	"First setup" to be carried out, user parameters to be stored in the EEPROM, consult your local sales partner
30	system run-up faulty (hardware or parameter error)	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	Switch device off and on, replace device
			system error, e.g. division by 0 or time-out checks, inadequate EMC	Comply with EMC protective measures, switch device off and on, contact your local service representative

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10.4 Table of error numbers

The cause of error for each error message is coded as an error number and stored in the parameter `FLT_err_num`. The following table shows all the error numbers and their meaning If "par." is shown under the error class, then the error class can be set as a parameter.

The error numbers are structured:

Error number	Error in area
E 1xxx	General error
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 212.

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 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.

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Error number	Class	Bit	Description, reason and correctives
E 1103	-	-	Parameter write not permissible (READ only) Write access to read only parameter.
E 1104	-	-	Write access denied (no access authorisation) 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 tool is active and fieldbus access was tried at the same time). Check the channel that blocks the access.
E 110B	3	30	Initialisation error (additional info=Modbus register address) Error detected at power enable parameter check e.g. reference speed value for profile position is greater than max. allowed speed of drive.# Value in additional error info shows the Modbus register address of the parameter where the initialisation error was detected.
E 110E	-	-	Parameter changed that requires a restart of the drive Only displayed by the commissioning tool. A parameter modifiication requires the drive to be switched off and on. Restart the drive to activate the parameter functionality. Check the parameter chapter for the parameter that required a restart of the drive.
E 110F	-	-	Function not avialable in this type of device The specific type of device does not support this function or this parameter value. Check if you have the correct device type, in particular type of motor, type of encoder, holding brake.
E 1300	3	4	Power Removal activated (PWRR_A, PWRR_B) The "Power Removal" safety function was activated in "Operation enable" status. Reset the fault; check the wiring of the PWRR inputs.
E 1301	4	24	PWRR_A and PWRR_B different level The levels of the input PWRR_A or PWRR_B were different for more than 1 second. The drive has to be switched off and the reason fixed (e.g.: check emergency stop active) before it is switched on.
E 1310	3	9	Reference signal frequency too high The frequency of the pulse signal (A/B, Pulse/Direction, CW/CCW) is higher than the allowed value. Adapt the output pulse frequency of the controller to fit the input specification of the drive. Take care to also adapt the electronic gear ratio for the application requirements (position accuracy and speed).
E 1312	-	-	Limit or reference switch signal in I/O functions not defined Reference movements require limit switches. These limit switches are not assigned to inputs. Assign the LIMP, LIMN and ref functions to the inputs.

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Error number	Class	Bit	Description, reason and correctives
E 2300	3	18	Power amplifier overcurrent Motor short circuit and deactivation of the power amplifier. Check the motor power connection.
E 3200	3	15	DC bus overvoltage Energy recovery during braking too high. Check deceleration ramp, check dimensioning of drive and braking resistor.
E 3201	3	14	DC bus undervoltage (switch-off threshold) Power supply loss, poor power supply.
E 3202	2	14	DC bus undervoltage (Quick Stop threshold) 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 4302	0	5	Motor overload (I2t) warning The current has exceeded the nominal value for an extended period of time.
E 610D	-	-	Error in selection parameter Wrong parameter value selected. Check the value to be written.
E 7328	4	19	Motor encoder sends: position capture errors Encoder signals internal position capturing fault. Contact technical support or replace the motor.
E 7329	0	8	Motor encoder sends: Warning EMC, encoder signals internal warning. Contact technical support or replace the motor.
E 7338	0	13	No valid motor absolute position Warning to inform you that absolute position has not 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.

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Error number	Class	Bit	Description, reason and correctives
E 7503	0	9	RS485/Modbus: receive error EMC; cabling problem. Check cables.
E A060	2	10	Calculated speed in electronic gear/pulse control too high Gear ratio or speed reference value too high Reduce the gear ratio or speed reference value.
E A061	2	10	Position change in reference value with electronic gear/pulse control too high Position reference change is too high. Reference value input signal disturbance. Reduce the resolution of the master. Check reference value input signal.
E 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.
E A307	-	-	Interruption by internal software stop In homing and jog modes, the movement is internally interrupted using an internal software stop. The activation of a new operating mode is not possible, the error code is sent as the response to the activation command. Clear break condition with command Fault Reset.
E A308	-	-	Drive in "Fault" status Error with error class 2 or higher occurred. Check error code (HMI or PS2), remove error condition and clear error status with command Fault Reset.

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Error number	Class	Bit	Description, reason and correctives
E A309	-	-	Drive not in status "Operation Enable" A command which requires the status "Operation enable" was sent (e.g.: opmode change). Set drive to status "OperationEnable" and repeat the command.
E A310	-	-	Power amplifier not active Command is not possible because the power amplifier is not enabled (status "Operation Enabled" or "Quick Stop"). Set drive to a status with the amplifier enabled, refer to the status diagram in the operation chapter of the manual.
E A313	-	-	Position overrun, reference point is therefore no longer defined (ref_ok=0) The position range limits were exceeded which resulted in a loss of the reference point. An absolute movement cannot be made until the definition of a new reference point. Define a new reference point by means of homing mode.
E A314	-	-	No reference position Command needs a defined reference point (ref_ok=1). Define a new reference point by means of homing mode.
E A315	-	-	Homing active Command not possible if homing status is active. Wait until homing movement is finished.
E A317	-	-	Drive is not at standstill Command send which is not allowed during the motor is not in standstill e.g. - change of softwarelimits - change handling of supervision signals - set reference point - teach in of data set Wait until drive has come to a standstimm (x_end = 1).
E A318	-	-	Operating mode active (x_end=0) Activation of a new operating mode is not possible while the current operating mode is still active. Wait until the command in the operating mode has finished (x_end=1) or terminate current operating mode with HALT command.
E A319	1	2	Manual/Autotuning: distance range overflow The motor exceeds the parameterised maximum allowed position range. Check allowed position range value and time interval.
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.

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Error number	Class	Bit	Description, reason and correctives
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 A324	1	10	Error during homing (additional info = detailed error number)
			Homing movement was stopped by an error, the detailed reason is indicated by the additional info in the error buffer.
			Possible sub error codes: EA325 EA326 EA327 EA328 EA329
E A325	1	10	Limit switch to be approached not enabled
			Homing to LIMP or LIMN and limit switches are disabled.
			Enable limit switch via 'IOsigLimP' or 'IOsigLimN'.
E A326	1	10	REF switch not found between LIMP and LIMN
			REF input switch defective or not correctly connected.
			Check the function and wiring of the REF switch.
E A327	1	10	Reference movement to REF without direction reversal, improper enabling of limit switch LIM
			Search of REF without direction reversal in positive (negative) direction with LIMP (LIMN) activated.
			Check the function and wiring of the LIMP (LIMN) switch.
E A328	1	10	Reference movement to REF without direction reversal, overrun of LIM or REF not permissible
			Search of REF without direction reversal and REF or LIM overrun.
			Reduce homing speed ('HMn') or increase deceleration ('RAMPdecel'). Check the function and wiring of LIMP, LIMN and REF switch.

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Error number	Class	Bit	Description, reason and correctives
E A329	1	10	More than one signal LIMP/LIMN/REF active REF or LIM not connected correctly or supply voltage for switches too low. Check the wiring and 24VDC supply voltage.
E A32A	1	10	Ext. monitoring signal LIMP with neg. direction of rotation Start reference movement with neg. direction of rotation (e.g. reference movement to LIMN) and activate the LIMP switch (switch in opposite direction of movement). Check correct connection and function of limit switch. Activate a jog movement with negative direction of rotation (target limit switch must be connected to the inputs LIMN).
E A32B	1	10	Ext. monitoring signal LIMN with pos. direction of rotation Start reference movement with pos. direction of rotation (e.g. reference movement to LIMP) and activate the LIMN switch (switch in opposite direction of movement). Check correct connection and function of limit switch. Activate a jog movement with positive rotation (target limit switch must be connected to the inputs LIMP).
E A32C	1	10	Error with REF (switch signal briefly enabled or switch overrun) Switch signal disturbance. Motor subjected to vibration or shock when stopped after activation of the switch signal. Check supply voltage, cabling and function of switch. Check motor reaction after stopping and optimise controller settings.
E A32D	1	10	Error with LIMP (switch signal briefly enabled or switch overrun) Switch signal disturbance. Motor subjected to vibration or shock when stopped after activation of the switch signal. Check supply voltage, cabling and function of switch. Check motor reaction after stopping and optimise controller settings.
E A32E	1	10	Error with LIMN (switch signal briefly enabled or switch overrun) Switch signal disturbance. Motor subjected to vibration or shock when stopped after activation of the switch signal. Check supply voltage, cabling and function of switch. Check motor reaction after stopping and optimise controller settings.
E A330	-	-	Reproducibility of the index pulse movement uncertain, index pulse too close to the switch The position difference between the change of the switch signal and the occurrence of the index pulse is too low. Change mounting point of limit switch (optim. to the point at half a motor revolution away from the current mechanical position, direction outside the working range).
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'). Optimise controller settings.

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Error number	Class	Bit	Description, reason and correctives
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 B500	0	7	DeviceNet: io data could not be processed
			Error while processing I/O data: output data contains invalid value.
			Check output data content (application).
E B501	2	7	DeviceNet: Duplicate MAC ID
			A device with the same MAC ID is found at the DeviceNet bus.
			Use another MAC ID for this device or for the other device.
E B502	2	0	DeviceNet: Receive queue overrun
E B503	2	0	DeviceNet: Transmit queue overrun
E B504	2	0	DeviceNet: Error when sending an io message
E B505	2	7	DeviceNet: CAN-Controller in Busoff
			Too many error frames have been detected, CAN devices with different baudrates.
			Check CAN bus installation.
E B506	2	0	DeviceNet: CAN overflow (message lost)
			Two short DeviceNet messages have been sent too fast.
E B507	2	7	DeviceNet: Reset request, change of baud rate or MAC-ID
			Master sent DeviceNet reset request while power amplifier of drive was enabled.
			Reset the device only while the power amplifier is disabled.

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Error number	Class	Bit	Description, reason and correctives
E B508	2	7	DeviceNet: Power supply disabled DeviceNet bus power supply was switched off while the drive power amplifier was enabled. Disable drive power amplifier before switching off the DeviceNet master.
E B509	2	7	DeviceNet: Timeout explicit connection
E B50A	2	7	DeviceNet: Timeout I/O connection
E B50B	2	7	DeviceNet: Explicit connection closed is state operational An explicit connection was closed while no I/O channel was open and the power amplifier of the drive was enabled. If you use explicit connections only, disable the power amplifier of the drive before closing the connection.
E B50C	2	7	DeviceNet: I/O connection closed is state operational An I/O connection was closed while the power amplifier of the drive was switched enabled. Disable the power amplifier of the drive before closing the I/O connection.
E B50D	-	-	DeviceNet: Data length not correct, too many bytes
E B50E	-	-	DeviceNet: Data length not correct, too less bytes

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11 Parameters

This chapter provides an overview of the parameters which can be addressed for the operation of the product.

⚠ WARNING

Unintentional behaviour due to parameters

The behaviour 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

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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.

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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

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11.2 List of all parameters

Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_acc_pref	Acceleration of setpoint generation Advance sign corresponding to the change of the value for speed: Increase in speed: pos. advance sign Decrease in speed: neg. advance sign	(1/min)/s - 0 -	INT32 INT32 R/- - -	Modbus 7954 DeviceNet 131.1.9
_AccessInfo	Current access channels for action objects Low byte: 0: Occupied by the channel in High byte 1: Occupied exclusively by the channel in High byte High byte: Current assignment of the access channel 0: reserved 1: IO 2: HMI 3: Modbus 4: CANopen 5: CANopen via second SDO channel 6: Profibus 7: DeviceNet	- - 0 -	UINT16 UINT16 R/- - -	Modbus 280 DeviceNet 101.1.12
_actionStatus	Action word Signal state: 0: not enabled 1: enabled Bit0: Error class 0 Bit1: Error class 1 Bit2: Error class 2 Bit3: Error class 3 Bit4: Error class 4 Bit5: reserved Bit6: Drive stopped (Actual speed _n_act [1/min] < 9) Bit7: drive is rotating in a positive direction Bit8: drive is rotating in a negative direction Bit9: reserved Bit10: reserved Bit11: Profile generator at a standstill (reference speed is 0) Bit12: profile generator decelerated Bit13: profile generator accelerated Bit14: profile generator moves in constant mode Bit15: reserved	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7176 DeviceNet 128.1.4
_I2t_act_M	Overload motor current	% - 0 -	INT16 INT16 R/- - -	Modbus 7218 DeviceNet 128.1.25

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_I2t_mean_M	Motor load	% - 0 -	INT16 INT16 R/- - -	Modbus 7220 DeviceNet 128.1.26
_Id_act	current motor current d-components in 0.01 Apk steps	A_{pk} - 0.00 -	INT16 INT16 R/- - -	Modbus 7684 DeviceNet 130.1.2
_Id_ref	Set motor current d component (field weakening) in 0.01 Apk steps	A_{pk} - 0.00 -	INT16 INT16 R/- - -	Modbus 7714 DeviceNet 130.1.17
_Idq_act	Total motor current (vector sum of d and q components in 0.01 Apk steps	A_{pk} - 0.00 -	INT16 INT16 R/- - -	Modbus 7686 DeviceNet 130.1.3
_IO_LIO_act	Status of digital inputs/outputs (105) Coding of the individual signals: Bit0: LIO1 Bit1: LIO2 ...	- - 0 -	UINT16 UINT16 R/- - -	Modbus 2090 DeviceNet 108.1.21
_Iq_act	current motor current q-components in 0.01 Apk steps	A_{pk} - 0.00 -	INT16 INT16 R/- - -	Modbus 7682 DeviceNet 130.1.1
_Iq_ref	Set motor current q component (torque-creating) in 0.01 Apk steps	A_{pk} - 0.00 -	INT16 INT16 R/- - -	Modbus 7712 DeviceNet 130.1.16
_LastWarning	Last warning as number Number of the last warning generated. If the warning becomes inactive again, the number is retained until the next fault reset. Value 0: No warning generated	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7186 DeviceNet 128.1.9
_n_act	Actual speed of motor	1/min - 0 -	INT16 INT16 R/- - -	Modbus 7696 DeviceNet 130.1.8
_n_actRAMP	Actual speed of the movement profile encoder	1/min - 0 -	INT32 INT32 R/- - -	Modbus 7948 DeviceNet 131.1.6

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_n_pref	Speed of setpoint generation	1/min - 0 -	INT32 INT32 R/- - -	Modbus 7950 DeviceNet 131.1.7
_n_ref	Reference speed of the speed controller	1/min - 0 -	INT16 INT16 R/- - -	Modbus 7694 DeviceNet 130.1.7
_n_targetRAMP	Target speed of the movement profile encoder	1/min - 0 -	INT32 INT32 R/- - -	Modbus 7946 DeviceNet 131.1.5
_OpHours	Operating hours counter	s - 0 -	UINT32 UINT32 R/- - -	Modbus 7188 DeviceNet 128.1.10
_p_absENCusr	Motor position rel. to encoder work stroke in user-def. units Value range is defined by encoder type On singleturn motor encoders, the value is supplied relative to one motor revolution, on multiturn motor encoders it is relative to the entire work stroke of the encoder (e.g. 4096 revs.) IMPORTANT: Position is only valid after determination of the motor absolute position. With invalid motor absolute position: _WarnLatched _WarnActive Bit 13=1: absolute position of motor not yet detected	usr - 0 -	UINT32 UINT32 R/- - -	Modbus 7710 DeviceNet 130.1.15
_p_absmodulo	Absolute pos. relative. to one motor rev. in internal units IMPORTANT: Position is only valid after determination of the motor absolute position. With invalid motor absolute position: _WarnLatched _WarnActive Bit 13=1: absolute position of motor not yet detected	Inc - 0 -	UINT32 UINT32 R/- - -	Modbus 7708 DeviceNet 130.1.14
_p_act	Actual position of motor in internal units	Inc - 0 -	INT32 INT32 R/- - -	Modbus 7700 DeviceNet 130.1.10
_p_actPosintf	Actual position at position interface Counted position increments on RS422 signal input	Inc -2147483648 - 2147483647	INT32 INT32 R/- - -	Modbus 2058 DeviceNet 108.1.5

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_p_actRAMPusr	Actual position of the movement profile encoder in user-defined units	usr - 0 -	INT32 INT32 R/- - -	Modbus 7940 DeviceNet 131.1.2
_p_actusr	Actual position of the motor in user units	usr - 0 -	INT32 INT32 R/- - -	Modbus 7706 DeviceNet 130.1.13
_p_addGEAR	Start position of electronic gearbox With an inactive gearing the reference position can be calculated here at the position controller that was set when the gearbox was enabled with the selection 'Synchronisation with compensation movement'.	Inc - 0 -	INT32 INT32 R/- - -	Modbus 7942 DeviceNet 131.1.3
_p_dif	Current variation between reference and actual position Corresponds to the current control deviation of the position controller	revolution -214748.3648 - 214748.3647	INT32 INT32 R/- - -	Modbus 7716 DeviceNet 130.1.18
_p_DifPeak	Value of max. reached tracking errors of the position controller The tracking error is the current position regulation offset minus the speed-dependent position regulation offset. Further information see SPV_p_maxDiff. A write operation resets the value again.	revolution 0.0000 - 429496.7295	UINT32 UINT32 R/W - -	Modbus 4382 DeviceNet 117.1.15
_p_ref	Reference position in internal units Value represents the setpoint position of the position controller	Inc - 0 -	INT32 INT32 R/- - -	Modbus 7698 DeviceNet 130.1.9
_p_refusr	Reference position in user-defined units Value represents the reference position of the position controller	usr - 0 -	INT32 INT32 R/- - -	Modbus 7704 DeviceNet 130.1.12
_p_tarRAMPusr	Target position of the movement profile generator Absolute position value of the profile generator calculated from transferred relative and absolute position values. in user-defined units	usr - 0 -	INT32 INT32 R/- - -	Modbus 7938 DeviceNet 131.1.1
_prgNoDEV	Firmware program number Example: PR840.1 Value is entered in decimals as: 8401	- - 0.0 -	UINT16 UINT16 R/- - -	Modbus 258 DeviceNet 101.1.1

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_prgVerDEV	Firmware version Example: V4.201 Value is entered in decimals: 4201	- - 0.000 -	UINT16 UINT16 R/- - -	Modbus 260 DeviceNet 101.1.2
_serialNoDEV	device serial number Serial number: Unique number for identification of the product	- 0 - 4294967295	UINT32 UINT32 R/- per. -	Modbus 302 DeviceNet 101.1.23
_SigActive	Current state of the monitoring signals Meaning see _SigLatched	- - 0 -	UINT32 UINT32 R/- - -	Modbus 7182 DeviceNet 128.1.7
_SigLatched	Stored state of the monitoring signals Signal state: 0: not enabled 1: enabled Bit assignment: Bit0: General error Bit1: Limit switch (LIMP/LIMN/REF) Bit2: Range exceeded (software limit switch, tuning) Bit3: Quickstop via fieldbus Bit4: Inputs PWRR are 0 Bit6: Error RS485 Bit7: Error CAN Bit9: Frequency of reference signal too high Bit10: Error current operating mode Bit12: Profibus error Bit14: DC bus undervoltage Bit15: DC bus overvoltage Bit16: No mains phase Bit17: Connection to motor faulty Bit18: Motor overcurrent/short-circuit Bit19: Motor encoder error Bit20: 24VDC undervoltage Bit21: Overtemperature (power amplifier, motor) Bit22: Tracking error Bit23: max. speed exceeded Bit24: PWRR inputs different Bit29: error in EEPROM Bit30: System run-up (hardware or parameter fault) Bit31: System error (e. g. Watchdog) Monitors are product-dependent	- - 0 -	UINT32 UINT32 R/- - -	Modbus 7184 DeviceNet 128.1.8
_StopFault	Fault number of the last interruption cause	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7178 DeviceNet 128.1.5

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_Temp_act_PA	Temperature of the power amplifier	°C - 0 -	INT16 INT16 R/- - -	Modbus 7200 DeviceNet 128.1.16
_Ud_ref	Set motor voltage d-components in 0.1V steps	V - 0.0 -	INT16 INT16 R/- - -	Modbus 7690 DeviceNet 130.1.5
_UDC_act	Voltage on DC bus Supply voltage VDC in 0.1V steps	V - 0.0 -	UINT16 UINT16 R/- - -	Modbus 7198 DeviceNet 128.1.15
_Udq_ref	Total motor current (vector sum of d and q components Root of (_Uq_ref^2 + _Ud_ref^2) in 0.1V steps	V - 0.0 -	INT16 INT16 R/- - -	Modbus 7692 DeviceNet 130.1.6
_Uq_ref	Set motor voltage q-components in 0.1V steps	V - 0.0 -	INT16 INT16 R/- - -	Modbus 7688 DeviceNet 130.1.4
_v_act_Posintf	Actual speed at position interface Determined pulse frequency at RS422 signal input	Inc/s -2147483648 - 2147483647	INT32 INT32 R/- - -	Modbus 2060 DeviceNet 108.1.6
_VoltUtil	Degree of utilisation of the DC bus voltage 100% means that the drive is at the voltage limit. _VoltUtil = (_Udq_ref / _Udq_ref) * 100%	% - 0 -	INT16 INT16 R/- - -	Modbus 7718 DeviceNet 130.1.19
_WarnActive	Active warnings bit-coded Meaning of Bits see _WarnLatched	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7190 DeviceNet 128.1.11

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
_WarnLatched	Stored warnings bit-coded Stored warning bits are erased in the event of a FaultReset. Bits 10,11,13 are automatically deleted. Signal state: 0: not enabled 1: enabled Bit assignment: Bit 0: General warning (see _LastWarning) Bit 1: Temperature of power amplifier high Bit 2: Temperature of motor high Bit 3: reserved Bit 4: Overload (I^2t) power amplifier Bit 5: Overload (I^2t) motor Bit 6: Overload (I^2t) braking resistor Bit 7: CAN warning Bit 8: Motor encoder warning Bit 9: RS485 protocol warning Bit 10: PWRR_A and/or PWRR_B Bit 11: DC Bus undervoltage, no mains phase Bit 12: Profibus warning Bit 13: Position not yet valid (position detection continuing) Bit 14: reserved Bit 15: reserved Monitors are product-dependent	- - 0 -	UINT16 UINT16 R/- - -	Modbus 7192 DeviceNet 128.1.12
AbsHomeRequest	Absolute positioning only after homing **0 / no**: No **1 / yes**: yes	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 1580 DeviceNet 106.1.22
AccessLock	Locking of other access channels 0: Other access channels enabled 1: Other access channels locked With this parameter, the fieldbus can lock active access to the device for the following access channels: - input signals - commissioning software The processing of the HALT input signal cannot be locked.	- 0 - 1	UINT16 UINT16 R/W - -	Modbus 316 DeviceNet 101.1.30
BRK_release	Processing of holding brake (108) 0: automatic processing (default) 1: manual brake release Activation of the brake output is only possible in 'Switch on disabled' or 'Ready to switch on' status if the power amplifier is activated the value 0 is automatically set.	- 0 0 1	UINT16 UINT16 R/W - -	Modbus 2068 DeviceNet 108.1.10

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
BRK_status	Status of holding brake 0: closed 1: Released 2: not available	- 0 0 2	UINT16 UINT16 R/- - -	Modbus 2070 DeviceNet 108.1.11
Cap1Activate	Capture unit 1 Start/Stop **0 / Capture stop**: Abort capture function **1 / Capture once**: Start once-off capture **2 / Capture continuous**: Start continuous capture function In the case of a once-off capture, the function is terminated with the first captured value. The capture continues endlessly with continuous capture.	- 0 - 2	UINT16 UINT16 R/W - -	Modbus 2568 DeviceNet 110.1.4
Cap1Config	Configuration of capture unit 1 **0 / 1->0**: position capture with 1->0 switch **1 / 0->1**: position capture with 0->1 switch	- 0 0 1	UINT16 UINT16 R/W - -	Modbus 2564 DeviceNet 110.1.2
Cap1Count	Capture unit 1 event counter Counts the capture events. Numerator is reset when the capture unit 1 is activated.	- - 0 -	UINT16 UINT16 R/- - -	Modbus 2576 DeviceNet 110.1.8
Cap1Pos	Capture unit 1 captured position Captured position at the time of the "capture signal". The captured position is recalculated after "set dimensions" or after a "homing".	usr - 0 -	INT32 INT32 R/- - -	Modbus 2572 DeviceNet 110.1.6
Cap2Activate	Capture unit 2 Start/Stop **0 / Capture stop**: Abort capture function **1 / Capture once**: Start once-off capture **2 / Capture continuous**: Start continuous capture function In the case of a once-off capture, the function is terminated with the first captured value. The capture continues endlessly with continuous capture.	- 0 - 2	UINT16 UINT16 R/W - -	Modbus 2570 DeviceNet 110.1.5
Cap2Config	Configuration of capture unit 2 **0 / 1->0**: position capture with 1->0 switch **1 / 0->1**: position capture with 0->1 switch	- 0 0 1	UINT16 UINT16 R/W - -	Modbus 2566 DeviceNet 110.1.3
Cap2Count	Capture unit 2 event counter Counts the capture events. Numerator is reset when the capture unit 2 is activated.	- - 0 -	UINT16 UINT16 R/- - -	Modbus 2578 DeviceNet 110.1.9

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
Cap2Pos	Capture unit 2 captured position Captured position at the time of the "capture signal". The captured position is recalculated after "set dimensions" or after a "homing".	usr - 0 -	INT32 INT32 R/- - -	Modbus 2574 DeviceNet 110.1.7
CapStatus	Status of capture units Read access: Bit 0: Position captured via input CAP1 Bit 1: Position captured via input CAP2	- - 0 -	UINT16 UINT16 R/- - -	Modbus 2562 DeviceNet 110.1.1
CTRL_I_max	Current limiting The value cannot exceed the max. allowable current of the drive M_I_max. Default is M_I_max	A_{pk} 0.00 - 299.99	UINT16 UINT16 R/W per. -	Modbus 4610 DeviceNet 118.1.1
CTRL_KFPp	Speed pre-control position controller Over-control up to 110% possible.	% 0.0 100.0 110.0	UINT16 UINT16 R/W per. -	Modbus 4624 DeviceNet 118.1.8
CTRL_KPn	Speed controller P-factor Default value is calculated from motor parameters	A/(1/min) 0.0001 - 1.2700	UINT16 UINT16 R/W per. -	Modbus 4614 DeviceNet 118.1.3
CTRL_KPp	Position controller P-factor Default value is calculated	1/s 2.0 - 495.0	UINT16 UINT16 R/W per. -	Modbus 4620 DeviceNet 118.1.6
CTRL_n_max	Speed limiter Setting value must not exceed Do not exceed speed of motor Default is maximum speed of motor (see M_n_max)	1/min 0 - 13200	UINT16 UINT16 R/W per. -	Modbus 4612 DeviceNet 118.1.2
CTRL_Pcdamp	Damping Posicast filter speed The filter is disabled at the value of 1000.	% 50.0 100.0 100.0	UINT16 UINT16 R/W per. expert	Modbus 4648 DeviceNet 118.1.20
CTRL_Pcdelay	Time delay Posicast filter speed The filter is disabled at the value of 0.	ms 0.00 0.00 25.00	UINT16 UINT16 R/W per. expert	Modbus 4650 DeviceNet 118.1.21
CTRL_TAUnref	Filter time constant reference value filter of the setpoint speed value	ms 0.00 0.00 327.67	UINT16 UINT16 R/W per. -	Modbus 4626 DeviceNet 118.1.9

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
CTRL_TNn	Speed controller correction time	ms 0.00 - 327.67	UINT16 UINT16 R/W per. -	Modbus 4616 DeviceNet 118.1.4
DVNadr	DeviceNet address (node number) A change of address is only accepted if the rotary switch is set to an address > 63 or if there is no rotary switch. IMPORTANT: A change of address is not activated until the device is switched on again.	- 1 63 63	UINT16 UINT16 R/W per. -	Modbus 5908 DeviceNet 123.1.10
DVNbaud	DeviceNet baud rate **0 / 125KBaud**: 125 kbaud **1 / 250KBaud**: 250 kbaud **2 / 500KBaud**: 500 kbaud **3 / Autobaud**: Autobaud	- 0 3 3	UINT16 UINT16 R/W per. -	Modbus 5910 DeviceNet 123.1.11
DVNbuspowerSpv	Monitoring DeviceNet bus power supply 0 = monitoring active 1 = monitoring inactive	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 5914 DeviceNet 123.1.13
DVNdiag	DeviceNet diagnostics Bit 0: expl. connection ID1: 0=closed, 1=open Bit 1: expl. connection ID5: 0=closed, 1=open Bit 2: expl. connection ID6: 0=closed, 1=open Bit 3: io connection ID2: 0=closed, 1=open Bit 4: io connection ID7: 0=closed, 1=open Bit 5: error state: 0=ok, 1=BUSOFF Bit 6: expl. connection EPR: 0=ok, 1=timeout Bit 7: io. connection EPR: 0=ok, 1=timeout Bit 8: error state: 0=ok, 1=passive Bit 9: receive error: 0=ok, 1=message error Bit 10: bus state: 0=offline, 1=online Write access : delete bits 7,8,9	- - 0 -	UINT32 UINT32 R/W - -	Modbus 5912 DeviceNet 123.1.12

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
ENC_pabsusr	Setting position of the motor sensor directly Value range depends on the sensor type. Singleturn encoder: 0..max_pos_usr/rev. - 1 Multiturn encoder: 0 .. (4096 * max_pos_usr/rev.) -1 max_pos_usr/rev.: maximum user position for one motor revolution, with default position scaling this value is 16384. IMPORTANT: * If processing is to be carried out with direction inversion, this must be set before setting the motor encoder position * The set value does not become active until the next time the controller is switched on. After the write access a wait of at least 1 second is required until the controller is switched off. * Changing the value also changes the position of the virtual index pulse and the index pulse displaced at ESIM function.	usr 0 - 2147483647	UINT32 UINT32 R/W - -	Modbus 1324 DeviceNet 105.1.22
FLT_class	Error class 0: Warning (no reaction) 1: Error (Quick Stop -> status 7) 2: Error (Quick Stop -> status 8,9) 3: Fatal error (state 9, resettable) 4: Fatal error (state 9, not resettable)	- 0 - 4	UINT16 UINT16 R/- - -	Modbus 15364 DeviceNet 160.1.2
FLT_del_err	Erase error memory 1: Deletion of all entries in error memory The process is completed if, when reading the parameters, a 0 is sent back.	- 0 - 1	UINT16 UINT16 R/W - -	Modbus 15112 DeviceNet 159.1.4
FLT_err_num	Error number Reading this parameter brings the complete error entry (error class, time of error ...) into an intermediate memory from which all components of the error can be read. In addition, the read indicator of the error memory is automatically switched forward to the next error entry.	- 0 - 65535	UINT16 UINT16 R/- - -	Modbus 15362 DeviceNet 160.1.1
FLT_Idq	Motor current at error time in 10 mA steps	O - 0.00 -	UINT16 UINT16 R/- - -	Modbus 15378 DeviceNet 160.1.9
FLT_MemReset	Reset the error memory read pointer 1: Set error memory read pointer to oldest error entry.	- 0 - 1	UINT16 UINT16 R/W - -	Modbus 15114 DeviceNet 159.1.5

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
FLT_n	Speed at error time	1/min - 0 -	INT16 INT16 R/- - -	Modbus 15376 DeviceNet 160.1.8
FLT_powerOn	Number of turn-on processes	- 0 - 4294967295	UINT32 UINT32 R/- - -	Modbus 15108 DeviceNet 159.1.2
FLT_Qual	Error additional information This entry contains additional information about the error, depending on the error number. Example: a parameter address	- 0 - 65535	UINT16 UINT16 R/- - -	Modbus 15368 DeviceNet 160.1.4
FLT_Temp_DEV	device temperature at error time	°C - 0 -	INT16 INT16 R/- - -	Modbus 15382 DeviceNet 160.1.11
FLT_Temp_PA	Power amplifier temperature at error time	°C - 0 -	INT16 INT16 R/- - -	Modbus 15380 DeviceNet 160.1.10
FLT_Time	Error time referenced to the operating hours counter	s 0 - 536870911	UINT32 UINT32 R/- - -	Modbus 15366 DeviceNet 160.1.3
FLT_UDC	DC bus voltage at error time in 100mV steps	V - 0.0 -	UINT16 UINT16 R/- - -	Modbus 15374 DeviceNet 160.1.7
FLTAmpOnCyc	ENABLE cycles up to time of error Number of power amplifier turn-on processes after switching on the power supply (control voltage) up to the appearance of the error	- - 0 -	UINT16 UINT16 R/- - -	Modbus 15370 DeviceNet 160.1.5
FLTAmpOnTime	Time error occurs after ENABLE	s - 0 -	UINT16 UINT16 R/- - -	Modbus 15372 DeviceNet 160.1.6
GEARdenom	Gear ratio denominator see description GEARnum	- 1 1 2147483647	INT32 INT32 R/W per. -	Modbus 9734 DeviceNet 138.1.3

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
GEARdir_enabl	Enabled direction of motion of the gear processing **1 / positive :** pos. direction **2 / negative**: neg. direction **3 / both**: both directions This can be used to activate a reverse interlock.	- 1 3 3	UINT16 UINT16 R/W per. -	Modbus 9738 DeviceNet 138.1.5
GEARnum	Gear ratio numerator $\text{Gear ratio} = \frac{\text{GEARnum}}{\text{GEARdenom}}$ The new gear ratio is implemented when the numerator value is transferred.	- -2147483648 1 2147483647	INT32 INT32 R/W per. -	Modbus 9736 DeviceNet 138.1.4
GEARposChgMode	Consideration of position changes with inactive power amplifier **0 / off:** Position changes in statuses with an inactive power amplifier are rejected: **1 / on**: Position changes in statuses with an inactive power amplifier are taken into account: Setting only effective if gear processing in 'Synchronisation with compensation movement' mode is started.	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 9750 DeviceNet 138.1.11
GEARratio	Selection of special gear ratios 0: Use of the specified gear ratio from GEARnum/GEARdenom 1: 200 2: 400 3: 500 4: 1000 5: 2000 6: 4000 7: 5000 8: 10000 9: 4096 10: 8192 11: 16384 Changing the reference value by the stated value results in one motor rotation.	- 0 0 11	UINT16 UINT16 R/W per. -	Modbus 9740 DeviceNet 138.1.6
HMdisREFtoIDX	Distance of switch - index pulse after reference movement Reading value provides the value of the difference between the index pulse position and the position on the switching flank of the limit or reference switch. Serves to monitor how far the index pulse is from the switching flank and serves to provide the criterion whether the reference movement with index pulse processing can be safely reproduced. in steps of 1/10000 revolutions	revolution - 0.0000 -	INT32 INT32 R/- - -	Modbus 10264 DeviceNet 140.1.12

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
HMdisusr	Distance between the switching point and the reference point After leaving the switch, the drive is still positioned in the working range for a defined path and this position is defined as a reference point. The parameters are only effective with reference movements without index pulse searching.	usr 1 200 2147483647	INT32 INT32 R/W per. -	Modbus 10254 DeviceNet 140.1.7
HMmethod	Reference movement method (146) 0: disabled 1: LIMN with index pulse 2: LIMP with index pulse 7: REF+ with index pulse, inv., outside 8: REF+ with index pulse, inv., inside 9: REF+ with index pulse, not inv., inside 10: REF+ with index pulse, not inv., outside 11: REF- with index pulse, inv., outside 12: REF- with index pulse, inv., inside 13: REF- with index pulse, not inv., inside 14: REF- with index pulse, not inv., outside 17: LIMN 18: LIMP 23: REF+, inv., outside 24: REF+, inv., inside 25: REF+, not inv., inside 26: REF+, not inv., outside 27: REF-, inv., outside 28: REF-, inv., inside 29: REF-, not inv., inside 30: REF-, not inv., outside 33: index pulse, neg. direction of rotation 34: index pulse, pos. direction of rotation Abbreviations: REF+: search movement in pos. direction REF-: search movement in neg. direction inv.: Invert direction of rotation in switch not inv.: direction of rotation in switch not inverted. outside: Index pulse/distance outside switch. inside: index pulse/distance inside switch.	- 0 - 35	R/W - -	
HMn_out	Set speed for release movement from switch The set value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 6 3000	UINT16 UINT16 R/W per. -	Modbus 10250 DeviceNet 140.1.5
HMn	Reference speed for search for the switch The set value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 60 13200	UINT16 UINT16 R/W per. -	Modbus 10248 DeviceNet 140.1.4

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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 0: Run-off check inactive >0: Run-off in user-defined units The switch must be disabled again inside this run-off, otherwise the reference movement is aborted	usr 0 0 2147483647	INT32 INT32 R/W per. -	Modbus 10252 DeviceNet 140.1.6
HMp_homeusr	Position on reference point After successful reference movement this position value is automatically set at the reference point.	usr -2147483648 0 2147483647	INT32 INT32 R/W per. -	Modbus 10262 DeviceNet 140.1.11
HMp_setpusr	Set dimensions to dimension setting position (156) Action object: Write access triggers dimension setting Only possible with motor standing still. Position standardisation is taken into account.	usr -2147483648 - 2147483647	R/W - -	
HMsrchdisusr	max. search distance after traversing over the switch 0: Search distance processing inactive >0: Search distance in user-defined units The switch must be enabled again inside this run-off, otherwise the reference movement is aborted	usr 0 0 2147483647	INT32 INT32 R/W per. -	Modbus 10266 DeviceNet 140.1.13
IO_AutoEnable	Processing power amplifier activation at PowerOn **0 / off:** active enable at switch-on does not activate the power amplifier **1 / on**: active enable at switch-on activates the power amplifier **2 / AutoOn**: The power amplifier is always automatically activated upon switch on	- 0 0 2	UINT16 UINT16 R/W per. -	Modbus 1292 DeviceNet 105.1.6
IO_LO_set	Setting digital outputs directly Write access to output bits is only effective if the signal pin exists as output and the function of the output was set to 'freely available'. Coding of the individual signals: Bit0: LO1_OUT Bit1: LO2_OUT ...	- - 0 -	UINT16 UINT16 R/W - -	Modbus 2082 DeviceNet 108.1.17
IO_PWRR_con	Wiring of PowerRemoval inputs **0 / not available**: inputs not available **1 / not connected**: inputs available but not wired (jumper inserted) **3 / connected**: inputs available and wired (function active) Inputs /PWRR_A and /PWRR_B	- 0 - 3	UINT16 UINT16 R/- - -	Modbus 2088 DeviceNet 108.1.20

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IODirPosintf	Counting direction at position interface **0 / clockwise:** Clockwise **1 / counter clockwise**: counterclockwise	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 2062 DeviceNet 108.1.7
IOfunct_LIO1	Function input/output LIO1 (182) **1 / Input Free available**: Freely available : **2 / Input Fault reset**: Reset error message **3 / Input Enable**: Enable **4 / Input Halt**: Halt **9 / Input Jog positive**: jog right **10 / Input Jog negative**: jog left **11 / Input Jog fast/slow**: Manual movement fast/slow : **20 / Input Reference switch (REF)**: Reference switch (REF) **21 / Input Positive limit switch (LIMP)**: Positive limit switch (LIMP) **101 / Output Free available**: Freely available : **102 / Output No fault**: No error **103 / Output Active**: Operating readiness	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1826 DeviceNet 107.1.17
IOfunct_LIO2	Function input/output LIO2 (183) **1 / Input Free available**: Freely available : **2 / Input Fault reset**: Reset error message **3 / Input Enable**: Enable **4 / Input Halt**: Halt **9 / Input Jog positive**: jog right **10 / Input Jog negative**: jog left **11 / Input Jog fast/slow**: Manual movement fast/slow : **20 / Input Reference switch (REF)**: Reference switch (REF) **22 / Input Negative limit switch (LIMN)**: Negative limit switch (LIMN) **101 / Output Free available**: Freely available : **102 / Output No fault**: No error **103 / Output Active**: Operating readiness	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1828 DeviceNet 107.1.18
IOfunct_LIO3	Function input/output LIO3 (183) **1 / Input Free available**: Freely available : **2 / Input Fault reset**: Reset error message **3 / Input Enable**: Enable **4 / Input Halt**: Halt **9 / Input Jog positive**: jog right **10 / Input Jog negative**: jog left **11 / Input Jog fast/slow**: Manual movement fast/slow : **20 / Input Reference switch (REF)**: Reference switch (REF) **101 / Output Free available**: Freely available : **102 / Output No fault**: No error **103 / Output Active**: Operating readiness	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1830 DeviceNet 107.1.19

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
IOfunct_LIO4	Function input/output LIO4 (183) **1 / Input Free available**: Freely available : **2 / Input Fault reset**: Reset error message **3 / Input Enable**: Enable **4 / Input Halt**: Halt **9 / Input Jog positive**: jog right **10 / Input Jog negative**: jog left **11 / Input Jog fast/slow**: Manual movement fast/slow : **20 / Input Reference switch (REF)**: Reference switch (REF) **101 / Output Free available**: Freely available : **102 / Output No fault**: No error **103 / Output Active**: Operating readiness	- - 0 -	UINT16 UINT16 R/W per. -	Modbus 1832 DeviceNet 107.1.20
IOposInterfac	Signal selection at position interface **0 / ABinput**: Input ENC_A, ENC_B 4x evaluation **1 / PDinput**: input PULSE, DIR RS422 IO interface (Pos) IMPORTANT: A change of the setting is not activated until the unit is switched on again	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 1284 DeviceNet 105.1.2
IOsigLimN	LIMN signal evaluation **0 / inactive:** inactive **1 / normally closed:** normally closed contact **2 / normally open**: normally-open switch	- 0 1 2	UINT16 UINT16 R/W per. -	Modbus 1566 DeviceNet 106.1.15
IOsigLimP	LIMP signal evaluation **0 / inactive:** inactive **1 / normally closed:** normally closed contact **2 / normally open**: normally-open switch	- 0 1 2	UINT16 UINT16 R/W per. -	Modbus 1568 DeviceNet 106.1.16
IOsigRef	REF signal evaluation **1 / normally closed:** normally closed contact **2 / normally open**: normally-open switch The reference switch is only activated while processing the reference movement to REF.	- 1 1 2	UINT16 UINT16 R/W per. -	Modbus 1564 DeviceNet 106.1.14
JOGactivate	Activation of jog (132) Bit0: clockwise rotation Bit1: counterclockwise rotation Bit2: 0=slow 1=fast If both direction bits are activated simultaneously, no movement is initiated. In the case of an ongoing jog, the simultaneous activation of the rotation direction bits has no effect.	- 0 0 7	R/W - -	

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
JOGn_fast	Speed for fast jog The set value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 180 13200	UINT16 UINT16 R/W per. -	Modbus 10506 DeviceNet 141.1.5
JOGn_slow	Speed for slow jog The set value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 60 13200	UINT16 UINT16 R/W per. -	Modbus 10504 DeviceNet 141.1.4
JOGstepusr	inching movement before continuous operation 0: direct activation of continuous operation >0: positioning section per inching cycle	usr 0 20 -	INT32 INT32 R/W per. -	Modbus 10510 DeviceNet 141.1.7
JOGtime	Waiting time before continuous operation Time is only effective if an inching section not equal to 0 has been set, otherwise direct transition to continuous operation.	ms 1 500 32767	UINT16 UINT16 R/W per. -	Modbus 10512 DeviceNet 141.1.8
LIM_HaltReaction	Type of deceleration with Halt (173) **1 / Deceleration ramp:** Deceleration ramp **3 / Torque ramp**: Torque ramp Setting the deceleration ramp using the RAMPdecel parameter. Setting of torque ramp via parameter LIM_I_maxHalt. The deceleration ramp is only possible in operating modes with profile generator. The torque ramp is always used in operating modes without a profile generator.	- 1 3 3	INT16 INT16 R/W per. -	Modbus 1582 DeviceNet 106.1.23
LIM_I_maxHalt	Current limiting for Stop max. Current during braking after Halt or termination of an operating mode. Maximum and default value setting depend on motor and power amplifier (Setting M_I_max and PA_I_max) in 0.01 Apk steps	A_{pk} - - -	UINT16 UINT16 R/W per. -	Modbus 4364 DeviceNet 117.1.6
LIM_I_maxQSTP	Current limiting for Quick Stop max. Current at braking via torque ramp due to error with error class 1 or 2, and on triggering of a software stop Maximum and default value setting depend on motor and power amplifier (Setting M_I_max and PA_I_max) in 0.01 Apk steps	A_{pk} - - -	UINT16 UINT16 R/W per. -	Modbus 4362 DeviceNet 117.1.5

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
LIM_QStopReact	Type of deceleration with Quick Stop (171) **6 / Deceleration ramp:** Deceleration ramp **7 / Torque ramp**: Torque ramp Setting for deceleration ramp via parameter RAMPquickstop. Setting for torque ramp via parameter LIM_I_maxQSTP. The deceleration ramp is only possible in operating modes with profile generator. The torque ramp is always used in operating modes without a profile generator.	- 6 7 7	INT16 INT16 R/W per. -	Modbus 1584 DeviceNet 106.1.24
M_I_0	Motor constant current at standstill in 0.01 Apk steps	A_{pk} - - -	UINT16 UINT16 R/- - -	Modbus 3366 DeviceNet 113.1.19
M_I_max	Motor maximum current in 0.01 Apk steps	A_{pk} - - -	UINT16 UINT16 R/- - -	Modbus 3340 DeviceNet 113.1.6
M_I_nom	Motor nominal current in 0.01 Apk steps	A_{pk} - - -	UINT16 UINT16 R/- - -	Modbus 3342 DeviceNet 113.1.7
M_I2t	max. allowable time for M_I_max	ms - - -	UINT16 UINT16 R/- - -	Modbus 3362 DeviceNet 113.1.17
M_Jrot	Motor moment of inertia in 0.1kgcm^2 steps	kg cm^2 - - -	UINT16 UINT16 R/- - -	Modbus 3352 DeviceNet 113.1.12
M_kE	Motor EMF constant kE Voltage constant in Vpk at 1000 1/min	- - - -	UINT16 UINT16 R/- - -	Modbus 3350 DeviceNet 113.1.11
M_L_d	Motor inductance d-direction in 0.01 mH steps	mH - - -	UINT16 UINT16 R/- - -	Modbus 3358 DeviceNet 113.1.15
M_L_q	Motor inductance q-direction in 0.01 mH steps	mH - - -	UINT16 UINT16 R/- - -	Modbus 3356 DeviceNet 113.1.14

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
M_M_max	Motor peak torque	N cm - - -	UINT16 UINT16 R/- - -	Modbus 3346 DeviceNet 113.1.9
M_M_nom	Motor nominal torque	N cm - - -	UINT16 UINT16 R/- - -	Modbus 3344 DeviceNet 113.1.8
M_n_max	maximum permissible motor speed	1/min - - -	UINT16 UINT16 R/- - -	Modbus 3336 DeviceNet 113.1.4
M_n_nom	Nominal motor speed	1/min - - -	UINT16 UINT16 R/- - -	Modbus 3338 DeviceNet 113.1.5
M_Polepair	Number of motor pole pairs	- - - -	UINT16 UINT16 R/- - -	Modbus 3368 DeviceNet 113.1.20
M_R_UV	Motor termination resistance in 10 mOhm steps	Ω - - -	UINT16 UINT16 R/- - -	Modbus 3354 DeviceNet 113.1.13
M_U_nom	Motor nominal voltage Voltage in 100mV steps	V - - -	UINT16 UINT16 R/- - -	Modbus 3348 DeviceNet 113.1.10
MBadr	Modbus address valid addresses: 1 to 247	- 1 1 247	UINT16 UINT16 R/W per. -	Modbus 5640 DeviceNet 122.1.4
MBbaud	Modbus baud rate Allowed baud rates: 9600 19200 38400 IMPORTANT: A change of the setting is not activated until the unit is switched on again	- 9600 19200 38400	UINT16 UINT16 R/W per. -	Modbus 5638 DeviceNet 122.1.3

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
MBformat	Modbus data format **1 / 8Bit NoParity 1Stop**: 8 bit, no parity bit, 1 stop bit **2 / 8Bit EvenParity 1Stop**: 8 bit, even parity bit, 1 stop bit **3 / 8Bit OddParity 1Stop**: 8 bit, odd parity bit, 1 stop bit **4 / 8Bit NoParity 2Stop**: 8 bit, no parity bit, 2 stop bits IMPORTANT: A change of the setting is not activated until the unit is switched on again	- 1 2 4	UINT16 UINT16 R/W per. -	Modbus 5642 DeviceNet 122.1.5
ModeError	Error code for synchronous errors (ME flag) Manufacturer-specific error code which led to setting of ModeError flag. In general this is an error that was triggered by starting an operating mode.	- - 0 -	UINT16 UINT16 R/- - -	Modbus 6962 DeviceNet 127.1.25
MT_dismax	Max. permissible distance If the maximum permissible distance is exceeded with an active reference value, a class 1 error is triggered. value 0 disables the monitoring.	revolution 0.0 1.0 999.9	UINT16 UINT16 R/W - -	Modbus 11782 DeviceNet 146.1.3
PA_T_max	maximum permissible temperature of the power amplifier	°C - 0 -	INT16 INT16 R/- per. -	Modbus 4110 DeviceNet 116.1.7
PA_T_warn	Temperature limit of the power amplifier	°C - 0 -	INT16 INT16 R/- per. -	Modbus 4108 DeviceNet 116.1.6
PA_U_maxDC	max. permissible DC bus voltage Voltage in 100mV steps	V - - -	UINT16 UINT16 R/- per. -	Modbus 4102 DeviceNet 116.1.3
PA_U_minDC	DC bus undervoltage threshold for drive switch-off Voltage in 100mV steps	V - - -	UINT16 UINT16 R/- per. -	Modbus 4104 DeviceNet 116.1.4
PA_U_minStopDC	DC bus undervoltage threshold for Quick Stop At this threshold, the drive performs a Quick Stop Voltage in 100mV steps	V - - -	UINT16 UINT16 R/- per. -	Modbus 4116 DeviceNet 116.1.10

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PAR_CTRLreset	Reset controller parameter **0 / no**: No **1 / yes**: yes Control parameter of the speed controller and the position controller are reset. The current controller is automatically set according to the connected motor.	- 0 - 1	UINT16 UINT16 R/W - -	Modbus 1038 DeviceNet 104.1.7
PAReeprSave	Back up the parameters in the EEPROM memory Bit 0=1: Back-up of all persistent parameters The current parameters are backed up in the non-volatile memory (EEPROM). The storing process is complete if a 0 is returned when reading the parameters.	- - - -	UINT16 UINT16 R/W - -	Modbus 1026 DeviceNet 104.1.1
PAReeprSaveDVN	Back up parameters to EEPROM with DeviceNet This parameter is the last transferred during a download of the configuration with RSNetWorx and it backs up the current parameters to non-volatile memory (EEPROM). The parameters can be switched between two values to force a download by a manual change in RSNetWorkx. The fuse is executed with both values.	- 0 0 1	UINT16 UINT16 R/W - -	Modbus 16218 DeviceNet 163.1.45
PARfactorySet	Restore factory setting (default values) **0 / no**: No **1 / Yes**: Yes Set all parameters to default values and back up in the EEPROM. A factory setting can only be triggered via commissioning software. The storing process is complete if a 0 is returned when reading the parameters. IMPORTANT: The default state only becomes active at the next start-up.	- 0 - 3	R/W - -	
PARuserReset	Resetting the user parameters Bit 0=1: Set persistent parameters to default values. All parameters are reset, with the exception of: - Communication parameter - Definition of the direction of rotation - Signal selection at position interface - IO functions IMPORTANT: The new settings are not backed up to the EEPROM!	- 0 - 7	UINT16 UINT16 R/W - -	Modbus 1040 DeviceNet 104.1.8

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
POSdirOfRotat	Definition of the direction of rotation **0 / clockwise:** Clockwise **1 / counter clockwise**: counterclockwise Meaning:1 The drive rotates clockwise with positive speeds, looking onto the motor shaft at the flange. IMPORTANT: When using limit switches, after changing the setting, the limit switch connections must be changed over. The limit switch which is actuated by moving in jog mode in a positive direction must be connected to the input LIMP, and vice versa. IMPORTANT: A change of the setting is not activated until the device is switched on again.	- 0 0 1	UINT16 UINT16 R/W per. -	Modbus 1560 DeviceNet 106.1.12
POSscaleDenom	Denominator of the position scaling factor For a description, see numerator (POSscaleNum) The new scaling is used when the numerator value is transferred.	usr 1 16384 2147483647	INT32 INT32 R/W per. -	Modbus 1550 DeviceNet 106.1.7
POSscaleNum	Numerator of the position scaling factor :Definition of scaling factor Motor revolutions [U] ---------- Change of user position [usr] The new scaling is used when the numerator value is transferred. User limit values may be reduced due to calculation of a system-internal factor	revolution 1 1 2147483647	INT32 INT32 R/W per. -	Modbus 1552 DeviceNet 106.1.8
PPn_target	Speed setpoint for profile position Maximum value is limited to the current setting in CTRL_n_max. The set value is internally limited to the current parameter setting in RAMPn_max.	1/min 1 60 13200	R/W - -	
PPp_absusr	Absolute target position of profile position operating mode Min/Max values are dependent upon: - scaling factor - software limit switch (if activated)	usr - 0 -	R/W - -	

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
PPp_relpactusr	Target position relative to curent motor position Min/max value : depending on: - position scaling factor - software limit switch (if activated) During running positioning in profile position mode, the relative positioning refers to the current motor position. An overrun of the absolute user-defined position limits is possible only if the drive is at standstill when starting the movement (x_end=1). In this case an implicit setting dimensions to position 0 is run.	usr - 0 -	R/W - -	
PPp_relprefusr	Target position rel. to current profile position target pos. Min/max value : depending on: - position scaling factor - software limit switch (if activated) During running positioning in profile position mode, the relative positioning refers to the target position of the current movement. An overrun of the absolute user-defined position limits is possible only if the drive is at standstill when starting the movement (x_end=1). In this case an implicit setting of the dimensions to position 0 is run.	usr - 0 -	R/W - -	
PVn_target	Setpoint velocity profile velocity operating mode Maximum value is limited to the current setting in CTRL_n_max. The set value is internally limited to the current parameter setting in RAMPn_max.	1/min -13200 - 13200	R/W - -	

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMP_TAUjerk	Jolt limiting **0 / off:** inactive **1 / 1**: 1 ms **2 / 2**: 2 ms **4 / 4**: 4 ms **8 / 8**: 8 ms **16 / 16**: 16 ms **32 / 32**: 32 ms **64 / 64**: 64 ms **128 / 128**: 128 ms Limits the acceleration changes (jerk) of the setpoint position generation during the positioning transitions: standstill - acceleration acceleration - constant movement constant movement - deceleration deceleration - standstill Processing in the following operating modes: - Profile velocity - Profile position - Jog - Homing Setting is only possible with inactive operating mode (x_end=1).	ms 0 0 128	UINT16 UINT16 R/W per. -	Modbus 1562 DeviceNet 106.1.13
RAMPacc	Profile generator acceleration	(1/min)/s 1 600 3000000	UINT32 UINT32 R/W per. -	Modbus 1556 DeviceNet 106.1.10
RAMPaccdec	Optimised ramp setting with one access Setting acceleration and deceleration values with one access High-Word: Acceleration Low-Word: Deceleration Values are entered in 10 rpm/s Write access changes the setting values under RAMPacc and RAMPdecel, the limit value check is carried out using the limit values there. If the current setting value cannot be mapped as a 16-bit value, then the max. UINT16 value is transferred	usr - 0 -	R/W - -	
RAMPdecel	Deceleration of the profile generator	(1/min)/s 750 750 3000000	UINT32 UINT32 R/W per. -	Modbus 1558 DeviceNet 106.1.11

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
RAMPn_max	Limiting set speed with operating modes with profile generation The parameters are effective in the following operating modes: - Profile position - Profile velocity - Homing - Jog If a higher target speed is set in one of these operating modes, the limit is automatically set to RAMPn_max. This makes it simple to conduct a commissioning with limited speed.	1/min 60 13200 13200	UINT16 UINT16 R/W per. -	Modbus 1554 DeviceNet 106.1.9
RAMPquickstop	Deceleration ramp at Quick Stop (171) Deceleration of drive when a software stop is triggered or if an error of error class 1 occurs	(1/min)/s 200 6000 3000000	UINT32 UINT32 R/W per. -	Modbus 1572 DeviceNet 106.1.18
RAMPsym	Symmetrical ramp Acceleration and deceleration of the profile generator (16bit value) in 10 (rpm)/s Write access changes the values under RAMPacc and RAMPdecel, limit value check is carried out using the limit values there. Reading access delivers the greater value of RAMPacc/RAMPdecel. If the current setting value cannot be mapped as a 16-bit value, then the max. UINT16 value is transferred	usr - 0 -	UINT16 UINT16 R/W - -	Modbus 1538 DeviceNet 106.1.1
SPEEDn_target	Set speed in operating mode speed control The internal maximum speed is limited by the current setting in CTRL_n_max	1/min -30000 0 30000	INT16 INT16 R/W - -	Modbus 8456 DeviceNet 133.1.4
SPEEDreference	Selection of reference source for speed control operating mode **0 / none:** None **1 / analogue input**: Reference value via +/-10V interface ANA1 : **2 / Parameter 'speedTarg'**: Reference value via parameter SPEEDn_target	- 0 0 2	UINT16 UINT16 R/W - -	Modbus 8450 DeviceNet 133.1.1
SPV_Flt_pDiff	Error response to tracking error **1 / ErrorClass1:** Error class 1 **2 / ErrorClass2**: error class 2 **3 / ErrorClass3**: error class 3	- 1 3 3	UINT16 UINT16 R/W per. -	Modbus 1302 DeviceNet 105.1.11

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Parameter Name	Description	Unit Minimum value Default value Maximum value	Data type R/W persistent Expert	Parameter address via fieldbus
SPV_p_maxDiff	Max. permissible tracking error of the position controller The tracking error is the current position regulation offset minus the speed-dependent position regulation offset. Actually, only the position offset caused by the moment requirements is still referred to for tracking error monitoring.	revolution 0.0001 1.0000 200.0000	UINT32 UINT32 R/W per. -	Modbus 4636 DeviceNet 118.1.14
SPV_SW_Limits	Monitoring the SW-limit switch **0 / none:** none (default) **1 / SWLIMP**: activating SW limit switch pos. direction **2 / SWLIMN**: activating SW limit switch neg. direction **3 / SWLIMP+SWLIMN**: activating SW limit switch both. directions The software limit switch is only monitored after a successful homing (ref_ok = 1)	- 0 0 3	UINT16 UINT16 R/W per. -	Modbus 1542 DeviceNet 106.1.3
SPVswLimNusr	negative position limit for SW-limit switch see description of 'SPVswLimPusr'	usr - -2147483648 -	INT32 INT32 R/W per. -	Modbus 1546 DeviceNet 106.1.5
SPVswLimPusr	positive position limit for SW-limit switch If a user-defined value outside the permissible user-defined area is set, the limit switch limits are automatically limited internally to the maximum user-defined value.	usr - 2147483647 -	INT32 INT32 R/W per. -	Modbus 1544 DeviceNet 106.1.4
STANDp_win	Standstill window, permissible offset The offset for the standstill window time must lie in this range of values to allow recognition of the standstill of the drive. The processing of the standstill window must be activated via the STANDpwinTime parameter.	revolution 0.0000 0.0010 3.2767	UINT16 UINT16 R/W per. -	Modbus 4370 DeviceNet 117.1.9
STANDpwinTime	Standstill window, time 0: Standstill window monitoring deactivated >0 : Time in ms within which the control deviation must lie in the standstill window	ms 0 0 32767	UINT16 UINT16 R/W per. -	Modbus 4372 DeviceNet 117.1.10
STANDpwinTout	Timeout for the standstill window monitor 0: Timeout monitor deactivated >0 : Timeout time in ms Processing of the standstill window is set via STANDp_win and STANDpwinTime Time monitoring begins when the target position is reached (position controller reference position) or. at the end of the profile generator processing.	ms 0 0 16000	UINT16 UINT16 R/W per. -	Modbus 4374 DeviceNet 117.1.11

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12 Accessories and spare parts

12.1 Accessories

Reference source of commissioning software

The current commissioning software is available for download from the internet.
http://www.berger-lahr.com/download

Source EPLAN Macros

For easier engineering, macro files and master article files are available for download from the Internet.
http://www.berger-lahr.com/download

Designation	Order number
Braking Resistor Controller UBC60	ACC3EA001
IclA Ixx Installation Set	0062501521001
IclA Ixx Cable Glands, 2 units	0062501520002
IclA Ixx Cable Glands, 10 units	0062501520001
IclA IFx Cable (power, DVN) 03m	0062501467030
IclA Ixx Cable (power, STAK 200) 03m	0062501470030
IclA Ixx Cable (power, STAK 200) 05m	0062501470050
IclA Ixx Cable (power, STAK 200) 10m	0062501470100
IclA Ixx Cable (power, STAK 200) 15m	0062501470150
IclA Ixx Cable (power, STAK 200) 20m	0062501470200
IclA Cable (PWRR M8x4) 03m	0062501485030
IclA Cable (PWRR M8x4) 05m	0062501485050
IclA Cable (PWRR M8x4) 10m	0062501485100
IclA Cable (PWRR M8x4) 15m	0062501485150
IclA Cable (PWRR M8x4) 20m	0062501485200
IclA IFx Female Connector DeviceNet M12	0062501550001
IclA IFx Connector 3I/O 24V	0062501523001
IclA IFx Connector 4I/O 24V	0062501523002
IclA IFx Connector 2I/O	0062501534001
IclA IFx Connector 3I/O	0062501534002
IclA IFx Connector 1PWRR out	0062501534005
IclA IFx Insert 3I/O 24V	0062501524001
IclA IFx Insert 4I/O 24V	0062501527001
IclA IFx Insert 3I/O	0062501533001
IclA IFx Insert 4I/O	0062501533002
IclA IFx Insert 2I/O 1PWRR	0062501533003
IclA IFx Insert 4I/O 2PWRR	0062501533004

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Cable Supplier recommendations:

- Hans Turck GmbH & Co. KG
  www.turck.com
- Franz Binder GmbH & Co. elektrische Bauelemente KG
  www.binder-connector.de
- PHOENIX CONTACT GmbH & Co. KG
  www.phoenixcontact.com
- Lumberg Automation
  www.lumberg-automation.com

Tool The tools required for fabrication must be ordered directly from the manufacturer.

- Crimping pliers for CN1: AMP 654174-1
- Crimping pliers for CN2, CN4 and CN5: Molex 69008-0982
- Crimping pliers for CN3: Molex 69008-0724
- Extraction tool for CN2, CN4 and CN5: Molex 11-03-0043
- Extraction tool for CN3: Molex 11-03-0044

Converter A converter is required for commissioning and for service purposes.

- Converter: USB-to-CAN compact, www.ixxat.com

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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.

⚠ CAUTION

Risk of injury when removing circuit board plugs

- When removing them note that the connectors must be unlocked.
  - Supply voltage VDC:
    unlock by pulling at the connector shell
  - Miscellaneous:
    unlock by pressing the locking lever
- Always hold the connector to remove it (not the cable).

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

You cannot carry out repairs yourself. The repair should only be carried out by a certified customer service organisation. No warranty or liability is accepted for repairs made by the customer.

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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 Operating life of safety function "Power Removal"

The operating life for the "Power Removal" 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 type plate.

▶ This date must be included in the system maintenance schedule.

Example The name plate on the device includes the DOM in the DD.MM.YY format, z.B. 31.12.06. (31 December 2006). This means that the safety function is guaranteed until 31 December 2026.

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13.3 Replacing units

⚠ WARNING

Unexpected behaviour

The behaviour 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 7.3.3 "BLCT commissioning software"
- ▶ Switch off all supply voltages. 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 6 "Installation"
- ▶ Carry out commissioning as described in Chapter 7 "Commissioning"

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13.4 Shipping, storage, disposal

Refer to the ambient conditions in Chapter 3.2 "Environmental conditions".

Shipping The product must be protected against shocks during transport. Use the original packaging for this purpose.

Storage Store the product only under the specified, approved environmental conditions for room temperature and humidity.
Protect the product against dust and dirt.

Disposal The product consists of various materials that can be recycled and must be disposed of separately. Dispose of the product in accordance with local regulations.

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14 Glossary

14.1 Units and conversion tables

The value in the specified unit (left column) is calculated for the desired unit (top row) with the formula (in the field).

Example: conversion of 5 metres [m] to yards [yd]
5 m / 0.9144 = 5.468 yd

14.1.1 Length

	in	ft	yd	m	cm	mm
in	-	/ 12	/ 36	* 0.0254	* 2.54	* 25.4
ft	* 12	-	/ 3	* 0.30479	* 30.479	* 304.79
yd	* 36	* 3	-	* 0.9144	* 91.44	* 914.4
m	/ 0.0254	/ 0.30479	/ 0.9144	-	* 100	* 1000
cm	/ 2.54	/ 30.479	/ 91.44	/ 100	-	* 10
mm	/ 25.4	/ 304.79	/ 914.4	/ 1000	/ 10	-

14.1.2 Mass

	lb	oz	slug	kg	g
lb	-	* 16	* 0.03108095	* 0.4535924	* 453.5924
oz	/ 16	-	* $1.942559*10^{-3}$	* 0.02834952	* 28.34952
slug	/ 0.03108095	/ $1.942559*10^{-3}$	-	* 14.5939	* 14593.9
kg	/ 0.453592370	/ 0.02834952	/ 14.5939	-	* 1000
g	/ 453.592370	/ 28.34952	/ 14593.9	/ 1000	-

14.1.3 Force

	lb	oz	p	dyne	N
lb	-	* 16	* 453.55358	* 444822.2	* 4.448222
oz	/ 16	-	* 28.349524	* 27801	* 0.27801
p	/ 453.55358	/ 28.349524	-	* 980.7	* $9.807*10^{-3}$
dyne	/ 444822.2	/ 27801	/ 980.7	-	/ $100*10^{3}$
N	/ 4.448222	/ 0.27801	/ $9.807*10^{-3}$	* $100*10^{3}$	-

14.1.4 Power

	HP	W
HP	-	* 745.72218
W	/ 745.72218	-

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Site web : www.hvssystem.com

14.1.5 Rotation

	1/min (RPM)	rad/s	deg./s
1/min (RPM)	-	* π / 30	* 6
rad/s	* 30 / π	-	* 57.295
deg./s	/ 6	/ 57.295	-

14.1.6 Torque

	lb·in	lb·ft	oz·in	Nm	kp·m	kp·cm	dyne·cm
lb·in	-	/ 12	* 16	* 0.112985	* 0.011521	* 1.1521	* $1.129*10^{6}$
lb·ft	* 12	-	* 192	* 1.355822	* 0.138255	* 13.8255	* $13.558*10^{6}$
oz·in	/ 16	/ 192	-	* $7.0616*10^{-3}$	* $720.07*10^{-6}$	* $72.007*10^{-3}$	* 70615.5
Nm	/ 0.112985	/ 1.355822	/ $7.0616*10^{-3}$	-	* 0.101972	* 10.1972	* $10*10^{6}$
kp·m	/ 0.011521	/ 0.138255	/ $720.07*10^{-6}$	/ 0.101972	-	* 100	* $98.066*10^{6}$
kp·cm	/ 1.1521	/ 13.8255	/ $72.007*10^{-3}$	/ 10.1972	/ 100	-	* $0.9806*10^{6}$
dyne·cm	/ $1.129*10^{6}$	/ $13.558*10^{6}$	/ 70615.5	/ $10*10^{6}$	/ $98.066*10^{6}$	/ $0.9806*10^{6}$	-

14.1.7 Moment of inertia

	lb·in²	lb·ft²	kg·m²	kg·cm²	kp·cm·s²	oz·in²
lb·in²	-	/ 144	/ 3417.16	/ 0.341716	/ 335.109	* 16
lb·ft²	* 144	-	* 0.04214	* 421.4	* 0.429711	* 2304
kg·m²	* 3417.16	/ 0.04214	-	* $10*10^{3}$	* 10.1972	* 54674
kg·cm²	* 0.341716	/ 421.4	/ $10*10^{3}$	-	/ 980.665	* 5.46
kp·cm·s²	* 335.109	/ 0.429711	/ 10.1972	* 980.665	-	* 5361.74
oz·in²	/ 16	/ 2304	/ 54674	/ 5.46	/ 5361.74	-

14.1.8 Temperature

	°F	°C	K
°F	-	(°F - 32) * 5/9	(°F - 32) * 5/9 + 273.15
°C	°C * 9/5 + 32	-	°C + 273,15
K	(K - 273.15) * 9/5 + 32	K - 273.15	-

14.1.9 Conductor cross section

AWG	1	2	3	4	5	6	7	8	9	10	11	12	13
mm²	42.4	33.6	26.7	21.2	16.8	13.3	10.5	8.4	6.6	5.3	4.2	3.3	2.6

AWG	14	15	16	17	18	19	20	21	22	23	24	25	26
mm²	2.1	1.7	1.3	1.0	0.82	0.65	0.52	0.41	0.33	0.26	0.20	0.16	0.13

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14.2 Terms and Abbreviations

Actual position	Current absolute or relative position of moving components in the drive system.
Assembly	Various attitudes are combined in one single data packet. Client and server know the structure of the packets. See also Explicit Message
Attribute	a single value of an object (in one network device) that can be read or written over the network. (see class - instance - object - attribute)
Big-endian format	memory method in which the highest-value byte of a data word is at the first position in the memory (big end first).
CIP	**C**ommon **I**ndustrial **P**rotocol, general specification for communication among fieldbus devices
Class	DeviceNet describes the behaviour of a network node in object classes. A class defines the behaviour of (related) objects and consists of attributes and services to work with these attributes (read/write) e.g.: vehicles class, car object, tank level attribute, fill service (see class - instance - object - attribute)
Client	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)
Consumer	Network device that receives data packets, see also producer
COS	**C**hange **O**f **S**tate: special I/O connection in which the data are only transmitted when changed
Default value	Factory setting.
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.
DOM	(**D**ate **o**f **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).
Drive system	The drive system consists of the controller, power amplifier and motor.
EDS	(**E**lectronic **D**ata **S**heet) electronic data sheet that contains specific features of a product.
EMC	Electromagnetic compatibility.
Encoder	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.
Error class	Classification of operational faults into groups corresponding to the error responses
ESD	(**e**lectro**s**tatic **d**ischarge) is the electrostatic discharge and describes the processes and effects during compensation of electrical charges.
I/O	Inputs/Outputs
I^2t-monitoring	Predictive temperature monitoring. The expected temperature rise of unit components is calculated in advance on the basis of the motor cur-

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	rent. If a limit value is exceeded, the drive system reduces the motor current.
Limit switch	Switch that signals an overrun of the permissible travel range.
Little-endian format	Memory method on which the highest-value byte is at the highest address and the least significant byte at the lowest address (little end first).
Inc	Increment
Index pulse	Encoder signal for referencing the rotor position in the motor. The encoder sends one index pulse per revolution.
Input	Data direction from network viewpoint: data packet/status message from device, see also output
Instance	An actual object that is derived from a specific class. (see class - instance - object - attribute)
Internal units	Resolution of the power amplifier with which the motor is directed to the new setpoint. Internal units are given in increments.
IT mains	Mains in which all active components are isolated from earth or are earthed by a high impedance. IT: isolé terre (French), isolated earth. Opposite: earthed networks, see TT/TN network
LED	Light-Emitting Diode
MAC ID	Node address (MAC=Media Access Control); a unique address in the entire network.
Master	Active bus user that controls the data traffic in the network.
MT	**M**ode**T**oggle, bit change 0 -> 1 or 1 -> 0
NTC	resistance with negative temperature coefficient. Resistance value is reduced as the temperature rises.
Object	An object is a member of a specific class Bicycle object is a member of the vehicle class Car object is a member of the vehicle class (see class - instance - object - attribute)
ODVA	**O**pen **D**eviceNet **V**endor **A**ssociation. User organisation for DeviceNet standards
Output	Data direction from network viewpoint: data packet/command to a device, see also input
Parameter	Device functions and values that can be set and called by the user.
PELV	Protective Extra Low Voltage, functional low voltage with safe isolation.
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.
RO , RW	Read Only = parameter is read-only Read/Write = parameter is read and write
Power amplifier	A device that generates current for controlling the motor in accordance with the positioning signals from the controller.
Producer	Network device that generates data packets, see also consumer

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Protection class	The protection class is a standardised specification for electrical equipment that describes the protection against the ingress of foreign bodies and water (for example, IP20).
PTC	resistance with positive temperature coefficient. Resistance value is increased as the temperature rises.
Pulse direction signals	Digital signals with variable pulse frequencies which signal changes in position and rotation direction via separate signal wires.
Quick Stop	Quick stop, function used to provide quick braking of the motor via a command or in the event of a fault.
RCD	Residual current device
rms	RMS value of a voltage (V_{rms}) or a current (A_{rms}); abbreviation of “Root Mean Square”.
RS485	Fieldbus interface compliant with EIA-485, which enables serial data transmission with multiple devices.
Scaling factor	This factor gives the relationship between an internal unit and the user unit.
Scanner	Bus device that as a master unit controls all data transmission on the bus. Corresponds to the master.
Server	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
Slave	Passive bus device that receives control commands and provides data to the master.
Slave address	Targeted communications between master and slave is only possible with the assignment of unique addresses.
PLC	Programmable Logic Controller
Toggle	switching a bit from 0 to 1 or vice versa, see MT, ModeToggle
TT mains, TN mains	Earthed mains, distinguished by the PE conductor connection. Opposite: unearthed networks, see IT mains
UCMM	**Unc**onnected **M**essage **M**anager: unvalidated message channel
User-defined unit	Unit whose reference to motor rotation can be determined by the user via parameters.
Watchdog	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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