BERGER LAHR

Technical Documentation

Intelligent Compact Drive

Fieldbus stepper motor

IclA IFS

Document: 0098 441 113 189

Edition: V1.03, 05.2005

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Breslauer Str. 7
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a company of Schneider Electric

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.

For more information see the chapter on safety.

Not all product types are available in all countries.
Please see the current catalogue for the availability of products.

We reserve the right to make technical changes.

All information refers to specifications and not to assured properties.

Most product designations are registered trademarks of their proprietors, even when not specifically noted.

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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.

Parameters

Parameters are shown as follows:

`Group.Name Index:Subindex`

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1 Introduction

The IclA IFS Intelligent Compact Drives consist of a stepper motor and integrated electronics. Control electronics and power amplifier are integrated in the housing with a fieldbus terminal (CAN, RS485 or Profibus DP) and motor. If the motor has a holding brake this is also integrated.

The Intelligent Compact Drives IclA IFS are part of the "IclA Intelligent Compact Drive" range of products.

Drive

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

The following operating modes have been implemented:

- Jog (from software version 1.101)
- Profile velocity
- Profile position
- Homing

Up to four different 24V I/O signals to which, for example, limit switches or reference switches can be connected are available.

Safety function

The integrated safety function "Safe Standstill" enables a stop of category 0 or 1 as per EN60204-1 without external power contactors. The supply voltage must not be interrupted. This reduces the system costs and response times.

The "Safe Standstill" safety function is available from unit revision RS10 (see type plate).

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1.1 Unit overview

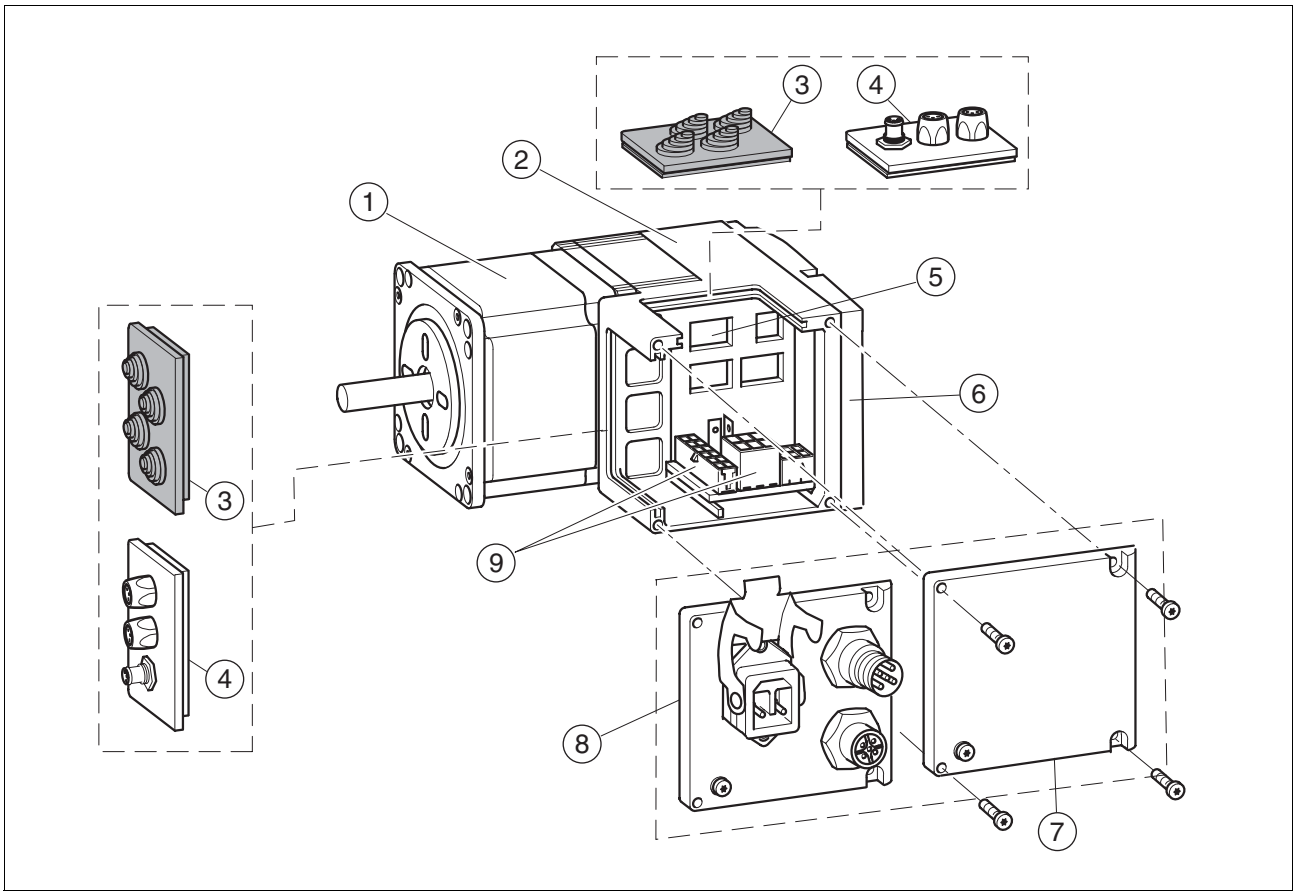

Figure 1.1 Components of the drive

(1) Three-phase stepper motor
(2) Electronics housing
(3) Plug-in unit cable bushing (accessory)
(4) I/O plug-in unit with industrial plug connector (accessory)
(5) Switches for making settings
(6) Electronics cover, must not be removed
(7) Plug cover, to be removed on installation
(8) Cover with industrial plug connector for VDC supply voltage and IN/OUT fieldbus terminal (optional)
(9) Electrical terminals

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1.2 Components and interfaces

1.2.1 Components

Motor Six types of motor are available (maximum torque in parentheses):

- IFS61 (45 Ncm)
- IFS62 (90 Ncm)
- IFS63 (150 Ncm)
- IFS91 (200 Ncm)
- IFS92 (400 Ncm)
- IFS93 (600 Ncm)

gear The motor can be operated with a planetary gearbox (PLE).

3 gear ratios are available:

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

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

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

There are also four different 24V signals available. Every one of them can be used as an input or output.

Holding brake The drive (IFS9x only) can be optionally fitted with an integrated holding brake. The holding brake is controlled by the drive.

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1.2.2 Interfaces

Standard available interfaces:

VDC supply voltage

Function:

- Power supply of control electronics and power amplifier

The earth terminals of all interfaces are electrically connected. For more information see chapter 5.2 “Ground design“. Information on reverse polarity protection can also be found there.

Fieldbus interface

Functions:

- Profibus DP connection
- CAN bus connection
- RS485 bus connection

The fieldbus interface is used for setting parameters and controlling the drive. This enables the drive to be integrated into a fieldbus network and controlled by a PLC.

The drive can be operated through any one of the above interfaces. For example, a PC with a corresponding fieldbus converter (e.g. USB-CAN) is required. The IclA Easy commissioning software is available for the PC. It supports the various fieldbus versions (for description see the IclA Easy CD-ROM)

The firmware can be updated through any interface.

24-V signal interface

Four different 24-V signals are available, which can be used as both input and output.

The 24V signals are freely accessible to the higher-level controller over the fieldbus. However, special functions such as connections to limit or reference switches can also be configured.

See the information in chapter 5.1 “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 plug connectors must be used from drives with an external 24V signal power supply.

1.3 Documentation and literature references

The following User's manuals are supplied with this drive system:

- **Manual**, describes the technical data, installation, commissioning and all operating modes and operating functions.
- **Fieldbus manuals**, essential description of integration of the drive system into a fieldbus.

The order numbers for these documents can be found in chapter 11 “Accessories and spare parts“.

The entire documentation is also available on CD.

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Additional literature

We recommend the following literature for more in-depth information:

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

1.4 Directives and standards

The EC directives define the minimum requirements - particularly safety requirements - applicable to a product and must be complied with by all manufacturers and dealers marketing the product in the member states of the European Union (EU).

The EC directives describe the main requirements for a product. The technical details are laid down in the harmonized standards, which are published in Germany as the DIN EN standards. If there is not yet any EN standard applicable to a particular product area, existing technical standards and regulations will apply.

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. The drive systems described here can be used anywhere in the world.

EC Machine Directive

The drive systems described here are not machines as defined by the EC Machine Directive (98/37/EEC) 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 (89/336/EEC) 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 our 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 (73/23/EEC) is not applicable to the compact drive, because it is operated with CD current under 50 V.

Declaration of conformity

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

Standards for safe operation

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

EN 60529: IP degrees of protection

IEC 61508; SIL 2; Functional safety of safety-related electric, electronic and programmable electronic systems.

pr IEC 62061; SIL 2; Safety of Machines - Functional safety of electrical, electronic and programmable controllers of machines

EN 954-1: Safety of machines, Safety of components of control devices, Part 1: General design requirements

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	pr EN 13849-1; Safety of machines - safety-related components of controllers - Part 1: General design requirements
Standards for retention of EMC limiting values	EN 61000-4-1: Measuring and test procedures, overview
	EN 61800-3: Variable-speed electrical drives

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1.5 Declaration of conformity

EC Declaration of Conformity
Year 2005

BERGER LAHR

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

☐ according to EC Directive Low Voltage 73/23/EC, changed by CE Marking Directive 93/68/EC
☒ according to EC Directive on Machinery 98/37/EC
☒ according to EC Directive EMC 2004/108/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:	IFA6x, IDSxx, IFSxx, IFE7x
Product number:	0x66206xxxxxx, 0x66006xxxxxx, 0x66106xxxxxx, 0x66307xxxxxx
Applied harmonized standards, especially:	pr EN ISO 13849-1:2004, Performance Level "d" EN 50178:1998 EN 61800-3:2001, second environment according to Berger Lahr EMC test conditions
Applied national standards and technical specifications, especially:	EN 61508:2000, SIL2 UL 508C Berger Lahr EMC test conditions 200.47-01 EN Product documentation
Company stamp:	Berger Lahr GmbH & Co. KG Postfach 11 80 · D-77901 Lahr Breslauer Str. 7 · D-77933 Lahr
Date/ Signature:	20 May 2005
Name/ Department:	Wolfgang Brandstätter/R & D Drive Systems

Figure 1.2 Declaration of conformity

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1.6 TÜV certificate for functional safety

The certificate of the Certification Body RWTÜV Systems GmbH of Product Safety and Medical Devices is subject to approval at the moment and will be provided soon.

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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.

In the system configuration described the drive systems must be used in industrial applications only and must have a fixed connection only.

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.

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

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2.3 Hazard categories

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

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

DANGER!

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

WARNING!

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

CAUTION!

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

2.4 General safety instructions

DANGER!

Risk of injury by complex system.

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.

WARNING!

Danger of injury and damage to system components by loss of control!

- Observe the accident prevention regulations.
- Consideration of possible errors must also include unexpected delay and failure of signals or functions.
- Separate redundant controller paths must be provided for dangerous functions.
- Verify the effectiveness of the measures.

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2.5 Safety functions

Using the safety functions integrated in this product requires careful planning. For more information see 5.3 ""Safe Standstill" safety function“ on page 5-3.

2.6 Monitoring functions

The monitoring functions in the drive protect the system and reduce the risk in the event of system malfunction. The monitoring functions are not designed for personal safety. The following faults and limit values can be monitored:

Monitoring	Task	Protective function
Stall detection (only for units with index pulse)	Checks the motor movement using the index pulse	Function safety
Data connection	Error response to connection break	Functional safety and system protection
Limit switch signals	Monitoring the allowable traverse range	System protection
STOP switch signal	Stop motor with "Quick Stop"	System protection
Motor overload	Monitoring for excessively high current in the motor phases	Functional safety and device protection
Overvoltage and undervoltage	Monitoring for overvoltage and undervoltage of the power supply	Functional safety and device protection
Overtemperature	Monitoring device for overtemperature	Device protection

Table 2.1 Monitoring functions

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3 Technical Data

3.1 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 clearance between the units and the required output. The relevant requirements in the chapter on installation are also very important.

Ambient temperature [1)]	°C	0 .. 65; 50°C.. 65°C: reduced power rating: 2%/K

1) Limit values of a flange-mounted motor (i.e. steel plate 300x300x10

Ambient climate for transport and storage

The environment during transport and storage must be dry and dust-free. The maximum oscillation and shock stress must be within the specified limits. The bearing and transport temperature must remain within the specified range.

Temperature for transportation and storage	°C	-25 .. 70

Motor temperature

Max. admissible motor temperature	°C	110

Relative humidity

The relative humidity is allowed as follows:

Relative humidity	%	15 .. 85

Installation height

Installation height without reduced power rating	m above MSL	< 1000 m above sea level

Vibration and shock loading

The strength during oscillation stress on the units corresponds to EN 50178 Section 9.4.3.2 and EN 61131 Section 6.3.5.1.

Vibration strain during operation as per DIN EN 60068-2-6		
Number of cycles		10
Acceleration amplitude	m/s²	20
Frequency range	Hz	10...500
Continuous shocks as per DIN EN 60068-2-29		
Number of shocks		1000
Peak acceleration	m/s²	150

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Degree of protection

Protection class according to DIN EN 60052-9-1	IP54 Gesamtgerät außer Wellendurchführung; IP41 Wellendurchführung

3.2 Electrical Data

Supply voltage

Rated voltage	V_{DC}	24 or 36
Limit values	V_{DC}	18 to 40
Ripple at rated voltage	V_{SS}	≤3.6
Max. power consumption IFS6x	O	3.5
Max. power consumption IFS9x	O	5
Starting current		charging current of capacitor C=1500µF
External fuse	O	≤16

3.3 Safety functions

Data for maintenance schedule and safety calculations

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)		67%
Probability of a dangerous failure per hour (PFH) (IEC 61508)		$1.84*10^{-9}$ 1/h
Response time (until shutdown of power amplifier)	ms	<50
Permitted test pulse width of upstream units	ms	≤1

3.4 UL 508C approval

Pollution degree

Pollution degree	Step 2

Power supply

Use only power supply units that are approved for overvoltage category 3.

Wiring

Use copper wiring resistant to at least 60°C or 75°C.

3.5 Additional data

See the catalogue for additional technical data:

- "IcIA Intelligent Compact Drives"
  Order no. 0059 941 201 001

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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. Safety-oriented functions are taken into consideration when planning automation and risks can be minimised more easily.

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 safety-related electric, electronic and programmable electronic 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. The standard establishes a basic standard that is virtually application-independent. 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 comparable risk is defined by the maximum achievable safety level SIL, which can be at level 1 to level 4 (maximum safety). 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	$\geq 10^{-9}$ to $<10^{-8}$
3	$\geq 10^{-8}$ to $<10^{-7}$
2	$\geq 10^{-7}$ to $<10^{-6}$
1	$\geq 10^{-6}$ to $<10^{-5}$

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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		
	0	1	2
<60%	SIL1	SIL2	SIL3
60%- <90%	SIL2	SIL3	SIL4
90%- < 99%	SIL3	SIL4	SIL4
≥ 99%	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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5 Engineering

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

5.1 External power supply units

DANGER!

Electric shock from incorrect power supply unit.

The +24VDC and VDC 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.

5.1.1 Supply voltage

General

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

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

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

Transformer power supply units with sufficient output capacity (e.g. 10,000 µF) should be used. They are generally available as $24V_{DC}$ power supplies.
For example, a standard $24V_{AC}$ transformer can be used to maintain up to $36V_{DC}$ depending on rectification and filtering.

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).

Wire cross-sections of 0.75 mm² to max. 4.0 mm² (with very long cables) can be used for the VDC supply voltage. The standard is 1.5 mm².

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

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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 from about 47V. Overvoltages resulting from energy recovery are limited to 50V by the drive.

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

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 they provide good results.

CAUTION!

Destruction of system components by loss of control over the controller caused by overvoltage at VDC!

During energy recovery while braking the drive the VDC supply voltage may increase up to 50 V. Components not designed for this voltage may be destroyed or they may malfunction.

- Use a separate power supply unit for the VDC supply voltage of the drive.
- Do not use the VDC supply voltage for other consumers (such as limit switches).
- Use only power supply units that will not be damaged by energy recovery.

5.1.2 Signal power supply

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.

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.

5.2 Ground design

The electrical bonding of all interfaces are electrically connected, including the earth for the VDC supply voltage (the module interfaces with electrical isolation such as Profibus are exceptions).

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

- the voltage drop on the VDC power supply lines must be kept as low as possible (less than 1 V). At higher frame potential differences

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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 line 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 power supply has no path back to the power supply unit via the master controller. The master controller earth must therefore be connected to the VDC power supply earth at one point only. This is generally the case in the switch 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 power supply 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 connection is not made in the other drives on the bus. 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.

5.3 "Safe Standstill" safety function

For some general information on the application of IEC 61508 see page 4-1.

5.3.1 Definitions

Safe Standstill

The Safe Standstill safely shuts down the motor torque. The supply voltage must not be interrupted. There is no monitoring at standstill.

Category 0 stop (EN60204-1)

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

Category 1 stop (EN60204-1)

A controlled stop with power available to the machine actuators to achieve the stop and then removal of power when the stop is achieved;

5.3.2 Function

The "Safe Standstill" safety function integrated into the product can be used to implement the control function "Emergency Stop" (EN 60204-1) for Stop Category 0 and Stop Category 1. In addition, this safety function prevents the drive from restarting unexpectedly.

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The following safety levels are implemented in accordance with the standards for functional safety:

- IEC 61508; SIL 2; Functional safety of safety-related electric, electronic and programmable electronic systems.
- pr IEC 62061; SIL 2; Safety of Machines - Functional safety of electrical, electronic and programmable controllers of machines
- EN 954-1: Safety of machines, Safety of components of control devices, Part 1: General design requirements
- pr EN 13849-1; Safety of machines - safety-related components of controllers - Part 1: General design requirements

Function

The Safe Standstill safety function can be triggered with the two redundant inputs $\overline{\text{SAFE\_DISABLE\_A}}$ and $\overline{\text{SAFE\_DISABLE\_B}}$. The circuits of the two inputs must be separate from each other to retain the two channels. The switching process must occur simultaneously for both inputs (skew <1s).
The power amplifier is without power and an error message is sent, even if one of the two inputs is shut down. Then the motor cannot generate torque and runs down without braking. A restart is only possible after resetting the error message.

5.3.3 Requirements for safe application

WARNING!

Danger of injury by incorrect usage!

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

- Observe the requirements for the safety function.

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

For a stop of category 1 a controlled stop can be requested over the fieldbus.The standstill is not monitored by the drive system and is not guaranteed if power fails or in the event of an error. The final shutdown is ensured by shutting down the inputs $\overline{\text{SAFE\_DISABLE\_A}}$ and $\overline{\text{SAFE\_DISABLE\_B}}$. 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

The drive offers protection against unexpected restart after restoration of power (e.g. after power failure). Note that a higher level controller must not trigger a dangerous restart.

Protected line layout

If short circuits and cross connections are possible with the lines for the signals $\overline{\text{SAFE\_DISABLE\_A}}$ and $\overline{\text{SAFE\_DISABLE\_B}}$ and this cannot be detected by upstream devices, a protected layout is required.

A protected layout can be achieved as follows:

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- Allocation of signals to different cables. Apart from $\overline{\text{SAFE\_DISABLE\_A}}$ and $\overline{\text{SAFE\_DISABLE\_B}}$ only wires with voltages corresponding to PELV are permitted to be run on these cables.
- Use of a shielded cable. The earthed shield protects the signals from outside voltages.

  If there are multiple wires in the cable, the signals $\overline{\text{SAFE\_DISABLE\_A}}$ and $\overline{\text{SAFE\_DISABLE\_B}}$ are kept separate from these wires by the earthed shield.

Data for maintenance schedule and safety calculations

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)		67%
Probability of a dangerous failure per hour (PFH) (IEC 61508)		$1.84*10^{-9}$ 1/h
Response time (until shutdown of power amplifier)	ms	<50
Permitted test pulse width of upstream units	ms	≤1

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 should be taken into account when using the "Safe Standstill" 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.

5.3.4 Application examples

Example: category 0 stop

Circuit without EMERGENCY STOP module, Stop category 0.

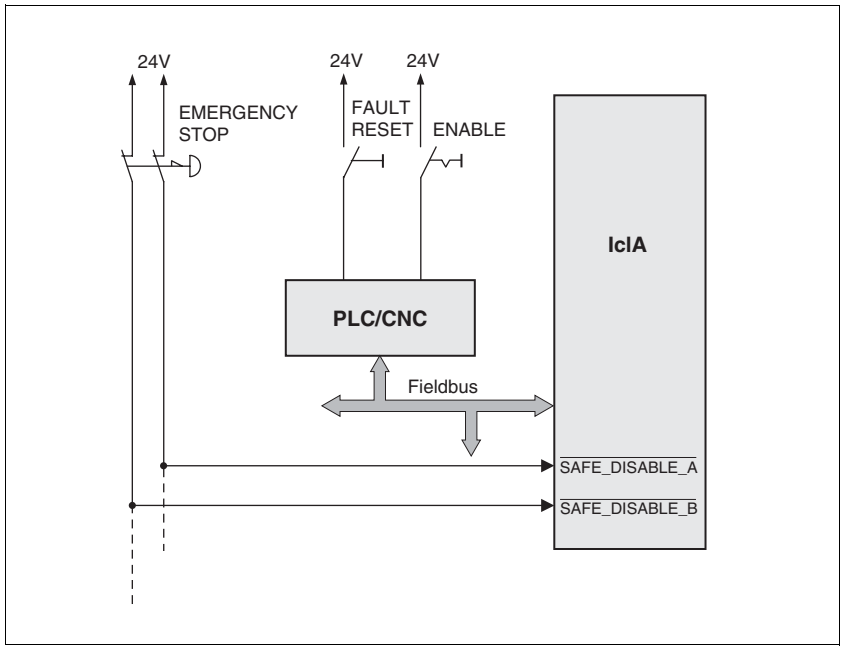

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Figure 5.1 Example: category 0 stop

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,

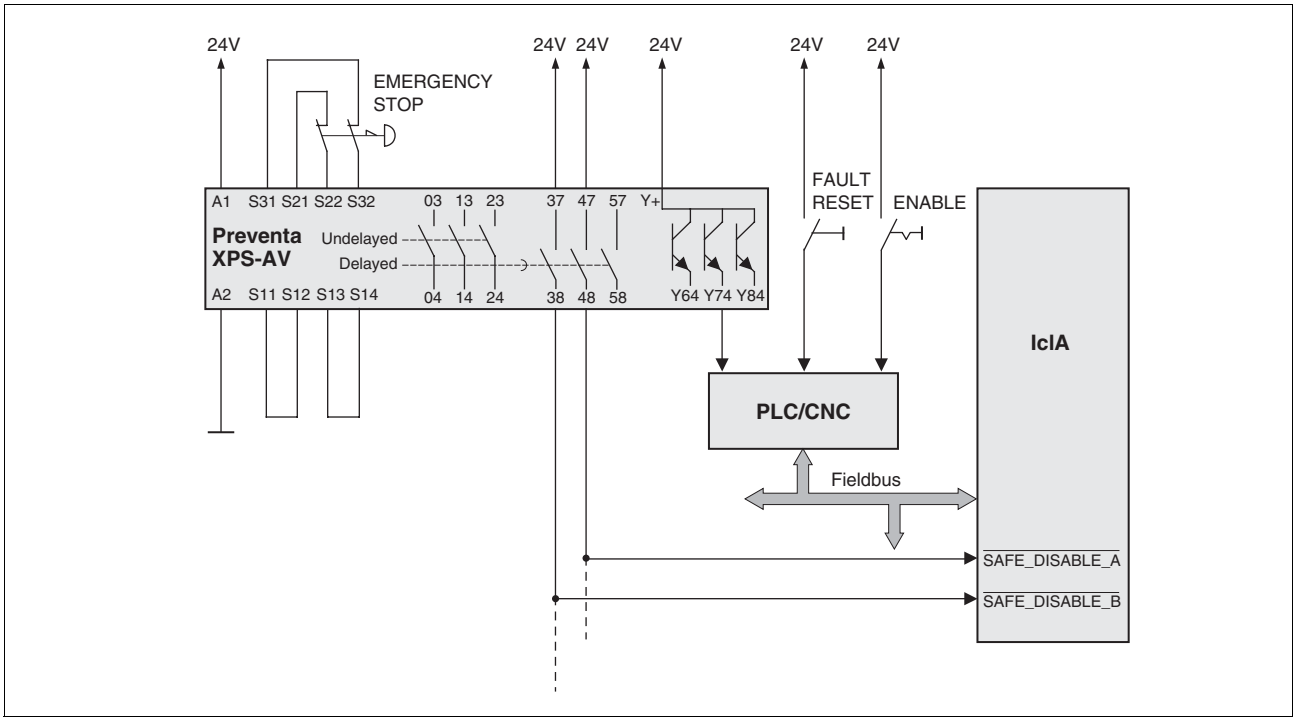

Figure 5.2 Example: category 1 stop

Please note:

- The master controller must initiate a "Quick Stop" without delay via the fieldbus.
- The $\overline{\text{SAFE\_DISABLE\_A}}$ and $\overline{\text{SAFE\_DISABLE\_B}}$ inputs are switched off after the delay time specified by the EMERGENCY STOP module. If the drive has not yet stopped at this time, it runs down without control (uncontrolled standstill).
- 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

6.1 General safety instructions

CAUTION!

Risk of injury when removing circuit board plugs

- When removing it make sure that the connectors are 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).

6.2 Electromagnetic compatibility, EMC

WARNING!

Interference with signals and devices may cause injury

Distorted signals can cause unexpected 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.

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 DIN EN 61800-3: 2001-02 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.

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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.	Reduced emissions, Increased resistance to interference
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.

Table 6.1 EMC measures

The following cables must be shielded:

- Fieldbus cable
- "Safe Standstill" safety function,
  note the requests in the chapter 5.3.3 “Requirements for safe application“

The following cables can be left unshielded:

- Supply voltageVDC
- 24-V signal interface

Equipotential bonding conductors

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

If lines 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.

6.3 Mechanical installation

CAUTION!

Hot surfaces can cause burns and damage to system components!

The drive temperature can exceed 100°C in some conditions.

- Avoid contact with the hot drive.
- Do not place combustible or heat-sensitive components in immediate vicinity.
- Follow the actions described for heat dissipation.
- Check the temperature of the drive during the test run.

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CAUTION!

Damage of drive and loss of control!

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

- Protect the shaft when working on the drive and during transport.
- Avoid shocks to the shaft during installation.
- Do not press any parts against the shaft. Any parts that must be attached to the shaft should be fastened by adhesives, clamping, shrinkage or screws.

WARNING!

Danger of injury and damage to system components by unbraked motor!

Loss of power or faults that result in switching off the power amplifier mean that the motor is no longer actively braked and may run against a mechanical stop at high speed.

- Check the mechanical conditions.
- If necessary, use an absorbent mechanical stop or a suitable brake.

WARNING!

Wear or high temperature will cause loss of braking power.

Incorrect use of the holding brake causes accelerated wear and loss of braking power. Heat reduces the holding torque.

- Do not use the brake as a service brake.
- At operating temperatures over 80°C do not exceed a maximum of 50% of the specified holding torque when using the brake.

WARNING!

Violations and system damage by falling loads during start-up.

When the brake is released on stepping motor drives with external forces (vertical axes), the load may fall if the friction is low.

- Restrict the load in these applications to a maximum of 25% of the static holding torque.

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.

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Heat dissipation The drive 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 must be fixed with four M5 bolts. Use washers with smaller bolts. Install the drive on a flat horizontal surface to prevent transmission of mechanical tension to the housing.

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

Note the bending radii of the cables used.

Ambient conditions Note the permissible environmental conditions.

6.4 Electrical installation

WARNING!

Danger of injury and damage to system components by loss of degree of protection

Foreign bodies, deposits or humidity can cause unexpected device responses.

- Prevent any foreign bodies from entering the terminal unit.
- Do not remove the electronic case cover. Only remove the plug cover.
- Check that seals and cable glands are correctly seated.

WARNING!

Danger of injury by loss of safety function!

The safety function may fail because of conductive foreign bodies, liquids or dust. The "Safe Stop" safety function must only be used when the degree of protection IP54 is assured.

- Ensure degree of protection IP54.

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CAUTION!

Destruction of unit 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.

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

The drive has DIP switches in the connector shell. Set the DIP switches before connecting the cables, because after connection they are difficult to access.

6.4.1 Wiring examples

The following figure shows an example of wiring for drives without internal 24V signal power supply.

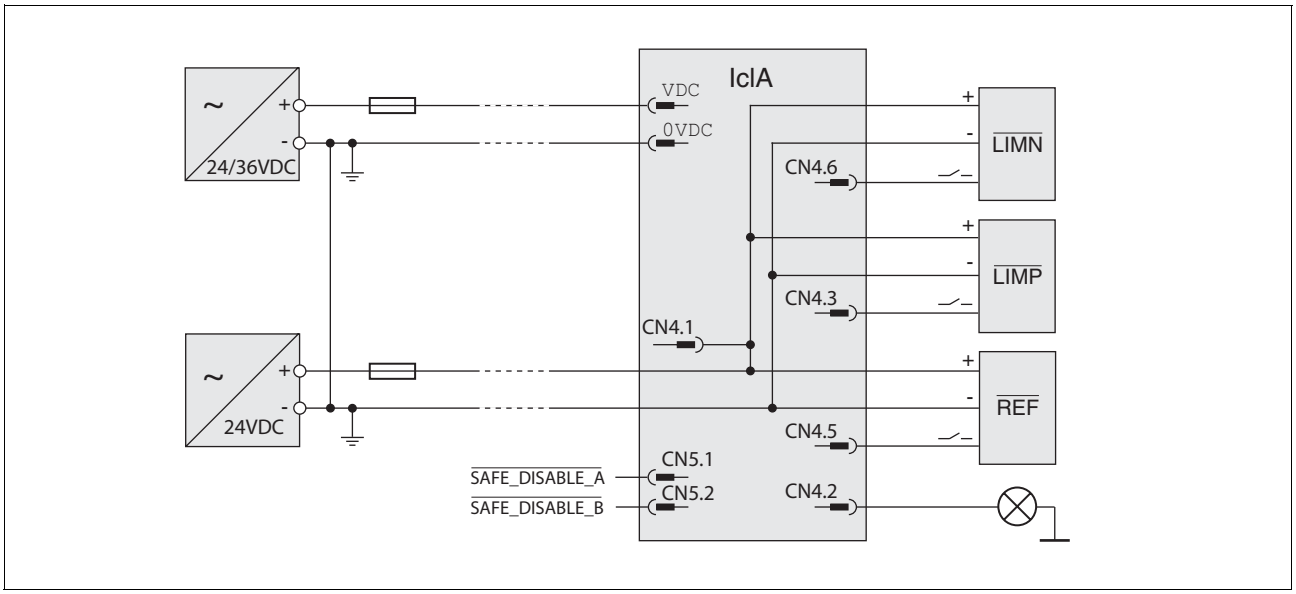

Figure 6.1 Wiring example without internal 24V signal power supply

The following figure shows an example of wiring for drives with internal 24V signal power supply.

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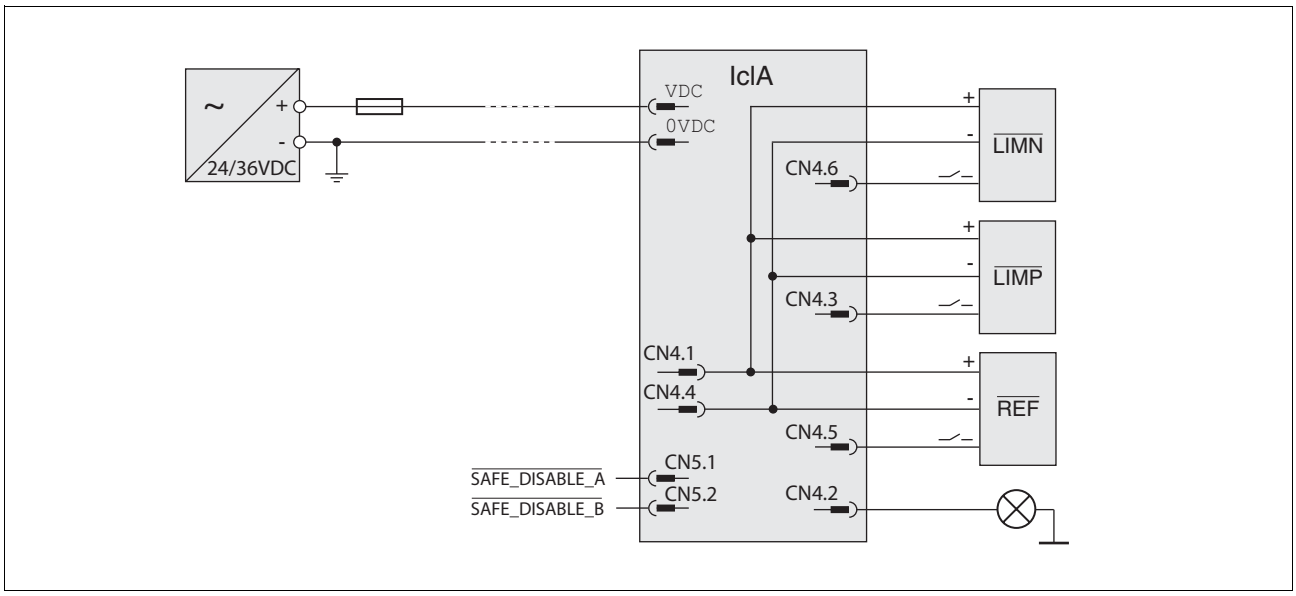

Figure 6.2 Wiring example with internal 24V signal power supply

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6.4.2 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.

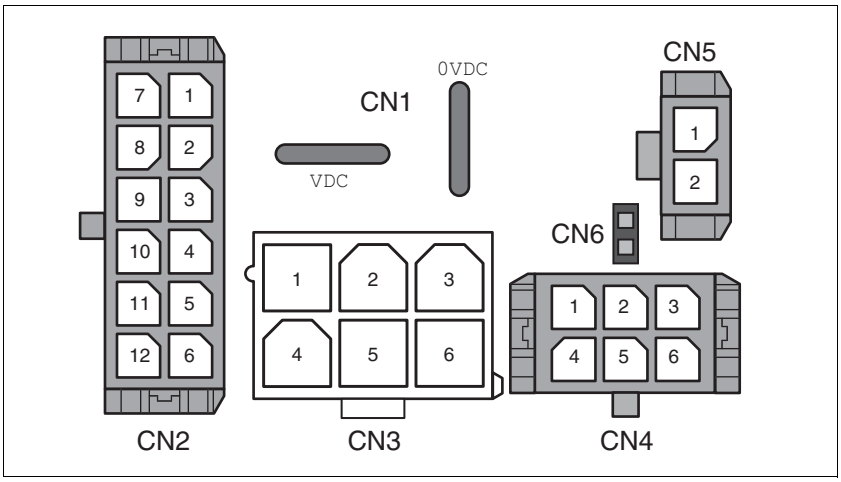

Figure 6.3 Overview of all connections

Terminal	Assignments
CN1	Supply voltage VDC
CN2	Interface for Profibus DP
CN3	Interface for CAN or RS485
CN4	24-V signal interface
CN5	Interface for "Safe Standstill" safety function
CN6	Bridge for disabling "Safe Standstill" safety function

The drive can be connected via cable bushings or industrial plug connectors.

For connection via cable bushing see page 6-7.
For connection via industrial plug connector see page 6-10.

6.4.3 Connection with cable bushing

You can order prepared cables with connectors installed from your dealer or prepare the cables yourself.

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

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Preparing and fastening wiring

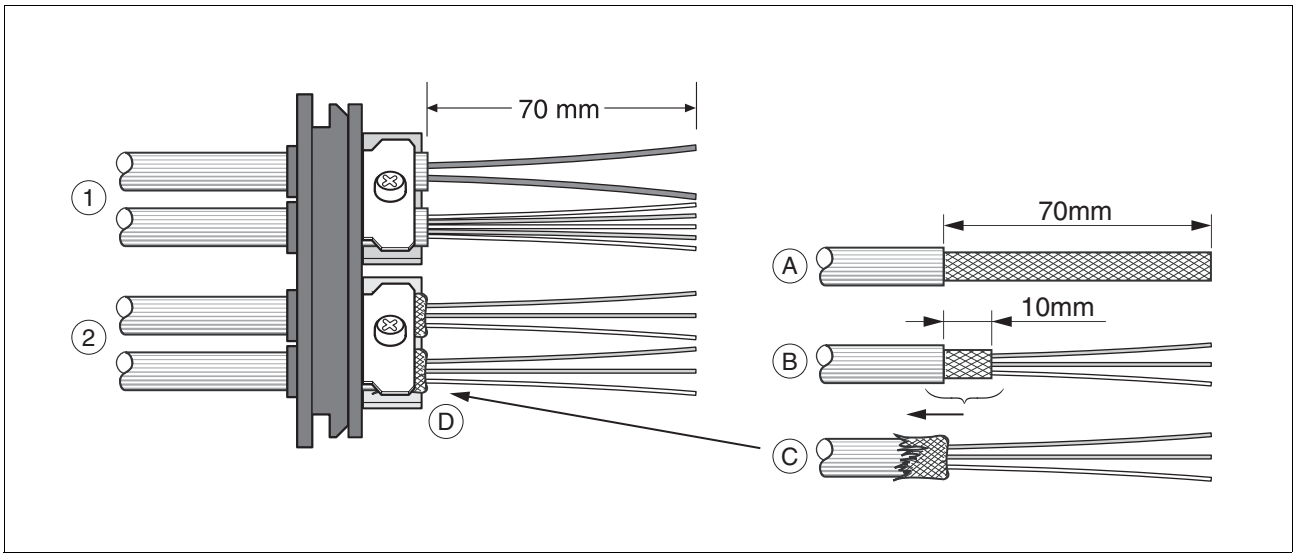

Figure 6.4 Fasten cable in bushing

(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 10 mm.
- ▶ (C) Slide the shield braiding back over the cable sheath.
- ▶ (D) Release 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.

Attach connector

The required parts and data for preparation are listed in the following table. Connector shell and crimp contacts are included in the accessory set. See also chapter 11 “Accessories and spare parts“

Terminal	Cable cross section [mm²]	Stripped length [mm]	Crimp contact manufacturer no.	Crimp pliers	Plug manufacturer	Plug type
CN1	0.5 .. 1.5 or 2.5 .. 4.0	5 .. 6	160773-6 341001-6	654174-1	AMP	Positive Lock 1-926 522-1
CN2	0.34 .. 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

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Terminal	Cable cross section [mm²]	Stripped length [mm]	Crimp contact manufacturer no.	Crimp pliers	Plug manufacturer	Plug type
CN5	0.34 .. 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.

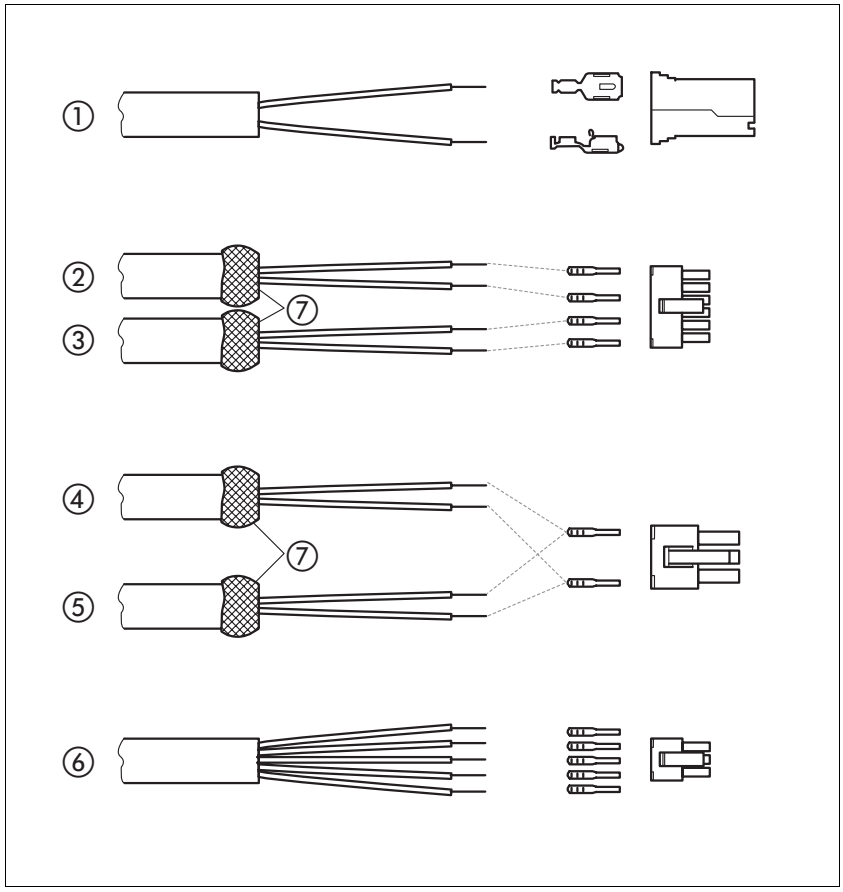

Figure 6.5 Connector, terminal end and crimp contacts

(1) Supply voltageVDC
(2) Fieldbus IN for Profibus
(3) Fieldbus OUT for Profibus
(4) Fieldbus IN for CAN or RS485
(5) Fieldbus OUT for CAN or RS485
(6) 24-V signal interface
(7) Shielded lead with EMC shield foil

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Installing cable bushing

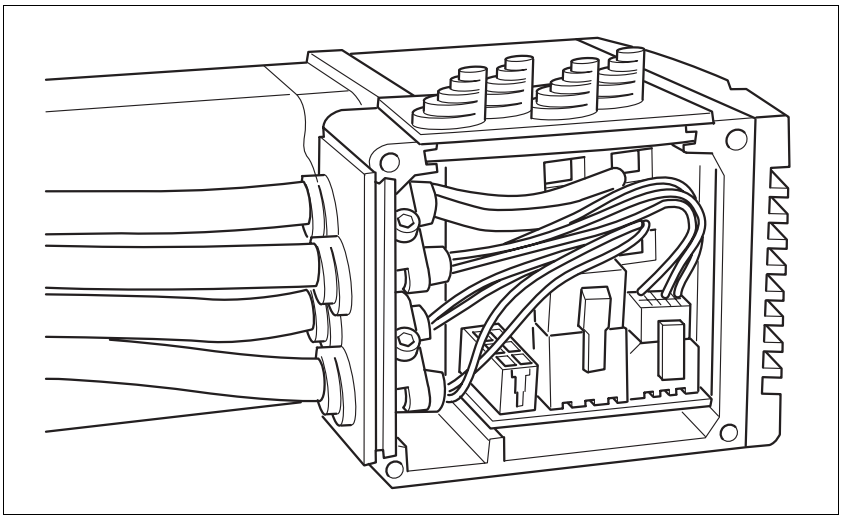

Figure 6.6 Inserting cable bushings

- ▶ Unscrew the side plug housing.
- ▶ If the drive has DIP switches set the DIP switches first, because they are difficult to access when the cables are connected.

  For a description of the DIP switch settings see below in the sections that describe the connections.
- ▶ Connect the connector on the prepared cable to the matching socket. All connectors cannot be confused and must click into place when plugged in.

  Always hold the connector 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 the side from which the cable is led out.

  CAUTION: 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.

6.4.4 Connection with industrial plug connectors

Interface	connectors used
Supply voltage$_{VDC}$	Hirschmann STASEI 200
Fieldbus Profibus in/out	Circular connector M12, 5-pin, B-coded
Fieldbus CAN in/out	Circular connector M12 , 5-pin, A-coded
24V signal inputs and outputs	Circular connector M8, 3-pin
"Safe Standstill" safety function	Circular connector M8, 4-pin

Table 6.2 Table of industrial plug connectors

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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 11 “Accessories and spare parts“.

6.4.5 Power supply connectionV_{DC}

CAUTION!

Destruction of system components by loss of control over the controller caused by overvoltage at V_{DC}!

During energy recovery while braking the drive the V_{DC} supply voltage may increase up to 50 V. Components not designed for this voltage may be destroyed or they may malfunction.

- Use a separate power supply unit for the V_{DC} supply voltage of the drive.
- Do not use the V_{DC} supply voltage for other consumers (such as limit switches).
- Use only power supply units that will not be damaged by energy recovery.

DANGER!

Electric shock from incorrect power supply unit.

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

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

CAUTION!

Destruction of contacts.

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

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

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CAUTION!

Destruction of unit 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.

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 5.1 “External power supply units“ and 5.2 “Ground design“.

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

Pin assignment for printed circuit board plug connector

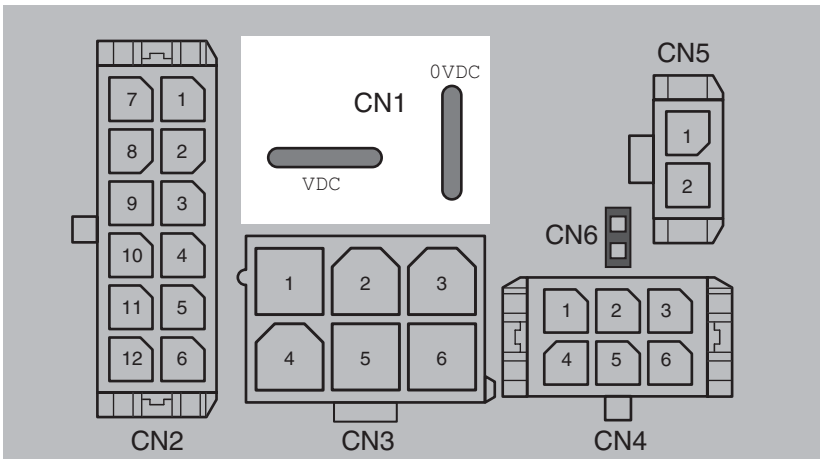

Figure 6.7 Pin assignment for supply voltage

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Signal	Meaning	Number 1)
VDC	Supply voltage VDC, 24/36 V_{DC}	1
0VDC	Reference potential	2

1) Information refers to prefabricated wiring

Table 6.3 Pin assignment for supply voltage VDC

You can crimp two leads together to supply multiple drives over one DC bus. Two different crimp contacts are available for different cable cross sections, see 6.4.3 “Connection with cable bushing“.

Pin assignment of industrial plug connector

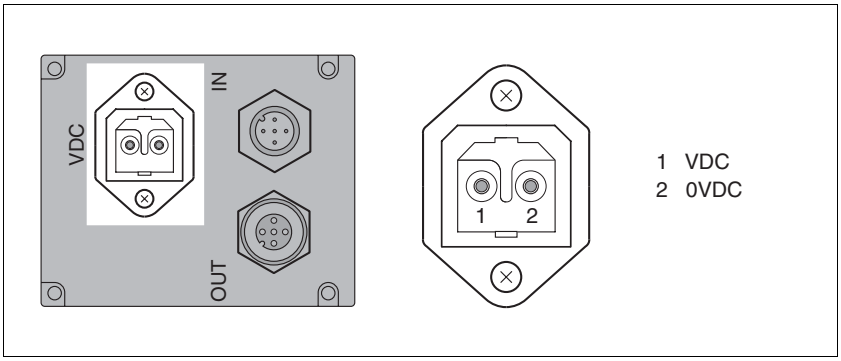

Figure 6.8 Pin assignment for supply voltage

Pin	Signal	Meaning	Number 1)
1	VDC	Supply voltage VDC, 24/36 V_{DC}	1
2	0VDC	Reference potential	2

1) Information refers to prefabricated wiring

Table 6.4 Pin assignment for supply voltage VDC

6.4.6 Profibus DP connection

Function

With the Profibus-DP interface you can connect the drive system to a Profibus network as a slave.

The drive system includes data and commands from a higher level bus device, the master. Status information such as operating status and processing status are sent to the master as acknowledgment.

The connection to the fieldbus is described in the relevant fieldbus manual.

Cable specifications

- Shielded cable
- Minimum cross section of signal wires: 0.34 mm²
- Twisted-pair cables
- Earthing of the screen at both ends
- The maximum length depends on the baud rate and the signal transmission times. The higher the baud rate the shorter the bus cable needs to be.

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Baud rate [Kbaud]	max. cable length [m]
9.6	1200
19.2	1200
45.45	1200
93.75	1200
187.5	1000
500	400
1500	200
3000	100
6000	100
12000	100

Table 6.5 Baud rate and cable length for Profibus

- ▶ Use equipotential bonding lines, see page 6-2.
- ▶ 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.

Terminating resistor

Both ends of the complete bus system must be terminated.

The resistor combination for the bus connection is already integrated and can be enabled as a switch at the end of the network.

The diagram below shows the layout of the integrated resistance combination.

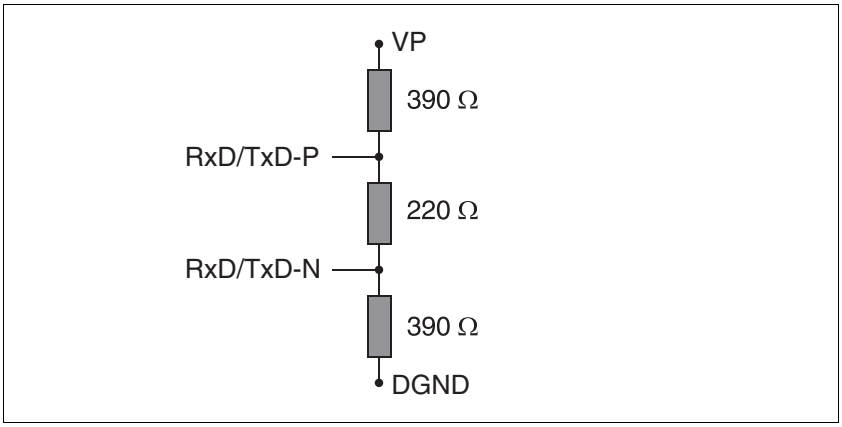

Figure 6.9 Profibus terminating resistor

Setting address and baud rate

Every device in the network is identified by a unique node address which can be set as desired. In a Profibus network a slave may only have addresses 3 to 126. Addresses 0 to 2 are reserved for master devices.

The baud rate is identified automatically.

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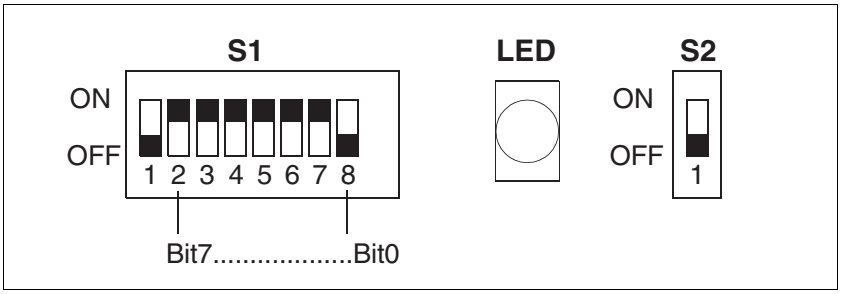

Figure 6.10 Assignment of Profibus DP DIP switches

LED	Display of Profibus communication to - > communication OK from - > no communication
S1	S1.1 = reserved S1.2 - S1.8 = fieldbus address
S2	ON = terminating resistor on OFF = terminating resistor off

Table 6.6 DIP switch settings for Profibus DP

Reserved DIP switches are reserved for future upgrades and must be set to "OFF".

Default settings:

- Address: 126
- Terminating resistor: OFF

Pin assignment for printed circuit board plug connector

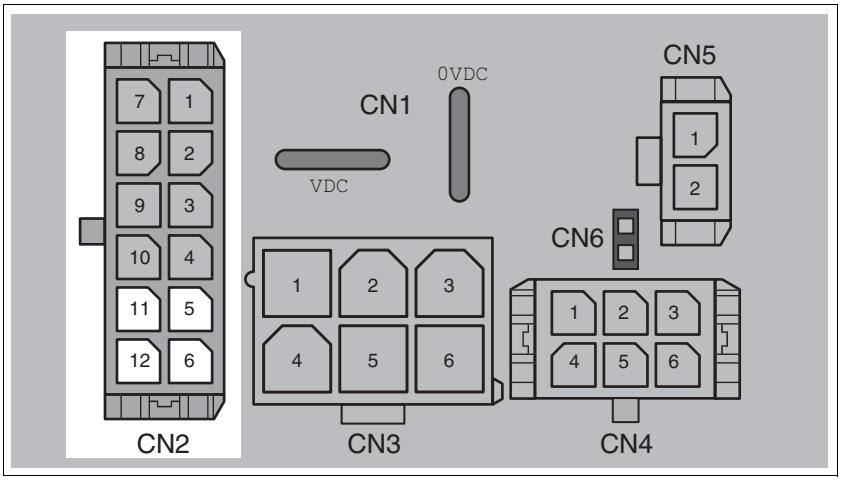

Figure 6.11 Pin assignment of Profibus fieldbus interface

Pin	Signal	Meaning (colour [1)])	SUB-D [1)]
12	RxD/TxD-P	IN data wire (green)	8
11	RxD/TxD-N	IN data wire inverted (red)	3
6	RxD/TxD-P	OUT data wire (green)	8

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Pin	Signal	Meaning (colour [1)])	SUB-D [1)]
5	RxD/TxD-N	OUT data wire inverted (red)	3

1) Information refers to prefabricated wiring

Pin assignment of industrial plug connector

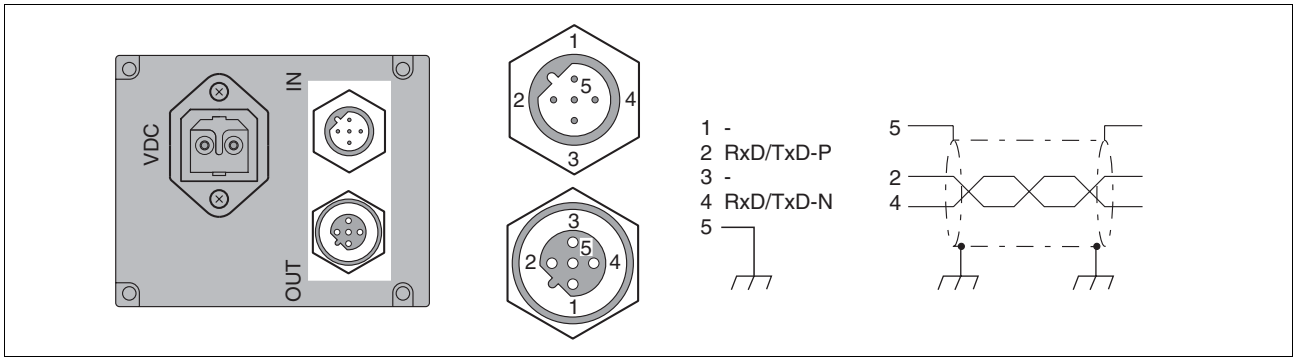

Figure 6.12 Pin assignment of Profibus fieldbus interface

Pin	Signal	Meaning
2	RxD/TxD-P	data wire
4	RxD/TxD-N	data wire, inverted
5	SHLD	Shield connection

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6.4.7 CAN connection

Function

The drive system can be connected as a slave on a CANopen network with the CAN interface as per DS301.

The drive system includes data and commands from a higher level bus device, the master. Status information such as operating status and processing status are sent to the master as acknowledgement.

The integration of a drive system into the fieldbus is described in the Technical documentation CANopen DS301 in the chapter "CANopen Communication".

Cable specifications

- Shielded cable
- Minimum cross section of signal wires: 0.25 mm²
- Twisted-pair lines
- Earthing of the screen at both ends
- The maximum length depends on the number of network devices, the baud rate and the signal transmission times. The higher the baud rate the shorter the bus cable needs to be.

Baud rate [Kbaud]	max. cable length [m]
1000	25
800	80
500	100
250	250
100	600
50	1000

Table 6.7 Baud rate and cable length for CAN

▶ Use equipotential bonding lines, see page 6-2.

▶ 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.

Terminating resistor

Both ends of the complete bus system must be terminated.

The terminating resistor is already integrated in drive systems with DIP switches and can be activated at the end of the network with a DIP switch.

Fieldbus	Terminating resistor
CAN bus	120 Ω between CAN_H and CAN_L

Setting address and baud rate with DIP switches

Every device in the network is identified by a unique node address which can be set as desired. The address and baud rate is set with DIP switches on drive systems with DIP switches.

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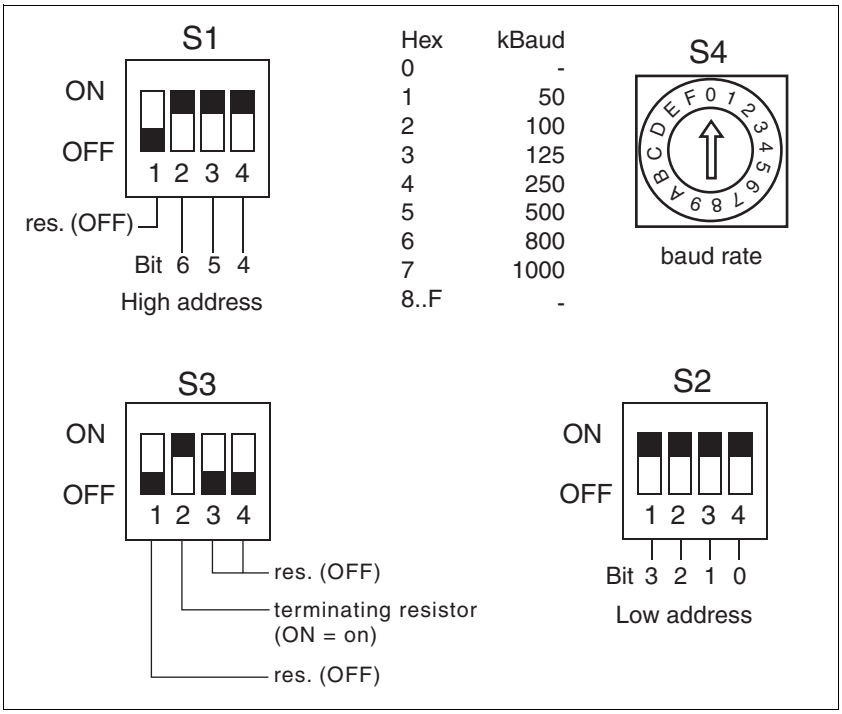

Figure 6.13 Assignment of CAN DIP switches

S1 and S2 switches:	S1.2	S1.3	S1.4	S2.1	S2.2	S2.3	S2.4
Address bit:	6	5	4	3	2	1	0
Address 127 (Default)	1	1	1	1	1	1	1
Address 25 (example)	0	0	1	1	0	0	1

Switch position S4	Baud rate (Kbaud)
1	50
2	100
3	125
4	250
5	500
6	800
7	1000

Reserved DIP switches are reserved for future upgrades and must be set to "OFF".

Default settings for the CAN interface:

- Address: 127
- Baud rate: 125 Kbaud

Setting address and baud rate without DIP switches

Every device in the network is identified by a unique node address which can be set as desired. The address and baud rate is set with parameters on drive systems without DIP switches.

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The drive system must be connected to a master over the CAN interface to set the parameters. If the settings are made after installation, the default fieldbus settings must be used to access the drive system from the master device.

Only one compact drive with default settings is permitted to be active on a network.

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
CAN.canAddr 23:2 (17:02$_h$)	Address CAN Bus 1..127 are allowed	UINT16 1..127	- 127	R/W/per
CAN.canBaud 23:3 (17:03$_h$)	Baud rate CAN Bus Following values are allowed: 50 = 50Kbaud 100 = 100Kbaud 125 = 125Kbaud 250 = 250Kbaud 500 = 500Kbaud 800 = 800Kbaud 1000 = 1Mbaud	UINT16 50..1000	- 125	R/W/per

Table 6.8 Parameters for the CAN bus

Pin assignment for printed circuit board plug connector

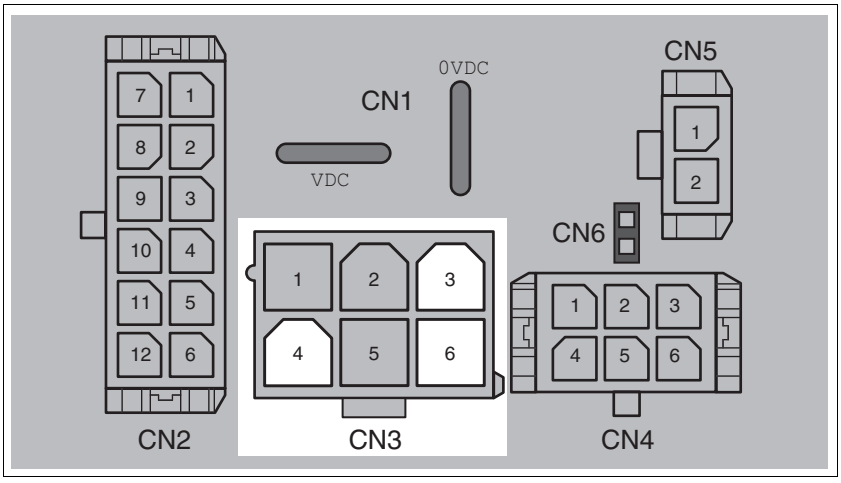

Figure 6.14 Pin assignment of CAN fieldbus interface

Pin	Signal	Meaning	SUB-D [1)]
3	CAN_H	CAN interface	7
6	CAN_L	CAN interface	2
4	CAN_0V	Internally connected with CN1.0VDC	3

1) Information refers to prefabricated wiring

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Pin assignment of industrial plug connector

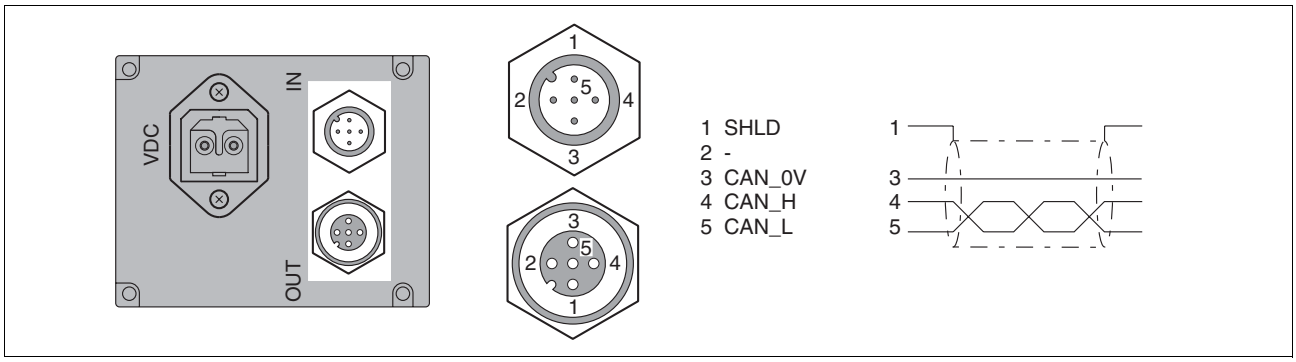

Figure 6.15 Pin assignment of CAN fieldbus interface

Pin	Signal	Meaning
1	SHLD	Shield connection
2	-	internally bridged from IN to OUT
3	CAN_0V	Internally connected with CN1.0VDC
4	CAN_H	CAN interface
5	CAN_L	CAN interface

6.4.8 RS485 connection

Function

With the RS485 interface you can connect the drive system to an RS485 network as a slave.

The drive system includes data and commands from a higher level bus device, the master. Status information such as operating status and processing status are sent to the master as acknowledgement.

The integration of a drive system into the fieldbus is described in the Technical documentation RS485 in the chapter "Communication in 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 6-2.

▶ 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.

Terminating resistor

Both ends of the complete bus system must be terminated.

The terminating resistor is already integrated in drive systems with DIP switches and can be activated at the end of the network with a DIP switch.

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Fieldbus	Terminating resistor
RS485 bus	120Ω between +RS485 and –RS485

Setting address and baud rate with DIP switches

Every device in the network is identified by a unique node address which can be set as desired. The address and baud rate is set with DIP switches on drive systems with DIP switches.

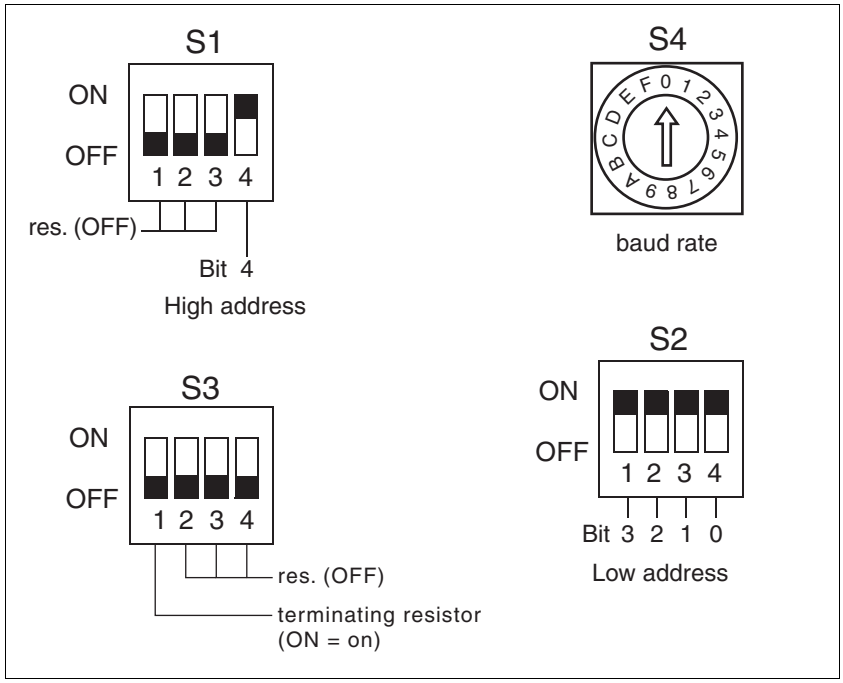

Figure 6.16 Assignment of RS485 DIP switches

S1 and S2 switches:	S1.4	S2.1	S2.2	S2.3	S2.4
Address bit:	4	3	2	1	0
Address 1 (Default)	0	0	0	0	1
Address 25 (example)	1	1	0	0	1

Switch position S4	Baud rate (Kbaud)	Format
0	9600	7-E-1
1	19200	7-E-1
2	38400	7-E-1
3	-	-
4	9600	7-N-1
5	19200	7-N-1
6	38400	7-N-1
7	-	-
8	9600	8-E-1
9	19200	8-E-1
A	38400	8-E-1
B	-	-

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Switch position S4	Baud rate (Kbaud)	Format
C	9600	8-N-1
D	19200	8-N-1
E	38400	8-N-1
F	-	-

Reserved DIP switches are reserved for future upgrades and must be set to "OFF".

Default settings for the RS485 interface:

- Address: 1
- Baud rate: 9600
- Data format: 7
  Bit Even Parity
  1 Stop Bit

Setting address and baud rate without DIP switches

Every device in the network is identified by a unique node address which can be set as desired. The address and baud rate is set with parameters on drive systems without DIP switches.

The compact drive must be connected to a master device over the RS485 interface to set the parameters. If the settings are made after installation, the default fieldbus settings must be used to access the compact drive from the master device.

Only one drive with default settings is permitted to be active on a network.

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
RS485.timeout 1:11 (01:0B$_h$)	Node Guard Timer Connection monitoring, time in milliseconds 0=inactive (default=0) Value returns automatically to 0 after a node guard error.	UINT16 0..10000	ms 0	R/W/-
RS485.serBaud 22:1 (16:01$_h$)	Baud rate Following values are allowed: 9600 19200 38400	UINT16 0..38400	- 9600	R/W/per
RS485.serAdr 22:2 (16:02$_h$)	Address 1...31 are allowed	UINT16 1..31	- 1	R/W/per
RS485.serFormat 22:3 (16:03$_h$)	Data format Bit0: 1=no parity, 0=parity on Bit1: 1=parity odd, 0=parity even Bit2: 1=8 data bits, 0=7 data bits Bit3: 1=2 stop bits, 0=1 stop bit Default is 0 = 7-E-1	UINT16 0..15	- 0	R/W/per

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Table 6.9 Parameters for the RS485 bus

Pin assignment for printed circuit board plug connector

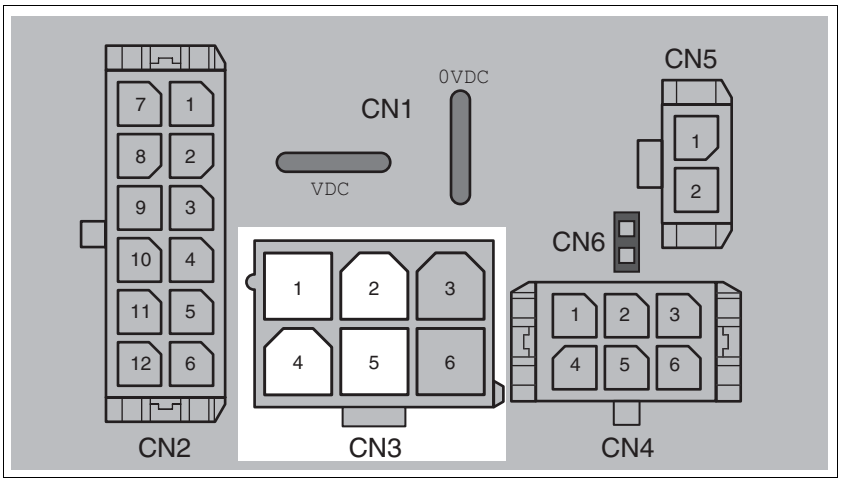

Figure 6.17 Pin assignment of the RS485 fieldbus interface

Pin	Signal	Meaning	SUB-D [1)]
2	+RS485	RS485 interface	7
5	−RS485	RS485 interface	2
4	RS485_0V	Internally connected with CN1.0VDC	3

1) Information refers to prefabricated wiring

Table 6.10 Pin assignment of the RS485 fieldbus interface

Pin assignment of industrial plug connector

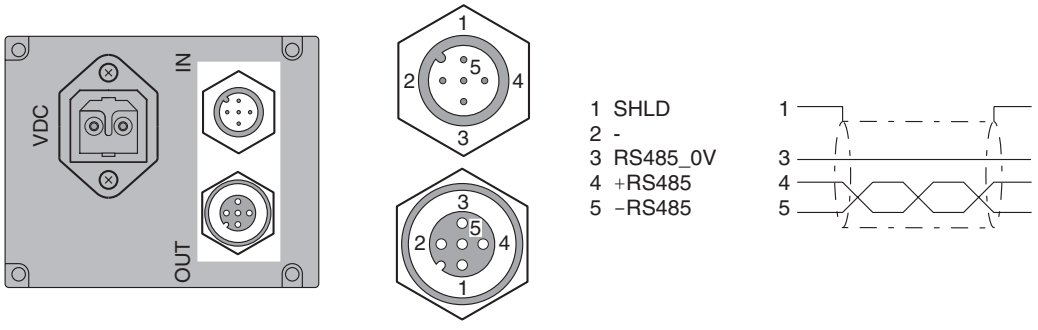

Figure 6.18 Pin assignment of the RS485 fieldbus interface

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Pin	Signal	Meaning
1	SHLD	Shield connection
2	-	not assigned
3	RS485_0V	Internally connected with CN1.0VDC
4	+RS485	RS485 interface
5	-RS485	RS485 interface

Table 6.11 Pin assignment of the RS485 fieldbus interface

6.4.9 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 +24VDC and VDC 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.

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.

Setting parameters

The 24V signals can be configured as input or output with the parameters IO.IO0_def, 34:1 to IO.IO3_def, 34:4. Specific functions can also be assigned.

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Function	possible for signal	Remarks
Positive limit switch	IO0	Logic level can be configured
Negative limit switch	IO1	Logic level can be configured
STOP switch	IO0..3	Logic level can be configured
Reference switch	IO0..3	For reference movement to REF, level can be configured
Freely usable	IO0..3	Free access via fieldbus
Programmable	IO0..3	see chapter 8.3.5 “Programmable inputs and outputs“
Index pulse output	IO0	only for devices with index pulse encoder

Table 6.12 Functions of the 24V signals

The external monitoring signals `LIMP`, `LIMN`, `REF` *and* `STOP` *are enabled with the parameter* `Settings.SignEnabl, 28:13`.

Use the active 0 monitoring signals if possible, because they are proof against wire breakage. The evaluation to active 0 or 1 are set with the parameter `Settings.SignLevel, 28:14`.

For more information see chapter 7 “Commissioning“.

Pin assignment for printed circuit board plug connector

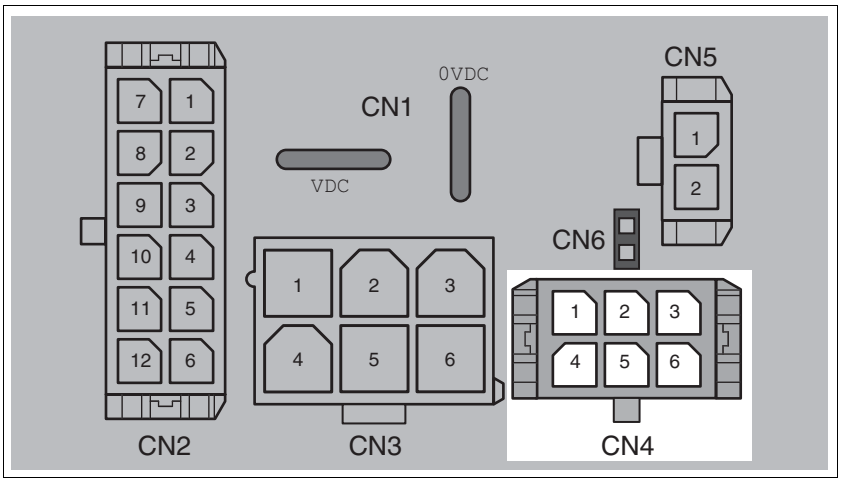

Figure 6.19 Pin assignment of the 24V signal interface

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Pin	Signal	Meaning
1 [1)]	+24VDC	An external 24V signal power supply is required if outputs are to be used
1 [2)]	+24VDC_OUT	The internal 24V signal power supply may be used for the power supply of the sensors (e.g. limit switches)
2	IO2	freely usable input or output
3	IO0	freely usable input or output
4	0VDC	Internally connected with CN1.0VDC
5	IO3	freely usable input or output
6	IO1	freely usable input or output

1) drives without internal 24V signal power supply.
2) drives with internal 24V signal power supply

Table 6.13 Pin assignment of the 24V signal interface

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

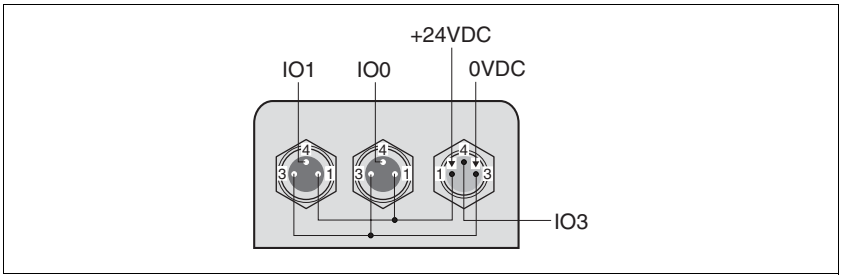

Figure 6.20 Pin assignment "Insert 3I/O 24V"

An external 24V signal power supply is required if IO0, IO1 or IO3 are to be used as output.

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

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

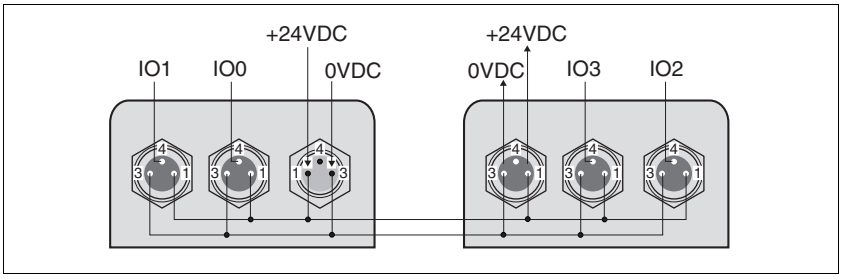

Figure 6.21 Pin assignment "Insert 4I/O 24V"

An external 24V signal power supply is required if IO0, IO1, IO2 or IO3 are to be used as output.

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

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

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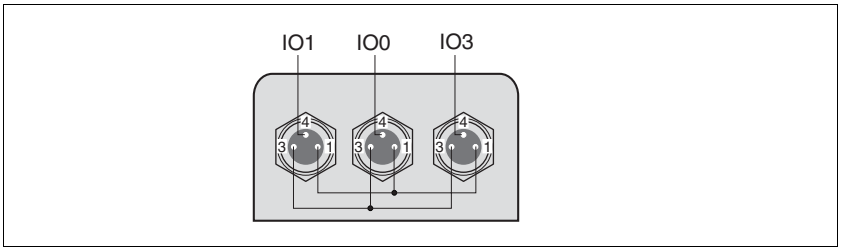

Figure 6.22 Pin assignment "Insert 3I/O"

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 "Insert 4I/O"

Pin assignment on drives with internal 24V signal power supply.

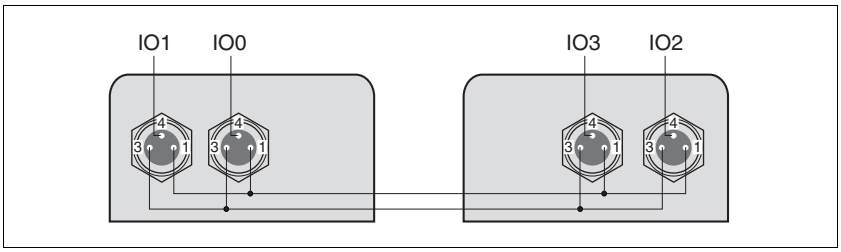

Figure 6.23 Pin assignment "Insert 4I/O"

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)

6.4.10 Safety function connection "Safe Standstill"

WARNING!

Danger of injury by incorrect usage!

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

- Observe the requirements for the safety function.

Function

Notes and requests to the safety signals $\overline{\text{SAFE\_DISABLE\_A}}$ and $\overline{\text{SAFE\_DISABLE\_B}}$ can be found in the chapter 5.3 ""Safe Standstill" safety function".

Protected line layout

If short circuits and cross connections are possible with the lines for the signals $\overline{\text{SAFE\_DISABLE\_A}}$ and $\overline{\text{SAFE\_DISABLE\_B}}$ and this cannot be detected by upstream devices, a protected layout is required.

A protected layout can be achieved as follows:

- Allocation of signals to different cables. Apart from $\overline{\text{SAFE\_DISABLE\_A}}$ and $\overline{\text{SAFE\_DISABLE\_B}}$ only wires with voltages corresponding to PELV are permitted to be run on these cables.

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- Use of a shielded cable. The earthed shield protects the signals from outside voltages.

  If there are multiple wires in the cable, the signals SAFE_DISABLE_A and SAFE_DISABLE_B are kept separate from these wires by the earthed shield.

Cable specifications

- Shielded cable corresponding to the requirements for protected layout of wires
- Minimum cross section of signal wires: 0.34 mm²
- ▶ Use equipotential bonding lines, see page 6-2.
- ▶ 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.

Pin assignment for printed circuit board plug connector

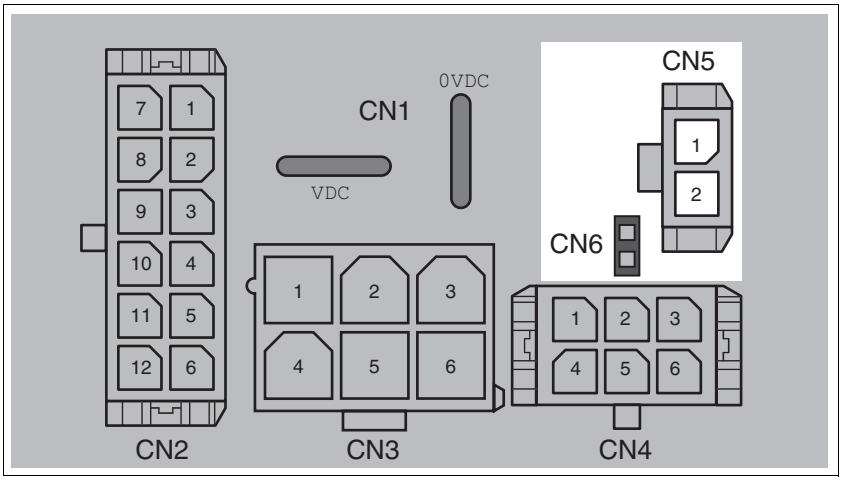

Figure 6.24 Pin assignment of safety function

Pin	Signal	Meaning
1	SAFE_DISABLE_A	Safety function
2	SAFE_DISABLE_B	Safety function

Table 6.14 Pin assignment of safety function

Function CN6

You use the CN6 bridge to specify whether the drive is operated with or without the "Safe Standstill" safety function.

- Bridge connected: "Safe Standstill" safety function disabled
- Bridge disconnected: "Safe Standstill" safety function enabled

The CN6 bridge also offers a simultaneous mechanical lock against CN5. Therefore, CN5 cannot be connected if the CN6 bridge is still connected.

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Pin assignment "Insert 2I/O 1SD"

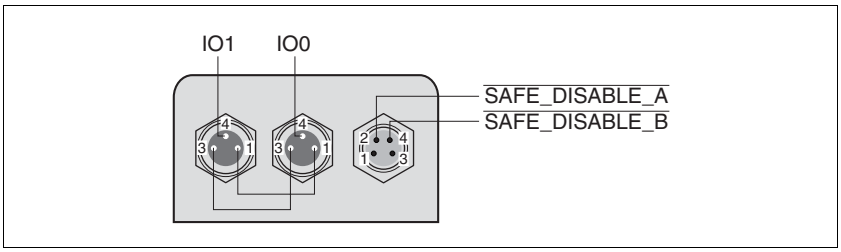

Figure 6.25 Pin assignment "Insert 2I/O 1SD"

Pin assignment "Insert 4I/O 2SD"

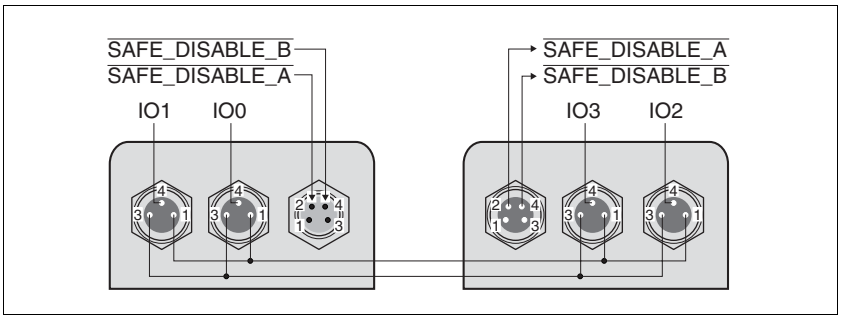

Figure 6.26 Pin assignment "Insert 4I/O 2SD"

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6.5 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 "Safe Standstill" safety function)

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7 Commissioning

7.1 General safety instructions

CAUTION!

Hot surfaces can cause burns and damage to system components!

The drive temperature can exceed 100°C in some conditions.

- Avoid contact with the hot drive.
- Do not place combustible or heat-sensitive components in immediate vicinity.
- Follow the actions described for heat dissipation.
- Check the temperature of the drive during the test run.

WARNING!

Unexpected motion may cause injury and damage to the system

When the drive is operated for the first time there is a high risk of unexpected motion because of possible wiring faults 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 motion before starting the function.

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WARNING!

Unexpected responses may cause injury and damage to the system

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 states 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.

WARNING!

Danger of injury and damage to system components by unbraked motor!

Loss of power or faults that result in switching off the power amplifier mean that the motor is no longer actively braked and may run against a mechanical stop at high speed.

- Check the mechanical conditions.
- If necessary, use an absorbent mechanical stop or a suitable brake.

WARNING!

Rotating parts may cause injury and damage to the system.

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

- After installation check all rotating parts (parallel keys, clutch, ..).
- Use a guard as protection against rotating parts.

WARNING!

Danger of injury from 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.

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7.2 Preparing for commissioning

The following tests are required before commissioning:

- ▶ Wiring and connection of all cables and system components
- ▶ Limit switch function, if installed

One of the following must be available:

- Fieldbus master (e.g. PLC) or industrial PC
- IclA Easy commissioning software

7.3 Running commissioning

7.3.1 The most important settings

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

Direction of rotation

The direction of rotation can be reversed with the parameter `Motion.invertDir 28:6`. In its default setting the motor rotates clockwise at positive speeds when the face of the motor shaft is viewed.

The new value of the parameter is only enabled when the motor is switched on.

- Save the parameter in the EEPROM.
- Switch the compact drive off and then on again.

If you activate the reversal of the direction of rotation, check the limit switch wiring again.

- ▶ Connect the positive limit switch to `IO0`
- ▶ Connect the negative limit switch to `IO1`

The positive limit switch is the switch that is tripped by the system mechanics if the motor shaft rotates as follows:

- without inversion of the direction of rotation: clockwise
- with inversion of the direction of rotation: anticlockwise

Set speed

The motor setpoint speed depends on the application requirements.

- ▶ Set the setpoint speed with the parameter `Motion.v_target0 29:23`.

Setpoint speed acceleration

Note that when the drive is decelerated it takes energy from the system and the voltage may increase depending on the external torque and the specified deceleration value.

The drive has two acceleration settings:

- acceleration/deceleration
  parameter `Motion.acc, 29:26`

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- delay for "Quick Stop"
  parameter `Motion.dec_Stop, 28:21`

7.3.2 Starting 24V signal interface

The monitoring by the $\overline{LIMP}$ / $\overline{LIMN}$ limit switches is enabled by default for safety reasons. In all drives without limit switches monitoring must be disabled with the parameter `Settings.SignEnabl, 23:13`, value = 0. The STOP input is disabled in its default setting.

7.3.2.1 Setting functions of the 24V signals

The 24V signals can be configured as input or output and specific functions can be assigned to the 24V signals with the parameters `IO.IO0_def 34:1` to `IO.IO3_def 34:4`.

For more information see chapter 6 “Installation“.

7.3.2.2 Testing 24V signals

The table below shows the status of the 24V signals and the possible parameter settings that can be read over the fieldbus interface.

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
I/O.IO_act 33:1 (21:01$_h$)	Status of the digital inputs and outputs 24V inputs/outputs: Bit0: IO0 Bit1: IO1 Bit2: IO2 Bit3: IO3 Bit4: SAFE_DISABLE_A Bit5: SAFE_DISABLE_B Read provides status of inputs and outputs. Write only changes the status of the outputs.	UINT16 0..15	- 0	R/W/-
I/O.IO0_def 34:1 (22:01$_h$)	Configuration of IO0 0 = input freely usable 1 = input LIMP (with IO0 only) 2 = input LIMN (with IO1 only) 3 = input STOP 4 = input REF 5 = input programmable 128 = output freely usable 129 = output index pulse (with IO0 only) 130 = output programmable Comments: 129 only at drives with index pulse	UINT16 0..255	- 1	R/W/per
I/O.IO1_def 34:2 (22:02$_h$)	Configuration of IO1 see parameter IO0_def	UINT16 0..255	- 2	R/W/per
I/O.IO2_def 34:3 (22:03$_h$)	Configuration of IO2 see parameter IO0_def	UINT16 0..255	- 3	R/W/per
I/O.IO3_def 34:4 (22:04$_h$)	Configuration of IO3 see parameter IO0_def	UINT16 0..255	- 4	R/W/per

Table 7.1 Parameters of the inputs and outputs

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Check signal inputs and limit switches

Proceed as follows for testing:

- Stimulate the input by, for example, triggering the limit switch or sensor manually.

  The corresponding bit in parameter `IO.IO_act 33:1` must be 1 so long as the input is logical 1.

Checking freely usable signal outputs

Proceed as follows for testing:

- Write the parameter `IO.IO_act 33:1` with the value required to set the associated output to logical 1.
- Measure the voltage at the output or check the response to the connected actuator.

7.3.2.3 Testing the function of limit switches

The monitoring by the $\overline{\texttt{LIMP}}$ / $\overline{\texttt{LIMN}}$ limit switches is enabled by default for safety reasons. In all drives without limit switches monitoring must be disabled with the parameter `Settings.SignEnabl, 23:13`, value = 0. The STOP input is disabled in its default setting.

Condition: The limit switch signals are monitored.

For more information see chapter 7.3.2.2 “Testing 24V signals“.

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Settings.SignEnabl 28:13 (1C:0D$_h$)	Activation of the monitoring inputs Bit0: LIMP (pos. limit switch) Bit1: LIMN (neg. limit switch) Bit2: STOP (STOP switch) Bit3: REF (reference switch) Bit value=0: Monitoring is not active Bit value=1: Monitoring is active Note: Monitoring is only active if the relevant I/O port is configured as the corresponding function (parameter I/O.IO0_def to IO3_def).	UINT16 0..15	- 3	R/W/per
Settings.SignLevel 28:14 (1C:0E$_h$)	Signal level for monitoring inputs Set here whether errors are triggered at 0 or at 1 level. Bit0: LIMP Bit1: LIMN Bit2: STOP Bit3: REF Bit value 0: Response at 0 level (wire-break security) Bit value 1: Response at 1 level	UINT16 0..15	- 0	R/W/per
Status.Sign_SR 28:15 (1C:0F$_h$)	Saved signal status external monitoring signals Bit0: LIMP Bit1: LIMN Bit2: STOP Bit3: REF Bit7: SW stop 0: not enabled 1: enabled Saved signal states of enabled external monitoring signals	UINT16 0..15	- -	R/-/-

Table 7.2 Parameters for checking the limit switches

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The release of the external monitoring signals $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$ and STOP can be changed with the parameter Settings.SignEnabl 28:13 and the evaluation to active LOW or HIGH can be changed with the parameter Settings.SignLevel 28:14.

- ▶ Connect the limit switch that limits the working range in the clockwise rotation to $\overline{\text{LIMP}}$.
- ▶ Connect the limit switch that limits the working range at anti-clockwise rotation to $\overline{\text{LIMN}}$.

Check the function of the limit switch with the parameter Status.Sign_SR 28:15.

- ▶ Enable the power amplifier.

  (Parameter Commands.driveCtrl 28:1 Bit 1)
- ▶ Run a "fault reset".

  (Parameter Commands.driveCtrl 28:1 Bit 3)

  Then in the parameter Status.Sign_SR 28:15 no bit must be set.
- ▶ Briefly actuate the limit switch manually.

  (Parameter Commands.driveCtrl 28:1 Bit 3)

  Then in the parameter Status.Sign_SR 28:15 the corresponding bit must be set.
- ▶ Run a "fault reset".

  Then in the parameter Status.Sign_SR 28:15 no bit must be set.

7.3.3 Setting motor phase currents

WARNING!

Violations and system damage by falling loads at standstill.

When the current reduction is enabled, the motor torque at standstill is reduced and result dropping in the case of axes with external forces (vertical axes).

- Check whether the load rations allow operation with current reduction.
- If necessary, switch on the current reduction.

For commissioning select low motor phase currents (10% of rated current) so the drive traverses at a low torque.

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Settings.I_still 14:1 (0E:01_h)	Motor phase current standstill Is active after 100ms motor standstill. Current is shown in percent of rated current.	UINT16 0..100	% 70	R/W/per
Settings.I_acc 14:2 (0E:02_h)	Motor phase current acceleration / deceleration Current given in percent of nominal current.	UINT16 0..100	% 100	R/W/per

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Settings.I_const 14:3 (0E:03_h)	Motor phase current constant travel Current given in percent of nominal current.	UINT16 0..100	% 100	R/W/per
Settings.I_stop 14:4 (0E:04_h)	Motor phase current for "Quick Stop" Current given in percent of nominal current.	UINT16 0..100	% 100	R/W/per

Table 7.3 Parameters for setting phase currents

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7.3.4 Testing safety functions

Operation with "Safe Standstill"

Carry out the following steps to use the "Safe Standstill" function: Make sure that the sequence is retained.

- Supply voltage switched off.
- ▶ Check that the inputs SAFE_DISABLE_A and SAFE_DISABLE_B are electrically isolated from each other. The two signals must not be electrically connected.
- Supply voltage switched on.
- ▶ Enable the power amplifier.

  (parameter Commands.driveCtrl, 28:1 bit 1)
- ▶ Trigger the safety disconnection. SAFE_DISABLE_A and SAFE_DISABLE_B must be switched off simultaneously (skew <1s).
- ◁ The power amplifier switches off and error message 0119_h is displayed. (CAUTION: error message $011A_h$ shows a wiring error.)

  (Parameter Status.StopFault, 32:7)
- ▶ Check the behaviour of the drive in error states.
- ▶ Record all tests of the safety function in the acceptance record.

Operation without "Safe Standstill"

If you do not want to use the safety function:

- ▶ Check whether the bridge CN6 is connected.

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Commands.driveCtrl 28:1 (1C:01_h)	Control word for status change Bit0: Disable power amplifier Bit1: Enable power amplifier Bit2: Quick-Stop Bit3: FaultReset Bit4: Quick-Stop release Bit5..15: reserved Preset Bit0..4="0", write access automatically triggers slope change 0->1 and processing of status machine.	UINT16 0..31	- 0	R/W/-

7.3.5 Testing with relative positioning

Positioning operation can be tested with a "relative positioning" in "point-to-point mode".

WARNING!

Danger of personal injury and damage to system parts by uncontrolled system 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

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All speed and position information below is based on the motor drive shaft (without gearbox).

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Commands.driveCtrl 28:1 (1C:01$_h$)	Control word for status change Bit0: Disable power amplifier Bit1: Enable power amplifier Bit2: Quick-Stop Bit3: FaultReset Bit4: Quick-Stop release Bit5..15: reserved Preset Bit0..4="0", write access automatically triggers slope change 0->1 and processing of status machine.	UINT16 0..31	- 0	R/W/-
PTP.p_relPTP 35:3 (23:03$_h$)	Path and relative positioning start action object: Write access triggers relative positioning in increments	INT32	IInc -	R/W/-
PTP.v_tarPTP 35:5 (23:05$_h$)	Setpoint speed of PTP positioning Positioning can be temporarily stopped with value 0. Default is the value of the parameter `Motion.v_target0`.	UINT16 0..3000	rpm 60	R/W/-

Table 7.4 Parameters for "profile position mode", "relative positioning"

Running test movement

Run the test movement as follows.

- ▶ Activate the limit switch.

  (Parameter `Commands.driveCtrl 28:1 Bit 1`)
- ▶ Set the setpoint speed, e.g. 600 rpm.

  (Parameter `PTP.v_tarPTP 35:5`)
- ▶ Start the "relative positioning", e.g. by 1000 increments.

  (Parameter `PTP.v_relPTP 35:3`)
- ▶ Check the limit switch function by moving the compact drive slowly and step-by-step to the limit switch.

7.3.6 Optimising travel behaviour of the motor

Setting the slope of the ramps

- ▶ Input the slopes of the ramp function into the parameter `Motion.acc, 29:26`. The following formulas can be used to estimate the values for input:

$$\text{Moment of acceleration} \leq \frac{30\,\alpha}{\pi}$$

$$\alpha = \frac{M_M - M_L}{J_{total}}$$

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Physical quantity/Characteristic value	Meaning	Unit
M_M	Available motor torque	Nm
M_L	Load torque	Nm
J_{total}	Mass moment of inertia	kgm^2
α	Angular acceleration	rad/sec^2
Motion.acc	Acceleration parameters	(rpm)/s

Table 7.5 Description of the quantities

Set speed

The motor setpoint speed depends on the application requirements.

▶ Set the setpoint speed with the parameter `Motion.v_target0 29:23`.

Torque characteristic of the motor

The available torque of the motor depends on the following factors:

- Size
- Speed
- Supply voltage 24 V to 36 V (dependency only from a specific speed from which the torque decreases sharply)

The dependence of the torque on the speed is specified in the catalogue as characteristic curve of the motor.

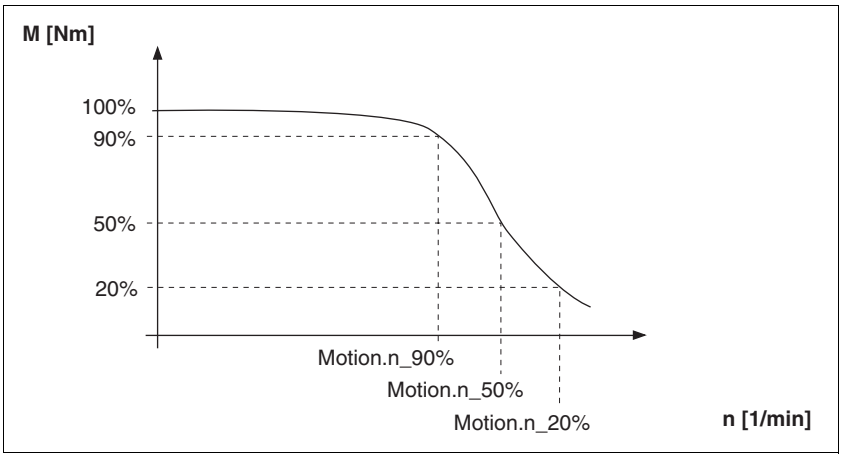

Figure 7.1 Typical torque characteristic of a stepper motor

From a specific speed the available torque decreases rapidly as the speed increases. The available acceleration is also correspondingly reduced.

7.4 IclA Easy commissioning software

The IclA Easy commissioning software has a graphic user interface and can be used for commissioning, diagnostics and testing.

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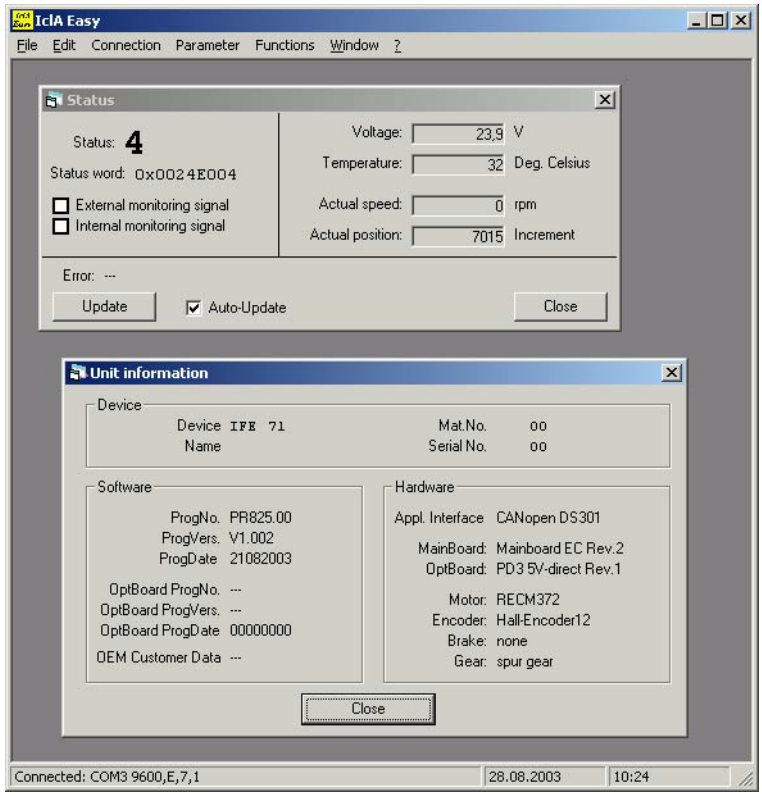

Functions

IclA Easy offers the following functions

- Input and display of device parameters
- Archiving and duplication of device parameters
- Display of status and device information
- Positioning the motor with the PC
- Triggering reference movements
- Access to all documented parameters
- Diagnosis of operating faults

Requirements and interfaces

IclA Easy runs on a PC under the Microsoft Windows 98/ME/NT/2000 operating system. The program communicates with the compact drives over RS485, CAN or Profibus DP using a field bus converter. The following field bus converters are supported:

Compact drive interface	PC interface	Required field bus converter	Supplier
RS485	USB	NuDAM ND-6530	http://www.acceed.com
RS485	RS232	NuDAM ND-6520	http://www.acceed.com
CAN	USB	PCAN-USB, Peak	http://www.peak-system.com
CAN	parallel	PCAN dongle, Peak	http://www.peak-system.com
Profibus DP	PCMCIA	Siemens CP5511/12	http://www.ad.siemens.com
Profibus DP	PCI	Siemens CP5611/13	http://www.ad.siemens.com

Reference source

The IclA Easy operating software is included on the IclA CD-ROM. The latest version is available for download at http://www.berger-lahr.com.

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7.4.1 Firmware update over fieldbus

CAUTION!

Damage to the product from failure of the supply voltage.

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

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

IcIA Flashkit

The IcIA Flashkit can be used to update the firmware of the drive over the relevant fieldbus. The Flashkit supports the same fieldbus converters as the IcIA Easy operating software. Please contact your local representative to obtain the Flashkit and for support with using it.

Finding the firmware version

The firmware number and the firmware version of your drive can be found with IcIA Easy by opening the device information window.

Information on the following parameters can be found over the fieldbus:

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Config.PrgNo 1:1 (01:01_h)	Firmware number High Word: Program number Low Word: Program types Example: PR802.10 High Word:802 Low Word: 10	UINT32	- -	R/-/-
Config.PrgVer 1:2 (01:02_h)	Firmware version High Word: Program version Low Word: Program revision Example: V1.003 High Word:1 Low Word: 3	UINT32	- -	R/-/-
Config.OptPrgNo 13:11 (0D:$0B_h$)	Firmware number in the option module Identifies the program number of the internal Profibus interface in drives with Profibus.	UINT32	- -	R/-/-
Config.OptPrgVer 13:12 (0D:$0C_h$)	Firmware version in the option module Identifies the program version of the internal Profibus interface in drives with Profibus.	UINT32	- -	R/-/-

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8 Operation

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

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

8.1 Basics

All speed and position information below is based on the motor drive shaft (without gearbox).

8.1.1 Default parameter values

The compact drive is supplied with default parameter values, which can be adapted to the requirements of the system.

Adjustable parameter values:

- Accelerations
  - Acceleration and deceleration in general
    (Parameter `Motion.acc, 29:26`)
  - Delay for "Quick Stop"
    (Parameter `Motion.dec_Stop, 28:21`)
- Definition of the direction of rotation
  (Parameter `Motion.invertDir, 28:6`)
- Motor phase currents
  - Standstill
    (Parameter `Settings.I_still, 14:1`)
  - Acceleration and deceleration
    (Parameter `Settings.I_acc, 14:2`)
  - Constant movement
    (Parameter `Settings.I_const, 14:3`)
  - Emergency stop
    (Parameter `Settings.I_stop, 14:4`)
- Signal interface
  - Definition of I/O signals
    (parameter group I/O)

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  - Enabling limit switches

    (parameter group I/O)

- User device name

  (parameter `Settings.name1, 11:1` and `Settings.name2, 11:2`)

8.1.2 External monitoring signals

You can enable, adjust and monitor the external monitoring signals.

Available external monitoring signals:

- Axis signals
  - Positive limit switch $\overline{\texttt{LIMP}}$
  - Negative limit switch $\overline{\texttt{LIMN}}$
  - Stop switch STOP
  - Reference switch $\overline{\texttt{REF}}$
- Software stop "software STOP"

8.1.2.1 Axis signals

Axis signals configuring

Before the external monitoring signals can be used, the IO signals for this function must be configured (parameter group I/O).

Setting the signal levels of theaxis signals

After configuring the IO signals, adjust the signal level for the various monitoring inputs.
(Parameter `Settings.SignLevel, 28:14`)

- Value 0 : Response at 0 level (wire-break security)
- Value 1 : Response at 1 level

Axis signals activate

In the last step you enable the external monitoring signals so the incoming signals will be evaluated
(parameter `Settings.SignEnable, 28:13`).

Axis signals status

The stored signal status of the enabled external monitoring signals can read out at any time.
(parameter `Status_SignSR, 28:15`).

Axis signals monitoring

During operation the two limit switches $\overline{\texttt{LIMN}}$ and $\overline{\texttt{LIMP}}$ are monitored. If the drive moves into a limit switch range, it stops the motor at the specified "Quick Stop" delay. (parameter `Motion.dec_Stop, 28:21`) and the event is stored (parameter `Status.Sign_SR, 28:15`, bit 0 ($\overline{\texttt{LIMP}}$) and bit 1 ($\overline{\texttt{LIMN}}$)

Set up the limit switches so the drive cannot traverse past the limit switch range. For example, longer actuation lugs can be used.

External monitoring signal $\overline{\texttt{REF}}$

The external monitoring signal $\overline{\texttt{REF}}$ does not have to be enabled for the reference movement. If the external monitoring signal $\overline{\texttt{REF}}$ is enabled, the reference switch also takes the function of an additional stop switch.

Retraction

The drive can be traversed out of the limit switch range at any time by a reference movement or a jog.

For more information see chapter 8.2.4 “Operation mode Homing“ or 8.2.1 “Jog operation mode“.

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External monitoring signal STOP

The external monitoring signal STOP stops the motor with a "Quick Stop"."" The signal is stored in the parameter Status.Sign_SR, 28:15, bit 2.

How to initiate further processing:

- Reset the external monitoring signal STOP at the signal input.
- Run a "Fault Reset".

  (parameter Commands.driveCtrl, 28:1, bit 4)
- Initiate a new travel command.

The external monitoring signal STOP is enabled with the parameter Settings.SignEnabl, 28:13, bit 2.

The signal level of the external monitoring signal STOP is set with the parameter Settings.SignLevel, 28:14, bit 2.

8.1.2.2 Software stop "software STOP"

The "software STOP" is a fieldbus command (parameter Commands.driveCtrl, 28:1, bit 2) and brings the drive to an immediate standstill at the specified "Quick Stop" delay (parameter Motion.dec_Stop, 28:21).

After a "software STOP" the drive switches to the "Quick Stop" operating status. The power amplifier remains enabled.

Carry out one of the following steps to continue processing:

- Run a "Fault Reset".

  (parameter Commands.driveCtrl, 28:1, bit 3)

  Note that in the event of a "Fault Reset" any other errors that have occurred will be reset.
- Run a "Quick Stop Release".

  (parameter Commands.driveCtrl, 28:1, bit 4)

After acknowledgement the drive remain in the "Operation enable" operating status and a new positioning command can be sent.

8.1.3 Positioning limits

The compact drive can be traversed to any point of the positioning range by specifying an absolute position.

The positioning range is -2^{31} to $+2^{31}$ increments (Inc).

The positioning resolution is 20000 increments per revolution measured at the motor output shaft (without gearbox).

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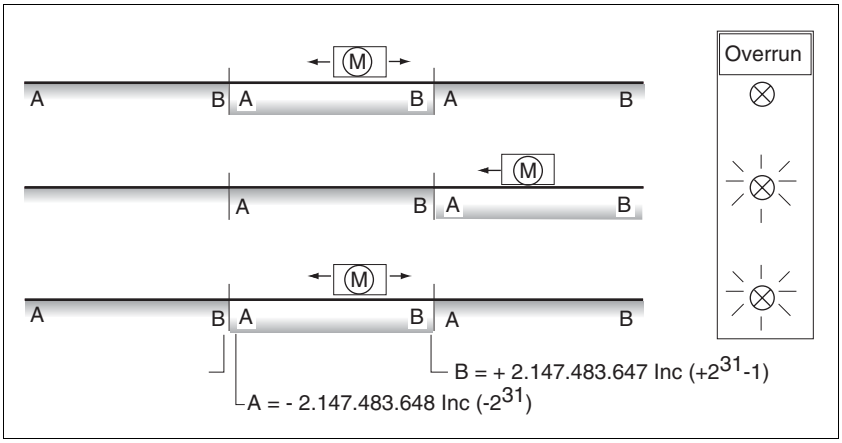

Figure 8.1 Positioning range and range overrun

If the motor crosses the positioning limits, the internal monitoring signal for position overrun (parameter `Status.WarnSig, 28:10`, bit 0) is set and the working range is moved by 2^{32} increments.

If the drive was previously referenced, the bit "ref_ok" (parameter `Status.xMode_act, 28:3`, bit 5) is also reset.

The internal monitoring signal remains set when the motor moves back into the valid range.

Use the parameter `Settings.WarnOvrun, 28:11` to configure whether the overrun of the positioning limits is reported as a warning in the parameter `Status.driveStat, 28:2` bit 7.

An absolute positioning cannot be run after a position overrun.

Resetting signal

To reset the signal run one of the following operating modes:

- Reference movement
- Dimension setting

Operating modes with position overrun

Operating modes in which the positioning limits can be overrun:

- Jog (from software version 1.101)
- profile velocity
- Relative positioning at profile position

8.1.4 Internal monitoring signals

The internal monitoring signals are used for control of the drive.

Available internal monitoring signals (parameter `Status.WarnSig, 28:10` and `Status.FltSig, 28:17`):

- Stall detection, drives with index pulse only
- Position overrun profile generator (warning)
- "Safe Standstill safety function"
- Hardware error

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- Internal system error
- Fieldbus nodeguard error
- Fieldbus protocol error
- Overvoltage or undervoltage error
- Motor overload
- Overtemperature error

Reading stored internal monitoring signals

The signal status of the enabled internal monitoring signal is stored. (Parameter `Status.FltSig, 28:17`)

If an internal monitoring error occurs, the corresponding bit is set in the parameters `Status.FltSig, 28:17` and `Status.FltSig_SR, 28:18`.

When the cause of error is corrected,the bit is automatically reset in the parameter `Status.FltSig, 28:17`.

The bit in the parameter `Status.FltSig_SR, 28:18` is only reset by a "Fault Reset" (parameter `Commands.driveCtrl, 28:1`, bit 3). This also allows errors that only occur briefly to be diagnosed.

Stall detection

The stall detection checks whether the index pulse is always triggered at the same angular position of the rotating field during the motor movement. If a stepper motor stalls, the motor shaft is displaced in relation to the rotating field by an angle corresponding to one or more complete pole pairs. One pair of poles corresponds to 1/50 of a revolution.

Restrictions:

- The stall detection is initially inactive every time the power amplifier is activated. The detection is automatically enabled as soon as the index pulse is overrun; this occurs after a maximum of one motor revolution. A stall of one or more pole pairs is only detected from this point on.
- If the stepper motor stalls during braking shortly before standstill, this will be only detected when the index pulse is overrun next time, i.e. possibly only on the next movement.
- If the area of travel of the application is less than one complete motor revolution, the stall detection will not operate reliably.
- If the motor shaft is rotated by external forces during standstill, the stall detection will not necessarily detect this. If the motor shaft remains at the standstill exactly at the index pulse, a distinction between oscillations and true rotary movement cannot be made. The stall is detected at the next movement unless the motor shaft was rotated exactly one full revolution.

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Settings.monitorM 14:7 (0E:07$_h$)	Motor monitoring Stall detection Bit0: 1=active, 0=not active Only at drives with index pulse.	UINT16 0..1	- 1	R/W/per

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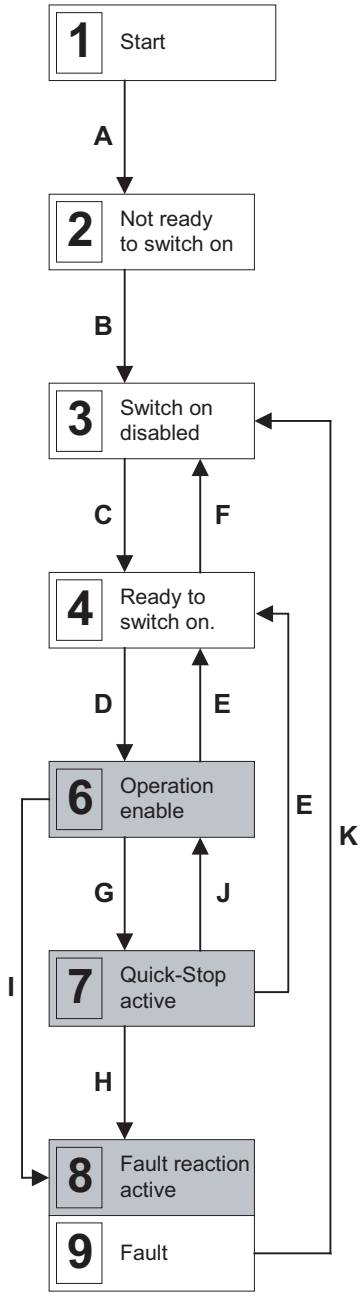
8.1.5 Operating status and status transitions



^ grey background:
Power amplifier switched on

Operating states

1
Initialisation of the device electronics and internal self-test

2
Power amplifier not ready to switch on
The device initialises the parameters

3
Power amplifier cannot be switched on. The drive monitors the supply voltage and responds if the supply voltage exceeds the threshold value.

4
The power amplifier is ready to switch on and is set to "Disable".

6
The power amplifier is set to "Enable". The motor has current. The drive is ready.

7
The "Quick Stop" operating function is active.

8
Error response

9
Drive is in the error status

State transitions

A
Automatic transition

B
If the operating status 2 was successful, an automatic transition follows, otherwise no transition.

C
SAFE_DISABLE_A/B must have 1-level and the supply voltage must increase above the threshold value. An automatic transition follows.

D
The transition is triggered by writing the parameter `Commands.driveCtrl, 28:1,` value 2.

E
The transition is triggered by writing the parameter `Commands.driveCtrl, 28:1,` value 1. For example, this transition can be applied to shut off current to the motor for maintenance or for work on the system.

F
If the supply voltage falls below the threshold value or the SAFE_DISABLE_A/B inputs fall to 0-level, an automatic transition follows.

G
Causes:
"Quick Stop" by writing the parameter `Commands.driveCtrl, 28:1,` value 4 or error of error class 1 or 2.

H
The motor is released.
The cause is an error of error class 2

I
The motor is released.
The cause is an error of error class 3 or 4.

J
An error of error class 1 or a "software STOP" was acknowledged by writing the parameter `Commands.driveCtrl, 28:1,` value 8 ("Fault Reset") or value 16 ("Quick Stop Release")

K
An error of error class 2 or 3 was acknowledged by writing the parameter `Commands.driveCtrl, 28:1,` value 8 ("Fault Reset")

Read current operating status The current operating status can be read at any time over the fieldbus. (parameter `Status.driveStat, 28:2`).

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Bit	Meaning
0..3	Operating status of the drive For more information see 8.1.5 “Operating status and status transitions“
5	Error message from internal monitoring The bit is set if at least one bit is set in the parameter `Status.FltSig_SR, 28:18`. The cause of error can be read with the parameter `Status.FltSig_SR, 28:18`.
6	Error message by external monitoring The bit is set if at least one bit is set in the parameter `Status.Sign_SR, 28:15`. The cause can be read with the parameter `Status.Sign_SR, 28:18`.
7	Warning message The bit is set if at least one bit is set in the parameter `Status.WarnSig, 28:10`. The cause can be read with the parameter `Status.WarnSig, 28:10`.
12..15	Monitoring the operating status The bits are identical with: `Manual.stateMan, 41:2`, bits 12..15 `VEL.stateVel, 36:2`, bits 12..15 `PTP.statePTP, 35:2`, bits 12..15 `Homing.stateHome, 40:2`, bits 12..15 `Gear.stateGear, 38:2`, bits 12..15 For more information see chapter8.2 “Operating modes“

8.1.6 Operating-mode-specific status information

Every operating mode has one acknowledgement parameter:

- Jog (from software version 1.101)

  (Parameter `Manual.stateMan, 41:2`)

- profile velocity

  (Parameter `VEL.stateVel, 36:2`)

- Profile position

  (Parameter `PTP.statePTP, 35:2`)

- Homing

  (Parameter `Homing.stateHome, 40:2`)

Information stored in every acknowledgement parameter:

- Bit 0: $\overline{\texttt{LIMP}}$ error

  Error message by positive limit switch

- Bit 1: $\overline{\texttt{LIMN}}$ error

  Error message by negative limit switch

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- Bit 2: Error`STOP`

  Error response with "Quick Stop"

- Bit 3: $\overline{\text{REF}}$ error

  Error message by reference switch

- Bit 7:"Software Stop"
- Bit 12: operating-mode-specific
- Bit 13: operating-mode-specific
- Bit 14:"xxx_end"

  Operating mode finished

- Bit 15:"xxx_err"

  Error arisen

Operating-mode-specific status information can be found in chapter 8.2 “Operating modes“.

If an error occurs during operation, only bit 15 "xxx_err" is set immediately.

In the event of an error of error class 1 or 2 the motor is ultimately brought to a standstill by "Quick Stop" and then bit 14 "xxx_end" is set.

In the case of an error of error class 3 the power amplifier is immediately switched off and bit 14 and 15 are set before the motor is released.

8.1.7 Other status information

In addition to the external and internal monitoring signals, there is status information that contains general information on the drive.

Other available status information:

- Current operating mode

  (parameter `Status.action_st, 28:19` and `Status.xMode_act, 28:3`)

- Speed in rpm
  - Speed of the rotor position reference value

    (Parameter `Status.n_pref, 31:45`)

  - Actual speed

    (Parameter `Status.n_act, 31:9`)

  - Actual speed of the travel profile generator

    (Parameter `Status.n_profile, 31:35`)

  - Setpoint speed of the travel profile generator

    (parameter `Status.n_target, 31:38`)

- Speed in Inc/s
  - Speed of the rotor position reference value

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(Parameter `Status.v_pref, 31:28`)

– Actual speed
(Parameter `Status.v_act, 31:2`)

– Set speed
(Parameter `Status.v_ref, 31:1`)

- Position
  – Position of position controller reference value
  (Parameter `Status.p_ref, 31:5`)
  – Motor position
  (Parameter `Status.p_act, 31:6`)
  – Target position of the travel profile generator
  (Parameter `Status.p_target, 31:30`)
  – Actual position of the travel profile generator
  (Parameter `Status.p_profile, 31:31`)
- Voltages
  – DC bus voltage
  (Parameter `Status.UDC_act, 31:20`)
- Current
  – current motor current
  (Parameter `Status.I_act, 31:12`)
- Temperatures
  – Temperature of the power amplifier
  (Parameter `Status.TPA_act, 31:25`)

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8.2 Operating modes

The following operating modes have been implemented:

- Jog (from software version 1.101)
- profile velocity
- Profile position
- Homing

The operating modes represent different options for positioning. The parameters of the operating modes can be set for the requirements of the system.

Operating mode mode

Action commands are used to switch between operating modes. Action commands are special parameters that trigger an action when they are written.

A new operating mode can only be started after the old one has been terminated.

The termination of an operating mode can be read out with the following parameters:

- Operating-mode independent
  - parameter `Status.driveStat, 28:2`, bit 14
- Mode-dependent
  - Jog

    (parameter `Manual.stateMan, 41:2`, bit 14)
  - Profile velocity

    (parameter `Vel.stateVel, 36:2`, bit 14)
  - Profile position

    (parameter `PTP.statePTP, 35:2`, bit 14)
  - Homing

    (parameter `Homing.stateHome, 40:2`, bit 14)

An operating mode is terminated under the following conditions:

- Jog: drive standstill
- Profile velocity: drive standstill
- Profile position: drive standstill
- Reference movement: drive standstill
- Dimension setting: immediately after dimension setting

Parameters for starting a new operating mode:

- Jog

  (Parameter `Manual.startMan, 41:1`)
- profile velocity

  (Parameter `VEL.velocity, 36:1`)

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- Profile position: Absolute positioning

  (Parameter `PTP.p_absPTP, 35:1`)

- Profile position: Relative positioning

  (Parameter `PTP.p_relPTP, 35:3`)

- Homing: Reference movement

  (Parameter `Homing.startHome, 40:1`)

- Homing: Dimension setting

  (Parameter `Homing.startSetP, 40:3`)

Operating-mode-independent setting options

Setting options applicable for all operating modes:

- Acceleration and deceleration behaviour with the "ramp setting" function
- Deceleration behaviour with the "Quick Stop" function
- Displacement of the zero point with the "set dimensions" operating mode

8.2.1 Jog operation mode

WARNING!

Danger of personal injury and damage to system parts by uncontrolled system 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

Availability

The operating mode is available from software version 1.100.

Overview

The jog is executed as a "classical manual movement". The motor is traversed over a prescribed travel by start signals. If the start signal is applied longer the motor switches to continuous movement.

Manual mode can be executed by

- Operating Software
- Fieldbus
- Inputs of the signal interface if the signal interface is appropriately configured with the "programmable inputs" function.

Operation with the operating software

The operating software supports this operating mode with special dialogues and menus.

Starting manual mode

The motor can be moved in both directions at two speeds. Jog is initiated by the 'Manual.startMan' parameter. The current axis position is the start position for jog. The values for position and speed are input with corresponding parameters.

Jog is finished when the motor has stopped and

- the direction signal is disabled,

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- the operating mode has been interrupted by a error response

The 'Manual.statusMan' parameter shows information on the status of the process.

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Manual.startMan 41:1 ($29:01_h$)	Starting a manual movement Coding of write data: Bit0: pos. sense of rotation Bit1: neg. sense of rotation Bit2: 0:slow 1:fast Bit3: auto. processing of power amplifier If Bit3 is set to 1 a manual movement can also be started with the power amplifier switched off: If the drive is in status 4 (ReadyToSwitchOn), the power amplifier is automatically switched on when the manual movement is started and switched off when the movement is finished.	UINT16 0..15	- 0	R/W/-
Manual.stateMan 41:2 ($29:02_h$)	Acknowledgement: Manual movement Bit15: manu_err Bit14: manu_end Bit7: error SW_STOP Bit3: error REF Bit2: error HW_STOP Bit1: error LIMN Bit0: error LIMP	UINT16	- -	R/-/-

Classical jog At the start signal for jog the motor first traverses a defined travel distance `Manual.step_Man`. If the start signal is still pending after a specific delay time `Manual.time_Man`, the controller switches to continuous movement mode until the start signal is cancelled.

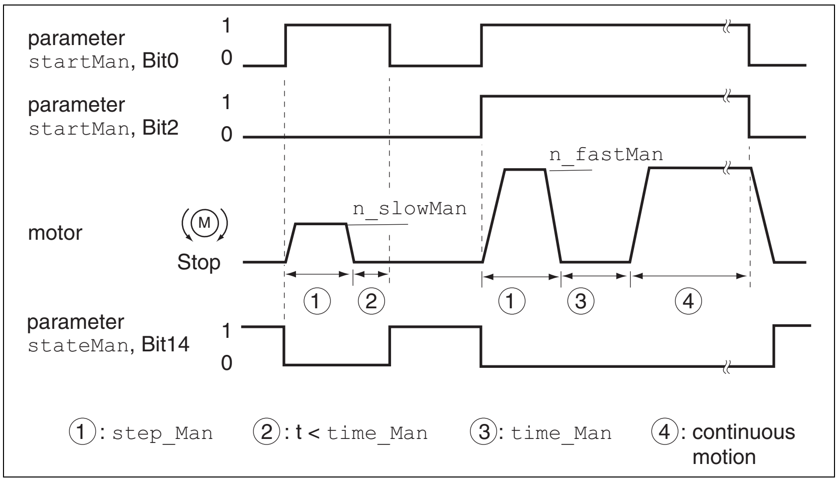

Figure 8.2 Classical jog, slow and fast

The inching distance, wait time and jog speeds can be set. If the inching distance is zero, jog starts directly with continuous movement irrespective of the wait time.

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Manual.n_slowMan 41:4 (29:04$_h$)	Speed for slow manual movement	UINT16 300..3000	rpm 60	R/W/per
Manual.n_fastMan 41:5 (29:05$_h$)	Speed for fast manual movement	UINT16 300..3000	rpm 600	R/W/per
Manual.step_Man 41:7 (29:07$_h$)	Jogging path with manual start 0: direct activation of continuous running	UINT16	Inc 20	R/W/per
Manual.time_Man 41:8 (29:08$_h$)	waiting period until continuous running waiting period until transition to continuous running. Only effective if jogging path is set not equal to 0.	UINT16 1..10000	ms 500	R/W/per

Retracting from the limit switch range

The compact drive can be traversed out of the limit switch range to a valid movement range at any time by a jog.

If the positive limit switch signal $\overline{\texttt{LIMP}}$ was tripped, the jog must be run in the negative direction, if the $\overline{\texttt{LIMN}}$ is tripped it must be run in the positive direction. If the motor does not retract, check that the correct direction for the jog was selected.

8.2.2 Operation mode Profile velocity

WARNING!

Danger of personal injury and damage to system parts by uncontrolled system 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

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.

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
VEL.velocity 36:1 (24:01$_h$)	Start with setpoint speed Action object: Write access triggers movement	INT16 -3000..3000	rpm -	R/W/-
VEL.stateVEL 36:2 (24:02$_h$)	Acknowledgement: profile velocity Bit15: vel_err Bit14: vel_end Bit13: setpoint speed reached Bit7: SW_STOP Bit3: error REF Bit2: error STOP Bit1: error LIMN Bit0: error LIMP	UINT16	- -	R/-/-

Table 8.1 Parameters of the "profile velocity" operating mode

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Start operating mode

As soon as a speed value with the parameter `VEL.velocity, 36:1` is transferred, the drive switches to the profile velocity operating mode and accelerates to the setpoint speed.

▶ Send the parameter `VEL.velocity, 36:1` with a value not equal to 0 to start the operating mode.

Monitoring operating mode

The setpoint speed can be changed at any time during operation:

- Set speed

  (Parameter `VEL.velocity, 36:1`)

The status of the operating mode can be read with the parameter `VEL.stateVel, 36:2`:

- Setpoint speed reached (bit 13)
- Profile velocity terminated (bit 14: vel_end)
- Error (bit 15: vel_err)

Position overrun

In the profile velocity operating mode the drive can overrun the position range (32 bit).

This is not an error, the operating mode continues to run unchanged. However, the following monitoring signals, which can be read via the status parameters, are set or reset:

- Parameter `Status.WarnSig, 28:10`, bit 0 is set.
- Parameter `Status.xMode_act, 28:3`, bit 5 is reset.

  This parameter shows that the drive has been referenced.

For more information see chapter 8.1.3 “Positioning limits“.

End operating mode

The following options are available for stopping the drive via the fieldbus:

- Set setpoint speed to "0"

  (Parameter `VEL.velocity, 36:1`)

- "Quick Stop" via fieldbus control word

  The drive comes to a stop by "Quick Stop".

  (parameter `Commands.driveCtrl, 28:1,` setting of bit 2)

In the case of an error the drive is also stopped. This is shown by parameter `VEL.state, 36:2`, bit 15.

The parameter `VEL.stateVel, 36:2` provides information on the processing status.

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8.2.3 Profile position operating mode

WARNING!

Danger of personal injury and damage to system parts by uncontrolled system 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

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.

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
PTP.p_absPTP 35:1 (23:01$_h$)	Target position and absolute positioning start action object: Write access triggers absolute positioning in increments	INT32	Inc -	R/W/-
PTP.StatePTP 35:2 (23:02$_h$)	Acknowledgment: PTP positioning Bit15: ptp_err Bit14: ptp_end Bit13: Set position reached Bit7: SW_STOP Bit3: error REF Bit2: error STOP Bit1: error LIMN Bit0: error LIMP	UINT16	- -	R/-/-
PTP.p_relPTP 35:3 (23:03$_h$)	Path and relative positioning start action object: Write access triggers relative positioning in increments	INT32	IInc -	R/W/-
PTP.continue 35:4 (23:04$_h$)	Continuation of an interrupted positioning The target position is specified with the preceding positioning command. The value transferred here is not relevant for the positioning.	UINT16	- 0	R/W/-
PTP.v_tarPTP 35:5 (23:05$_h$)	Setpoint speed of PTP positioning Positioning can be temporarily stopped with value 0. Default is the value of the parameter `Motion.v_target0`.	UINT16 0..3000	rpm 60	R/W/-

Table 8.2 Parameters of the "profile position" operating mode

Setting options

The positioning path can be entered in two ways:

- Absolute positioning, reference point is the zero point of the axis.
- Relative positioning, reference point is the current setpoint position of the motor (parameter `Status.p_ref, 31:5`).

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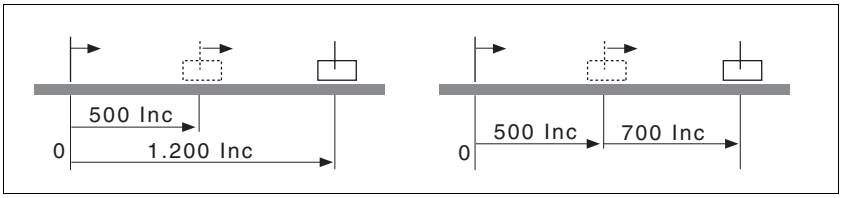

Figure 8.3 Absolute positioning (left) and relative positioning (right)

Start operating mode

As soon as the positioning value is sent to the parameters `PTP.p_absPTP, 35:1` or `PTP.p_relPTP, 35:3`, the drive switches to the profile position operating mode and starts the positioning at the setpoint speed stored in parameter `PTP.v_tarPTP, 35:5`.

A positioning can also be started if a drive is not referenced.

Starting absolute positioning

Procedure for starting an absolute positioning:

- ▶ Set the setpoint speed with the parameter `PTP.v_tarPTP, 35:5`.
- ▶ Start the absolute positioning by sending the absolute position with the parameter `PTP.p_absPTP, 35:1`.

An absolute positioning cannot be started after a position overrun, because the absolute position reference is lost by the position overrun.

The position overrun is shown in parameter `Status.WarnSig, 28:10`, bit 0. Bit 5 (ref_ok) in parameter `Status.xMode_act, 28:3` is also reset.

Starting relative positioning

Procedure for starting a relative positioning:

- ▶ Set the setpoint speed with the parameter `PTP.v_tarPTP, 35:5`.
- ▶ Start the relative positioning by sending the relative position with the parameter `PTP.p_relPTP, 35:3`.

Continuing PTP operation

If a positioning is interrupted, e.g. by an external stop signal, the process can be continued by a write access to the parameter `PTP.continue, 35:4` and completed. The cause of interruption must be disabled beforehand and a Fault-Reset run. The value transferred with `PTP.continue, 35:4` is not evaluated.

Monitoring operating mode

The processing status can be queried with the parameter `PTP.statePTP, 35:2`.

- Setpoint position reached and operating mode ended. Not signalled if movement was interrupted. (Bit 13)
- Profile position operation ended (bit 14: ptp_end)
- Error (bit 15: ptp_err)

End operating mode

Conditions that end the operating mode:

- Target position is reached, motor stopped

  (parameter `PTP.statePTP, 35:2`, bit 14)

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- In the case of an error the drive is stopped. This is shown by parameter PTP.statePTP, 35:2, bit 15.
- Fieldbus command "Quick Stop"

  (Write the value 4 in parameter Commands.driveCtrl, 28:1)

  The drive comes to a stop with "Quick Stop".

- Changing the setpoint speed to "0".

  (Parameter PTP.v_tarPTP, 35:5)

  This enables the drive to be stopped at the standard delay at any time.

  If the setpoint speed is set to "0“, the compact drive is only stopped temporarily! This means that as soon as the setpoint speed is set to a value unequal to "0", the compact drive will start again immediately.

8.2.4 Operation mode Homing

WARNING!

Danger of personal injury and damage to system parts by uncontrolled system 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

8.2.4.1 Overview

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 $\overline{\text{LIMN}}$, $\overline{\text{LIMP}}$ and $\overline{\text{REF}}$ 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.

There are six standard reference movements:

- Movement to negative limit switch $\overline{\text{LIMN}}$

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- Movement to positive limit switch LIMP
- Movement to reference switch REF with movement in anti-clockwise rotation
- Movement to reference switch REF with movement in clockwise rotation
- Movement to index pulse with movement in anti-clockwise sense of rotation (drives with index pulse only)
- Movement to index pulse with movement in clockwise rotation (drives with index pulse only)

Monitoring reference movement

The parameter Homing.stateHome, 40:2 can be used to query the processing status.

The Parameter Status.xMode_act, 28:3, Bit 5 is set if the reference movement was successful.

Reference movement terminate

Conditions the end the reference movement:

- The drive has reached the target position and is stopped.
- Error response
- "Quick Stop" via fieldbus commands

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Homing.startHome 40:1 (28:01$_h$)	Start of referencing mode action object: Write access triggers reference movement from 1: LIMP 2: LIMN 3: REF neg. direction of rotation 4: REF pos. direction of rotation 5: Index pulse neg. sense of rotation 6: Index pulse pos. sense of rotation Comments: 5 and 6 only at drives with index pulse	UINT16 1..8	- -	R/W/-
Homing.stateHome 40:2 (28:02$_h$)	Acknowledgment: Referencing Bit15: ref_err Bit14: ref_end Bit7: error SW_STOP Bit3: error REF Bit2: error HW_STOP Bit1: error LIMN Bit0: error LIMP	UINT16	- -	R/-/-
Homing.startSetp 40:3 (28:03$_h$)	Dimension setting to dimension setting position action object: Write access triggers dimension setting Only possible with motor at standstill.	INT32	Inc -	R/W/-
Homing.v_Home 40:4 (28:04$_h$)	Set speed for searching for the switch	UINT16 1..3000	rpm60	R/W/per
Homing.v_outHome 40:5 (28:05$_h$)	Setpoint speed for retracting from switch	UINT16 1..3000	rpm 6	R/W/per
Homing.p_outHome 40:6 (28:06$_h$)	Max. run-off The drive starts to search for the defined switching edge after detecting the switch. If it is not found after the distance specified here, the reference movement stops with an error	INT32 1.. 2147483647	Inc 200000	R/W/per

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Homing.p_disHome 40:7 (28:07$_h$)	Distance between the switching point and the reference point After leaving the switch the drive is positioned over a defined path to the working range and this is defined as a reference point.	INT32 1.. 2147483647	Inc 200	R/W/per
Homing.RefSwMod 40:9 (28:09$_h$)	Processing sequence during reference movement to REF Bit0: direction of movement withdrawal path 0: Withdrawal in positive direction 1: Withdrawal in negative direction Bit1: direction of movement safety distance 0: in positive direction 1: in negative direction	UINT16 0..3	- 0	R/W/per
Homing.IndexMod 40:10 (28:0A$_h$)	Process sequence on reference movement to index pulse Bit0: direction of movement run-off 0: retraction in same direction 1: retraction in opposite direction	UINT16 0..1	- 0	R/W/per
Homing.RefAppPos 40:11 (28:0B$_h$)	Application position at reference point On completion of reference movement the position value is set at the reference point. This automatically defines the application zero point.	INT32	Inc 0	R/W/per
Homing.refError 40:13 (28:0D$_h$)	Cause of error during reference movement Error code during reference movement processing	UINT16	- -	R/-/-

Table 8.3 Parameters of the "homing" operating mode

8.2.4.2 Reference movement towards limit switch

A reference movement to the negative limit switch with distance to the switching edge is shown below (`Homing.startHome, 40:1` = 2).

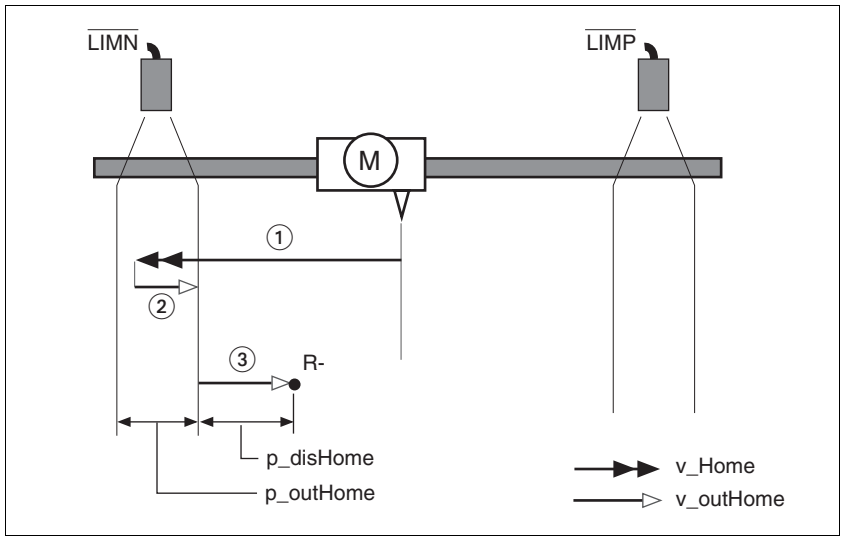

Figure 8.4 Reference movement to the negative limit switch

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

Start reference movement Procedure:

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- ▶ Set the search speed.
  (Parameter `Homing.v_Home, 40:4`)
- ▶ Set the clearance speed.
  (parameter `Homing.v_outHome, 40:5`).
- ▶ Set the distance to the switching edge.
  (parameter `Homing.p_disHome, 40:7`).
- ▶ Start the reference movement to the positive limit switch $\overline{\texttt{LIMP}}$
  (parameter `Homing.startHome, 40:1` = 1)

  or to the negative limit switch $\overline{\texttt{LIMN}}$.
  (parameter `Homing.startHome, 40:1` = 2)

8.2.4.3 Reference movement to reference switch

A reference movement to the reference switch does not require the reference switch to be enabled. The signal level can be inverted with the parameter `Settings.SignLevel, 28:14`.

Reference movements to the reference switches with the distance to the switching edge are shown below (`Homing.startHome, 40:1` = 3).

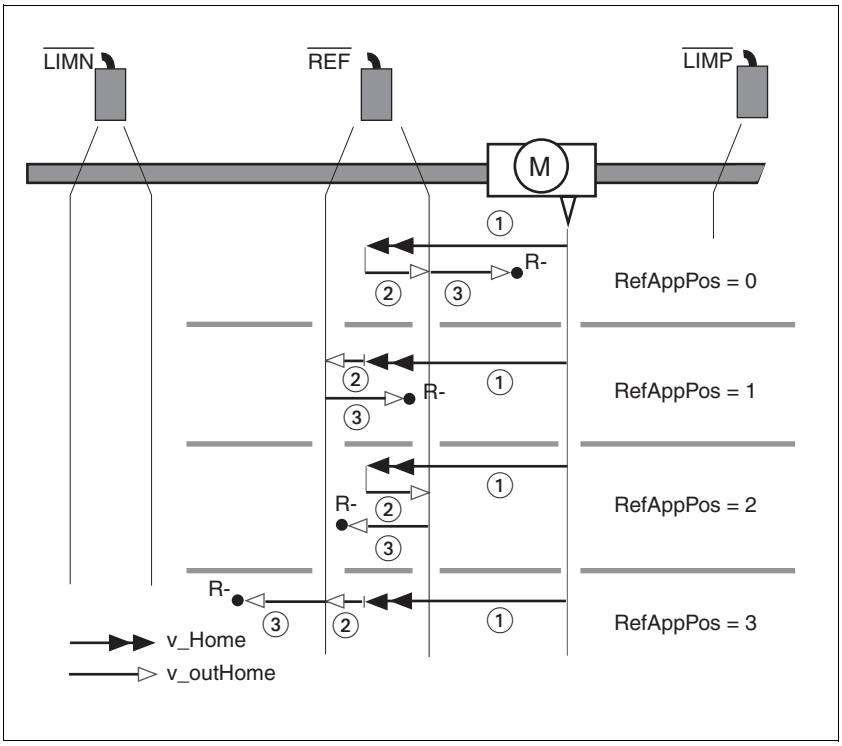

Figure 8.5 Reference movement to reference switch

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

If a reference movement was started in the wrong direction of rotation, the compact drive meets a limit switch. The reference movement is interrupted and must be restarted in the correct direction of rotation.

Start reference movement

Procedure:

- ▶ Set the search speed.
  (parameter `Homing.v_Home, 40:4`).

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- ▶ Set the clearance speed.
  (Parameter `Homing.v_outHome, 40:5`)
- ▶ Set the movement directions for the run-off and the distance to the switching edge.
  (Parameter `Homing.RefSwMod, 40:9`)
- ▶ Set the distance to the switching edge.
  (Parameter `Homing.p_disHome, 40:7`)
- ▶ Start the reference movement to the reference switch with movement in the anti-clockwise sense of rotation (parameter `Homing.startHome, 40:1` = 3)

  or with movement in clockwise rotation
  (parameter `Homing.startHome, 40:1` = 4)

8.2.4.4 Reference movement to index pulse

The reference movement to index pulse is only available for drives with index pulse. The index pulse is a permanent range on the shaft that sends one pulse per revolution at the same angular position.

A reference movement to index pulse can be used to arrive at an exact absolute reference from an inexact absolute reference (e.g. after a reference movement to a switch that does not respond accurately).

When making a reference movement to index pulse the drive searches for the index pulse within the next motor revolution and traverses exactly to the edge of the index pulse.

Reproducibility

With reference to reproducibility ensure that the motor is not in the vicinity of the index pulse because of position tolerances. On completion of the reference movement check this as follows:

The distance between the start position and the edge of the index pulse is stored in the parameter `Homing.p_diffind, 40:12`.

If the calculated value of `Homing.p_diffind, 40:12` is between approx. 2000 and 18000 increments, corresponding to 10% or 90% of a motor revolution, the reference movement can be safely reproduced.

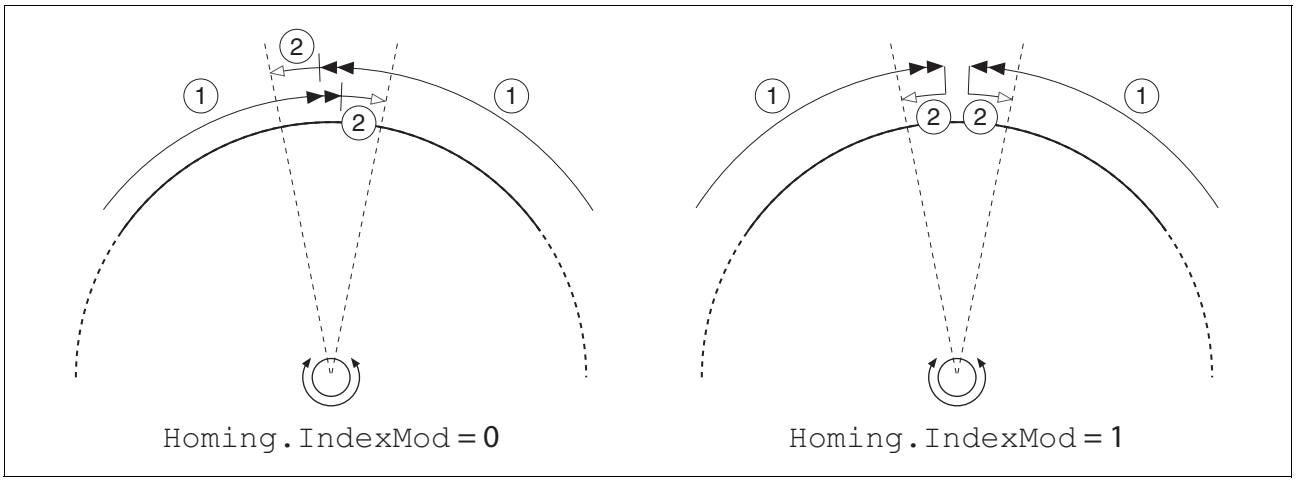

Figure 8.6 Reference movement to index pulse

(1) Movement to index pulse at search speed
(2) Movement to index pulse edge at clearance speed

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Start reference movement

Procedure:

- ▶ Set the search speed.
  (parameter `Homing.v_Home, 40:4`).
- ▶ Set the clearance speed.
  (Parameter `Homing.v_outHome, 40:5`)
- ▶ Set the direction of travel for the run-off.
  (Parameter `Homing.IndexMod, 40:10`)
- ▶ Start the reference movement to the index pulse with movement in the anti-clockwise sense of rotation
  (parameter `Homing.startHome, 40:1` = 5)

  or with movement in clockwise rotation
  (parameter `Homing.startHome, 40:1` = 6)

8.2.4.5 Dimension setting

An absolute position reference is defined depending on the current motor position in dimension setting.

The position value is transferred in increments in the parameter `Homing.startSetP, 40:3`.

Dimension setting can only be carried out when the motor is at a standstill. Dimension setting can be used to carry out a continuous absolute positioning without exceeding the positioning limits.

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Homing.startSetp 40:3 (28:03$_h$)	Dimension setting to dimension setting position action object: Write access triggers dimension setting Only possible with motor at standstill.	INT32	Inc -	R/W/-

Table 8.4 Parameters for "dimension setting" operating mode

Example

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

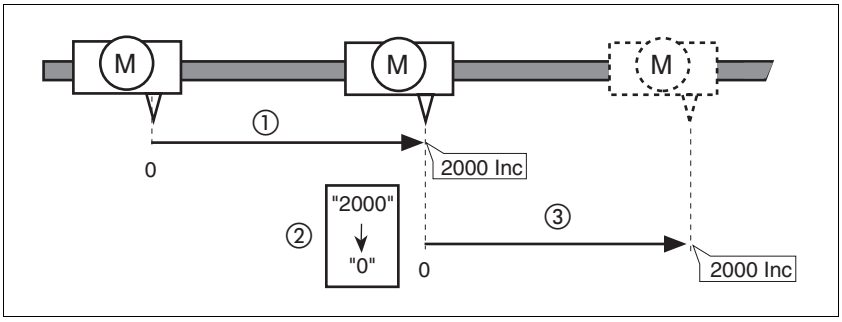

Figure 8.7 Positioning by 4000 increments with set dimensions

(1) The motor is positioned by 2000 Inc.
(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 by 2000 Inc the new target position is 2000 Inc.

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

Dimension setting running

Procedure:

▶ Write the new dimension setting position.
(Parameter `Homing.startSetP, 40:3`)

The command is executed immediately and the operating mode is ended.

Dimension setting monitoring

The processing status can be queried with the parameter `Homing.stateHome, 40:2`.

The parameter `Status.xMode_act, 28:3`, bit 5 is set if the set dimensions was successful.

Ending dimension setting

The "dimension setting" mode is ended immediately after the dimension setting command has been executed.

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8.3 Functions

8.3.1 Definition of the direction of rotation

The direction of rotation of the compact drive can be reversed.

The direction of rotation for the compact drive should only be defined once during commissioning. The definition of direction of rotation is not intended for changing the direction of movement during operation.

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Motion.invertDir 28:6 (1C:06$_h$)	Definition of the direction of rotation Value 0: no inversion of direction Value 1: direction reversal active No reversal of direction means: A clockwise direction of rotation is defined as the motor shaft rotating clockwise as the observer faces the end of the protruding shaft. Note: New value only imported when the drive is switched on.	UINT16 0..1	- 0	R/W/per

Table 8.5 Parameters of the "definition of direction of rotation" operating function

8.3.2 Movement profile

The acceleration and deceleration behaviour of the motor is controlled by creating a travel profile. The travel profile describes the steepness and shape of the ramp and the acceleration behaviour.

Creating the movement profile of all positioning modes has the following characteristics.

- Symmetrical and linear acceleration ramp.
- Changing speed and position during movement.
- Acceleration parameters in rpm*s.

  Value range 1..765000 rpm*s.

  Internal resolution approx. 12 rpm*s.

- Speed parameters in rpm

  Value range 1..3000 rpm.

  Resolution1 rpm

- Position presets in increments (Inc).

  Value range -2^{31} to $+2^{31}-1$ Inc.

  Based on the motor output shaft the drive has a resolution of 20000 Inc/rev.

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Motion.dec_Stop 28:21 (1C:15$_h$)	Deceleration for "Quick Stop" Deceleration used for every "Quick Stop": - "Quick Stop" via control word - "Quick Stop" by ext. monitoring signal - "Quick Stop" by class 1 and 2 errors	UINT32 1...765000	rpm/s 6000	R/W/per
Motion.v_target0 29:23 (1D:17$_h$)	Default setpoint speed Remanent default value for the parameter PTP.v_tarPTP. Speed for PTP mode if no value was written to PTP.v_tarPTP. Note: This remanent value is used exclusively when switching on the drive as a default assignment for PTP.v_tarPTP.	UINT16 1..3000	rpm 60	R/W/per
Motion.acc 29:26 (1D:1A$_h$)	Acceleration Value determines acceleration and deceleration. New values are only imported after standstill.	UINT32 1...765000	rpm/s 600	R/W/per

8.3.3 Quick Stop

The "Quick Stop" function is an emergency braking function.

Events that trigger a "Quick Stop":

- STOP input signal

  (Parameter Status.Sign_SR, Bit 2)

- Limit switch overrun

  (Parameter Status.Sign_SR, Bit 0 and Bit 1)

- Error of error class 1 or 2
- Quick-Stop triggered by a field bus command

  (Parameter Commands.driveCtrl, 28:1, Bit 2)

The "Quick Stop" remains active until acknowledged by the user. The power amplifier remains switched on, except with errors of error class 2.

Setting options

In the following operating modes the motor is braked by profile control. The deceleration can be specified with the parameter Motion.dec_Stop, 28:21.

- Profile velocity
- Profile position
- Homing
- Manual movement

The compact drive absorbs excess braking energy during a "Quick Stop". If the DC bus voltage exceeds the permissible threshold, the compact drive switches off the power amplifier and displays the "overvoltage" error. The motor then runs down under no braking.

Procedure if the compact drive repeatedly switches off with an "overvoltage" error during "Quick Stop".

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- ▶ Reduce the "Quick Stop" deceleration or the maximum current for Stop via torque ramp.
- ▶ Reduce the drive load.

Quick Stop reset

Procedure after an error or a "Quick Stop" executed by a fieldbus command:

- ▶ Reset the error.

  (parameter `Commands.driveCtrl, 28:1`, bit 3)

Procedure after a "STOP" signal:

- ▶ Reset the "STOP" signal at the signal input.
- ▶ Reset the error.

  (parameter `Commands.driveCtrl, 28:1`, bit 3)

Procedure after a "Quick Stop" via the limit switch signals $\overline{\texttt{LIMN}}$ and $\overline{\texttt{LIMP}}$:

- ▶ Traverse the compact drive out of the limit switch range.

  (For more information see chapter 8.1.2 “External monitoring signals“.)

More information

For more information see Chapter 8.1.5 “Operating status and status transitions“ and Chapter 6 “Installation“.

8.3.4 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" operating function.

- IO2 (CAP1)
- IO3 (CAP2)

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

- Position capture with positive or negative slope at capture input.
- One-time or continuous capture with multiple slope change at capture input.

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

The CAP1 and CAP2 capture inputs have a time constant of $t = 10\ \mu s$. The jitter is less than $\pm 3\ \mu s$.

The captured motor position is inexact while the drive is accelerating or decelerating.

Enable fast position capture

Enable single position capture

- For CAP1: write value 1 in parameter `Capture.CapStart1, 20:15`

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- For CAP2: write value 1 parameter `Capture.CapStart2, 20:16`

Enable continuous position capture

- For CAP1: write value 2 parameter `Capture.CapStart1, 20:15`
- For CAP2: write value 2 parameter `Capture.CapStart2, 20:16`

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 missing signal edge the capture can be ended by writing the parameter `Capture.CapStart1, 20:15`, value 0 or `Capture.CapStart2, 20:16`, value 0 .

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Capture.CapLevel 20:14 (14:0E$_h$)	Signal level for capture inputs Bit0: Setting of level for CAP1 Bit1: Setting of level for CAP2 Assignment of bits: 0: Position capture with 1->0 change 1: Position capture with 0->1 change	UINT16 0..3	- 3	R/W/-
Capture.CapStart1 20:15 (14:0F$_h$)	Start capture at CAP1 Value 0: Stop capture function Value 1: Start single capture Value 2: Start continuous capture The function ends after the first captured value with one-time capture. The capture continues endlessly with continuous capture.	UINT16 0..2	- 0	R/W/-
Capture.CapStart2 20:16 (14:10$_h$)	Start capture on CAP2 as with CAP1	UINT16 0..2	- 0	R/W/-
Capture.CapStatus 20:17 (14:11$_h$)	Status of capture channels Read access: Bit0: Position captured via CAP1 Bit1: Position capture via CAP2	UINT16 0..3	- 0	R/-/-
Capture.CapPact1 20:18 (14:12$_h$)	Motor position on signal to CAP1 Output of captured position of the actual position encoder (actual motor position) This is always the commutation position with stepper motor units.	INT32	Inc -	R/-/-
Capture.CapPact2 20:19 (14:13$_h$)	Motor position on signal to CAP2 As with CAP1	INT32	Inc -	R/-/-

Table 8.6 Parameters of the "fast position capture" operating function

8.3.5 Programmable inputs and outputs

If a 24V signal is configured as a "programmable input or output", the compact drive independently accesses this signal input or output.

This can be specified for each of the four signals with the parameters `IO.IO0_def` to `IO.IO3_def`.

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Programmable input

If a signal is configured as a programmable input, the compact drive monitors this signal continuously and independently accesses parameters at every detected edge change. The parameter accesses can be configured as follows:

- Evaluation of positive or negative edges
- Parameters to be influenced by input of index and subindex
- Write value for parameter on positive edge
- Write value for parameter on negative edge
- Bit mask for writing the object

The parameter access always follows the same plan:

- Positive or negative edge detected
- Read parameter
- AND operating result with bit mask
- OR operation result with write value for parameter at positive or negative edge
- Write result to parameter

Shown as pseudo code:

- positive edge -> object_write_value = (object_read_value AND bit mask) OR write_value_pos
- negative edge -> object_write_value = (object_read_value AND bit mask) OR write_value_neg

Special case if bit mask = 0:

- positive edge -> object_write_value = write_value_pos
- negative edge -> object_write_value = write_value_neg

Programmable output

If a signal is defined as a programmable output, the compact drive runs cyclic read accesses and sets the signal level in accordance with the read value. The accesses can be configured with the following parameters:

- Selection of parameters to be read by input of index and subindex
- Comparison value for high level at output
- Comparison operator: equal, unequal, smaller, greater
- Bit mask for the comparison

The parameter access always follows the same plan:

- Read parameter
- AND operation result with bit mask
- Compare result by comparison value
- Set output HIGH or LOW depending on result

Shown as pseudo code:

IF (object_read_value AND bit mask) <comparison operator> comparison value THEN set output=1

ELSE set output=0

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
ProgIO0.Index 800:1 (320:01$_h$)	Index of control parameter If prog. input: Index of the parameter to be written If prog. output: Index of the parameter to be read If prog. input: write(Index,Subindex) = (read(Index,Subindex) BAND BitMask) BOR VALUEx If prog. output: high level at output if (read(Index,Subindex) BAND BitMask) =<> VALUE1	UINT16	- -	R/W/per
ProgIO0.Subindex 800:2 (320:02$_h$)	Subindex of control parameter If prog. input: Subindex of the parameter to be written If prog. output: Subindex of parameter to be read	UINT16	- -	R/W/per
ProgIO0.BitMask 800:3 (320:03$_h$)	Bit mask for parameter value If prog. input or prog. Output: Bit mask with the read value of the parameter (Index,Subindex) is logically ANDed before it is further processed.	UINT32	- -	R/W/per
ProgIO0.Switch 800:4 (320:04$_h$)	Edge detection or comparison operator If prog. input: Selection of the slopes to be captured: Value 0: no response to level change Value 1: response to pos. edge Value 2: response to neg. edge Value 3: Response to both edges If prog. output: Selection of condition for comparison: Value 0: (parameter read value = comparison value) Value 1: (parameter read value <> comparison value) Value 2: (parameter read value < comparison value) Value 3: (parameter read value > comparison value)	UINT16	- -	R/W/per
ProgIO0.Value1 800:5 (320:05$_h$)	Write value at pos. edge or comparison value If prog. input: Parameter write value with pos. slope If prog. output: Comparison value for condition	INT32 0.. 4294967295	- -	R/W/per
ProgIO0.Value2 800:6 (320:06$_h$)	Write value with neg. slope If prog. input: Parameter write value with neg. slope If prog. output: no meaning	INT32 0.. 4294967295	- -	R/W/per

Table 8.7 Parameters of the "programmable inputs and outputs" operating function

Example **Setting parameters for simple manual controller**

IO0 as input,	positive edge = switch on power amplifier	negative edge = power amplifier off + reset error
IO1 as input,	positive edge = traverse forwards	negative edge = stop
IO2 as input,	positive edge = traverse backwards	negative edge = stop
IO3 as output,	Output = 1 if compact drive ready	

Table 8.8 Setting parameters for simple manual controller

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Input IO0

Input	L -> H	Commands.driveCtrl 2	(Enable)
	H -> L	Commands.driveCtrl 9	(Disable + FaultReset)

Table 8.9 Input IO0

Parameter name	Idx:Six	Value	Remarks
I/O.IO0_def	34:1	5	Input programmable
ProgIO0.Index	800:1	28	Index 28
ProgIO0.Subindex	800:2	1	Subindex 1
ProgIO0.Bitmask	800:3	0	Mask
ProgIO0.Switch	800:4	3	Detect both edges
ProgIO0.Value1	800:5	2	Value at pos. edge: Enable
ProgIO0.Value2	800:6	9	Value at neg. edge: Disable+Fault-Reset

Table 8.10 Parameters of input IO0

Input IO1

Input	L -> H	VEL.velocity 600	(positive movement)
	H -> L	VEL.velocity 0	(stop)

Table 8.11 Input IO1

Parameter name	Idx:Six	Value	Remarks
I/O.IO1_def	34:2	5	Input programmable
ProgIO1.Index	801:1	36	Index 36
ProgIO1.Subindex	801:2	1	Subindex 1
ProgIO1.Bitmask	801:3	0	Mask
ProgIO1.Switch	801:4	3	Detect both edges
ProgIO1.Value1	801:5	600	Speed value at positive edge
ProgIO1.Value2	801:6	0	Speed value at negative edge

Table 8.12 Parameters of input IO1

Input IO2

Input	L -> H	VEL.start -600	(neg. movement)
	H -> L	VEL.start 0	(stop)

Table 8.13 Input IO2

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Parameter name	Idx:Six	Value	Remarks
I/O.IO2_def	34:3	5	Input programmable
ProgIO2.Index	802:1	36	Index 36
ProgIO2.Subindex	802:2	1	Subindex 1
ProgIO2.Bitmask	802:3	0	Mask
ProgIO2.Switch	802:4	3	detect both edges
ProgIO2.Value1	802:5	-600	speed value at positive edge
ProgIO2.Value2	802:6	0	speed value at negative edge

Table 8.14 Parameters of input IO2

Output IO3

Output	High	if status 6	(Status.driveStat AND 15) = 6

Table 8.15 Output IO3

Parameter name	Idx:Six	Value	Remarks
I/O.IO3_def	34:4	130	Output programmable
ProgIO3.Index	803:1	28	Index 28
ProgIO3.Subindex	803:2	2	Subindex 2
ProgIO3.Bitmask	803:3	15	Mask: Bit 0..3
ProgIO3.Switch	803:4	0	condition: "="
ProgIO3.Value1	803:5	6	Comparison value: 6 = Operation Enable

Table 8.16 Parameters of output IO3

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9 Diagnostics and troubleshooting

9.1 Error display and troubleshooting

9.1.1 Diagnostics with commissioning software

The "IclA Easy" commissioning software can be used to find the following diagnostics information

- Status of status machine
  Allows conclusions to to made about the causes if the drive is not ready.
- Status word Indicates which of the 3 following signals is pending:
  - External monitoring signal
  - Internal monitoring signal
  - Warning
- Parameter `Status.StopFault, 32:7`
  Last cause of interruption, error number
- Error memory
  The error memory contains the last 7 errors. The contents of the error memory are retained even when the drive is switched off.

  The following information is output for every error:
  - Age
  - Description of the error in text
  - Error class
  - Error number
  - Frequency
  - Additional information

9.1.2 Diagnosis over fieldbus

Asynchronous error

In fieldbus operation device faults are reported as asynchronous errors by the controller's monitoring system. An asynchronous error is recognised by the status word 'fb_statusword'. Signal status "1" indicates an error or warning message. You can find details of the error from the parameters.

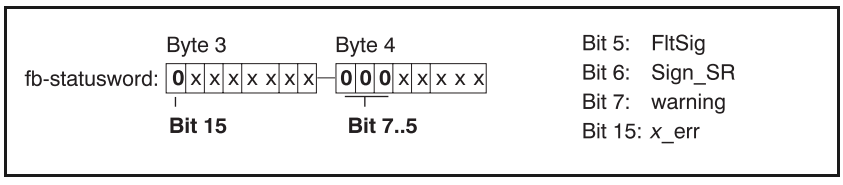

Figure 9.1 Evaluation of asynchronous errors

Description of the bits:

- Bit 5, "FltSig"

  Message from internal monitoring signal (e.g. power amplifier overtemperature)

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ParameterStatus.FltSig_SR, 28:18

- Bit 6, "Sign_SR"

  Message from external monitoring signals (e.g. movement interruption by limit switch)

  ParameterStatus.Sign_SR, 28:15

- Bit 7, "warning"

  warning message (e.g. temperature warning)

  ParameterStatus.WarnSig, 28:10

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Status.driveStat 28:2 (1C:02$_h$)	Status word for the operating status LOW-UINT16: Bit0..3: No. of current state of status machine Bit4: reserved Bit5: fault by internal monitoring Bit6: fault by external monitoring Bit7: warning active Bit8..11: reserved Bit12..15: Axis-specific coding of the processing status Corresponds to the assignment of bits12..15 in the mode-specific acknowledgement data (e.g. PTP.statePTP with PTP positioning) HIGH-UINT16: allocate see parameter Status.xMode_act	UINT32	- -	R/-/-
Status.xMode_act 28:3 (1C:03$_h$)	current axis mode with additional information Bit0..3: current mode (see below) Bit4: reserved Bit5: drive referenced (ref_ok) Bit6..15: reserved Numbering of current operating mode: 1: manual movement 2: homing 3: profile position 4: profile velocity Other numbers are reserved for future expansion.	UINT16	- -	R/-/-
Status.WarnSig 28:10 (1C:0A$_h$)	Warnings Monitoring signals with error class 0. Bit0: position overrun profile generator Bit1: overtemperature power amplifier The remaining bits are reserved for later extensions.	UINT16	- -	R/-/-
Status.Sign_SR 28:15 (1C:0F$_h$)	Saved signal status external monitoring signals Bit0: LIMP Bit1: LIMN Bit2: STOP Bit3: REF Bit7: SW stop 0: not enabled 1: enabled Saved signal states of enabled external monitoring signals	UINT16 0..15	- -	R/-/-

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Status.FltSig 28:17 (1C:11_h)	Active monitoring signals Error bits remain set only as long as errors are pending (i.e. as long as limit value is exceeded). Assignment as parameter `Status.FltSig_SR`	UINT32	- -	R/-/-
Status.FltSig_SR 28:18 (1C:12_h)	Saved monitoring signals Error bits remain set until FaultReset is run. Bit0: undervoltage 1 power supply Bit1: undervoltage 2 power supply Bit2: overvoltage power supply Bit5: motor overload Bit12: overtemperature power amplifier Bit16: blocking error Bit17: contouring error Bit18: motor position sensor failure Bit21: fieldbus protocol error Bit22: node guard error Bit23: pulse/direction input timing Bit25: Safe Standstill triggered Bit26: SAFE_DISABLE_A/B different level Bit28: hardware error EEPROM Bit29: start-up error Bit30: internal system error Bit31: Watchdog	UINT32	- -	R/-/-
Status.action_st 28:19 (1C:13_h)	Action word Bit0: bit latched error class 0 Bit1: bit latched error class 1 Bit2: bit latched error class 2 Bit3: bit latched error class 3 Bit4: bit latched error class 4 Bit5: reserved Bit6: Drive stopped: actual speed is zero Bit7: drive rotates in positive direction Bit8: drive rotates in negative direction Bit9: reserved Bit10: reserved Bit11: Drive stopped: setpoint speed is 0 Bit12: drive decelerates Bit13: drive accelerates Bit14: Drive operates constant speed Bit15: reserved	UINT16	- -	R/-/-
Status.v_act 31:2 (1F:02_h)	Actual speed	INT32	Inc/s -	R/-/-
Status.p_ref 31:5 (1F:05_h)	Setpoint position	INT32	Inc -	R/-/-
Status.p_act 31:6 (1F:06_h)	Motor position Identical with the parameter `Status.p_ref`.	INT32	Inc -	R/-/-
Status.n_act 31:9 (1F:09_h)	Actual speed Corresponds to the parameter `Status.v_act` converted to rpm.	INT16	rpm -	R/-/-
Status.UDC_act 31:20 (1F:14_h)	Voltage of power supply in [0.1V]	UINT16	V -	R/-/-
Status.TPA_act 31:25 (1F:19_h)	Temperature of power amplifier in degrees Celsius	UINT16 20..110	°C -	R/-/-
Status.v_pref 31:28 (1F:$1C_h$)	Speed of rotor position setpoint value `Status.p_ref`	INT32	Inc/s -	R/-/-

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Status.p_target 31:30 (1F:1E$_h$)	Target position of travel profile generator Absolute position value of the profile generator calculated from transferred relative and absolute position values.	INT32	Inc -	R/-/-
Status.p_profile 31:31 (1F:1F$_h$)	Actual position of travel profile generator Corresponds to setpoint position `Status.p_ref`.	INT32	Inc -	R/-/-
Status.p_actusr 31:34 (1F:22$_h$)	Motor position Parameters for improving compatibility to Twin Line. Corresponds to motor position `Status.p_act`.	INT32	Inc -	R/-/-
Status.n_profile 31:35 (1F:23$_h$)	Actual speed of travel profile generator Corresponds to the speed of the rotor position setpoint value `Status.n_pref`.	INT16	rpm -	R/-/-
Status.n_target 31:38 (1F:26$_h$)	Target speed of travel profile generator	INT16	rpm -	R/-/-
Status.n_pref 31:45 (1F:2D$_h$)	Speed of rotor position setpoint value Status.p_ref Corresponds to `Status.v_pref` converted to rpm.	INT16	rpm -	R/-/-
Status.StopFault 32:7 (20:07$_h$)	Last cause of interruption, error number	UINT16	- 0	R/-/-

Table 9.1 Parameters for asynchronous error messages

Synchronous error

Besides asynchronous errors, synchronous errors are also reported in field bus operation, triggered by a communication error (e.g. by unauthorized access or an incorrect command).

Both error types are described in the compact drive field bus manual.

Error memory

The last 7 error messages are saved in a separate error memory. The error messages are arranged in chronological order and can be read via index and subindex values. The last error that caused an interruption is also stored in the parameter `Status.StopFault, 32:7`.

Index:Subindex	Meaning
900:1, 900:2, 900:3 …	1. Entry, oldest error message
901:1, 901:2, 901:3 …	2. Entry
…	…
906:1, 906:2, 906:3	7. Entry, newest error message

Table 9.2 Structure of the error memory

More information on every error message can be obtained from subindices 1 … 5:

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
ErrMem0.ErrNum 900:1 (384:01$_h$)	Coded error number Index 900: first error entry (oldest) Index 901: second error entry ... Note: Reading this parameter brings the entire error entry (9xx.1 – 9xx.5) into a clipboard, from which all other elements can then be loaded.	UINT16	- -	R/-/-
ErrMem0.Class 900:2 (384:02$_h$)	Error class The error class specifies the error response of the controller	UINT16 0..4	- -	R/-/-
ErrMem0.Age 900:3 (384:03$_h$)	Age of error in device activation cycles 0 = errors since the last time the drive was switched on 1 = errors occurring in last operation 2 = errors in penultimate operation etc.	UINT32	- -	R/-/-
ErrMem0.Repeat 900:4 (384:04$_h$)	Error repetitions Number of sequential errors occurring with this error number: 0 = errors occurring only once 1 = 1 repetition 2 = 2 repetitions etc. The repetition counter does not change after the maximum number of 255.	UINT16 0..255	- -	R/-/-
ErrMem0.ErrQual 900:5 (384:05$_h$)	Error identification This entry contains supplementary information for qualification of the error. The meaning depends on the error number.	UINT16	- -	R/-/-

Table 9.3 Error memory entries

9.1.3 Operation and error display

The motor and the power amplifier are protected against overload and overheating by various monitoring systems.

Status display The LED shows error messages and warnings. It shows the operating status in coded form.

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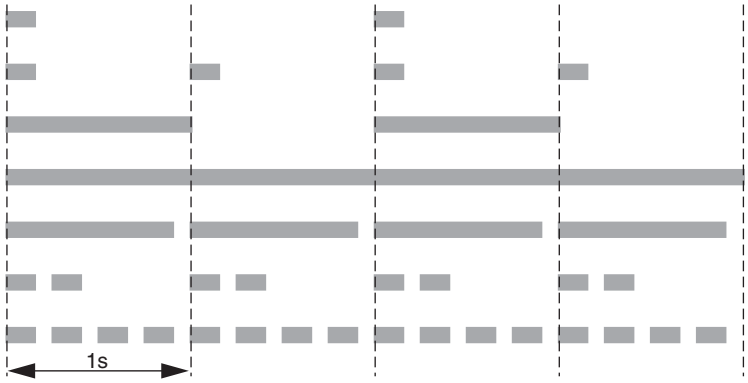
Status display	Meaning
	• Start-up • Undervoltage • Power amplifier inactive • Power amplifier active • "Quick Stop" • Error • internal error

9.1.4 Reset error message

To reset the error message are correction of the malfunction, send a "Fault Reset" command over the fieldbus by writing the value 8 to the control word, parameter `Commands.driveCtrl, 28:1`. The PC commissioning tool can also be used to reset an error message.

9.1.5 Error classes and error response

Error response

The product triggers an error response in the event of a fault. Depending upon the gravity of the fault, the unit 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 unit off.

9.1.6 Causes of errors and troubleshooting

If communication with the compact drive over the fieldbus is impossible, proceed as follows:

- ▶ Open the plug cover
- ▶ Compare the LED display with the output in Table 9.4.

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Error	Error-class	Cause of error	Troubleshooting
Fieldbus communication not possible	-	Incorrect communication parameters	Set DIP switches correctly Set parameters correctly
Fieldbus communication unreliable	-	Missing terminating resistor Defective line shielding	Connect terminating resistor correctly Set shielding correctly (see chapter 6 “Installation“)
LED off	–	No power	Check power supply and fuses
LED flashes at 6 Hz	4	Flash checksum incorrect	Install firmware again or replace compact drive
LED flashes at 10 Hz	4	Hardware error Internal system error Watchdog	Switch drive off and on or send drive to service

Table 9.4 Troubleshooting when fieldbus communication is not possible

The motor and the power amplifier are protected against overload and overheating by various monitoring systems.

Error messages and warnings are read out over the fieldbus.

Errors detected by internal monitoring are shown by correspondingly set bits in the parameter `Status.FltSig_SR, 28:18`.

The bits remain set even if the monitored limit values are no longer exceeded.

The bits can be cleared by a "fault reset".

Monitoring bit	Error	Error-class	Cause of error	Troubleshooting
0	Undervoltage 1	2	Supply voltage below threshold value for switching off the drive	Check voltage, check connections on drive
1	Undervoltage 2	3	Supply voltage below threshold value for switching off the drive	Check voltage, check connections on drive
2	Overvoltage	3	Overvoltage, feedback, loss of synchronism at high speed	See chapter 5.1 “External power supply units“
5	Motor overload		Load torque too high Motor phase current set too high	Reduce load torque Reduce motor phase current
12	Power amplifier excess temperature	3	Motor phase current set too high	Reduce motor phase current
16	Blocking error	3	Drive is blocked or stalled Movement frequency too high Acceleration too high	Reduce load torque or motor torque; check settings for motor phase current; reduce travel frequency reduce acceleration
21	CAN/RS485 protocol error			Check shield on serial cable Prevent earth loops
22	Nodeguard error	2	Serial or fieldbus connection broken	Check serial connection
25	Inputs for SAFE_DISABLE have 0-level	3	"Safe Standstill" has been triggered	Check guard door, wiring
26	Inputs for SAFE_DISABLE different	4	Interruption of the signal wiring	Signal cable/connection to be checked, check signal encoder or change

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Monitoring bit	Error	Error-class	Cause of error	Troubleshooting
28	Hardware error EEPROM		Hardware error	Drive requires service
29	Startup error		Hardware error	Drive requires service
	Drive remains in operating status 2		Startup error because of illegal parameters; Incorrect EEPROM checksum	Initialise the parameter with default values (Parameter Commands.default 11:8). If this does not correct the problem, the drive must be serviced

Table 9.5 Troubleshooting

The cause of the error can be read out as an error number in the "Last cause of interruption" parameter (parameter `Status.StopFault, 32:7`):

Error number	Error type	Cause of error/troubleshooting
$013F_h$	EEPROM not initialised	Hardware error/return compact drive
0140_h	EEPROM not compatible to current software	Hardware error/return compact drive
0141_h	EEPROM read error	Hardware error/return compact drive
0142_h	EEPROM write error	Hardware error/return compact drive
0143_h	Checksum error in EEPROM	Hardware error/return compact drive
0148_h	Serial interface: Overrun-error	Check shield on serial cable, prevent ground loop
0149_h	Serial interface: Framing-error	Check shield on serial cable, prevent ground loop
$014A_h$	Serial interface: Parity-error	Check shield on serial cable, prevent ground loop
$014B_h$	Serial interface: Receive error	Check shield on serial cable, prevent ground loop
$014C_h$	Serial interface: buffer overrun	Check shield on serial cable, prevent ground loop
$014D_h$	Serial interface: Protocol error	Check shield on serial cable, prevent ground loop
$014E_h$	Nodeguarding	Serial connection broken.
0150_h	Illegal limit switch active	- reference movement in wrong direction started?- limit switch incorrectly wired
0151_h	Switch was overrun, retraction impossible	Search speed configured too high for reference movement?
0152_h	Switching edge within run-off not found	Run-off for reference movement set too small?
0153_h	Index pulse not found	- device without index pulse- Encoder/Hall sensor defective?
0154_h	Reproducibility of the index pulse movement uncertain, index pulse too close to the switch	- Position of index pulse too close to switch.- Switch or motor shaft out of adjustment, re-install
0155_h	Switch still active after retraction, cause possible bouncing of switch	Set longer run-off
0157_h	LIMP causes interruption or Quick-Stop	Limit switch was activated
0158_h	Interruption/QuickStopActive by LIMN	Limit switch was activated
0159_h	REF causes interruption or Quick-Stop	Reference switch was activated and is configured as interruption input

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Error number	Error type	Cause of error/troubleshooting
$015A_h$	STOP causes interruption or Quick-Stop	Stop input was activated and is configured as interrupt input

Table 9.6 Frequently occurring errors and troubleshooting

9.2 Overview of error numbers

hex	dec	Error class	Description
0100_h	256	2	Undervoltage 1 power supply
0101_h	257	3	Undervoltage 2 power supply
0102_h	258	3	Overvoltage power supply
0105_h	261	3	Motor overload
$010C_h$	268	2	Power amplifier excess temperature
0110_h	272	3	Motor blocked or stalled
0111_h	273	3	Contouring error
0112_h	274	4	Motor position sensor defective
0115_h	277	1	Fieldbus protocol error
0116_h	278	2	Fieldbus: Nodeguarding/Watchdog or Clear
0117_h	279	3	Frequency at pulse/direction input too high
0118_h	280	3	Short circuit dig. outputs
0119_h	281	3	"Safe Standstill" safety function tripped (SAFE_DISABLE_A/B)
$011A_h$	282	4	SAFE_DISABLE_A and SAFE_DISABLE_B have >1s different level
$011C_h$	284	4	Hardware error EEPROM
$011D_h$	285	4	Startup error
$011E_h$	286	4	Internal system error
$011F_h$	287	4	Watchdog
0120_h	288	0	Warning position overrun profile generator
0121_h	289	0	Warning overtemperature IGBTs
0128_h	296	0	Warning I/O timing
0130_h	304	0	Parameter does not exist, invalid index
0131_h	305	0	Parameter does not exist, invalid subindex
0132_h	306	0	Communication protocol: unknown service
0133_h	307	0	Parameter not writable
0134_h	308	0	Parameter out of range
0135_h	309	0	Segment service not initialised
0136_h	310	0	Error with recording function
0137_h	311	0	Status not Operation Enable
0138_h	312	0	Processing in current operating status of status machine not possible
0139_h	313	0	Setpoint position generation interrupted
$013A_h$	314	0	Switchover during axis operating mode not possible

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hex	dec	Error class	Description
$013B_h$	315	0	Command not allowed during processing (xxxx_end=0)
$013C_h$	316	0	Error in selection parameter
$013D_h$	317	0	Position overrun exists/occurred
$013E_h$	318	0	Actual position is not yet defined
$013F_h$	319	4	EEPROM not initialised
0140_h	320	4	EEPROM not compatible to current software
0141_h	321	4	EEPROM read error
0142_h	322	4	EEPROM write error
0143_h	323	4	Checksum error in EEPROM
0144_h	324	0	Non-calculable value
0145_h	325	0	Function only allowed at standstill
0146_h	326	0	Reference movement is active
0147_h	327	0	Command not allowed during processing (xxx_end=0)
0148_h	328	1	RS485 interface: Overrun-error
0149_h	329	1	RS485 interface: Framing-error
$014A_h$	330	1	RS485 interface: Parity-error
$014B_h$	331	1	RS485 interface: Receive error
$014C_h$	332	1	RS485 interface: buffer overrun
$014D_h$	333	1	RS485 interface: Protocol error
$014E_h$	334	1	Node guarding, interface no longer serviced
$014F_h$	335	0	Quick-Stop status activated
0150_h	336	1	Illegal limit switch active
0151_h	337	1	Switch was overrun, retraction impossible
0152_h	338	1	Switching edge within run-off not found
0153_h	339	1	Index pulse not found
0154_h	340	1	Reproducibility of the index pulse movement uncertain, index pulse too close to the switch
0155_h	341	1	Switch still active after retraction, cause possible bouncing of switch
0156_h	342	1	Input not configured as LIMP/LIMN/REF
0157_h	343	1	LIMP causes interruption or Quick-Stop
0158_h	344	1	Interruption/Quick-Stop by LIMN
0159_h	345	1	Interruption/Quick-Stop by REF
$015A_h$	346	1	STOP causes interruption or Quick-Stop
$015B_h$	347	1	Limit switch not enabled
$015C_h$	348	0	Processing not allowed in current axis operating mode
$015D_h$	349	0	Parameters not available with this device
$015E_h$	350	0	Function not available with this device
$015F_h$	351	0	Access denied
0160_h	352	4	Production data in EEPROM not compatible with current software
0161_h	353	4	Index pulse sensor not compensated
0162_h	354	0	Drive is not referenced

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hex	dec	Error class	Description
0163_h	355	0	CAN interface COB-ID not correct
0164_h	356	0	CAN interface Error in query
0165_h	357	0	CAN interface Overrun-error
0166_h	358	0	CAN interface telegram could not be stored
0167_h	359	0	CAN interface general error CAN stack
0168_h	360	0	Fieldbus: Data type and parameter length do not match
0169_h	361	0	Blocking detection is switched off
$016A_h$	362	0	Connection failure to DSP boot loader
$016B_h$	363	0	Communication error to DSP boot loader
$016C_h$	364	0	Error initialising SPC3 memory
$016D_h$	365	0	Error in calculation of the length of input/output data
$016E_h$	366	0	Specified Profibus address is outside legal range
$016F_h$	367	0	Illegal use of DIP switch S1.1
0170_h	368	0	DSP software not compatible with Profibus software
0171_h	369	0	Checksum of Profibus DP interface software incorrect
0172_h	370	0	Oscilloscope function: no other data available
0173_h	371	0	Oscilloscope function: trigger variable was not defined
0174_h	372	0	Oscilloscope function incompletely configured
0175_h	373	1	Internal communication

Table 9.7 Error numbers

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10 Parameters

10.1 Layout of 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.

A parameter display has the following features:

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Example.Name 12:34 (C:22_h)	Example	UINT16 1..127	- 127	R/W/per

Group.Name Parameter name consisting of the name of the parameter group (="Group") and the name of the specific parameter (="Name").

Default value Factory settings.

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 on reading and writing the values
"R/-" values are read-only
"R/W" values are read and write.

per Designation of whether the value of the parameter is persistent, i.e. after switching off the unit 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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10.2 Overview Parameters

CAN	CAN bus settings
Capture	Operating function "Fast Position Capture"
Commands	Change of state Save parameter in EEPROM Initialise default parameter
Config	Drive configuration
ErrMem0	Error memory
Homing	Operating mode "Homing"
I/O	Status and definition of inputs and outputs
Manual	Operating mode "Jog"
Motion	Operating function "Definition of direction of rotation" Operating function "Quick-Stop" Default set speed acceleration and delay
Profibus	Profibus settings
ProgIO0..3	Operating function "programmable inputs/outputs"
PTP	Operating mode "profile position"
RS485	RS485 bus settings
Settings	User device names Phase currents Monitoring inputs
Status	Status information and reading values
VEL	Operating mode "profile velocity"

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10.3 Parameter groups

10.3.1 Parameter group "CAN"

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
CAN.canAddr 23:2 (17:02$_h$)	Address CAN Bus 1..127 are allowed	UINT16 1..127	- 127	R/W/per
CAN.canBaud 23:3 (17:03$_h$)	Baud rate CAN Bus Following values are allowed: 50 = 50Kbaud 100 = 100Kbaud 125 = 125Kbaud 250 = 250Kbaud 500 = 500Kbaud 800 = 800Kbaud 1000 = 1Mbaud	UINT16 50..1000	- 125	R/W/per
CAN.pdo4msk1 30:9 (1E:09$_h$)	32bit mask for process data change part 1 32bit mask for event-controlled PDO4: This value allows bytes 1..4 to be unmasked. With event-driven transmission a message is sent at every modification to the T-PDO data. Message transmission can specified more precisely or restricted with this mask. Modifications for event-driven transmission are ignored at all bit positions at which the mask contains a 0. Exact assignment: Bit31..24: x_end x_err x_info Bit23..16: warn Sig_SR FltSig cos Bit15..8: modeStat Bit7..0: ioSignals The default value 4294967295 corresponds to 0xFFFFFFFF	UINT32	- 4294967295	R/W/-
CAN.pdo4msk2 30:10 (1E:0A$_h$)	32bit mask for process data change part 2 32bit mask for event-controlled PDO4: Mask for bytes 5..8. For description see object pdo4msk1.	UINT32	- 0	R/W/-

10.3.2 Parameter group "Capture"

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Capture.CapLevel 20:14 (14:0E$_h$)	Signal level for capture inputs Bit0: Setting of level for CAP1 Bit1: Setting of level for CAP2 Assignment of bits: 0: Position capture with 1->0 change 1: Position capture with 0->1 change	UINT16 0..3	- 3	R/W/-
Capture.CapStart1 20:15 (14:0F$_h$)	Start capture at CAP1 Value 0: Stop capture function Value 1: Start single capture Value 2: Start continuous capture The function ends after the first captured value with one-time capture. The capture continues endlessly with continuous capture.	UINT16 0..2	- 0	R/W/-

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Capture.CapStart2 20:16 (14:10$_h$)	Start capture on CAP2 as with CAP1	UINT16 0..2	- 0	R/W/-
Capture.CapStatus 20:17 (14:11$_h$)	Status of capture channels Read access: Bit0: Position captured via CAP1 Bit1: Position capture via CAP2	UINT16 0..3	- 0	R/-/-
Capture.CapPact1 20:18 (14:12$_h$)	Motor position on signal to CAP1 Output of captured position of the actual position encoder (actual motor position) This is always the commutation position with stepper motor units.	INT32	Inc -	R/-/-
Capture.CapPact2 20:19 (14:13$_h$)	Motor position on signal to CAP2 As with CAP1	INT32	Inc -	R/-/-

10.3.3 Parameter group "Commands"

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Com- mands.eeprSave 11:6 (0B:06$_h$)	Save parameter values in EEPROM memory Value 1: Backup user parameters The current parameters are backed up in the non-volatile memory (EEPROM). The save process is complete when the parameter `Commands.stateSave, 11:7` returns a 1. Attention: Saving is only possible when the drive is at a standstill.	UINT16	- -	R/W/-
Commands.stateS- ave 11:7 (0B:07$_h$)	Save processing status of parameters in EEPROM 0: save process active 1: Save process complete	UINT16	- -	R/-/-
Commands.default 11:8 (0B:08$_h$)	Resetting the user parameters Bit0: 1= All user parameters are initialised with default values and saved in the EEPROM. The default state only becomes active at the next start-up. Attention: only possible when the drive is at standstill.	UINT16	- -	R/W/-
Commands.state- Def 11:9 (0B:09$_h$)	Processing status of the parameter `Commands.default` 0: basic initialisation active 1: basic initialisation complete	UINT16	- -	R/-/-
Commands.driveC- trl 28:1 (1C:01$_h$)	Control word for status change Bit0: Disable power amplifier Bit1: Enable power amplifier Bit2: Quick-Stop Bit3: FaultReset Bit4: Quick-Stop release Bit5..15: reserved Preset Bit0..4="0", write access automatically triggers slope change 0->1 and processing of status machine.	UINT16 0..31	- 0	R/W/-

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Commands.del_err 32:2 (20:02$_h$)	Clear error memory write value 1: Clear all error entries in error memory	UINT16 1..1	- 1	R/W/-

10.3.4 Parameter group "Config"

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Config.PrgNo 1:1 (01:01$_h$)	Firmware number High Word: Program number Low Word: Program types Example: PR802.10 High Word:802 Low Word: 10	UINT32	- -	R/-/-
Config.PrgVer 1:2 (01:02$_h$)	Firmware version High Word: Program version Low Word: Program revision Example: V1.003 High Word:1 Low Word: 3	UINT32	- -	R/-/-
Config.SerialNo1 1:20 (01:14$_h$)	Serial number of drive part 1 digits 10-13 of serial number. Displayed as decimal number.	UINT16	- -	R/-/-
Config.SerialNo2 1:21 (01:15$_h$)	Serial number of drive part 2 digits 1-9 of serial number. Displayed as decimal number.	UINT32	- -	R/-/-
Config.OptPrgNo 13:11 (0D:0B$_h$)	Firmware number in the option module Identifies the program number of the internal Profibus interface in drives with Profibus.	UINT32	- -	R/-/-
Config.OptPrgVer 13:12 (0D:0C$_h$)	Firmware version in the option module Identifies the program version of the internal Profibus interface in drives with Profibus.	UINT32	- -	R/-/-
Config.GearNum 13:14 (0D:0E$_h$)	Gear ration counter Gear ratio of installed gearbox. Note: The value is only correct if the gearbox was installed at the factory.	INT32	- -	R/-/-
Config.GearDen 13:15 (0D:0F$_h$)	Gear ratio denominator Gear ratio of the installed gearbox. Note: The value is only correct if the gearbox was installed at the factory.	INT32	- -	R/-/-
Config.SafeDisab 13:16 (0D:10$_h$)	Inputs for Safe Standstill Values: 0: inputs $\overline{\text{SAFE\_DISABLE}}$ not present 1: inputs $\overline{\text{SAFE\_DISABLE}}$ present, but not connected (jumper plugged in) 3: inputs $\overline{\text{SAFE\_DISABLE}}$ present and connected (function active)	UINT16 0..3	- -	R/-/-

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Config.ResolutM 29:2 (1D:02$_h$)	Positioning resolution of the drive Read value for the resolution of the drive in increments per revolution. Value is applicable directly at the motor shaft (without gearbox).	UINT16	Inc 20000	R/-/-

10.3.5 Parameter group "ErrMem0"

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
ErrMem0.ErrNum 900:1 (384:01$_h$)	Coded error number Index 900: first error entry (oldest) Index 901: second error entry ... Note: Reading this parameter brings the entire error entry (9xx.1 – 9xx.5) into a clipboard, from which all other elements can then be loaded.	UINT16	- -	R/-/-
ErrMem0.Class 900:2 (384:02$_h$)	Error class The error class specifies the error response of the controller	UINT16 0..4	- -	R/-/-
ErrMem0.Age 900:3 (384:03$_h$)	Age of error in device activation cycles 0 = errors since the last time the drive was switched on 1 = errors occurring in last operation 2 = errors in penultimate operation etc.	UINT32	- -	R/-/-
ErrMem0.Repeat 900:4 (384:04$_h$)	Error repetitions Number of sequential errors occurring with this error number: 0 = errors occurring only once 1 = 1 repetition 2 = 2 repetitions etc. The repetition counter does not change after the maximum number of 255.	UINT16 0..255	- -	R/-/-
ErrMem0.ErrQual 900:5 (384:05$_h$)	Error identification This entry contains supplementary information for qualification of the error. The meaning depends on the error number.	UINT16	- -	R/-/-

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10.3.6 Parameter group "Homing"

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Homing.startHome 40:1 (28:01$_h$)	Start of referencing mode action object: Write access triggers reference movement from 1: LIMP 2: LIMN 3: REF neg. direction of rotation 4: REF pos. direction of rotation 5: Index pulse neg. sense of rotation 6: Index pulse pos. sense of rotation Comments: 5 and 6 only at drives with index pulse	UINT16 1..8	- -	R/W/-
Homing.stateHome 40:2 (28:02$_h$)	Acknowledgment: Referencing Bit15: ref_err Bit14: ref_end Bit7: error SW_STOP Bit3: error REF Bit2: error HW_STOP Bit1: error LIMN Bit0: error LIMP	UINT16	- -	R/-/-
Homing.startSetp 40:3 (28:03$_h$)	Dimension setting to dimension setting position action object: Write access triggers dimension setting Only possible with motor at standstill.	INT32	Inc -	R/W/-
Homing.v_Home 40:4 (28:04$_h$)	Set speed for searching for the switch	UINT16 1..3000	rpm60	R/W/per
Homing.p_outHome 40:6 (28:06$_h$)	Max. run-off The drive starts to search for the defined switching edge after detecting the switch. If it is not found after the distance specified here, the reference movement stops with an error	INT32 1.. 2147483647	Inc 200000	R/W/per
Homing.p_disHome 40:7 (28:07$_h$)	Distance between the switching point and the reference point After leaving the switch the drive is positioned over a defined path to the working range and this is defined as a reference point.	INT32 1.. 2147483647	Inc 200	R/W/per
Homing.RefSwMod 40:9 (28:09$_h$)	Processing sequence during reference movement to REF Bit0: direction of movement withdrawal path 0: Withdrawal in positive direction 1: Withdrawal in negative direction Bit1: direction of movement safety distance 0: in positive direction 1: in negative direction	UINT16 0..3	- 0	R/W/per
Homing.IndexMod 40:10 (28:0A$_h$)	Process sequence on reference movement to index pulse Bit0: direction of movement run-off 0: retraction in same direction 1: retraction in opposite direction	UINT16 0..1	- 0	R/W/per
Homing.RefAppPos 40:11 (28:0B$_h$)	Application position at reference point On completion of reference movement the position value is set at the reference point. This automatically defines the application zero point.	INT32	Inc 0	R/W/per
Homing.p_diffind 40:12 (28:0C$_h$)	Start position distance - index pulse after reference movement Absolute value of the position difference between start position and index pulse. Can be read to check whether reference movement with index pulse processing can be safely reproduced.	UINT16 0..20000	Inc -	R/-/-

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Homing.refError 40:13 (28:0D$_h$)	Cause of error during reference movement Error code during reference movement processing	UINT16	- -	R/-/-

10.3.7 Parameter group "I/O"

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
I/O.IO_act 33:1 (21:01$_h$)	Status of the digital inputs and outputs 24V inputs/outputs: Bit0: IO0 Bit1: IO1 Bit2: IO2 Bit3: IO3 Bit4: SAFE_DISABLE_A Bit5: SAFE_DISABLE_B Read provides status of inputs and outputs. Write only changes the status of the outputs.	UINT16 0..15	- 0	R/W/-
I/O.IO0_def 34:1 (22:01$_h$)	Configuration of IO0 0 = input freely usable 1 = input LIMP (with IO0 only) 2 = input LIMN (with IO1 only) 3 = input STOP 4 = input REF 5 = input programmable 128 = output freely usable 129 = output index pulse (with IO0 only) 130 = output programmable Comments: 129 only at drives with index pulse	UINT16 0..255	- 1	R/W/per
I/O.IO1_def 34:2 (22:02$_h$)	Configuration of IO1 see parameter IO0_def	UINT16 0..255	- 2	R/W/per
I/O.IO2_def 34:3 (22:03$_h$)	Configuration of IO2 see parameter IO0_def	UINT16 0..255	- 3	R/W/per
I/O.IO3_def 34:4 (22:04$_h$)	Configuration of IO3 see parameter IO0_def	UINT16 0..255	- 4	R/W/per
I/O.progDelay 34:7 (22:07$_h$)	Delay period for programmed I/O process After switching on the drive the function "programmable inputs and outputs" is not enabled until after the delay period, which can be set here. This enables a manual system to be locked for a period during power up until a field bus controller takes over.	UINT16 0..60	Sec 0	R/W/per

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10.3.8 Parameter group "Manual"

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Manual.startMan 41:1 (29:01$_h$)	Starting a manual movement Coding of write data: Bit0: pos. sense of rotation Bit1: neg. sense of rotation Bit2: 0:slow 1:fast Bit3: auto. processing of power amplifier If Bit3 is set to 1 a manual movement can also be started with the power amplifier switched off: If the drive is in status 4 (ReadyToSwitchOn), the power amplifier is automatically switched on when the manual movement is started and switched off when the movement is finished.	UINT16 0..15	- 0	R/W/-
Manual.stateMan 41:2 (29:02$_h$)	Acknowledgement: Manual movement Bit15: manu_err Bit14: manu_end Bit7: error SW_STOP Bit3: error REF Bit2: error HW_STOP Bit1: error LIMN Bit0: error LIMP	UINT16	- -	R/-/-
Manual.n_slowMan 41:4 (29:04$_h$)	Speed for slow manual movement	UINT16 300..3000	rpm 60	R/W/per
Manual.n_fastMan 41:5 (29:05$_h$)	Speed for fast manual movement	UINT16 300..3000	rpm 600	R/W/per
Manual.step_Man 41:7 (29:07$_h$)	Jogging path with manual start 0: direct activation of continuous running	UINT16	Inc 20	R/W/per
Manual.time_Man 41:8 (29:08$_h$)	waiting period until continuous running waiting period until transition to continuous running. Only effective if jogging path is set not equal to 0.	UINT16 1..10000	ms 500	R/W/per

10.3.9 Parameter group "Motion"

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Motion.invertDir 28:6 (1C:06$_h$)	Definition of the direction of rotation Value 0: no inversion of direction Value 1: direction reversal active No reversal of direction means: A clockwise direction of rotation is defined as the motor shaft rotating clockwise as the observer faces the end of the protruding shaft. Note: New value only imported when the drive is switched on.	UINT16 0..1	- 0	R/W/per
Motion.dec_Stop 28:21 (1C:15$_h$)	Deceleration for "Quick Stop" Deceleration used for every "Quick Stop": - "Quick Stop" via control word - "Quick Stop" by ext. monitoring signal - "Quick Stop" by class 1 and 2 errors	UINT32 1...765000	rpm/s 6000	R/W/per

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Motion.v_target0 29:23 (1D:17$_h$)	Default setpoint speed Remanent default value for the parameter PTP.v_tarPTP. Speed for PTP mode if no value was written to PTP.v_tarPTP. Note: This remanent value is used exclusively when switching on the drive as a default assignment for PTP.v_tarPTP.	UINT16 1..3000	rpm 60	R/W/per
Motion.acc 29:26 (1D:1A$_h$)	Acceleration Value determines acceleration and deceleration. New values are only imported after standstill.	UINT32 1...765000	rpm/s 600	R/W/per

10.3.10 Parameter group "Profibus"

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Profibus.MapOut 24:2 (18:02$_h$)	Value in PZD5+6 to drive Index and subindex of the object that is mapped on data transfer from the master to the drive in the PPO2. The setpoint acceleration is mapped by default. Possible values: 00000000$_h$: no mapping active 001A001D$_h$: setpoint acceleration (29:26) 00010021$_h$: digital outputs (33:1) Low word: Index mapped object High word: Subindex mapped object	UINT32	- see text left	R/W/per
Profibus.MapIn 24:3 (18:03$_h$)	Value in PZD5+6 to the master device Index and subindex of the object that is mapped to the PPO2 during the data transfer from the drive to the master device. No mapping is active by default.Possible values: 00000000$_h$: No mapping active 00070020$_h$: error number (32:7) 0009001F$_h$: actual speed (31:9) 0019001F$_h$: temperature of power amplifier (31:25) 0014001F$_h$: power supply (31:20) 000C001F$_h$: current motor current (31:12) Low word: index mapped object High word: Subindex mapped object	UINT32	- 0	R/W/per
Profibus.PkInhibit 24:4 (18:04$_h$)	Refresh cycle for static read jobs The reader value is refreshed cyclically at the defined period with a static pending read job.	UINT32 1..60000	ms 1000	R/W/per
Profibus.SafeState 24:5 (18:05$_h$)	Response to safe status Response of drive in status 'Clear' of the ProfibusDP master and response with watchdog sequence. 0 = no reaction 1 = error of class 2 , drive goes to FAULT status if power amplifier was enabled.	UINT32 0..1	- 1	R/W/per
Profibus.profiAddr 24:13 (18:0D$_h$)	Profibus address Address set with the DIP switch.	UINT32 3..126	- -	R/-/-

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10.3.11 Parameter group "ProgIO0"

The parameter groups "ProgIO0 "(Index 800), "ProgIO1" (Index 801), "ProgIO2" (Index 802), "ProgIO3" (Index 803) have identical meanings.

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
ProgIO0.Index 800:1 (320:01$_h$)	Index of control parameter If prog. input: Index of the parameter to be written If prog. output: Index of the parameter to be read If prog. input: write(Index,Subindex) = (read(Index,Subindex) BAND BitMask) BOR VALUEx If prog. output: high level at output if (read(Index,Subindex) BAND BitMask) =<> VALUE1	UINT16	- -	R/W/per
ProgIO0.Subindex 800:2 (320:02$_h$)	Subindex of control parameter If prog. input: Subindex of the parameter to be written If prog. output: Subindex of parameter to be read	UINT16	- -	R/W/per
ProgIO0.BitMask 800:3 (320:03$_h$)	Bit mask for parameter value If prog. input or prog. Output: Bit mask with the read value of the parameter (Index,Subindex) is logically ANDed before it is further processed.	UINT32	- -	R/W/per
ProgIO0.Switch 800:4 (320:04$_h$)	Edge detection or comparison operator If prog. input: Selection of the slopes to be captured: Value 0: no response to level change Value 1: response to pos. edge Value 2: response to neg. edge Value 3: Response to both edges If prog. output: Selection of condition for comparison: Value 0: (parameter read value = comparison value) Value 1: (parameter read value <> comparison value) Value 2: (parameter read value < comparison value) Value 3: (parameter read value > comparison value)	UINT16	- -	R/W/per
ProgIO0.Value1 800:5 (320:05$_h$)	Write value at pos. edge or comparison value If prog. input: Parameter write value with pos. slope If prog. output: Comparison value for condition	INT32 0.. 4294967295	- -	R/W/per
ProgIO0.Value2 800:6 (320:06$_h$)	Write value with neg. slope If prog. input: Parameter write value with neg. slope If prog. output: no meaning	INT32 0.. 4294967295	- -	R/W/per

10.3.12 Parameter group "PTP"

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
PTP.p_absPTP 35:1 (23:01$_h$)	Target position and absolute positioning start action object: Write access triggers absolute positioning in increments	INT32	Inc -	R/W/-

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
PTP.StatePTP 35:2 (23:02$_h$)	Acknowledgment: PTP positioning Bit15: ptp_err Bit14: ptp_end Bit13: Set position reached Bit7: SW_STOP Bit3: error REF Bit2: error STOP Bit1: error LIMN Bit0: error LIMP	UINT16	- -	R/-/-
PTP.p_relPTP 35:3 (23:03$_h$)	Path and relative positioning start action object: Write access triggers relative positioning in increments	INT32	IInc -	R/W/-
PTP.continue 35:4 (23:04$_h$)	Continuation of an interrupted positioning The target position is specified with the preceding positioning command. The value transferred here is not relevant for the positioning.	UINT16	- 0	R/W/-
PTP.v_tarPTP 35:5 (23:05$_h$)	Setpoint speed of PTP positioning Positioning can be temporarily stopped with value 0. Default is the value of the parameter `Motion.v_target0`.	UINT16 0..3000	rpm 60	R/W/-

10.3.13 Parameter group "RS485"

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
RS485.timeout 1:11 (01:0B$_h$)	Node Guard Timer Connection monitoring, time in milliseconds 0=inactive (default=0) Value returns automatically to 0 after a node guard error.	UINT16 0..10000	ms 0	R/W/-
RS485.serBaud 22:1 (16:01$_h$)	Baud rate Following values are allowed: 9600 19200 38400	UINT16 0..38400	- 9600	R/W/per
RS485.serAdr 22:2 (16:02$_h$)	Address 1...31 are allowed	UINT16 1..31	- 1	R/W/per
RS485.serFormat 22:3 (16:03$_h$)	Data format Bit0: 1=no parity, 0=parity on Bit1: 1=parity odd, 0=parity even Bit2: 1=8 data bits, 0=7 data bits Bit3: 1=2 stop bits, 0=1 stop bit Default is 0 = 7-E-1	UINT16 0..15	- 0	R/W/per

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10.3.14 Parameter group "Settings"

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Settings.name1 11:1 (0B:01_h)	User-defined device name part 1 Default = 538976288 = 0x20202020 = 4 spaces User-programmed naming in the form of an 8 character long text	UINT32	- 538976288	R/W/per
Settings.name2 11:2 (0B:02_h)	User-defined device name part 2 Default = 538976288 = 0x20202020 = 4 spaces User-programmed naming in the form of an 8 character long text	UINT32	- 538976288	R/W/per
Settings.I_still 14:1 (0E:01_h)	Motor phase current standstill Is active after 100ms motor standstill. Current is shown in percent of rated current.	UINT16 0..100	% 70	R/W/per
Settings.I_acc 14:2 (0E:02_h)	Motor phase current acceleration / deceleration Current given in percent of nominal current.	UINT16 0..100	% 100	R/W/per
Settings.I_const 14:3 (0E:03_h)	Motor phase current constant travel Current given in percent of nominal current.	UINT16 0..100	% 100	R/W/per
Settings.I_stop 14:4 (0E:04_h)	Motor phase current for "Quick Stop" Current given in percent of nominal current.	UINT16 0..100	% 100	R/W/per
Settings.monitorM 14:7 (0E:07_h)	Motor monitoring Stall detection Bit0: 1=active, 0=not active Only at drives with index pulse.	UINT16 0..1	- 1	R/W/per
Settings.WarnOvrun 28:11 (1C:$0B_h$)	Response to position overrun 0 = set bit in status word 1 = do not set bit in status word	UINT16 0..1	- 0	R/W/per
Settings.SignEnabl 28:13 (1C:$0D_h$)	Activation of the monitoring inputs Bit0: LIMP (pos. limit switch) Bit1: LIMN (neg. limit switch) Bit2: STOP (STOP switch) Bit3: REF (reference switch) Bit value=0: Monitoring is not active Bit value=1: Monitoring is active Note: Monitoring is only active if the relevant I/O port is configured as the corresponding function (parameter I/O.IO0_def to IO3_def).	UINT16 0..15	- 3	R/W/per
Settings.SignLevel 28:14 (1C:$0E_h$)	Signal level for monitoring inputs Set here whether errors are triggered at 0 or at 1 level. Bit0: LIMP Bit1: LIMN Bit2: STOP Bit3: REF Bit value 0: Response at 0 level (wire-break security) Bit value 1: Response at 1 level	UINT16 0..15	- 0	R/W/per

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10.3.15 Parameter group "Status"

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Status.driveStat 28:2 (1C:02$_h$)	Status word for the operating status LOW-UINT16: Bit0..3: No. of current state of status machine Bit4: reserved Bit5: fault by internal monitoring Bit6: fault by external monitoring Bit7: warning active Bit8..11: reserved Bit12..15: Axis-specific coding of the processing status Corresponds to the assignment of bits12..15 in the mode-specific acknowledgement data (e.g. PTP.statePTP with PTP positioning) HIGH-UINT16: allocate see parameter Status.xMode_act	UINT32	- -	R/-/-
Status.xMode_act 28:3 (1C:03$_h$)	current axis mode with additional information Bit0..3: current mode (see below) Bit4: reserved Bit5: drive referenced (ref_ok) Bit6..15: reserved Numbering of current operating mode: 1: manual movement 2: homing 3: profile position 4: profile velocity Other numbers are reserved for future expansion.	UINT16	- -	R/-/-
Status.WarnSig 28:10 (1C:0A$_h$)	Warnings Monitoring signals with error class 0. Bit0: position overrun profile generator Bit1: overtemperature power amplifier The remaining bits are reserved for later extensions.	UINT16	- -	R/-/-
Status.Sign_SR 28:15 (1C:0F$_h$)	Saved signal status external monitoring signals Bit0: LIMP Bit1: LIMN Bit2: STOP Bit3: REF Bit7: SW stop 0: not enabled 1: enabled Saved signal states of enabled external monitoring signals	UINT16 0..15	- -	R/-/-
Status.FltSig 28:17 (1C:11$_h$)	Active monitoring signals Error bits remain set only as long as errors are pending (i.e. as long as limit value is exceeded). Assignment as parameter Status.FltSig_SR	UINT32	- -	R/-/-

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Status.FltSig_SR 28:18 (1C:12$_h$)	Saved monitoring signals Error bits remain set until FaultReset is run. Bit0: undervoltage 1 power supply Bit1: undervoltage 2 power supply Bit2: overvoltage power supply Bit5: motor overload Bit12: overtemperature power amplifier Bit16: blocking error Bit17: contouring error Bit18: motor position sensor failure Bit21: fieldbus protocol error Bit22: node guard error Bit23: pulse/direction input timing Bit25: Safe Standstill triggered Bit26: SAFE_DISABLE_A/B different level Bit28: hardware error EEPROM Bit29: start-up error Bit30: internal system error Bit31: Watchdog	UINT32	- -	R/-/-
Status.action_st 28:19 (1C:13$_h$)	Action word Bit0: bit latched error class 0 Bit1: bit latched error class 1 Bit2: bit latched error class 2 Bit3: bit latched error class 3 Bit4: bit latched error class 4 Bit5: reserved Bit6: Drive stopped: actual speed is zero Bit7: drive rotates in positive direction Bit8: drive rotates in negative direction Bit9: reserved Bit10: reserved Bit11: Drive stopped: setpoint speed is 0 Bit12: drive decelerates Bit13: drive accelerates Bit14: Drive operates constant speed Bit15: reserved	UINT16	- -	R/-/-
Status.ModeError 30:11 (1E:0B$_h$)	Manufacturer-specific error code that results in setting the ModeError flag In general this is an error that was triggered by starting an operating mode.	UINT16	- 0	R/-/-
Status.v_act 31:2 (1F:02$_h$)	Actual speed	INT32	Inc/s -	R/-/-
Status.p_ref 31:5 (1F:05$_h$)	Setpoint position	INT32	Inc -	R/-/-
Status.p_act 31:6 (1F:06$_h$)	Motor position Identical with the parameter `Status.p_ref`.	INT32	Inc -	R/-/-
Status.n_act 31:9 (1F:09$_h$)	Actual speed Corresponds to the parameter `Status.v_act` converted to rpm.	INT16	rpm -	R/-/-
Status.UDC_act 31:20 (1F:14$_h$)	Voltage of power supply in [0.1V]	UINT16	V -	R/-/-
Status.TPA_act 31:25 (1F:19$_h$)	Temperature of power amplifier in degrees Celsius	UINT16 20..110	°C -	R/-/-
Status.v_pref 31:28 (1F:1C$_h$)	Speed of rotor position setpoint value `Status.p_ref`	INT32	Inc/s -	R/-/-

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Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
Status.p_target 31:30 (1F:1E$_h$)	Target position of travel profile generator Absolute position value of the profile generator calculated from transferred relative and absolute position values.	INT32	Inc -	R/-/-
Status.p_profile 31:31 (1F:1F$_h$)	Actual position of travel profile generator Corresponds to setpoint position `Status.p_ref`.	INT32	Inc -	R/-/-
Status.p_actusr 31:34 (1F:22$_h$)	Motor position Parameters for improving compatibility to Twin Line. Corresponds to motor position `Status.p_act`.	INT32	Inc -	R/-/-
Status.n_profile 31:35 (1F:23$_h$)	Actual speed of travel profile generator Corresponds to the speed of the rotor position setpoint value `Status.n_pref`.	INT16	rpm -	R/-/-
Status.n_target 31:38 (1F:26$_h$)	Target speed of travel profile generator	INT16	rpm -	R/-/-
Status.n_pref 31:45 (1F:2D$_h$)	Speed of rotor position setpoint value Status.p_ref Corresponds to `Status.v_pref` converted to rpm.	INT16	rpm -	R/-/-
Status.StopFault 32:7 (20:07$_h$)	Last cause of interruption, error number	UINT16	- 0	R/-/-

10.3.16 Parameter group "VEL"

Group.Name Index:Subindex dec. (hex.)	Description Bit assignment	Data type Range dec.	Unit Default dec.	R/W/per Info
VEL.velocity 36:1 (24:01$_h$)	Start with setpoint speed Action object: Write access triggers movement	INT16 -3000..3000	rpm -	R/W/-
VEL.stateVEL 36:2 (24:02$_h$)	Acknowledgement: profile velocity Bit15: vel_err Bit14: vel_end Bit13: setpoint speed reached Bit7: SW_STOP Bit3: error REF Bit2: error STOP Bit1: error LIMN Bit0: error LIMP	UINT16	- -	R/-/-

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11 Accessories and spare parts

11.1 Documentation

Designation	Ordering number
IclA Ixx CD-ROM multilingual	0098 441 113 207
IclA IFS device manual, DE	0098 441 113 188
IclA IFS device manual, EN	0098 441 113 189
IclA IFx CANopen fieldbus manual, DE	0098 441 113 184
IclA IFx CANopen fieldbus manual, EN	0098 441 113 185
IclA IFx RS485 fieldbus manual, DE	0098 441 113 186
IclA IFx RS485 fieldbus manual, EN	0098 441 113 187
IclA IFx Profibus fieldbus manual, DE	0098 441 113 192
IclA IFx Profibus fieldbus manual, EN	0098 441 113 193

11.2 Accessories

Designation	Ordering number
Ixx Installation Set	0062 501 521 001
Ixx cable bushings (2 units)	0062 501 520 002
Ixx cable bushings (10 units)	0062 501 520 001
IFx cable (power, CAN), 3m	0062 501 462 030
IFx cable (power, RS485), 3m	0062 501 463 030
IFx cable (power, Profibus), 3m	0062 501 484 030
IFx cable (power, STAK), 3m	0062 501 470 030
IFx cable (power, STAK), 5m	0062 501 470 050
IFx cable (power, STAK), 10m	0062 501 470 100
IFx cable (power, STAK), 15m	0062 501 470 150
IFx cable (power, STAK), 20m	0062 501 470 200
Ixx Cable (safe disable M8x4), 3m	0062 501 485 030
Ixx Cable (safe disable M8x4), 5m	0062 501 485 050
Ixx Cable (safe disable M8x4), 10m	0062 501 485 100
Ixx Cable (safe disable M8x4), 15m	0062 501 485 150
Ixx Cable (safe disable M8x4), 20m	0062 501 485 200
IFx Connector Set Profibus M12	0062 501 525 001
IFx Connector Set CAN M12	0062 501 526 001
IFx Insert 3I/O 24V	0062 501 524 001
IFx Insert 4I/O 24V	0062 501 527 001
IFx Insert 3I/O	0062 501 533 001
IFx Insert 4I/O	0062 501 533 002
IFx Insert 2I/O 1SD	0062 501 533 003

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Designation	Ordering number
IFx Insert 4I/O 2SD	0062 501 533 004
IFx Connector 3I/O 24V	0062 501 523 001
IFx Connector 4I/O 24V	0062 501 523 002
IFx Connector 2I/O	0062 501 534 001
IFx Connector 3I/O	0062 501 534 002
IFx Connector 1SD out	0062 501 534 005

Recommended suppliers for Profibus cables:

- Profibus Cable (M12-M12) xxm: Profibus signal line, prepared both ends with M12 plug connector- M12 coupling, 5-pin B-coded. Supplier: Lumberg, www.lumberg.de Order no.: 0975 254 101 / ... M
- Profibus Cable (M12 SubD) xxm: Profibus signal line prepared both ends with M12 coupling, 5-pin B-coded, 9-pin SubD plug connector with switchable terminator. Supplier: Lumberg, www.lumberg.de Order no.: 0975 254 104 / ... M
- Profibus Cable (M12 SubD) xxm: Profibus signal line prepared both ends with M12 plug connector, 5-pin B-coded, 9-pin SubD plug connector with switchable terminator. Supplier: Lumberg, www.lumberg.de Order no.: 0975 254 105 / ... M

The tools required for fabrication must be ordered directly from the manufacturer.

- Crimping pliers for CN1: AMP 654174-1
- Crimping pliers for CN2 and CN4: Molex 69008-0982
- Crimping pliers for CN3: Molex 69008-0724
- Extraction tool for CN2 and CN4: Molex 11-03-0043
- Extraction tool for CN3: Molex 11-03-0044

An RS232/USB to RS485 converter is required for service and to upgrade the operating system.

- NuDAM RS232-RS485 converter: Acceed ND-6520
- NuDAM USB-RS485 converter: Acceed ND-6530

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12 Service, maintenance and disposal

CAUTION!

Destruction of unit 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.

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.

12.1 Service address

If you cannot resolve the fault yourself please contact your appointed sales partner. Have the following details available:

- Type, identification number and serial number of the product (type plate)
- Type of fault (possibly with 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.

12.2 Maintenance

The unit is maintenance free

12.2.1 Operational duration of safety function

The operating life for the Safe Standstill function is designed to be 20 years. After this period correct function is no longer ensured. The expiry date of the unit is determined by adding 20 years to the DOM shown on the type plate.

▶ This date must be included in the system maintenance schedule.

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Example The name plate on the unit includes the DOM in the DD.MM.YY format, e.g. 31.12.06. (31 December 2006). This means that the safety function is guaranteed until 31 December 2026 (06 + 20 = 26).

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12.3 Replacing units

WARNING!

Unexpected responses may cause injury and damage to the system

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 states 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.

Observe the following procedure when changing the units.

▶ Save all parameter settings on your PC with the commissioning software, see chapter 7.4 “IclA Easy commissioning software“.

▶ Switch off all power supplies. Make sure that power is no longer connected (safety instructions).

▶ Label all connections and remove the product.

▶ Note the identification number and the serial number from the product type plate for later identification.

▶ Install the new product as specified in 6 “Installation“

▶ Carry out commissioning in accordance with chapter 7 “Commissioning“.

12.4 Shipping, storage, disposal

Removal Removal procedure:

▶ Switch off the power supply.

▶ Disconnect the power supply.

▶ Pull out all plugs.

▶ Remove the compact drive from the system.

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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13 Glossary

13.1 Terms and Abbreviations

AC	Alternating Current
ASCII	American Standard Code for Information Interchange; Standard for coding text characters
Stall detection	The stall detection monitors that the optional index pulse is always correctly triggered at the same angular setting of the motor axis. Only for stepper motor drives with index pulse.
CAN	(**C**ontroller **A**rea **N**etwork), standardized open Fieldbus over which the drives and other devices from different manufacturers communicate with one another.
DC	Direct current
Default value	Factory settings.
DIP switch	Small switches positioned side by side. They must be set during installation.
DOM	(**D**ate **o**f **m**anufacturing), the type plate of the device shows the date of manufacture in the format DD.MM.YY, e.g. 31.12.06 (31. December 2006).
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.
I/O	Inputs/Outputs
E	Encoder
EC motor	Electronically commutated motor
EC	European Community
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.
Limit switch	Switch that signals an overrun of the permissible travel range.
Power amplifier	A device that generates current for controlling the motor in accordance with the positioning signals from the controller.
EU	European Union
Error class	Classification of possible operating faults of the drive system that result in an error status.
High/open	Signal status of an input or output signal; in the idle state the signal voltage is high, high level.
Inc	Increment
Index pulse	Encoder signal for referencing the rotor position in the motor. The encoder sends one index pulse per revolution.
LED	Light-Emitting Diode

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Low/open	Signal status of an input or output signal; in the idle state signal voltage is low (low level).
M	Motor
Torque ramp	Brakes the motor with the maximum possible deceleration, which is only limited by the maximum permissible current. The higher the permissible braking current, the stronger the deceleration. Because energy is taken up depending on the coupled load, the voltage may increase to excessive values. In this case the maximum permissible current must be reduced.
Motor phase current	In a stepper motor the available torque is specified by the motor phase current. The higher the motor phase current the higher the torque.
Node-Guarding	Monitoring function with slave at an interface for cyclic communication.
Parameter	Device functions and values that can be set and called by the user.
PC	Personal Computer
per	Designation of whether the value of the parameter is persistent, i.e. after switching off the unit 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.
Profibus	Standardised open fieldbus compliant with EN 50254-2 over which drives and other devices from different manufacturers communicate with one another.
PWM	Pulse Width Modulation
Quick Stop	Quick stop, function used to provide quick braking of the motor via a command or in the event of a fault.
RS485	Fieldbus interface compliant with EIA-485, which enables serial data transmission with multiple devices.
SM	Stepper motor
PLC	Programmable Logic Controller
Watchdog	Equipment that monitors cyclic basic functions in the drive system. Power amplifier and outputs are switched off in the event of error.

13.2 Product name

IclA IDS	Intelligent Compact Drive with pulse/direction interface and stepper motor
IclA IFA	Intelligent Compact Drive with fieldbus interface and servomotor
IclA IFE	Intelligent Compact Drive with fieldbus interface and EC motor
IclA IFS	Intelligent Compact Drive with fieldbus interface and stepper motor

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