# ILA1B, ILA1F, ILA1R 

Lexium Integrated Drive
Product manual
v2.00, 09.2008


## Important information

This manual is part of the product.
Carefully read this manual and observe all instructions.
Keep this manual for future reference.
Hand this manual and all other pertinent product documentation over to all users of the product.

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

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

Subject to technical modifications without notice.
All details provided are technical data which do not constitute warranted qualities.

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

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## Writing conventions and symbols

Work steps If work steps must be performed consecutively, this sequence of steps is represented as follows:

■ Special prerequisites for the following work steps

- Step 1
$\triangleleft$ Specific response to this work step
- Step 2

If a response to a work step is indicated, this allows you to verify that the work step has been performed correctly.

Unless otherwise stated, the individual steps must be performed in the specified sequence.

Bulleted lists
The items in bulleted lists are sorted alphanumerically or by priority. Bulleted lists are structured as follows:

- Item 1 of bulleted list
- Item 2 of bulleted list
- Subitem for 2
- Subitem for 2
- Item 3 of bulleted list

Making work easier
Information on making work easier is highlighted by this symbol:


Sections highlighted this way provide supplementary information on making work easier.

Parameters
Parameters are shown as follows:
Gruppe.Name Index:Subindex
SI units SI units are the original values. Converted units are shown in brackets behind the original value; they may be rounded.

Example:
Minimum conductor cross section: $1.5 \mathrm{~mm}^{2}$ (AWG 14)

## 1 Introduction

### 1.1 About this manual

This manual is valid for all ILA1B, ILA1F, ILA1R standard products. This chapter lists the type code for this product. The type code can be used to identify whether your product is a standard product or a customized model.

### 1.2 Unit overview

Reference value supply

## Safety function

The integrated safety function STO (IEC 61800-5-2) meets the requirements of Safety Integrity Level SIL2. The safety function allows for a category 0 stop as per EN 60204-1 without external power contactors. It is not necessary to interrupt the supply voltage. This reduces the system costs and the response times.

The STO safety function is available as of device revision RS10 (see nameplate).


Using the library considerably facilitates controlling the device. The library is available for download from the Internet.
http://www.schneider-electric.com

### 1.3 Components and interfaces



Figure 1.2 Components and interfaces
(1) Synchronous AC servo motor
(2) Holding brake (optional)
(3) Encoder
(4) Electronics housing
(5) Insert for sealing (accessory)
(6) Insert with cable entry (accessory)
(7) I/O insert with industrial connector (accessory)
(8) Switches for settings
(9) Cover of electronics housing, must not be removed
(10) Cover of connector housing, to be removed for installation
(11) Cover with industrial connector for Vdc supply voltage and IN/ OUT fieldbus connection (optional)
(12)

### 1.3.1 Components

> Motor $\begin{aligned} & \text { The motor is a brushless AC synchronous servo motor with 3-phase } \\ & \text { technology. The motor has a high power density due to the use of the lat- } \\ & \text { est magnetic materials and an optimized design. }\end{aligned}$ Encoder $\begin{aligned} & \text { The standard drive system operates with a singleturn encoder. } \\ & \text { The singleturn encoder has an internal resolution of } 16384 \text { increments } \\ & \text { per revolution. } \\ & \text { The drive system can optionally be equipped with a multiturn encoder. } \\ & \text { The multiturn encoder covers a range of } 4096 \text { motor revolutions. }\end{aligned}$ Electronics $\begin{aligned} & \text { The electronic system comprises control electronics and power stage. } \\ & \text { They have a common power supply and are not galvanically isolated. } \\ & \text { The drive can be parameterized and controlled via the fieldbus interface. } \\ & \\ & \text { 4 digital } 24 \mathrm{~V} \text { signals are also available. Each of them can be used as an } \\ & \text { input or output. }\end{aligned}$ Holding brake $\begin{aligned} & \text { The drive can optionally be equipped with an integrated holding brake. } \\ & \text { The holding brake is controlled automatically. }\end{aligned}$

### 1.3.2 Interfaces

Standard available interfaces:
Supply voltage VDC The supply voltage VDC supplies the control electronics and the power stage.


Fieldbus interface

The ground connections of all interfaces are galvanically connected. For more information see chapter 5.2 "Ground design". This chapter also provides information on protection against reverse polarity.

Functions:

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

The fieldbus interface is used for parameterizing and controlling the drive. The fieldbus interface allows the drive to be integrated into a fieldbus network and controlled by a master such as a PLC.

The drive can be commissioned via any of the above interfaces. This requires, for example, a PC with a suitable fieldbus converter (e.g. USBCAN). The commissioning software is available for PCs; it supports the various fieldbus versions.

The firmware can be updated via any of the interfaces.
24 V signal interface 4 digital 24 V signals are available. Each of them can be used as an input or outputs.

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

### 1.4 Name plate

The nameplate contains the following data:


Figure 1.3 Nameplate
(1) Type code
(2) Type code (old designation)
(3) Nominal voltage
(4) Nominal torque
(5) Maximum input current
(6) Nominal speed
(7) Date of manufacture
(8) Thermal class
(9) Maximum ambient air temperature
(10) Software revision
(11) Hardware revision
(12) Firmware number
(13) Material number
(14) Serial Number

### 1.5 Type code

| Motor |
| :--- |
| ILA $=$ Servo motor | ILA

[^0]
### 1.6 Documentation and literature references

The following manuals belong to this product:

- Product manual, describes the technical data, installation, commissioning and all operating modes and functions.
- Fieldbus manual, description required to integrate the product into a fieldbus.

Source product manuals
The current product manuals are available for download from the Internet. http://www.schneider-electric.com
Source EPLAN Macros For easier engineering, macro files and product master data are available for download from the Internet at:
http://www.schneider-electric.com
Additional literature
We recommend the following literature for more in-depth information:

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


### 1.7 Declaration of conformity

## EC Declaration of Conformity YEAR 2008

区 according to EC Directive Machinery 98/37/ECaccording to EC Directive EMC 2004/108/EC
$\square$ according to EC Directive Low Voltage 2006/95/EC

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

| Designation: | Motors with integrated control electronics |
| :--- | :--- |
| Type: | ILA, ILE, ILS |
| Product number: | 0x6600xxxxxxx, 0x6610xxxxxxx, 0x66206xxxxxx, 0x66307xxxxxx <br> 0x6640xxxxxxx, 0x66606xxxxxx, 0x66707xxxxxx |

Applied EN ISO 13849-1:2006, Performance Level "d" (category 3) harmonized EN 61800-3:2004, second environment
standards,
EN 62061:2005, SILcl 2
especially:
EN 61508:2001, SIL 2

Applied
UL 508C
national standards Product documentation
and technical specifications, especially:

| Schneider Electric Motion Deutschland <br> GmbH \& Co. KG |
| :--- |
| Company stamp:Postfach $1180 \cdot$ D-77901 Lahr <br> Breslauer Str $7 \cdot$ D-77933 Lahr |
| Date/ Signature: 10 July 2008 |
| Name/ Department: Wolfgang Brandstätter/Development |

### 1.8 TÜV certificate for functional safety

## 10

## Certificate

TÜV NORD SysTec GmbH \& Co. KG hereby certifies

## Schneider Electric Motion GmbH

Breslauerstr. 7 77933 Lahr
for the realisation of the functions "Safe Torque Off" (STO) and "Emergency Stop" in the drive

IcIA |xx


## 2 Before you begin - safety information

### 2.1 Qualification of personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product. In addition, these persons must have received safety training to recognize and avoid hazards involved. These persons must have sufficient technical training, knowledge and experience and be able to foresee and detect potential hazards that may be caused by using the product, by changing the settings and by the mechanical, electrical and electronic equipment of the entire system in which the product is used.

All persons working on and with the product must be fully familiar with all applicable standards, directives, and accident prevention regulations when performing such work.

### 2.2 Intended use

This product is a motor with an integrated drive and intended for industrial use according to this manual.

The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements and the technical data.

Prior to using the product, you must perform a risk assessment in view of the planned application. Based on the results, the appropriate safety measures must be implemented.

Since the product is used as a component in an entire system, you must ensure the safety of persons by means of the design of this entire system (e.g. machine design).
Operate the product only with the specified cables and accessories. Use only genuine accessories and spare parts.

The product must NEVER be operated in explosive atmospheres (hazardous locations, Ex areas).

Any use other than the use explicitly permitted is prohibited and can result in hazards.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel.

### 2.3 Hazard categories

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

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

## DANGER

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

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


| A CAUTION |
| :--- |
| CAUTION indicates a potentially hazardous situation, which, if not |
| avoided, can result in injury or equipment damage. |

## CAUTION

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

### 2.4 Basic information

## DANGER

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

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

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

| 』 WARNING |
| :--- |
| UNEXPECTED MOVEMENT |
| Drives may perform unexpected movements because of incorrect wir- |
| ing, incorrect settings, incorrect data or other errors. |
| Interference (EMC) may cause unpredictable responses in the sys- |
| tem. |
| - $\quad$ Carefully install the wiring in accordance with the EMC require- |
| ments. |
| - Switch off the voltage at the inputs $\overline{\text { STO_A }}$ (PWRR_A) and $\overline{\text { STO_B }}$ |
| (PWRR_B) to avoid an unexpected restart of the motor before |
| switching on and configuring the drive system. |
| - Do NOT operate the drive system with unknown settings or data. |
| - Perform a comprehensive commissioning test. |
| Failure to follow these instructions can result in death or serious |
| injury. |

## A WARNING

LOSS OF CONTROL

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

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

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

| $\quad$ A CAUTION |
| :--- |
| UNEXPECTED BEHAVIOR AND DESTRUCTION OF SYSTEM COMPO- |
| NENTS |
| When you work on the wiring and when you unplug or plug in connec- |
| tors, this may cause unexpected behavior and destruction of system |
| components. |
| - Switch the power supply off before working on the wiring. |
| Failure to follow these instructions can result in injury or equip- |
| ment damage. |

### 2.5 Functional safety

Using the safety functions integrated in this product requires careful planning. For more information see chapter5.3 "Safety function STO ("Safe Torque Off")" on page 40.

### 2.6 Standards and terminology

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

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

Among others, these standards include:

- IEC 61800 series: "Adjustable speed electrical power drive systems"
- IEC 61800-7 series: "Adjustable speed electrical power drive systems - Part 7-1: Generic interface and use of profiles for power drive systems - Interface definition"
- IEC 61158 series: "Industrial communication networks - Fieldbus specifications"
- IEC 61784 series: "Industrial communication networks - Profiles"
- IEC 61508 series: "Functional safety of electrical/electronic/programmable electronic safety-related systems"

Also see the glossary at the end of this manual.

## 3 Technical Data

This chapter contains information on the ambient conditions and on the mechanical and electrical properties of the device family and the accessories.

### 3.1 Certifications

Product certifications:

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

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

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


### 3.2 Ambient conditions

Ambient temperature during operation

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

| Operating temperature ${ }^{1) 2)}$ | $\left[{ }^{\circ} \mathrm{C}\right]$ | $0 \ldots 50$ |
| :--- | :--- | :--- |
| Operating temperature with cur- <br> rent reduction of 2\% per Kelvin ${ }^{1)}$ | $\left[{ }^{\circ} \mathrm{C}\right]$ | $50 \ldots 65$ |

1) Limit values with flanged motor (steel plate $300 \times 300 \times 10 \mathrm{~mm}$ )
2) If the product is to be used in compliance with UL 508C, note the information provided in chapter 3.5 "Conditions for UL 508C".

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

| Temperature | $\left[{ }^{\circ} \mathrm{C}\right]$ | $-25 \ldots+70$ |
| :--- | :--- | :--- |
|  |  |  |
| Max. temperature of power <br> stage ${ }^{1)}$ | $\left[{ }^{\circ} \mathrm{C}\right]$ | 105 |
| Max. temperature of motor ${ }^{2)}$ | $\left[{ }^{\circ} \mathrm{C}\right]$ | 110 |

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

Relative humidity
The following relative humidity is permissible during operation:
Relative humidity (non-condens- [\%] $15 \ldots 85$
ing)
ing)

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

| Installation altitude | $[\mathrm{m}] \quad \leq 1000$ |
| :--- | :--- | :--- |


| Vibration and shock |  |  |
| :--- | :--- | :--- |
|  | Vibartion, sinusoidal | As per IEC/EN 60068-2-6 |
| 0.15 mm (from $10 \mathrm{~Hz} \ldots 60 \mathrm{~Hz}$ ) |  |  |
| $20 \mathrm{~m} / \mathrm{s}^{2}$ (from $10 \mathrm{~Hz} \ldots 500 \mathrm{~Hz}$ ) |  |  |

### 3.3 Mechanical data

### 3.3.1 Degree of protection

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


Figure 3.1 IP degree of protection

| Item |  | Degree of <br> protection |
| :--- | :--- | :--- |
| 1 | Shaft bushing | IP41 |
|  | Shaft bushing with GBX gear (accessory) | IP54 |
| 2 | Housing, except shaft bushing | IP54 |

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

Overview of IP degrees of
protection

First digit
Second digit
Protection against intrusion of Protection against intrusion of water objects

| 0 | No protection | 0 | No protection |
| :--- | :--- | :--- | :--- |
| 1 | External objects $>50 \mathrm{~mm}$ | 1 | Vertically falling dripping water |
| 2 | External objects $>12 \mathrm{~mm}$ | 2 | Dripping water falling at an angle <br> $\left(75^{\circ} \ldots 90^{\circ}\right)$ |
| 3 | External objects $>2.5 \mathrm{~mm}$ | 3 | Spraying water |
| 4 | External objects $>1 \mathrm{~mm}$ | 4 | Splashing water |
| 5 | Dust-protected | 5 | Water jets |
| 6 | Dust-tight | 6 | Heavy sea |
|  | 7 | Immersion |  |

Degree of protection if STO is used
You must ensure that conductive substances cannot get into the product (pollution degree 2). If you use the safety function and conductive substances get into the product, the safety function may become inoperative.

### 3.3.2 Mounting position

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

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


### 3.3.3 Dimensions



Figure 3.2 Dimensions
(1) Insert with cable entry (accessory)
(2) Insert kit (accessory)
(3) Industrial connector (option)

| Total length L | ILA••571... |  | $\bullet \bullet 1$ A0 | - 2 2A0 | $\bullet$-1F0 |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | L | [mm] | 145.3 | 179.3 | 190.8 |
|  | ILA••572... |  | $\bullet \bullet 1$ A0 | - 2 2A0 | $\bullet \bullet 2 \mathrm{~F} 0$ |
|  | L | [mm] | 163.8 | 197.8 | 209.3 |

### 3.4 Electrical Data

Overview of printed circuit board connectors


Figure 3.3 Overview of printed circuit board connectors

### 3.4.1 Supply Voltage VDC at CN1

|  |  | ILA1•571 | ILA1•572 |
| :--- | :--- | :--- | :--- |
| Nominal voltage | $\left[\mathrm{V}_{\mathrm{dc}}\right]$ | $24 / 36$ | $24 / 36$ |
| Limit values | $\left[\mathrm{V}_{\mathrm{dc}}\right]$ | $18 \ldots 40$ | $18 \ldots 40$ |
| Ripple at nominal voltage | $\left[\mathrm{V}_{\mathrm{pp}}\right]$ | $\leq 3.6$ | $\leq 3.6$ |
| Max. continuous current input ${ }^{1)}$ | $[\mathrm{A}]$ |  |  |
| Winding type $P$ |  | 5 | 7.5 |
| Winding type T | $[\mathrm{A}]$ | 7 | 7.5 |
| Peak input current |  | 11 | 8.5 |
| Winding type $P$ | $[\mathrm{~A}]$ | $\leq 16$ | $\leq 16$ |
| Winding type T |  |  |  |
| Fuse to be connected upstream ${ }^{2)}$ |  |  |  |

1) The actual power requirement is often significantly lower, because the maximum possible motor torque is usually not required for operation of a system.
2) See chapter 5.1.1 "Supply voltage"

Inrush current current
Charging current for capacitor $\mathrm{C}=1500 \mu \mathrm{~F}$

### 3.4.2 Fieldbus at CN2

CAN bus signals The CAN bus signals comply with the ISO 11898 standard and are not galvanically isolated.

| Transmission rate | [kBaud]$50 / 100 / 125 / 250 / 500 / 800 /$ <br>  <br>  <br> Transmission protocol$\quad$ CANopen as per DS301 |
| :--- | :--- |

Profibus signals The Profibus signals comply with the RS485 standard and are galvanically isolated.

| Transmission rate | [kBaud]$9.6 / 19.2 / 45.45 / 93.75 / 187.5 /$ <br>  <br>  <br> Transmission protocol$\quad$ Profibus DP V0 |
| :--- | :---: |

### 3.4.3 Reference value supply to CN2

Pulse/direction, $A / B / /$ input signals
Reference signals for operating mode Electronic Gear

| Symmetrical |  | Conforming to RS422 |
| :--- | :--- | :--- |
| Input frequency pulse/direction | $[\mathrm{kHz}]$ | $\leq 200$ |
| Input frequency A/B | $[\mathrm{kHz}]$ | $\leq 200$ |

### 3.4.4 Fieldbus at CN3

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

| Transmission rate | [kBaud] | $9.6 / 19.2 / 38.4$ |
| :--- | :--- | :--- |
| Transmission protocol |  | Manufacturer-specific protocol |

### 3.4.5 24V signals to CN4

Signal inputs The signal inputs are galvanically connected to OVDC and not protected against reverse polarity.

| Logic $0\left(\mathrm{U}_{\text {low }}\right)$ | $[\mathrm{V}]$ | $-3 \ldots+4.5$ |
| :--- | :--- | :--- |
| Logic $1\left(\mathrm{U}_{\text {high }}\right)$ | $[\mathrm{V}]$ | $+15 \ldots+30$ |
| Input current (typical at 24 V$)$ | $[\mathrm{mA}]$ | 2 |
| Debounce time I00 ... IO3 | $[\mathrm{ms}]$ | 0.1 |
| Debounce time I02 and I03 ${ }^{1)}$ | $[\mathrm{ms}]$ | 0.01 |

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

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

| Nominal voltage | $[\mathrm{V}]$ | 24 |
| :--- | :--- | :--- |
| Voltage range | $[\mathrm{V}]$ | $23 \ldots 25$ |
| Maximum current (total) | $[\mathrm{mA}]$ | 200 |
| Maximum current per output | $[\mathrm{mA}]$ | 100 |
| Suitable for inductive loads | $[\mathrm{mH}]$ | 1000 |

### 3.4.6 STO safety function at CN5 and CN6

The signal inputs are galvanically connected to OVDC.

| Logic 0 ( $\mathrm{U}_{\text {low }}$ ) | [V] | -3 $\ldots+4.5$ |
| :---: | :---: | :---: |
| Logic 1 ( $U_{\text {high }}$ ) | [V] | +15 ... +30 |
| Input current STO_A (PWRR_A) (typical at 24V) | [mA] | $\leq 10$ |
| Input current STO_B (PWRR_B) (typical at 24V) | [mA] | $\leq 3$ |
| Debounce time | [ms] | 1 |
| Detection of signal difference between STO_A (PWRR_A) and STO_B (PWRR_B) | [s] | $\geq 1$ |
| Response time (until shutdown of power stage) | [ms] | <50 |
| Permitted test pulse width of upstream devices | [ms] | <1 |

Data for maintenance plan and safety calculations

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

| Lifetime (IEC 61508) |  | 20 years |
| :---: | :---: | :---: |
| SFF (IEC 61508) <br> Safe Failure Fraction | [\%] | 66 |
| HFT (IEC 61508) <br> Hardware Fault Tolerance <br> Type A subsystem |  | 1 |
| Safety integrity level <br> IEC 61508 <br> IEC 62061 |  | $\begin{aligned} & \text { SIL2 } \\ & \text { SILCL2 } \end{aligned}$ |
| PFH (IEC 61508) <br> Probability of Dangerous Hardware Failure per Hour | [1/h] | $1.84 * 10^{-9}$ |
| PL (ISO 13849-1) <br> Performance Level |  | d (Category 3) |
| MTTF $_{\mathrm{d}}$ (EN 13849-1) <br> Mean Time to Dangerous Failure |  | 4566 years |
| DC (EN 13849-1) <br> Diagnostic Coverage | [\%] | 90 |

### 3.5 Conditions for UL 508C

| Ambient temperature during operation | If the product is used to comply with UL 508C, the following conditions must be met: |  |  |
| :---: | :---: | :---: | :---: |
|  | Surrounding air temperature | [ ${ }^{\circ} \mathrm{C}$ ] | $0 \ldots+50$ |
|  | Surrounding air temperature with current reduction of $2 \%$ per Kelvin | $\left[{ }^{\circ} \mathrm{C}\right]$ | $50 . . .65$ |

Pollution degree Use in an environment with pollution degree 2.
Power supply Use only power supply units that are approved for overvoltage category III.

Wiring Use only $60 / 75{ }^{\circ} \mathrm{C}$ copper conductors.

## 4 Basics

### 4.1 Functional safety

IEC 61508 standard

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

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

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

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

| SFF | HFT type A subsystem |  |  | HFT type $\mathbf{B}$ <br> subsystem |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :---: |
|  | $\mathbf{0}$ | $\mathbf{1}$ | $\mathbf{2}$ | $\mathbf{0}$ | $\mathbf{1}$ | $\mathbf{2}$ |  |
| $<60 \%$ | SIL1 | SIL2 | SIL3 | --- | SIL1 | SIL2 |  |
| $60 \% \ldots<90 \%$ | SIL2 | SIL3 | SIL4 | SIL1 | SIL2 | SIL3 |  |
| $90 \% \ldots<99 \%$ | SIL3 | SIL4 | SIL4 | SIL2 | SIL3 | SIL4 |  |
| $\geq 99 \%$ | SIL3 | SIL4 | SIL4 | SIL3 | SIL4 | SIL4 |  |

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

## 5 Engineering

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

### 5.1 External power supply units

## A DANGER

ELECTRIC SHOCK CAUSED BY INCORRECT POWER SUPPLY UNIT
The VDC and +24 VDC supply voltages are connected with many exposed signal connections in the drive system.

- Use a power supply unit that meets the PELV (Protective Extra Low Voltage) requirements.
- Connect the negative output of the power supply unit to PE (ground).
Failure to follow these instructions will result in death or serious injury.


### 5.1.1 Supply voltage

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

The actual power requirements are often significantly lower because the maximum possible motor torque is usually not required for normal operation of a system.
When designing the system, note that the input current of the drive is higher during the motor acceleration phase than during constant movement.

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

Fuse: a circuit-breaker (16 A, trip characteristic B) or a blade fuse (FKS, max. 15 A ) or a fuse ( $5 \mathrm{~mm} \times 20 \mathrm{~mm}, 10$ A slow-blow).

Regeneration condition

24 V signal power supply

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

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

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

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

Braking resistor controllers can be found in chapter 11 "Accessories and spare parts". See the product manual for a description of the braking resistor controller.

## A CAUTION <br> LOSS OF CONTROL DUE TO REGENERATION CONDITION <br> Regeneration conditions resulting from braking or external driving forces may increase the VDC supply voltage to an unexpected level. Components not rated for this voltage may be destroyed or cause misoperation. <br> - Verify that all VDC consumers are rated for the voltage occurring during regeneration conditions (for example limit switches). <br> - Use only power supply units that will not be damaged by regeneration conditions. <br> - Use a braking resistor controller, if necessary. <br> Failure to follow these instructions can result in injury or equipment damage.

A constant 24 V signal power supply is available for the sensor system. It must not be connected in parallel with the 24 V signal power supply of a different drive.

### 5.2 Ground design

The ground connections of all interfaces are galvanically connected, including the ground for the VDC supply voltage.
The module interfaces with galvanic isolation such as Profibus are exceptions to this.

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

- The voltage drop in the VDC power supply lines must be kept as low as possible (less than 1 V ). At higher ground potential differences between different drives, the communication / control signals may be affected.
- If the distance between the system components is greater, it is recommended to use decentralized power supply units close to the individual drives to supply the VDC voltage. However, the ground connections of the individual power supply units must be connected with the largest possible conductor cross section.
- The internal 24 V signal power supply must not be connected in parallel with the internal 24 V signal power supply of a different drive.
- If the master controller (e.g. PLC, IPC etc.) does not have galvanically isolated outputs for the drives, you must verify that the current of the VDC supply voltage has no path back to the power supply unit via the master controller. Therefore, the master controller ground may be connected to the VDC supply voltage ground at a single point only. This is usually the case in the control cabinet. The ground contacts of the various signal connectors in the drive are therefore not connected; there is already a connection via the VDC supply voltage ground.
- If the controller has a galvanically isolated interface for communication with the drives, the ground of this interface must be connected to the signal ground of the first drive. This ground may be connected to a single drive only to avoid ground loops. This also applies to a galvanically isolated CAN connection.

Potential differences can result in excessive currents on the cable shields. Use equipotential bonding conductors to reduce currents on the cable shields.

The equipotential bonding conductor must be rated for the maximum current flowing. Practical experience has shown that the following conductor cross sections can be used:

- $16 \mathrm{~mm}^{2}$ (AWG 4) for equipotential bonding conductors up to a length of 200 m
- $20 \mathrm{~mm}^{2}$ (AWG 4) for equipotential bonding conductors with a length of more than 200 m


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

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

### 5.3.1 Definitions

Safety function STO (IEC 61800-5-
the motor torque safely. It is not necessary to interrupt the supply voltage. There is no monitoring for standstill.
"Power Removal" The STO safety function ("Safe Torque Off") is also known as "Power Removal".

Category 0 stop (EN 60204-1) Stopping by immediate removal of power to the machine actuators (i.e. an uncontrolled stop).

Category 1 stop (EN 60204-1) Controlled stop with power available to the machine actuators to achieve the stop. Power is not interrupted until the stop is achieved.

### 5.3.2 Function

|  | The STO safety function integrated into the product can be used to implement an "EMERGENCY STOP" (EN 60204-1) for category 0 stops. With an additional, approved EMERGENCY STOP module, it is also possible to implement category 1 stops. |
| :---: | :---: |
| Function principle | The STO safety function is triggered via 2 redundant inputs. The circuits of the two inputs must be separate so that there are always two channels. |
|  | The switching process must be simultaneous for both inputs (skew <1s). The power stage is disabled and an error message is generated. The motor can no longer generate torque and coasts down without braking. A restart is possible after resetting the error message with a "Fault Reset". |
|  | The power stage is disabled and an error message is generated if only one of the two inputs is switched off or if the skew is too great. This error message can only be reset by switching off the product. |

### 5.3.3 Requirements for using the safety function

## A WARNING <br> LOSS OF SAFETY FUNCTION <br> Incorrect usage may cause a hazard due to the loss of the safety function. <br> - Observe the requirements for using the safety function. <br> Failure to follow these instructions can result in death or serious injury.

$\left.\begin{array}{ll}\begin{array}{l}\text { Category } 0 \text { stop }\end{array} & \begin{array}{l}\text { During a category } 0 \text { stop, the motor coasts down in an uncontrolled way. } \\ \text { If access to the machine coasting down involves a hazard (results of the } \\ \text { hazard and risk analysis), you must take appropriate measures. }\end{array} \\ \text { Category } 1 \text { stop }\end{array} \quad \begin{array}{l}\text { A controlled stop must be triggered with a category } 1 \text { stop. The control- } \\ \text { led stop is not monitored by the drive system; in the case of a power out- } \\ \text { age or an error, the stop may not be performed correctly. Final shutoff of } \\ \text { the motor is achieved by switching off the two inputs of the STO safety } \\ \text { function. The shutoff is usually controlled by a standard EMERGENCY }\end{array}\right\}$

Degree of protection if STO is used You must ensure that conductive substances cannot get into the product (pollution degree 2). If you use the safety function and conductive substances get into the product, the safety function may become inoperative.

Protected cable installation

Data for maintenance plan and safety calculations

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

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

- Use separate cables for two signals. Any additional wires in these cables may only carry voltages according to PELV.
- Use a shielded cable. The grounded shield is designed to dissipate the external voltage in the case of damages and to trip the fuse in this way.
- Use a separately grounded shield. If there are other wires in the cable, the two signals must be isolated from these wires by a grounded, separate shield.
Use the following data of the STO safety function for your maintenance plan and the safety calculations:

| Lifetime (IEC 61508) |  | 20 years |
| :--- | :--- | :--- |
| SFF (IEC 61508) <br> Safe Failure Fraction | [\%] | 66 |
| HFT (IEC 61508) <br> Hardware Fault Tolerance <br> Type A subsystem |  | 1 |
| Safety integrity level <br> IEC 61508 |  | SIL2 |
| IEC 62061 | SILCL2 |  |
| PFH (IEC 61508) <br> Probability of Dangerous Hard- <br> ware Failure per Hour | $1.84^{\star 10-9}$ |  |
| PL (ISO 13849-1) <br> Performance Level |  |  |
| MTTF |  |  |
| Mean Time 13849-1) |  | 4566 years |
| DC (EN 13849-1) | [\%] | 90 |
| Diagnostic Coverage |  |  |

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

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

### 5.3.4 Application examples STO

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


Figure $5.1 \quad$ Example of category 0 stop
Please note:

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

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


Figure 5.2 Example of category 1 stop
Please note:

- The master controller must immediately trigger a controlled stop, e.g. via the "Quick Stop" function.
- The inputs $\overline{\text { STO_A }}$ ( $\overline{\text { PWRR_A }}$ ) and $\overline{\text { STO_B }}$ ( $\overline{\text { PWRR_B }}$ ) must be switched off with a time delay. The delay is set at the EMERGENCY STOP safety module. If the motor has not yet stopped when the delay time has elapsed, it coasts down in an uncontrolled way (uncontrolled stop).
- The specified minimum current and the permissible maximum current of the relay must be observed if the relay outputs of the EMERGENCY STOP module are used.


### 5.4 Monitoring functions

The monitoring functions in the product can help to guard the system and reduce the risks involved in a system misoperation. These monitoring functions may not be used to protect persons.

The following monitoring functions are available:

| Monitoring | Task |
| :--- | :--- |
| Data link | Error response if the link becomes inoperative |
| Limit switch signals | Monitors for permissible range of travel |
| $1^{2}$ t limitation | Power limitation in event of overloading |
| Tracking error | Monitors for difference between actual motor position and reference position |
| STOP switch signal | Stops motor with "Quick Stop" |
| Overvoltage and undervoltage | Monitors for overvoltage and undervoltage of the supply voltage |
| Motor overload | Monitors for excessively high current in the motor phases |
| Overtemperature | Monitors the device for overtemperature |

## 6 Installation

## A WARNING

## LOSS OF CONTROL

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

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

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

## A CAUTION

## RISK OF INJURY WHEN REMOVING CIRCUIT BOARD PLUGS

- When removing them note that the connectors must be unlocked.
- Supply voltage VDC:

Unlock by pulling at the plug housing

- Miscellaneous:

Unlock by pressing the locking lever

- Always hold the plug to remove it (not the cable).

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

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

### 6.1 Electromagnetic compatibility, EMC

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

This drive system meets the EMC requirements according to the standard IEC 61800-3, if the described measures are implemented during installation. If it is operated outside this scope, note the following:

## WARNING

HIGH-FREQUENCY INTERFERENCE
In a domestic environment this product may cause high-frequency interference that may require action to suppress interference.

| EMC measures | Effect |
| :--- | :--- |
| Keep cables as short as possible. Do not | Reduces capacitive and induc- |
| install unnecessary cable loops, use short | tive interference. |
| cables from the star point in the control cabi- |  |
| net to the external ground connection. |  |
| Ground the product via the motor flange or | Reduces emissions, increases |
| with a ground strap to the ground connection | immunity. |
| at the cover of the connector housing. |  |
| Ground shields of digital signal wires at both | Reduces interference affecting |
| ends by connecting them to a large surface or the signal wires, reduces emis- |  |
| via conductive connector housings. | sions |
| Connect large surface areas of cable shields, | Reduces emissions. |
| use cable clamps and ground straps |  |

The following cables must be shielded:

- Fieldbus cable
- STO safety function, see the requirements in chapter 5.3.3 "Requirements for using the safety function".

The following cables do not need to be shielded:

- Supply voltage VDC
- 24 V signal interface

Potential differences can result in excessive currents on the cable shields. Use equipotential bonding conductors to reduce currents on the cable shields.

The equipotential bonding conductor must be rated for the maximum current flowing. Practical experience has shown that the following conductor cross sections can be used:

- $16 \mathrm{~mm}^{2}$ (AWG 4) for equipotential bonding conductors up to a length of 200 m
- $20 \mathrm{~mm}^{2}$ (AWG 4) for equipotential bonding conductors with a length of more than 200 m


### 6.2 Mechanical installation

| $\quad$ A CAUTION |
| :--- |
| HOT SURFACES |
| Depending on the operation, the surface may heat up to more than |
| $100^{\circ} \mathrm{C}\left(212^{\circ} \mathrm{F}\right)$. |
| - Do not allow contact with the hot surfaces. |
| - Do not allow flammable or heat-sensitive parts in the immediate |
| vicinity. |
| - Consider the measures for heat dissipation described. |
| - Check the temperature during test runs. |
| Failure to follow these instructions can result in injury or equip- |
| ment damage. |

## A CAUTION

## MOTOR DAMAGE AND LOSS OF CONTROL

Shock or strong pressure applied to the motor shaft may destroy the motor.

- Protect the motor shaft during handling and transportation.
- Avoid shocks to the motor shaft during mounting.
- Do not press parts onto the shaft. Mount parts to the shaft by glueing, clamping, shrink-fitting or screwing.
Failure to follow these instructions can result in injury or equipment damage.

| A WARNING |
| :--- |
| MOTOR WITHOUT BRAKING EFFECT |
| If power outage and faults cause the power stage to be switched off, |
| the motor is no longer stopped by the brake and may increase its |
| speed even more until it reaches a mechanical stop. |
| - Verify the mechanical situation. |
| - If necessary, use a cushioned mechanical stop or a suitable |
| brake. |
| Failure to follow these instructions can result in death, serious |
| injury or equipment damage. |

## A WARNING

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

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

- Do not use the brake as a service brake.
- Note that "EMERGENCY STOPS" may also cause wear
- At operating temperatures of more than $80^{\circ} \mathrm{C}\left(176^{\circ} \mathrm{F}\right)$, do not exceed a maximum of $50 \%$ of the specified holding torque when using the brake.
Failure to follow these instructions can result in death, serious injury or equipment damage.


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

Heat dissipation

Mounting

Ambient conditions

The motor may become very hot, e.g. in the case of incorrect arrangement of multiple motor. The surface temperature of the motor must not exceed $110^{\circ} \mathrm{C}$ during continuous operation.

- Verify that the maximum temperature is not exceeded.
- Verify that there is sufficient heat dissipation, e.g. by means of good ventilation or heat dissipation via the motor flange.

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

Painted surfaces have an insulating effect. During mounting verify that the motor flange is mounted in such a way as to allow for good conductivity (electrical and thermal).
No minimum clearances are required for installation. However, note that the motor can become very hot.

Observe the bending radii of the cables used.
Observe the permissible ambient conditions.

### 6.3 Electrical installation

## A WARNING <br> UNEXPECTED BEHAVIOR CAUSED BY FOREIGN OBJECTS <br> Foreign objects, deposits or humidity can cause unexpected behavior. <br> - Keep foreign objects from getting into the product. <br> - Do not remove the cover of the electronics housing. Only remove the connector housing cover. <br> - Verify correct seat of seals and cable entries. <br> Failure to follow these instructions can result in death, serious injury or equipment damage.

## A WARNING <br> LOSS OF SAFETY FUNCTION CAUSED BY FOREIGN OBJECTS <br> Conductive foreign objects, dust or liquids may cause the STO safety function to become inoperative. <br> - You may not use the STO safety function unless you have protected the system against contamination by conductive substances. <br> Failure to follow these instructions can result in death or serious injury.

## A CAUTION

DAMAGE TO SYSTEM COMPONENTS AND LOSS OF CONTROL
Interruptions of the negative connection of the controller supply voltage can cause excessively high voltages at the signal connections.

- Do not interrupt the negative connection between the power supply unit and load with a fuse or switch.
- Verify correct connection before switching on.
- Do not connect the controller supply voltage or change its wiring while the is supply voltage present.
Failure to follow these instructions can result in injury or equipment damage.


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

The drive is equipped with parameter switches in the connector housing. Set the parameter switches before connecting the cables, because after connection they are difficult to access.

### 6.3.1 Wiring examples

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


Figure 6.1 Wiring example
The UBC60 braking resistor controller is available as an accessory, see chapter 11 "Accessories and spare parts".

### 6.3.2 Overview of all connections

Overview of printed circuit board connectors

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


Figure 6.2 Overview of all connections

| Connection | Assignment |
| :--- | :--- |
| CN1 | Supply voltage VDC |
| CN2 | Interface for PROFIBUS DP and operating mode Electronic <br> Gear (reference signals) |
| CN3 | Interface for CAN or RS485 |
| CN4 | 24 V signal interface |
| CN5 | Interface for STO safety function |
| CN6 | Jumper for disabling STO safety function |

The drive can be connected via cable entries or industrial connectors.
For connection via cable entries see page 52.
For connection via industrial connectors see page 55.

### 6.3.3 Connection via cable entry

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

Preparing and fastening cables


Figure 6.3 Fastening the cable in the cable entry
(1) Unshielded cable
(2) Shielded cable

- Trim the cable bushings to fit the cable.

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

- (A) Strip the jacket of all cables; length 70 mm .
- (B) Shorten the shield to a rest of 10 mm .
- (C) Slide the shield braiding back over the cable jacket.
- (D) Loosen the strain relief.
- Push the cables though the strain relief.
- Glue EMC shielding foil around the shield.
- Pull the cable back to the strain relief.
- Fasten the strain relief.

Mounting connectors
The table below lists the parts and data required for assembly. Connector housings and crimp contacts are included in the accessories kit. See also chapter 11 "Accessories and spare parts".


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

| Connection | Conductor cross section of the crimp contact [ $\mathrm{mm}^{2}$ ] | Stripping length [mm] | Manufacturer's crimp contact no. | Crimping tool | Connector manufacturer | Connector type |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CN1 | $\begin{aligned} & 0.75 \ldots 1.5 \text { (AWG } 18 \ldots \text { 16) } \\ & 2.5 \ldots 4.0 \text { (AWG 12) } \end{aligned}$ | 5... $65 \ldots 6$ | $\begin{aligned} & 160773-6 \\ & 341001-6 \end{aligned}$ | 654174-1 | Tyco Electronics | Positive Lock 1-926 522-1 |
| CN2 | 0.14 ... 0.6 (AWG $24 . . .20$ ) | 2.5 ... 3.0 | 43030-0007 | 69008-0982 | Molex | $\begin{aligned} & \text { Micro-Fit } 3.0 \\ & 43025-1200 \end{aligned}$ |
| CN3 | 0.25 ... 1.0 (AWG $24 . . .18$ ) | 3.0 ... 3.5 | 39-00-0060 | 69008-0724 | Molex | Mini-Fit Jr. 39-01-2065 |
| CN4 | 0.14 ... 0.6 (AWG $24 . . .20$ ) | 2.5 ... 3.0 | 43030-0007 | 69008-0982 | Molex | $\begin{aligned} & \text { Micro-Fit } 3.0 \\ & 43025-0600 \end{aligned}$ |
| CN5 | 0.14 ... 0.6 (AWG $24 . . .20$ ) | 2.5 ... 3.0 | 43030-0007 | 69008-0982 | Molex | $\begin{aligned} & \text { Micro-Fit } 3.0 \\ & 43645-0200 \end{aligned}$ |

Prepare the cable for connection as follows:

- Strip the ends of the cable.
- Attach cable lugs and crimp contacts. Verify that you have the correct crimp contacts and the matching crimping tool.
- Slide the cable lugs and crimp contacts straight into the connector until they snap in place.


Figure 6.4 Connectors, cable lugs and crimp contacts
(1) Supply voltage VDC
(2) Fieldbus IN for PROFIBUS DP
(3) Fieldbus OUT for PROFIBUS DP
(4) Fieldbus IN for CAN or RS485
(5) Fieldbus OUT for CAN or RS485
(6) 24 V signal interface
(7) Shield wire with EMC shield foil

## Mounting the cable entry



Figure 6.5 Inserting the cable entries

- Unscrew the connector housing cover.

NOTE: Shipping locks made of cardboard must not be used for operating the drive. Replace all shipping locks by cable entries or signal inserts.

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

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

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

Only pull the connector housing (not the cable).

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

NOTE: The pointed corners of the cable entry must point in the direction of the connector housing cover. Degree of protection IP54 is not reached if the cable entry is mounted the other way round.


- Close the cutout that is not used with a sealing insert for cutouts.
- Finally, screw the connector housing cover back into place.

If screws are lost use M3x12 only.

### 6.3.4 Connection with industrial connectors

| Interface | Connector used |
| :--- | :--- |
| Supply voltage VDC | Hirschmann STASEI 200 |
| Fieldbus PROFIBUS DP <br> in/out | Circular connector M12, 5 poles, B-coded |
| Fieldbus CAN in/out | Circular connector M12, 5 poles, A-coded |
| 24 V signal inputs and out- Circular connector M8, 3 poles <br> puts  |  |
| Safety function STO "Safe <br> Torque Off" (IEC/EN 61800- <br> 5-2) | Circular connector M8, 4 poles |

Because the requirements are different depending on the system configuration, pre-assembled cables specially designed for Ethernet fieldbus connections can be procured from various suppliers.
Information on pre-assembled cables, connector kits and recommended suppliers can be found in chapter 11 "Accessories and spare parts".

### 6.3.5 Connection of VDC supply voltage

## DANGER

ELECTRIC SHOCK CAUSED BY INCORRECT POWER SUPPLY UNIT
The VDC and +24VDC supply voltages are connected with many exposed signal connections in the drive system.

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

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

| ! CAUTION |
| :--- |
| LOSS OF CONTROL DUE TO REGENERATION CONDITION |
| Regeneration conditions resulting from braking or external driving |
| forces may increase the VDC supply voltage to an unexpected level. |
| Components not rated for this voltage may be destroyed or cause mi- |
| soperation. |
| - Verify that all VDC consumers are rated for the voltage occurring |
| during regeneration conditions (for example limit switches). |
| - Use only power supply units that will not be damaged by regener- |
| ation conditions. |
| - Use a braking resistor controller, if necessary. |
| Failure to follow these instructions can result in injury or equip- |
| ment damage. |

## CAUTION <br> DAMAGE TO CONTACTS <br> The connection for the controller supply voltage at the product does not have an inrush current limitation. If the voltage is switched on by means of switching of contacts, damage to the contacts or contact welding may result. <br> - Use a power supply unit that limits the peak value of the output current to a value permissible for the contact. <br> - Switch the power input of the power supply unit instead of the output voltage. <br> Failure to follow these instructions can result in equipment damage.

| CAUTION |
| :--- |
| DAMAGE TO SYSTEM COMPONENTS AND LOSS OF CONTROL |
| Interruptions of the negative connection of the controller supply volt- |
| age can cause excessively high voltages at the signal connections. |
| - Do not interrupt the negative connection between the power sup- |
| ply unit and load with a fuse or switch. |
| - Verify correct connection before switching on. |
| - Do not connect the controller supply voltage or change its wiring |
| while the is supply voltage present. |
| Failure to follow these instructions can result in injury or equip- |
| ment damage. |

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

| Minimum conductor cross section | $\left[\mathrm{mm}^{2}\right]$ | 0.75 (AWG 18) |
| :--- | :--- | :--- |
| Maximum connection cross section | $\left[\mathrm{mm}^{2}\right]$ | 4.0 (AWG 12) |
| Stripping length | $[\mathrm{mm}]$ | $5 \ldots 65 \ldots 6$ |
|  |  |  |
| Crimp contact 1607736-6 | $\left[\mathrm{mm}^{2}\right]$ |  |
| Minimum connection cross section |  | 0.75 (AWG 18) |
| Maximum connection cross section |  | 1.5 (AWG 16) |
| Crimp contact 341001-6 | $\left[\mathrm{mm}^{2}\right]$ |  |
| Minimum connection cross section |  | 2.5 (AWG 12) |
| Maximum connection cross section |  | 4.0 (AWG 12) |

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

- Use pre-assembled cables to reduce the risk of wiring errors.
- Verify that wiring, cables and connected interfaces meet the PELV requirements.

Connecting the cables

Pin assignment printed circuit board connector

- Note the specified technical data.
- Note the information provided in chapters 5.1 "External power supply units" and 5.2 "Ground design".
- Install fuses for the power supply cable accordance with the selected conductor cross section / wire gauge (note the inrush currents).


Figure 6.6 Pin assignment supply voltage

| Signal | Meaning | Number ${ }^{1)}$ |
| :--- | :--- | :--- |
| VDC | Supply voltage | 1 |
| OVDC | Reference potential to VDC | 2 |

1) Information relates to pre-assembled cables

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

## Pin assignment industrial connector



Figure 6.7 Pin assignment supply voltage

| Pin | Signal | Meaning | Number ${ }^{\text {1) }}$ |
| :--- | :--- | :--- | :--- |
| 1 | VDC | Supply voltage | 1 |
| 2 | OVDC | Reference potential to VDC | 2 |
| 1) Information relates to pre-assembled cables |  |  |  |

### 6.3.6 PROFIBUS DP connection

Function The PROFIBUS DP interface allows you to network the product as a slave in a Profibus network.

The drive system receives data and commands from a master bus device. Status information such as operating state and processing state is sent to the master as acknowledgement.

The fieldbus manual for the product provides detailed description on fieldbus networking.

Cable specifications and terminal

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

| Maximum cable length | $[\mathrm{m}]$ | See next table |
| :--- | :--- | :--- |
| Minimum conductor cross section | $\left[\mathrm{mm}^{2}\right]$ | 0.34 (AWG 24) |
| Maximum connection cross section | $\left[\mathrm{mm}^{2}\right]$ | 0.6 (AWG 20) |
| Stripping length | $[\mathrm{mm}]$ | $2.5 \ldots 3.0$ |

The maximum cable length depends on the baud rate and the signal propagation delay. The higher the baud rate, the shorter the bus cable needs to be.

| 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 |

- Use equipotential bonding conductors, see page 46.
- Use pre-assembled cables to reduce the risk of wiring errors.
- Verify that wiring, cables and connected interfaces meet the PELV requirements.

Terminating resistor Both ends of the entire bus system must be terminated with a terminating resistor.

The terminating resistor is already integrated and can be activated at the end of the network with a switch.

The diagram below shows the integrated terminating resistor.


Figure 6.8 Terminating resistor

Setting address and baud rate
Every device on the network is identified by a unique, adjustable node address. Slaves on a Profibus network may have addresses in the range from 3 to 126. Addresses 0 to 2 are reserved for master devices.

The baud rate is detected automatically.
Factory settings:

- Address: 126
- Terminating resistor: OFF

|  | LED | S2 |
| :---: | :---: | :---: |
|  |  | $\begin{array}{c\|c} \text { ON } & \square \\ \text { OFF } & \square \end{array}$ |
| Bit6.................Bit0 |  |  |

Figure 6.9 Parameter switch

| Switch setting S1: | S1.2 | S1.3 | S1.4 | S1.5 | S1.6 | S1.7 | S1.8 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Address bit: | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Fieldbus address 126 (default) | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Fieldbus address 25 (example) | 0 | 0 | 1 | 1 | 0 | 0 | 1 |


| Switch setting S2: | S2.1 |
| :--- | :--- |
| Terminating resistor on | ON |
| Terminating resistor off | OFF |


| LED | Communication indicator |
| :--- | :--- |
| LED on | Communication OK |
| LED off | No communication |

Reserved parameter switches are provided for future extensions and must be set to OFF.

NOTE: Each device must have its own unique node address, which may only be assigned once in the network.

Pin assignment printed circuit board connector


Figure 6.10 Pin assignment of Profibus fieldbus interface

| Pin | Signal | Meaning (Color ${ }^{\text {1) }}$ ) | SUB-D ${ }^{\text {1) }}$ |
| :--- | :--- | :--- | :--- |
| $\mathbf{1 2}$ | R×D/T×D-N | Profibus interface (green) IN | 8 |
| 11 | R×D/T×D-P | Profibus interface (red) IN | 3 |
| 6 | R×D/T×D-N | Profibus interface (green) OUT | 8 |
| 5 | R×D/T×D-P | Profibus interface (red) OUT | 3 |

1) Information refers to pre-assembled cables

Pin assignment industrial connector


Figure 6.11 Pin assignment of Profibus fieldbus interface

| Pin | Signal | Meaning |
| :--- | :--- | :--- |
| 2 | R×D/TxD-N | Profibus interface |
| 4 | R×D/TxD-P | Profibus interface |
| 5 |  | Internally connected to housing |

The shield of the cable (SHLD) must be connected to the connector housing.

### 6.3.7 CAN connection

Function The CAN interface allows you to network the product as a slave in a CANopen network as per DS301.

The drive system receives data and commands from a master bus device. Status information such as operating state and processing state is sent to the master as acknowledgement.

The fieldbus manual for the product provides detailed description on fieldbus networking.

Cable specifications and terminal

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

| Maximum cable length | $[\mathrm{m}]$ | See next table |
| :--- | :--- | :--- |
| Minimum conductor cross section | $\left[\mathrm{mm}^{2}\right]$ | $0.25($ AWG 22) |
| Maximum connection cross section | $\left[\mathrm{mm}^{2}\right]$ | $1.0($ AWG 18) |
| Stripping length | $[\mathrm{mm}]$ | $3.0 \ldots 3.5$ |

The maximum cable length depends on the number of network devices, the baud rate and the signal propagation delay. 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 |

- Use equipotential bonding conductors, see page 46.
- Use pre-assembled cables to reduce the risk of wiring errors.
- Verify that wiring, cables and connected interfaces meet the PELV requirements.

Terminating resistor
Both ends of the entire bus system must be terminated with a terminating resistor.

The terminating resistor is already integrated and can be activated at the end of the network with a switch.

| Fieldbus | Terminating resistor |
| :--- | :--- |
| CAN-Bus | $120 \Omega$ between CAN_H and CAN_L |

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

Factory settings:

- Address: 127
- Baud rate: 125 kBaud


Figure 6.12 Parameter switch

| Switch settings S1 and S2: | S1.2 | S1.3 | S1.4 | S2.1 | S2.2 | S2.3 | S2.4 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Address bit: | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Fieldbus address 127 (default) | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Fieldbus address 25 (example) | 0 | 0 | 1 | 1 | 0 | 0 | 1 |


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

Reserved parameter switches are provided for future extensions and must be set to OFF.

Pin assignment printed circuit board
NOTE: Each device must have its own unique node address, which may only be assigned once in the network.

## connector



Figure 6.13 Pin assignment of CAN fieldbus interface

| Pin | Signal | Meaning | SUB-D ${ }^{\mathbf{1 4}}$ |
| :--- | :--- | :--- | :--- |
| 3 | CAN_H | CAN interface | 7 |
| 6 | CAN_L | CAN interface | 2 |
| 4 | CAN_0V | Internally connected to CN1.0VDC | 3 |

1) Information relates to pre-assembled cables

Pin assignment industrial connector


1 SHLD
2 CAN_OV 4 CAN_H
5 CAN_L


Figure 6.14 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 to CN1.0VDC |
| 4 | CAN_H | CAN interface |
| 5 | CAN_L | CAN interface |

### 6.3.8 RS485 connection

Function The drive system is commissioned via the RS485 interface and the commissioning software.

In addition, the RS485 interface allows you to network the product as a slave in an RS485 network.

The fieldbus manual for the product provides detailed description on fieldbus networking.

Cable specifications and terminal

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

| Maximum cable length | $[\mathrm{m}]$ | 400 |
| :--- | :--- | :--- |
| Minimum conductor cross section | $\left[\mathrm{mm}^{2}\right]$ | 0.25 (AWG 22) |
| Maximum connection cross section | $\left[\mathrm{mm}^{2}\right]$ | 1.0 (AWG 18) |
| Stripping length | $[\mathrm{mm}]$ | $3.0 \ldots 3.5$ |

- Use equipotential bonding conductors, see page 46.
- Use pre-assembled cables to reduce the risk of wiring errors.
- Verify that wiring, cables and connected interfaces meet the PELV requirements.

Terminating resistor
Both ends of the entire bus system must be terminated with a terminating resistor.

The terminating resistor is already integrated and can be activated at the end of the network with a switch

| Fieldbus | Terminating resistor |
| :--- | :--- |
| RS485 bus | $120 \Omega$ between +RS485 and -RS485 |

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

Factory settings:

- Address: 1
- Baud rate: 9600
- Data format: 7 bits

Even parity
1 stop bit
In the case of devices with CAN or Profibus fieldbus interfaces, the address and the baud rate of the RS485 interface are set via the commissioning software.

In the case of devices without CAN or Profibus fieldbus interfaces, the address and the baud rate of the RS485 interface are set via parameter switches.


Figure 6.15 Parameter switch

| Switch settings S1 and S2: | 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 setting S4 | Baud rate (Kbaud) | Format |
| :--- | :--- | :--- |
| 0 | 9600 | $7-\mathrm{E}-1$ |
| 1 | 19200 | $7-\mathrm{E}-1$ |
| 2 | 38400 | $7-\mathrm{E}-1$ |
| 3 | - | - |
| 4 | 9600 | $7-\mathrm{N}-1$ |
| 5 | 19200 | $7-\mathrm{N}-1$ |
| 6 | 38400 | $7-\mathrm{N}-1$ |
| 7 | - | - |
| 8 | 9600 | $8-\mathrm{E}-1$ |
| 9 | 19200 | $8-\mathrm{E}-1$ |
| $A$ | 38400 | $8-\mathrm{E}-1$ |
| $B$ | - | - |
| $C$ | 9600 | $8-\mathrm{N}-1$ |
| $D$ | 19200 | $8-\mathrm{N}-1$ |
| $E$ | 38400 | $8-\mathrm{N}-1$ |
| $F$ | - | - |

Reserved parameter switches are provided for future extensions and must be set to OFF.

NOTE: Each device must have its own unique node address, which may only be assigned once in the network.

Pin assignment printed circuit board connector


Figure 6.16 Pin assignment RS485

| Pin | Signal | Meaning | SUB-D ${ }^{\text {1) }}$ |
| :--- | :--- | :--- | :--- |
| 2 | +RS485 | RS485 interface | 7 |
| 5 | -RS485 | RS485 interface | 2 |
| 4 | RS485_0V | Internally connected to CN1.0VDC | 3 |

1) Information relates to pre-assembled cables

Pin assignment industrial connector


Figure 6.17 Pin assignment of the RS485 fieldbus interface

| Pin | Signal | Meaning |
| :--- | :--- | :--- |
| 1 | SHLD | Shield connection |
| 2 | - | Not assigned |
| 3 | RS485_0V | Internally connected to CN1.0VDC |
| 4 | +RS485 | RS485 interface |
| 5 | - RS485 | RS485 interface |

### 6.3.9 24 V signal interface connection

24 V signal power supply The 24 V signal power supply provided for constant supply of the sensor system.

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

Cable specifications and terminal

| Minimum conductor cross section | $\left[\mathrm{mm}^{2}\right]$ | 0.2 (AWG 24) |
| :--- | :--- | :--- |
| Maximum connection cross section | $\left[\mathrm{mm}^{2}\right]$ | 0.6 (AWG 20) |
| Stripping length | $[\mathrm{mm}]$ | $2.5 \ldots 3.0$ |

- Use pre-assembled cables to reduce the risk of wiring errors.
- Verify that wiring, cables and connected interfaces meet the PELV requirements.

The 24 V signals can be configured with the parameters IO.IO0_def, 34:1 to IO.I03_def, $34: 4$ as either input or output. Specific functions can also be assigned.

| Function | Possible <br> for <br> signal | Remarks |
| :--- | :--- | :--- |
| Positive limit switch | 100 | Logic level can be configured |
| Negative limit switch | 101 | Logic level can be configured |
| STOP switch | $100 . .3$ | Logic level can be configured |
| Reference switch | $100 . .3$ | For reference movement to REF, level can <br> be configured |
| Freely usable | IO0..3 | Free access via fieldbus |
| Programmable | $100 . .3$ | see chapter 8.3.4 "Programmable inputs <br> and outputs" |



The external monitoring signals $\overline{\text { LIMP }}, \overline{L I M N}, \overline{R E F}$ and STOP are enabled with the parameter
Settings.SignEnabl, 28:13.

Use active 0 monitoring signals if possible, because they are failsafe. Evaluation for active 0 or 1 is set with the parameterSettings.SignLevel, 28:14.

For more information see chapter 7 "Commissioning".

Pin assignment printed circuit board connector


Figure 6.18 Pin assignment of the 24 V signal interface

| Pin | Signal | Meaning | I/O |
| :--- | :--- | :--- | :---: |
| 1 | +24VDC_OUT | The 24V signal supply may be used to supply <br> the sensor system (e.g. limit switches) | O |
| 2 | IO2 | Freely usable input / output | I/O |
| 3 | IO0 | Freely usable input / output | I/O |
| 4 | 0VDC | Internally connected to CN1. 0VDC |  |
| 5 | IO3 | Freely usable input / output | I/O |
| 6 | IO1 | Freely usable input / output | I/O |

### 6.3.10 Connection of STO safety function

| A WARNING |
| :--- |
| LOSS OF SAFETY FUNCTION |
| Incorrect usage may cause a hazard due to the loss of the safety func- |
| tion. |
| - Observe the requirements for using the safety function. |
| Failure to follow these instructions can result in death or serious |
| injury. |

Requirements For information and requirements relating to the STO safety function, see chapter 5.3 "Safety function STO ("Safe Torque Off")".

Cable specifications and terminal

- Shielded cable corresponding to the requirements for protected layout of wires

| Minimum conductor cross section | $\left[\mathrm{mm}^{2}\right]$ | 0.34 (AWG 20) |
| :--- | :--- | :--- |
| Maximum connection cross section | $\left[\mathrm{mm}^{2}\right]$ | 0.6 (AWG 20) |
| Stripping length | $[\mathrm{mm}]$ | $2.5 \ldots 3.0$ |

- Use equipotential bonding conductors, see page 46.
- Use pre-assembled cables to reduce the risk of wiring errors.
- Verify that wiring, cables and connected interfaces meet the PELV requirements.

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

Pin assignment printed circuit board connector


Figure 6.19 Pin assignment of safety function

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

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

Connecting the safety function


- Remove jumper CN6.
- Connect the connector to CN5.


### 6.3.11 Connection of reference signals for CAN or RS485

Function External reference signals for the operating mode "Electronic Gear" can be supplied via CN2. The type of reference signal is set with parameter switch S3.3.

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

- Interface mode "PULSE/DIR"

Pulse/direction signals

- Interface mode "A/B"
$A B$ encoder signals
Cable specifications and terminal
- Shielded cable
- Twisted-pair cables
- Grounding of the shield at both ends

| Maximum cable lenght ${ }^{1)}$ | $[\mathrm{m}]$ | 100 |
| :--- | :--- | :--- |
| Minimum conductor cross section | $\left[\mathrm{mm}^{2}\right]$ | 0.14 (AWG 24) |
| Maximum connection cross section | $\left[\mathrm{mm}^{2}\right]$ | 0.6 (AWG 20) |
| Stripping length | $[\mathrm{mm}]$ | $2.5 \ldots 3.0$ |
| 1) The cable length depends on the conductor cross section and the driver circuit <br> used |  |  |

- Use equipotential bonding conductors, see page 46.
- Use pre-assembled cables to reduce the risk of wiring errors.
- Verify that wiring, cables and connected interfaces meet the PELV requirements.
- Shielded cable
- Twisted-pair cables
- Grounding of the shield at both ends

| Maximum cable lenght ${ }^{1)}$ | $[\mathrm{m}]$ | 100 |
| :--- | :--- | :--- |
| Minimum conductor cross section | $\left[\mathrm{mm}^{2}\right]$ | 0.14 (AWG 24) |
| Maximum connection cross section | $\left[\mathrm{mm}^{2}\right]$ | 0.6 (AWG 20) |
| Stripping length | $[\mathrm{mm}]$ | $2.5 \ldots 3.0$ |

1) The cable length depends on the conductor cross section and the driver circuit used

- Use equipotential bonding conductors, see page 46.
- Use pre-assembled cables to reduce the risk of wiring errors.
- Verify that wiring, cables and connected interfaces meet the PELV requirements.

Signal level The inputs operate with the RS422 level and are not galvanically isolated.


Figure 6.20 Circuit of the signal inputs

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

Open inputs are logic 0 .
Interface mode "PULSE/DIR"
The motor executes an angle step with the rising edge of the PULSE signal. The direction of rotation is controlled by the DIR signal.


Figure 6.21 Pulse/direction signals

| Signal | Signal value | Meaning |
| :--- | :--- | :--- |
| PULSE | Rising edge | Angle step |
| DIR | $0 /$ open | Clockwise direction of rotation |
|  | 1 | Counterclockwise direction of rotation |

Interface mode "A/B"
In "A/B" interface mode, $A / B$ encoder signals are supplied as reference values.


Figure 6.22 AB encoder signals
Pin assignment printed circuit board connector


Figure 6.23 Pin assignment of the pulse/direction or A/B interface

| Pin | Signal | Meaning |
| :---: | :---: | :---: |
| 7 | POS_0V | Internally connected with CN1. 0VDC |
| 5 | $\begin{aligned} & \text { +DIR } \\ & \text { or } \\ & \text { +A } \end{aligned}$ | Direction of rotation "DIR" or <br> Channel $A$ of $A B$ encoder signals |
| 11 | $\begin{aligned} & \text {-DIR } \\ & \text { or } \\ & \text {-A } \end{aligned}$ | Direction of rotation "DIR" or Channel A of AB encoder signals |
| 6 | +PULSE or $\begin{aligned} & \text { or } \\ & +B \end{aligned}$ | Motor step "PULSE" or Channel $B$ of $A B$ encoder signals |
| 12 | -PULSE or -B | Motor step "PULSE" <br> or <br> Channel $B$ of $A B$ encoder signals |


| Pin | Signal | Meaning |
| :--- | :--- | :--- |

### 6.3.12 Connection of reference signals for PROFIBUS DP

Function External reference signals for the operating mode "Electronic Gear" can be supplied via CN2.

Cable specifications and terminal

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

| Maximum cable lenght ${ }^{1)}$ | $[\mathrm{m}]$ | 100 |
| :--- | :--- | :--- |
| Minimum conductor cross section | $\left[\mathrm{mm}^{2}\right]$ | 0.14 (AWG 24) |
| Maximum connection cross section | $\left[\mathrm{mm}^{2}\right]$ | 0.6 (AWG 20) |
| Stripping length | $[\mathrm{mm}]$ | $2.5 \ldots 3.0$ |

1) The cable length depends on the conductor cross section and the driver circuit used

- Use equipotential bonding conductors, see page 46.
- Use pre-assembled cables to reduce the risk of wiring errors.
- Verify that wiring, cables and connected interfaces meet the PELV requirements.

Signal level
The inputs operate with the RS422 level and are not galvanically isolated.


Figure 6.24 Circuit of the signal inputs

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

Open inputs are logic 0.
The maximum frequency is 200 Hz

Interface mode "A/B"
In "A/B" interface mode, $A / B$ encoder signals are supplied as reference values.


Figure 6.25 AB encoder signals
Pin assignment printed circuit board connector


Figure 6.26 Pin assignment of the $A / B$ interface

| Pin | Signal | Meaning |
| :--- | :--- | :--- |
| 7 | POS_0V | Internally connected to CN1.0VDC |
| 3 | + A | Channel A of AB encoder signals |
| 9 | - A | Channel A of AB encoder signals |
| 2 | + B | Channel B of AB encoder signals |
| 8 | - B | Channel B of AB encoder signals |

### 6.4 Connection accessories

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

The accessory makes the signals I00, I01 and I03 available outside of the device via industrial connectors.


Figure 6.27 Pin assignment
Pin 1 is internally connected to CN4.1 (+24VDC_OUT).
Pin 3 is internally connected to CN4.4 (0VDC).

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

The accessory makes the signals I00, IO1 and the signals of the STO safety function available outside of the device via industrial connectors.


Figure 6.28 Pin assignment
Pin 1 is internally connected to CN4.1 (+24VDC_OUT).
Pin 3 is internally connected to CN4.4 (0VDC).

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

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


Figure 6.29 Pin assignment

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

The accessory makes the signals I00, I01, IO2 and IO3 and the signals of the STO safety function available outside of the device via industrial connectors.


Figure 6.30 Pin assignment
Pin 1 is internally connected to CN4.1 (+24VDC_OUT).
Pin 3 is internally connected to CN4.4 (0VDC).

### 6.5 Checking wiring

Check the following:

- Did you properly install and connect all cables and connectors?
- Are there any live, exposed cables?
- Did you properly connect the signal wires?
- Did you properly install all seals (degree of protection IP54)?


## 7 Commissioning

## A WARNING <br> UNEXPECTED MOVEMENT <br> When the drive is operated for the first time, there is a risk of unexpected movements caused by possible wiring errors or unsuitable parameters. <br> - Perform the first test run without coupled loads. <br> - Verify that a functioning button for EMERGENCY STOP is within reach. <br> - Anticipate movements in the incorrect direction or oscillation of the drive. <br> - Only start the system if there are no persons or obstructions in the hazardous area. <br> Failure to follow these instructions can result in death, serious injury or equipment damage.

## A WARNING <br> UNINTENDED BEHAVIOR <br> The behavior of the drive system is governed by numerous stored data or settings. Unsuitable settings or data may trigger unexpected movements or responses to signals and disable monitoring functions. <br> - Do NOT operate the drive system with unknown settings or data. <br> - Verify that the stored data and settings are correct. <br> - When commissioning, carefully run tests for all operating states and potential fault situations.

- Verify the functions after replacing the product and also after making changes to the settings or data.
- Only start the system if there are no persons or obstructions in the hazardous area.

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

| WARNING |
| :--- |
| ROTATING PARTS |
| Rotating parts may cause injuries and may catch clothing or hair. |
| Loose parts or parts that are unbalanced may be flung. |
| - Verify correct mounting and installation of all rotating parts. |
| - Use a cover to help protect against rotating parts. |
| Failure to follow these instructions can result in death, serious |
| injury or equipment damage. |


| © WARNING |
| :--- |
| MOTOR WITHOUT BRAKING EFFECT |
| If power outage and faults cause the power stage to be switched off, |
| the motor is no longer stopped by the brake and may increase its |
| speed even more until it reaches a mechanical stop. |
| - Verify the mechanical situation. |
| - If necessary, use a cushioned mechanical stop or a suitable |
| brake. |
| Failure to follow these instructions can result in death, serious |
| injury or equipment damage. |

## A WARNING

## FALLING PARTS

The motor may move as a result of the reaction torque; it may yyyyy tip and fall.

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

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

| $\quad$ CAUTION |
| :--- |
| HOT SURFACES |
| Depending on the operation, the surface may heat up to more than |
| $100^{\circ} \mathrm{C}\left(212^{\circ} \mathrm{F}\right)$. |
| - Do not allow contact with the hot surfaces. |
| - Do not allow flammable or heat-sensitive parts in the immediate |
| vicinity. |
| - Consider the measures for heat dissipation described. |
| - Check the temperature during test runs. |
| Failure to follow these instructions can result in injury or equip- |
| ment damage. |

### 7.1 Preparing for commissioning

The following tests are required before commissioning:

- Wiring and connection of all cables and system components
- Function of the limit switch, if installed

One of the following must be available:

- Fieldbus master (e.g. PLC) or industrial PC
- Commissioning software


### 7.2 Running commissioning

### 7.2.1 First setup



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

Direction of rotation
Rotation of the motor shaft in a clockwise or counterclockwise direction of rotation. Clockwise rotation is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft.

The direction of rotation can be reversed with the parameter Motion.invertDir 28:6.

The new value is only activated when the drive is switched on.

- Save the parameter to the EEPROM
- Switch the supply voltage off and on.

If you invert the direction of rotation, verify once again that the limit switches are properly wired.

- Connect the positive limit switch to IOO
- Connect the negative limit switch to I01


Reference speed

Acceleration/deceleration
The positive limit switch is the switch that is tripped by the mechanical system if the motor shaft rotates as follows:

- Without inversion of the direction of rotation: Clockwise
- Without inversion of the direction of rotation: Counter-clockwise

The reference speed for the motor depends on the application requirements.

- Set the reference speed with the parameter Motion.v_target0 29:23.

Note that when the drive decelerates, it recovers energy from the system and the voltage may increase depending on the external torque and the deceleration value set.

The drive has two acceleration settings:

- Acceleration/deceleration Parameter Motion.acc, 29:26
- Deceleration for "Quick Stop" Parameter Motion.dec_Stop, 28:21

Setting the current limitation
The motor controller limits the maximum current and, by implication, the maximum torque of the drive to an adjustable configurable value. The maximum possible value depends on the combination of drive power stage, motor and gearbox

Parameter:

- Read value: Nominal current of drive Config.I_nomDrv, 15:1
- Read value: Maximum current of drive Config.I_maxDrv, 15:2
- User-defined maximum current for normal operation Settings.I_max, 15:3
- User-defined maximum current for Stop via torque ramp Settings.I_maxStop, 15:4

Current limitation is also controlled by $\mathrm{I}^{2} \mathrm{t}$ monitoring; this type of monitoring is described in chapter 8.1.4 "Internal monitoring signals".
Tuning the controllers The drive has an encoder and operates as a "closed loop" system. The controller is a classic cascade controller with current, speed and positioning loops.

The controller parameters are factory-set and do not need to be modified for most applications.

- Speed controller P term Control.KPn, 15:8
- Speed controller integral action time Control.TNn, 15:9
- Position controller P term Control.KPp, 15:10
- Speed feed-forward control position controller Control.KFPp, 15:11


### 7.2.2 Starting 24V signal interface

### 7.2.2.1 Setting the functions of the $24 V$ signals

You can configure the 24 V signals as input or output with the parameters IO.IO0_def $34: 1$ to IO. IO3_def $34: 4$ and assign specific functions to the 24 V signals.

For more information see chapter 6 "Installation".

### 7.2.2.2 Testing 24V signals

The following table shows the readable and writable status of the 24 V signals and the possible parameter settings.

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { I/O.IO_act } \\ & 33: 1\left(21: 01_{h}\right) \end{aligned}$ | Status of digital inputs and outputs <br> Assignment of bits: <br> Bit 0: 100 <br> Bit 1: IO1 <br> Bit 2: 102 <br> Bit 3: 103 <br> Bit 4: STO_A (PWRR_A) <br> Bit 5: STO_B (PWRR_B) <br> Reading returns the status of the inputs and outputs. Writing only changes the status of outputs. | $\begin{aligned} & \text { UINT16 } \\ & 0 . .15 \end{aligned}$ | $0$ | R/W |
| $\begin{aligned} & \text { I/O.IOO_def } \\ & 34: 1\left(22: 01_{h}\right) \end{aligned}$ | Configuration of IOO <br> Value 0: Input freely usable <br> Value 1: Input LIMP (only with IOO) <br> Value 2: Input LIMN (only with IO1) <br> Value 3: Input STOP <br> Value 4: Input REF <br> Value 5: Input programmable <br> Value 128: Output freely usable <br> Value 130: Output programmable | $\begin{aligned} & \text { UINT16 } \\ & 0 . .255 \end{aligned}$ | $1$ | R/W per. |
| $\begin{aligned} & \text { I/O.IO1_def } \\ & 34: 2\left(22: 02_{h}\right) \end{aligned}$ | Configuration of IO1 See parameter 100_def | $\begin{aligned} & \text { UINT16 } \\ & 0 . .255 \end{aligned}$ | $2$ | R/W per. |
| $\begin{aligned} & \text { I/O.IO2_def } \\ & 34: 3\left(22: 03_{h}\right) \end{aligned}$ | Configuration of IO2 <br> See parameter IOO_def | $\begin{aligned} & \text { UINT16 } \\ & 0 . .255 \end{aligned}$ | $3$ | R/W per. |
| $\begin{aligned} & \text { I/O.IO3_def } \\ & 34: 4\left(22: 04_{h}\right) \end{aligned}$ | Configuration of IO3 See parameter IOO_def | $\begin{aligned} & \text { UINT16 } \\ & 0 . .255 \end{aligned}$ | $4$ | R/W per. |

Proceed as follows for testing:

- Trigger the limit switch or the sensor manually.

> Testing the signal inputs and limit switches

> Checking the freely usable signal outputs

The corresponding bit in parameter IO.IO_act $33: 1$ must be 1 as long as the input is logic 1.

Proceed as follows for testing:

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


### 7.2.2.3 Testing the function of limit switches



Monitoring of the $\overline{\text { LIMP }} / \overline{\text { LIMN }}$ limit switches is activated in the factory settings. In all drives without limit switches, monitoring must be disabled with the parameter Settings.SignEnabl, 23:13, value = 0 . The factory setting for the STOP input is "disabled".

Condition: The limit switch signals are monitored.
For more information see chapter 7.2.2.2 "Testing 24V signals".

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Settings.SignEnabl 28:13 ( $1 \mathrm{C}: 0 \mathrm{D}_{\mathrm{h}}$ ) | Activation of monitoring inputs <br> Bit value 0: Monitoring is not active <br> Bit value 1: Monitoring is active <br> Assignment of bits: <br> Bit 0: LIMP (positive limit switch) <br> Bit 1: LIMN (negative limit switch) <br> Bit 2: STOP (STOP switch) <br> Bit 3: REF (reference switch) <br> NOTE: Monitoring is only active if the I/O port is configured as the corresponding function (parameter I/O.IOO_def to IO3_def). | $\begin{aligned} & \text { UINT16 } \\ & 0 . .15 \end{aligned}$ | $3$ | R/W per. |
| Settings.SignLevel 28:14 (1C:0E $\mathrm{E}_{\mathrm{h}}$ ) | Signal level for monitoring inputs <br> Used to define whether errors are triggered at 0 or 1 level. <br> Bit value 0: Response at 0 level <br> Bit value 1: Response at 1 level <br> Assignment of bits: <br> Bit 0: LIMP <br> Bit 1: LIMN <br> Bit 2: STOP <br> Bit 3: REF | $\begin{aligned} & \text { UINT16 } \\ & 0 . .15 \end{aligned}$ | $0$ | R/W per. |
| Status.Sign_SR 28:15 (1C:0F $)$ | Stored signal status of external monitoring signals <br> Bit value 0: not activated <br> Bit value 1: activated <br> Assignment of bits: <br> Bit 0: LIMP <br> Bit 1: LIMN <br> Bit 2: STOP <br> Bit 3: REF <br> Bit 5: SW_LIMP <br> Bit 6: SW_LIMN <br> Bit 7: SW stop <br> Stored signal status of released external monitoring signals | $\begin{aligned} & \text { UINT16 } \\ & 0 . .15 \end{aligned}$ | - | R/- |

You can change enabling of the external monitoring signals LIMP, LIMN and STOP with the parameter Settings.SignEnabl 28:13; use the parameter Settings.SignLevel 28:14 to change evaluation for active LOW or HIGH.

- Connect the limit switch that limits the working range for clockwise rotation to LIMP.
- Connect the limit switch that limits the working range for counterclockwise rotation to LIMN.
- Verify the function of the limit switches with the parameter Status.Sign_SR 28:15.
- Enable the power stage.
- Run a "Fault Reset".

After that, no bit may be set in parameter Status.Sign_SR 28:15.

- Briefly actuate the limit switch manually.

After that, the corresponding bit must be set in parameter Status.Sign_SR 28:15.

- Run a "Fault Reset".

After that, no bit may be set in parameter Status.Sign_SR 28:15.

### 7.2.3 Setting parameters for encoder

Setting an encoder absolute position

When starting up, the device reads the absolute position of the motor from the encoder. The current absolute position can be read with the parameter Status.p_act, 31:6.

When the motor is at a standstill, the current mechanical motor position can be defined as the new absolute position of the motor with the parameter Commands.SetEncPos, 15:19. The value can be set with the power stage enabled or disabled. Setting the absolute position also shifts the position of the index pulse of the encoder.

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Status.p_act$31: 6\left(1 \mathrm{~F}: 06_{\mathrm{h}}\right)$ | Actual position of motor | INT32 | Inc | R/- |
|  | The motor position captured by the encoder. |  |  |  |
| Commands.SetEncPos 15:19 (0F:13h) | Directly set the encoder position | INT32 <br> See text left | Inc0 | R/W |
|  | During writing, the current motor position Status.p_act and the absolute position Status.p_abs are adjusted immediately. |  |  |  |
|  | Permissible values: <br> Singleturn encoder: 0 ... 16384-1 <br> Multiturn encoder: 0 ... (4096 * 16384) -1 |  |  |  |
|  | NOTE: <br> This command automatically disables the power stage. Changing the value also changes the position of the virtual index pulse. |  |  |  |



If you have replaced the device, you must check the absolute position of the motor. If there is a deviation or if you replace the motor variation, you must readjust the absolute position.

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

In the case of a multiturn encoder, the mechanical working range of the motor can be shifted to the continuous range of the encoder by setting a new absolute position.
If the motor is moved counterclockwise from the absolute position 0 , there is an underrun of the absolute position of the multiturn encoder. However, the internal actual position keeps counting forward and delivers a negative position value. After switching off and on, the internal actual position would no longer be the negative position value, but the absolute position of the encoder.

Overruns or underruns are discontinuous positions in the working range. To avoid such jumps, the absolute position in the encoder must be set in such a way that the mechanical limits are within the continuous range of the encoder.


Figure 7.1 Position values of multiturn encoder

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

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

After setting the absolute position the drive must be switched off and switched on again.

### 7.2.4 Testing safety functions

Operation with STO If you wish to use the STO safety function, carry out the following steps. Perform the steps exactly in the sequence described.

■ Supply voltage switched off.

- Verify that the inputs STO_A (PWRR_A) and STO_B (PWRR_B) are electrically isolated from each other. The two signals must not be electrically connected.

■ Supply voltage switched on.

- Enable the power stage.
(Parameter Commands.driveCtrl, 28:1 bit 1)
- Trigger the safety function. $\overline{\text { STO_A }}$ ( $\overline{\text { PWRR_A }) ~ a n d ~} \overline{\text { STO_B }}$ (PWRR_B $)$ must be switched off simultaneously (time offset <1s).
$\triangleleft$ The power stage is disabled and error message $0119_{h}$ is generated. (NOTE: Error message $011 \mathrm{~A}_{\mathrm{h}}$ indicates a wiring error.)
(Parameter Status.StopFault, 32:7)
- Check the behavior of the drive during fault conditions.
- Document all tests of the safety function in your acceptance certificate.

Operation without STO If you do not want to use the STO safety function:

- Verify that jumper CN6 is connected.
$\left.\begin{array}{lllll}\hline \begin{array}{lll}\text { Group.Name } \\ \text { Index:Subindex } \\ \text { dec. (hex.) }\end{array} & \begin{array}{lll}\text { Description } \\ \text { Bit assgnment }\end{array} & \begin{array}{l}\text { Data type } \\ \text { range } \\ \text { dec. }\end{array} & \begin{array}{l}\text { Unit } \\ \text { Default } \\ \text { dec. }\end{array} & \begin{array}{l}\text { R/W } \\ \text { per. }\end{array} \\ \hline \text { Commands.driveCtrl } & \text { Control word } & \text { UINT16 } & - & \text { R/W } \\ 28: 1\left(1 \mathrm{C}: 01_{h}\right) & \text { Assignment of bits: } & 0 . .31 & 0\end{array}\right]$


### 7.2.5 Releasing the holding brake manually

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

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

| WARNING |
| :--- |
| UNEXPECTED MOVEMENT |
| Manual release of the holding brake or an error may cause an unex- |
| pected movement in the system. |
| - Switch off the voltage at the inputs $\overline{\text { STO_A }}(\overline{\text { PWRR_A }})$ and $\overline{\text { STO_B }}$ |
| (PWRR_B) to avoid an unexpected restart of the motor. |
| - Take appropriate measures to avoid damage caused by the fall- |
| ing loads. |
| - Only run the test if there are no persons or obstacles in the haz- |
| ardous area. |
| Failure to follow these instructions can result in death or serious |
| injury. |

Power stage disabled
The holding brake can be released with the parameter Commands.Brake, 33:7 and the commissioning software when the power stage is not enabled.

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

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

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Commands.Brake 33:7 (21:07 h) | Holding brake control | $\begin{aligned} & \text { UINT16 } \\ & 0 . .1 \end{aligned}$ | - | R/W |
|  | Value 0: automatic |  |  |  |
|  | Value 1: Releasing holding brake manually |  |  |  |
|  | NOTE: If the power stage is enabled, the value 0 is automatically set. |  |  |  |
| Status.Brake | Status of holding brake | UINT16 | - | R/- |
| 33:8 (21:08h) | Value 0: Holding brake applied <br> Value 1: Holding brake released | $0 . .1$ | - |  |

### 7.2.6 Testing with relative positioning

Positioning can be tested by means of relative positioning in "Profile Position" operating mode.

| WARNING |
| :--- |
| UNINTENDED OPERATION |
| - Note that any changes to the values of these parameters are exe- |
| cuted by the drive controller immediately on receipt of the data |
| set. |
| - Verify that the system is free and ready for movement before |
| changing these parameters. |
| Failure to follow these instructions can result in death, serious |
| injury or equipment damage. |



All speed and position values listed below relate to the motor drive shaft (without gearbox).

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | $\overline{R / W}$ per. |
| :---: | :---: | :---: | :---: | :---: |
| Commands.driveCtrl $28: 1\left(1 \mathrm{C}: 01_{h}\right)$ | Control word <br> Assignment of bits: <br> Bit 0: Disable power stage <br> Bit 1: Enable power stage <br> Bit 2: Quicktop <br> Bit 3: FaultReset <br> Bit 4: QuickStop-Release <br> Bits 5..15: Reserved <br> Default bits 0 ... 4: 0 <br> A write access automatically triggers processing of the operating states. | $\begin{aligned} & \text { UINT16 } \\ & 0 . .31 \end{aligned}$ | $\overline{0}$ | R/W |
| $\begin{aligned} & \text { PTP.p_reIPTP } \\ & 35: 3\left(23: 03_{h}\right) \end{aligned}$ | Target position for relative positioning and start of positioning Action object: write access triggers relative positioning in increments | INT32 | Inc | R/W |
| $\begin{aligned} & \text { PTP.v_tarPTP } \\ & 35: 5\left(23: 05_{\mathrm{h}}\right) \end{aligned}$ | Target speed of rotation for positioning <br> Positioning can be temporarily stopped with value 0. <br> The default value is the value of parameter <br> Motion.v_target0. <br> The maximum speed of rotation is the value of parameter Config.n_maxDrv, 15:18. | UINT16 | $\begin{aligned} & \min ^{-1} \\ & 60 \end{aligned}$ | R/W |

Performing the test run To perform the test run, proceed as described below.

- Enable the power stage.
(Parameter Commands.driveCtrl 28:1 Bit 1)
- Set the target speed, e.g. $600 \mathrm{~min}^{-1}$.
(Parameter PTP.v_tarPTP 35:5)
- Start relative positioning, e.g. by 1000 increments.
(Parameter PTP.v_relPTP 35:3)
- Verify the function of the limit switches at a low speed.


### 7.2.7 Optimizing the motor behavior

Setting the slope of the ramps

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

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

$$
\alpha=\frac{\mathrm{M}_{\mathrm{M}}-\mathrm{M}_{\mathrm{L}}}{\mathrm{~J}_{\text {total }}}
$$

| Physical value/ <br> nominal value | Meaning | Unit |
| :--- | :--- | :--- |
| $\mathrm{M}_{\mathrm{M}}$ | Available torque of motor | Nm |
| $\mathrm{M}_{\mathrm{L}}$ | Load torque | Nm |
| $\mathrm{J}_{\text {total }}$ | Mass moment of inertia | $\mathrm{kgm}^{2}$ |
| $\alpha$ | Angular acceleration | $\mathrm{rad} / \mathrm{sec}^{2}$ |
| Motion.acc | Acceleration parameters | $\mathrm{min}^{-1 / \mathrm{s}}$ |

Reference speed
The reference speed for the motor depends on the application requirements.

- Set the reference 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 (the dependency starts at a specific speed of rotation at which the torque decreases drastically)

See the characteristic curve of the motor in the catalog for the dependency of the torque on the speed.


Figure 7.2 Typical torque characteristic of a servo motor
(1.1) 36 V peak torque
(1.2) 24 V peak torque
(2) Continuous torque

At a specific speed of rotation the available torque decreases drastically with increasing speeds. The available acceleration is reduced correspondingly.

### 7.3 Lexium CT commissioning software

Source commissioning software
Functions of the commissioning
software

The commissioning software has a graphic user interface and is used for commissioning, diagnostics and testing settings.
Source commissioning software The latest version of the commissioning software is available for download from the internet:

## http://www.schneider-electric.com

The functions of the commissioning software include:

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

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

- IBM-compatible PC
- Approx. 200 MB of hard disk space
- 512 MB RAM
- Graphics card and monitor with a resolution of at least $1024 \times 768$ pixels
- Free serial interface (RS232) or free USB interface
- Operating system Windows 2000, Windows XP Professional or Windows Vista
- Acrobat Reader 5.0 or newer
- Internet connection (for initial installation and updates)

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

| Interface | PC interface | Required fieldbus converter | Source |
| :--- | :--- | :--- | :--- |
| RS485 | USB | NuDAM ND-6530 | $\underline{\text { http://www.acceed.com }}$ |
| RS485 | RS232 | NuDAM ND-6520 | $\underline{\text { http://www.acceed.com }}$ |
| CAN | USB | PCAN-USB, Peak | $\underline{\text { http://www.peak-system.com }}$ |
| CAN | parallel | PCAN-Dongle, Peak | $\underline{\text { http://www.peak-system.com }}$ |
| PROFIBUS DP | USB | PROFlusb PB-USB | $\underline{\text { http://www.softing.com }}$ |
| Profibus-DP | PCMCIA | Siemens CP5511/12 | $\underline{\text { http://www.ad.siemens.com }}$ |
| Profibus-DP | PCI | Siemens CP5611/13 | $\underline{\text { http://www.ad.siemens.com }}$ |

### 7.3.1 Firmware update via fieldbus

|  | CAUTION |
| :--- | :--- |
|  | DAMAGE TO THE PRODUCT CAUSED BY POWER OUTAGE <br> If the supply voltage becomes unavailable during an update, the prod- <br> uct will be damaged and must be sent in for repair. <br> - Do not switch off the supply voltage during the update. <br> - Update the firmware only with a reliable supply voltage. <br> Failure to follow these instructions can result in equipment dam- <br> age. |
| FlashkitThe Flashkitallows you to update the firmware via the relevant fieldbus. <br> The Flashkit supports the same fieldbus converters as the commission- <br> ing software. <br> Please contact your local sales office to obtain the Flashkit <br> and for support. |  |


| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Config.PrgNo$1: 1\left(01: 01_{h}\right)$ | Firmware number | UINT32 | - | R/- |
|  | High word: Program number Low word: Program version |  |  |  |
|  | Example: PR802.10 <br> High word: 802 <br> Low word: 10 |  |  |  |
| Config.PrgVer$1: 2\left(01: 02_{h}\right)$ | Firmware version | UINT32 | - | R/- |
|  | High word: Program version Low word: Program revision |  |  |  |
|  | Example: V1.003 <br> High word: 1 <br> Low word: 3 |  |  |  |
| Config.OptPrgNo 13:11 (0D:OB ${ }_{h}$ ) | Firmware number in option module | UINT32 | - | R/- |
|  | Identifies the program number of the internal Profibus interface of drives with Profibus |  |  |  |
| Config.OptPrgVer 13:12 (0D:0Ch) | Firmware version in option module | UINT32 | - | R/- |
|  | Identifies the program version of the internal Profibus interface of drives with Profibus |  |  |  |

### 7.4 Controller optimization with step response

### 7.4.1 Controller structure

The controller structure corresponds to the classical cascaded closed positioning loop with current controller, speed controller and position controller.

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


Figure 7.3 Controller structure
Current controller The current controller determines the torque of the motor. The current controller is automatically optimally tuned with the stored motor data.
Speed controller The speed controller maintains the required speed of rotation of the motor by varying the output motor torque depending on the load situation. It has a decisive influence on the speed with which the drive responds. The dynamics of the speed controller depend on

- the moment of inertia of the drive and the controlled system
- the torque of the motor
- the stiffness and elasticity of the elements in the flow of forces
- the play of the mechanical drive elements
- the friction

Position controller The position controller reduces the position deviation to zero. The reference position for the closed positioning loop is generated by the profile generator or by the pulse/direction input.

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

### 7.4.2 Checking and optimizing default settings



Figure 7.4 Step responses with good control performance
The controller is properly set when the step response is approximately identical to the signal shown. Good control performance is characterized by

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

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

- If the controller is too slow: Use a higher "KPn" value.
- If the closed-loop control tends to oscillate: Use a lower "KPp" value.

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


Figure 7.5 Optimizing inadequate speed controller settings


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

### 7.4.3 Optimization

You can tune the device to meet your application requirements. The functions include:

- Selecting control loops. Higher level control loops are automatically disconnected.
- Defining reference signals: signal type, height, frequency and starting point
- Testing control performance with the signal generator.
- Recording the control performance on screen and evaluating it with the commissioning software.
Setting reference signals
- Start the tool for drive optimization in the commissioning software.


Figure 7.6 Commissioning software, optimizing controller settings
The screenshot shows the the reference signal and the responses of the controller. Up to 2 response signals can be transmitted and displayed simultaneously.

- Set the reference signal to the following values in the "Signal generator" box:
- Signal type: "Positive step"
- Amplitude: $400 \mathrm{~min}^{-1}$
- Frequency: 1 Hz
- Number of repetitions: 1.


Only the signal types "Step" and "Square" allow you to determine the entire dynamic behavior of a control loop.

Select the signals that are to be displayed as the step response of the control loop:

-     - Actual speed of motor n_act
- Reference speed of the speed controller n_ref
- Enter 1 ms in the "Timebase" field
- Select the speed controller as type. The speed controller is optimized first.
- Enter 100 in the "Measurements" field; measured data is recorded for $100 * 1 \mathrm{~ms}$.

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

A step function is triggered as soon as you start recording in the commissioning software bar with the "Start" button (arrow icon).

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

### 7.4.4 Optimizing the speed controller

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

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

| Group.Name <br> Index:Subindex <br> dec. (hex.) | Description <br> Bit assgnment | Data type <br> range <br> dec. | Unit <br> Default <br> dec. | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- |
| Control.KPn Speed controller P term UINT16 $\mathrm{A} / \mathrm{min}^{-1}$ | $\mathrm{R} / \mathrm{W}$ |  |  |  |
| $15: 8\left(0 \mathrm{~F}: 08_{\mathrm{h}}\right)$ |  |  |  |  |

Determining the mechanical system of the system

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

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


## Rigid

mechanical system
low elasticity

e. g. Direct drive

Rigid coupling

## Less rigid

 mechanical systemhigher elasticity

e. g. Belt drive

Weak drive shaft
Elastic coupling

Figure 7.7 Rigid and less rigid mechanical systems

- Couple the motor and the mechanical system
- After mounting the motor, test the function of the limit switches, see 7.2.2.3 "Testing the function of limit switches".

Determining control parameter values for rigid mechanical systems

Prerequisites for tuning the control performance as per the table comprise:

- Known and constant inertia of load and motor
- Rigid mechanical system

The P term "KPn" and the integral action time "TNn" depend on:

- $J_{L}$ : Mass moment of inertia of the load
- $\mathrm{J}_{\mathrm{M}}$ : Mass moment of inertia of the motor
- Determine the control parameter values using the table below:

|  | $\mathbf{J}_{\mathbf{L}}=\mathbf{J}_{\mathbf{M}}$ |  |  | $\mathbf{J}_{\mathbf{L}}=\mathbf{5}{ }^{*} \mathbf{J}_{\mathbf{M}}$ |  | $\mathbf{J}_{\mathbf{L}}=\mathbf{1 0}{ }^{*} \mathbf{J}_{\mathbf{M}}$ |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :---: |
| $\mathbf{J}_{\mathbf{L}}\left[\mathrm{kgcm}{ }^{2}\right]$ | $\mathbf{K P n}$ | $\mathbf{T N n}$ | $\mathbf{K P n}$ | $\mathbf{T N n}$ | $\mathbf{K P n}$ | $\mathbf{T N n}$ |  |
| 1 | 0.0125 | 8 | 0.008 | 12 | 0.007 | 16 |  |
| 2 | 0.0250 | 8 | 0.015 | 12 | 0.014 | 16 |  |
| 5 | 0.0625 | 8 | 0.038 | 12 | 0.034 | 16 |  |
| 10 | 0.125 | 8 | 0.075 | 12 | 0.069 | 16 |  |
| 20 | 0.25 | 8 | 0.15 | 12 | 0.138 | 16 |  |

Determining controller values with less rigid mechanics

For optimization purposes the P-factor of the speed controller at which the controller adjusts the speed ' $n$ _act' as quickly as possible without overshooting is determined.

- Set the correction time TNn (TNN) to infinite TNn = 327.67 ms.

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


In the case of drive systems in which the motor is under load while at standstill, e.g. vertical axes, setting the integral action time to "Infinite" may result in unwanted position deviations so that the value needs to be reduced. However, this can adversely affect optimization results.

## A WARNING

## UNEXPECTED MOVEMENT

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

- Check that the selected values for speed and time do not exceed the available distance.
- If possible, use limit switches or stop as well.
- Make sure that a functioning button for EMERGENCY STOP is within reach.
- Make sure that the system is free and ready for the motion before starting the function.


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

- Initiate a step function.
- After the first test check the maximum amplitude for the current setpoint "l_act".

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

- Trigger another step function if you had to to modify "n_ref" and check the amplitude of "I_act".
- Increase or decrease the $P$ term in small increments until " $n \_a c t$ " is obtained as fast as possible. The following diagram shows the required transient response on the left. Overshooting - as shown on the right - is reduced by reducing the " KPn " value.

Deviations from "n_ref" and "n_act" result from setting "TNn" to "Infinite".


Figure 7.8 Determining "TNn" for the aperiodic limit


Graphic determination of the 63\% value

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

Graphically determine the point at which the actual speed "n_act" reaches $63 \%$ of the final value. The integral action time 'TNn' then results as a value on the time axis. The commissioning software supports you with the evaluation:

### 7.4.5 Setting the Posicast filter

Function principle The Posicast filter is uptream of the speed controller. It can increase the dynamics of the drive system even more for recurring identical acceleration conditions. It uses the system overshoot as a positive factor.

The reference speed ( $100 \%$ ) is first reduced by a parameterizable value. The vertex of the overshoot amplitude corresponds precisely to the reference speed (100\%) when set correctly. At this point in time, the reference speed is increased to the original reference speed (100\%) again. The time to reach the vertex value is also set with a parameter.

Settings for the Posicast filter
To determine the two parameters, a step is applied to the speed controller at $T_{D}=0$, e.g. $n_{\text {ref }}=100$ to $400 \mathrm{~min}^{-1}$ and the step response is measured.


Figure 7.9 Evaluation of the step response for the Posicast filter
The parameters are determined as follows:

| Control.pscDamp | $c=\frac{n_{-} r e f}{m a x\left(n_{-} a c t\right)} \cdot 100$ |
| :--- | :--- |
| Control.pscDelay | $T_{D}=t_{\max \left(n_{-} a c t\right)}$ |

Figure 7.10 Determination of parameters for Posicast filter

| Group.Name <br> Index:Subindex <br> dec. (hex.) | Description <br> Bit assgnment | Data type <br> range <br> dec. | Unit <br> Default <br> dec. | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- |
| Control.pscDamp | Posicast filter for speed controller: attenuation | UINT16 | $\%$ | R/W |
| $15: 20\left(0 \mathrm{~F}: 14_{\mathrm{h}}\right)$ |  |  |  |  |

### 7.4.6 Optimizing the position controller

Optimization requires good control dynamics in the subordinate speed control circuit.

When tuning the position controller, you must optimize the P term KPp in two limits:

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

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { Control.KPp } \\ & \text { 15:10 }\left(0 \mathrm{~F}: \mathrm{OA}_{h}\right) \end{aligned}$ | Position controller P term | UINT16 <br> $0 . .1250$ | 1/s | R/W per. |
|  | Unit: [0.1 1/s] |  |  |  |
| Control.KFPp <br> 15:11 ( $0 \mathrm{~F}: \mathrm{OB}_{\mathrm{h}}$ ) | Speed feed-forward control position controller | $\begin{aligned} & \hline \text { UINT16 } \\ & 0 . .32767 \end{aligned}$ | $32767$ | R/W per. |
|  | Value 32767: 100\% compensation |  |  |  |


|  | A WARNING |
| :---: | :---: |
|  | UNEXPECTED MOVEMENT <br> The jump function moves the motor in speed mode at constant speed until the specified time has expired. <br> - Check that the selected values for speed and time do not exceed the available distance. <br> - If possible, use limit switches or stop as well. <br> - Make sure that a functioning button for EMERGENCY STOP is within reach. <br> - Make sure that the system is free and ready for the motion before starting the function. <br> Failure to follow these instructions can result in death, serious injury or equipment damage. |
| Setting the reference signal | Select Position Controller as the reference value generator in the commissioning software. <br> Set the reference signal: <br> - Signal type: "Step" <br> - Set the amplitude to approx. $1 / 10$ motor revolution. |
| Selecting the recording signals | Select the values in the box General Recording Parameters: <br> - Reference position of position controller p_ref <br> - Actual position of position controller p_act <br> Controller values for the position controller can be changed in the same parameter group that you already used for the speed controller. |

Optimizing the position controller value

- Start a step function with the default control values.
- After the first test check the settings of the values "n_act" and "I_act" for current and speed control. The values must not be in current and speed limitation range.


Figure 7.11 Step responses of a position controller good control performance
The setting of the proportional term "KPp' is optimal when the motor reaches its target position rapidly and with little or no overshooting.

If the control performance does not correspond to the curve shown, change the $P$ term "KPp" in increments of approx. 10\% and trigger another step function.

- If the closed-loop control tends to oscillate: Use a lower "KPp" value.
- If the actual value is too slow reaching the reference value: Use a higher "KPp" value.


Figure 7.12 Optimizing insufficient position controller

## 8 Operation

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


An alphabetically sorted overview of all parameters can be found in the chapter "Parameters". The use and the function of some parameters are explained in more detail in this chapter.

### 8.1 Basics



All speed and position values listed below relate to the motor drive shaft (without gearbox).

### 8.1.1 Default parameter values

The following default parameter values can be adapted to meet the requirements of the application.

- Accelerations
- Acceleration and deceleration in general (parameter Motion.acc, 29:26)
- Deceleration for "Quick Stop" (parameter Motion.dec_Stop, 28:21)
- Definition of the direction of rotation
(parameter Motion.invertDir, 28:6)
- Controller settings
- Signal interface
- Definition of I/O signals (Parameter group I/O)
- Enabling limit switches (Parameter group I/O)
- User device name
(Parameters Settings.name1, 11:1 and Settings.name2, 11:2)


### 8.1.2 External monitoring signals

You can enable, set and monitor the external monitoring signals.
Available external monitoring signals:

- Axis signals
- Positive limit switch LIMP
- Negative limit switch LIMN
- Stop switch STOP
- Reference switch REF
- Software stop "SW STOP"


### 8.1.2.1 Axis signals

Configuring the axis signals

Setting the signal levels

Reading the axis signals

Monitoring the axis signals

Moving away from switch

External monitoring signal $\overline{R E F}$

After you have configured the signal inputs, adjust the signal levels for the individual signal inputs. (parameter Settings.SignLevel, 28:14)

- Value 0: Response at 0 level (failsafe)
- Value 1: Response at 1 level

Activating the axis signals In the last step you enable the external signal inputs so the incoming signals will be evaluated (parameter Settings.SignEnable, 28:13).

The saved signal status of the enabled external signal inputs can read out at any time. (parameter Status_SignSR, $28: 15$ ).
Before the external monitoring signals can be used, the signal inputs must be configured for this function (parameter group I/O).

During operation the two limit switches $\overline{\text { LIMN }}$ and $\overline{\text { LIMP }}$ are monitored. If a limit switch is tripped, the motor stops with the set "Quick Stop" deceleration (parameter Motion.dec_Stop, 28:21) and the event is saved (parameter Status.Sign_SR, 28:15).
Set up the limit switches in such a way as to keep the motor from overtraveling the limit switches.

The drive can be moved away from the limit switch range at any time by a reference movement or a jog movement.
For more information see chapter 8.2.4 "Operating mode Homing" or 8.2.1 "Operating mode Jog".

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

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.

To resume processing:

- Reset the external monitoring signal STOP at the signal input.
- Run a "Fault Reset".
(parameter Commands.driveCtrl, 28:1, Bit 3)
- Start a new motion 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 "SW STOP"

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

After an "SW STOP" the drive switches to the operating state "Quick Stop". The power stage 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 may have occurred are also reset!
- Run a "Quick Stop Release".

```
(parameter Commands.driveCtrl, 28:1, Bit 4)
```

After acknowledgement, the drive switches to the operating state "Operation Enable".

### 8.1.3 Positioning limits



The motor can move to any point within the positioning range once an absolute position has been specified.

The positioning range is $-2^{31}$ to $+2^{31}$ increments (inc).
The positioning resolution is 16384 increments per revolution measured at the motor output shaft (without gearbox).


Figure 8.1 Positioning range and range overrun
If the motor exceeds the positioning limits, the internal monitoring signal for position overrun (parameter Status.WarnSig, $28: 10$, bit 0 ) is set and the working range is shifted 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 parameterize whether the overrun of the positioning limits is signaled as a warning in the parameter Status.driveStat, 28:2 bit 7 .

Resetting the signal

Operating modes with position overrun
"Absolute positioning" is no longer possible after a position overrun.

A reference movement or position setting resets the internal monitoring signal for position overrun.
Modes in which the positioning limits can be overtraveled:

- Jog (as of software version 1.101 and later)
- Profile Velocity
- Relative positioning in Profile Position


### 8.1.4 Internal monitoring signals

The internal monitoring signals are used to monitor the drive itself.
Available internal monitoring signals (parameters Status .WarnSig, 28:10 and Status.FltSig, $28: 17$ ):

- Software limit switch, only in the case of drives with multiturn encoder
- Position overrun profile generator (warning)
- Safety function STO "Safe Torque Off" (IEC/EN 61800-5-2)
- Hardware error
- Internal system error
- Nodeguard error fieldbus
- Protocol error fieldbus
- Position deviation of position controller
- I2t Limit (warning)
- Overvoltage or undervoltage error
- Motor overload
- Overtemperature error

Reading stored internal monitoring signals

Software limit switches
The signal status of the enabled internal monitoring signals is saved.
If an internal monitoring error occurs, the corresponding bit is set in the parameters Status.FltSig, 28:17 and Status.FltSig_SR, 28:18.

After the cause of the error has been corrected, the bit in parameter Status.FltSig, 28:17 is automatically reset.
The bit in parameter Status.FltSig_SR, 28:18 is not automatically reset. The bis is only reset by a "Fault Reset" (parameter Commands.driveCtrl, 28:1, bit 3). This way it is possible to even detect errors that occur for a very short period of time only.
The positioning range can be limited by software limit switches. The position values are specified with reference to the zero point.

The software limit switches are set via the parameters
Settings.SwLimP, 29:4 and Settings.SwLimP, 29:5 and activated via the parameter Settings. SwLimEna, 29:6.
The parameter Status.p_act, $31: 6$ is monitored.

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Settings.SwLimP 29:4 (1D:04h) | Positive position limit for software limit switch | INT32 | $\begin{aligned} & \text { Inc } \\ & 0 \end{aligned}$ | R/W per. |
| Settings.SwLimN 29:5 (1D:05h) | Negative position limit for software limit switch | INT32 | $\begin{aligned} & \text { Inc } \\ & 0 \end{aligned}$ | R/W per. |


| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Status.SwLimEna 29:6 (1D:06h) | Monitoring of software limit switches | UINT16 | - | R/W |
|  | Value 0: None | $0 . .3$ | 0 | per. |
|  | Value 1: Enable software limit switch clockwise direction of rotation |  |  |  |
|  | Value 2: Enable software limit switch counterclockwise direction of rotation |  |  |  |
|  | Value 3: Enable software limit switches both directions of rotation |  |  |  |
|  | The software limit switches are only available for drives with multiturn encoders. |  |  |  |

Tracking error monitoring

| ! WARNING |
| :--- |
| UNEXPECTED MOVEMENT |
| If the error response to tracking errors is set to error class 1, the motor |
| does not stop in the case of a tracking error unless the position devi- |
| ation has been cleared. |
| This may cause motor to restart after correction of an overload con- |
| dition. |
| - Only use error class 1 as an error response to tracking errors if a |
| restart does not involve any hazard. |
| Failure to follow these instructions can result in death, serious |
| injury or equipment damage. |

Tracking error monitoring monitors the position deviation between the reference position and the actual position of the motor. If the difference exceeds a limit value, the drive signals a tracking error. The limit value for the tracking error deviation can be parameterized. In addition, it is possible to change the error response to a tracking error.

If "error class 2 " is selected, the motor is stopped. As soon as the motor has come to a standstill, the power stage is disabled, even if the position deviation has not yet been cleared.

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Settings.p_maxDif2 15:17 ( $0 \mathrm{~F}: 11_{\mathrm{h}}$ ) | Maximum permissible tracking error of the position controller Maximum value corresponds to 8 motor revolutions | $\begin{aligned} & \text { UINT32 } \\ & 0 . .131072 \end{aligned}$ | $\begin{aligned} & \text { Inc } \\ & 16384 \end{aligned}$ | R/W per. |
| Settings.Flt_pDif $28: 24(1 \mathrm{C} \cdot 18 \mathrm{~h})$ 28:24 (1C:18 ) | Error response to tracking error <br> Value 1: Error class 1 <br> Value 2: Error class 2 <br> Value 3: Error class 3 | $\begin{aligned} & \text { UINT16 } \\ & 0 . .3 \end{aligned}$ | $3$ | R/W per. |
| Status.p_difPeak $15: 13\left(0 \mathrm{~F}: O D_{h}\right)$ | Maximum position deviation reached <br> The value is updated an ongoing basis. <br> The parameter value is set to the current position deviation value by writing 0 . | UINT32 <br> 0. <br> 2147483647 | $\begin{aligned} & \text { Inc } \\ & 0 \end{aligned}$ | R/- |
| $\begin{aligned} & \text { Status.p_dif } \\ & 31: 7\left(1 \mathrm{~F}: 07_{\mathrm{h}}\right) \end{aligned}$ | Position deviation of position controller | INT32 | Inc | R/- |

$I^{2} t$ monitoring If the drive is operating with high peak currents, temperature monitoring with sensors may too slow. With $\mathrm{I}^{2} \mathrm{t}$ monitoring the closed loop control anticipates a rise in temperature in time and if the $\mathrm{I}^{2} \mathrm{t}$ threshold is exceeded, it reduces the motor and power amplifier current to the specified nominal value. If the temperature drops below the threshold, the component can again be operated at the performance limit.

Bit 5 is set in the warning word as long as the monitoring is reducing the current.

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Status.WarnSig 28:10 (1C:0A ${ }_{h}$ ) | Warnings | UINT16 |  | R/- |
|  | Monitoring signals with error class 0. |  |  |  |
|  | Assignment of bits: <br> Bit 0: Position overrun profile generator <br> Bit 1: Temperature of power stage $>100^{\circ} \mathrm{C}$ <br> Bit 5 : $I^{2}$ t limitation active <br> Bit 10: Absolute position not yet read |  |  |  |
|  | The remaining bits are reserved for later extensions. The remaining bits are reserved for future extensions. |  |  |  |

### 8.1.5 Operating states and state transitions



The current operating state can be read at any time via the fieldbus. (parameter Status.driveStat, 28:2).

| Bit | Meaning |
| :--- | :--- |
| $0 . .3$ | Operating state of the drive |
|  | For more information see 8.1.5 "Operating states and state transi- |
| tions" |  |
| 5 | Error message by internal monitoring |
|  | The bit is set if at least one bit is set in the parameter |
|  | Status.FltSig_SR, $28: 18$. |
|  | The cause of the error can be read with the parameter |
|  | Status.FltSig_SR, $28: 18$. |

### 8.1.6 Operating-mode-specific status information

Each operating mode has an acknowledgement parameter:

- Jog (as of software version 1.101 and later)
(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)
- Electronic Gear
(parameter Gear.stateGear, 38:2)
Information stored in every acknowledgement parameter:
- Bit 0: Error LIMP

Error message caused by positive limit switch

- Bit 1: Error LIMN

Error message caused by negative limit switch

- Bit 2: Error STOP

Error response with "Quick Stop"

- Bit 3: Error REF

Error message caused by reference switch

- Bit 7: "SW Stop"
- Bit 12: Operating-mode-specific
- Bit 13: Operating-mode-specific
- Bit 14: "xxx_end"

Operating mode terminated

- Bit 15: "xxx_err"

Fault occurred

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:

- Operating mode
- Current operating mode Status.action_st, 28:19 and Status.xMode_act, 28:3
- Speed of rotation per minute $\left(\mathrm{min}^{-1}\right)$
- Actual speed of motor Status.n_act, 31:9
- Reference speed Status.n_ref, 31:8
- Actual speed of profile generator Status.n_profile, 31:35
- Target speed of profile generator Status.n_target, 31:38
- Speed in increments per second (Inc/s)
- Actual speed of motor Status.v_act, 31:2
- Reference speed Status.v_ref, 31:1
- Position
- Actual position of motor Status.p_act, 31:6
- Reference position Status.p_ref, 31:5
- Actual position of profile generator Status.p_profile, 31:31
- Target position of profile generator Status.p_target, 31:30
- Voltage
- Voltage at DC bus Status.UDC_act, 31:20
- Current
- Current of motor Status.I_act, 31:12
- Temperature
- Power stage temperature Status.TPA_act, 31:25


### 8.2 Operating modes

The following operating modes have been implemented:

- Jog
- Profile Velocity
- Profile Position
- Homing
- Electronic Gear

The operating modes represent different options for positioning. You can parameterize the operating modes to meet the requirements of your application.

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

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

- Operating-mode-independent
- Parameter Status.driveStat, 28:2, bit 14
- Operating-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)
- Electronic Gear
(Parameter Gear.stateGear, 38:2, bit 14)
An operating mode is considered to be terminated under the following conditions:
- Jog: Drive at standstill
- Profile Velocity: Drive at standstill
- Profile Position: Drive at standstill
- Reference Movement: Drive at standstill
- Position setting: Immediately after position setting
- Electronic Gear: Immediately after deactivation of the gear function

Parameters for starting a new operating mode:

- Jog
(parameter Manual.startMan, 41:1)
- Profile Velocity (parameter VEL.velocity, 36:1)
- Profile Positioning: Absolute positioning (parameter PTP.p_absPTP, 35:1)
- Profile Positioning: Relative positioning (parameter PTP.p_relPTP, 35:3)
- Homing: Reference movement (parameter Homing.startHome, 40:1)
- Homing: Position setting (parameter Homing.startSetP, 40:3)
- Electronic Gear (parameter Gear.startGear, $38: 1$ )

Operating-mode-independent settings

Setting options that apply in all operating modes:

- Acceleration and deceleration behavior with the function "Ramp Setting" function
- Deceleration behavior with the function "Quick Stop"


### 8.2.1 Operating mode Jog

| A WARNING |
| :--- |
| UNINTENDED OPERATION |
| - Note that any changes to the values of these parameters are exe- |
| cuted by the drive controller immediately on receipt of the data |
| set. |
| - Verify that the system is free and ready for movement before |
| changing these parameters. |

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

Availability
Description

Operation with commissioning software

The operating mode is available as of firmware version 1.100 and later.
Jog movements represent "classical jogging". The motor is moved over a selected distance by start signals. If the start signal is applied for a longer period of time, the motor switches to continuous movement.

The operating mode can be started via:

- Commissioning software
- Fieldbus
- Inputs of the signal interface if the signal interface is configured with the "programmable inputs" function.

The commissioning software supports this operating mode with special dialog boxes and menus.
Starting the operating mode
The motor can be moved in both directions at two speeds. Jog movements are started with the Manual. star tMan parameter. The current axis position is the start position for jog movements. The values for position and speed are specified via the corresponding parameters.
Jog is finished when the motor has come to a standstill

- the direction signal is inactive,
- the operating mode was interrupted by an error response.

The Manual.statusMan parameter provides information on the processing status.

| Group.Name Index:Subindex dec. (hex.) | Description <br> Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Manual.startMan $41: 1$ (29:01 $h$ ) | Starting a jog | UINT16 | - | R/W |
|  | Assignment of bits: | $0 . .15$ | 0 |  |
|  | Bit 0: Clockwise direction of rotation |  |  |  |
|  | Bit 1: Counterclockwise direction of rotation |  |  |  |
|  | Bit 2: 0 = slow 1 = fast |  |  |  |
|  | Bit 3: Automatic processing of power stage |  |  |  |
|  | If bit 3 is set to 1 , a jog movement can be started even if the |  |  |  |
|  | power stage is switched off: If the drive is in state 4 (Ready- |  |  |  |
|  | ToSwitchOn), the power stage is automatically switched on |  |  |  |
|  | when the jog movement is started and switched off when the movement is finished. |  |  |  |


| Group.Name <br> Index:Subindex <br> dec. (hex.) | Description <br> Bit assgnment | Data type <br> range <br> dec. | Unit <br> Default <br> dec. | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- |
| Manual.stateMan | Acknowledgement: Jog | UINT16 | - | R/- |
| $41: 2\left(29: 02_{h}\right)$ | Assignment of bits: |  | - |  |
|  | Bit 0: Error LIMP |  |  |  |
|  | Bit 1: Error LIMN | Bit 2: Error HW_STOP |  |  |
|  | Bit 3: Error REF |  |  |  |
|  | Bit 5: Error SW_LIMP | Bit 6: Error SW_LIMN |  |  |
|  | Bit 7: Error SW_STOP | Bit 14: manu_end |  |  |
|  | Bit 15: manu_err |  |  |  |
|  |  |  |  |  |

Classical jog Triggered by the start signal for jog, the motor first moves over a defined distance Manual.step_Man. If the start signal is still available after a specific delay time Manual. time_Man, the controller switches to continuous movement.


Figure 8.2 Classical jog, slow and fast
Jog distance, waiting time and jog speeds are adjustable. If the jog distance is zero, the jog movement starts directly as a continuous movement, irrespective of the waiting time.

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Manual.n_slowMan 41:4 (29:04h) | Speed for slow jog <br> The maximum speed of rotation is the value of parameter Config.n_maxDrv, 15:18. | UINT16 | $\begin{aligned} & \min ^{-1} \\ & 60 \end{aligned}$ | R/W per. |
| Manual.n_fastMan 41:5 (29:05h) | Speed for fast jog <br> The maximum speed of rotation is the value of parameter Config.n_maxDrv, 15:18. | UINT16 | $\begin{aligned} & \min ^{-1} \\ & 600 \end{aligned}$ | R/W per. |
| Manual.step_Man 41:7 (29:07 ${ }_{h}$ ) | Jogging distance at jog start <br> Value 0: Direct activation of continuous movement | UINT16 | $\begin{aligned} & \text { Inc } \\ & 20 \end{aligned}$ | R/W per. |


| Group.Name <br> Index:Subindex <br> dec. (hex.) | Description <br> Bit assgnment | Data type <br> range <br> dec. | Unit <br> Default <br> dec. | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- |
| Manual.time_Man Waiting time until continuous movement starts UINT16 ms | R/W <br> $41: 8\left(29: 08_{h}\right)$ | Only effective if jog distance is not set to equal 0. | $1 . .10000$ | 500 |

Moving away from limit switch range
The drive can be moved away out of the limit switch range to a valid movement range at any time by means of a jog movement.

If the positive limit switch signal LIMP was activated, the jog movement must be in negative direction; in the case of LIMN, the movement must be in positive direction. If the motor does not move away, verify that you have selected the correct direction for the jog movement.

### 8.2.2 Operating mode Profile velocity

| A WARNING |
| :--- |
| UNINTENDED OPERATION |
| - Note that any changes to the values of these parameters are exe- |
| cuted by the drive controller immediately on receipt of the data |
| set. |
| - Verify that the system is free and ready for movement before |
| changing these parameters. |
| Failure to follow these instructions can result in death, serious |
| injury or equipment damage. |

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

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| VEL.velocity <br> 36:1 (24:01 ${ }_{h}$ ) | Start with target speed | INT16 | $\min ^{-1}$ | R/W |
|  | Action object: write access triggers a movement |  |  |  |
|  | The value of Config.n_maxDrv, $15: 18$ is the maximum speed of rotation. |  |  |  |
| $\begin{aligned} & \text { VEL.stateVEL } \\ & 36: 2\left(24: 02_{h}\right) \end{aligned}$ | Acknowledgement: Profile Velocity | UINT16 | - | R/- |
|  | Assignment of bits: Bit 0: Error LIMP |  |  |  |
|  | Bit 1: Error LIMN |  |  |  |
|  | Bit 2: Error STOP |  |  |  |
|  | Bit 3: Error REF |  |  |  |
|  | Bit 5: Error SW_LIMP |  |  |  |
|  | Bit 6: Error SW_LIMN |  |  |  |
|  | Bit 7: SW_STOP |  |  |  |
|  | Bit 13: Target speed reached |  |  |  |
|  | Bit 14: vel_end |  |  |  |
|  | Bit 15: vel_err |  |  |  |

As soon as a target speed of rotation is transmitted with the parameter VEL.velocity, $36: 1$, the drive switches to the operating mode Profile Velocity and accelerates to the target speed of rotation.

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

Monitoring the operating mode

Position overrun

The target speed of rotation can be changed at any time during operation:

- Target speed of rotation
(parameter VEL.velocity, $36: 1$ )
The status of the operating mode can be read with the parameter VEL.stateVel, 36:2.
- Target speed of rotation reached (bit 13)
- Operating mode ended (bit 14: vel_end)
- Error (bit 15: vel_err)

In the Profile Velocity operating mode, the drive may exceed the position range (32 bit).

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

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

This parameter indicates that the drive has been referenced.
For more information see chapter 8.1.3 "Positioning limits".
The following options are available for stopping the drive via the fieldbus:

- Set the target speed of rotation to 0
(parameter VEL.velocity, 36:1)
- "Quick Stop" via fieldbus

The drive comes to a stop via "Quick Stop".
(parameter Commands.driveCtrl, 28:1, setting of bit 2)

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

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

### 8.2.3 Operating mode Profile position

| WARNING |
| :--- |
| UNINTENDED OPERATION |
| -Note that any changes to the values of these parameters are exe- <br> cuted by the drive controller immediately on receipt of the data <br> set. <br> - <br> Verify that the system is free and ready for movement before <br> changing these parameters. <br> Failure to follow these instructions can result in death, serious <br> injury or equipment damage. |

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

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

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { PTP.p_absPTP } \\ & 35: 1\left(23: 01_{h}\right) \end{aligned}$ | Target position for absolute positioning and start of positioning Action object: write access triggers absolute positioning in increments | INT32 | Inc | R/W |
| PTP.StatePTP <br> 35:2 (23:02h) | Acknowledgement: Profile Position <br> Assignment of bits: <br> Bit 0: Error LIMP <br> Bit 1: Error LIMN <br> Bit 2: Error STOP <br> Bit 3: Error REF <br> Bit 5: Error SW_LIMP <br> Bit 6: Error SW_LIMN <br> Bit 7: SW_STOP <br> Bit 13: Target position reached <br> Bit 14: ptp_end <br> Bit 15: ptp_err | UINT16 |  | R/- |
| $\begin{aligned} & \text { PTP.p_reIPTP } \\ & 35: 3\left(23: 03_{\mathrm{h}}\right) \end{aligned}$ | Target position for relative positioning and start of positioning Action object: write access triggers relative positioning in increments | INT32 | Inc | R/W |
| $\begin{aligned} & \text { PTP.continue } \\ & \text { 35:4 (23:04 }) \end{aligned}$ | Continue interrupted positioning <br> The target position was specified with the previous positioning command. <br> The value indicated here is not relevant for positioning. | UINT16 | $\overline{0}$ | R/W |
| $\begin{aligned} & \text { PTP.v_tarPTP } \\ & 35: 5\left(23: 05_{\mathrm{h}}\right) \end{aligned}$ | Target speed of rotation for positioning <br> Positioning can be temporarily stopped with value 0 . <br> The default value is the value of parameter <br> Motion.v_target0. <br> The maximum speed of rotation is the value of parameter Config.n_maxDrv, 15:18. | UINT16 | $\begin{aligned} & \min ^{-1} \\ & 60 \end{aligned}$ | R/W |

Settings The positioning path can be entered in 2 ways:

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


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

Starting the operating mode

Starting relative positioning

Continuing the operating mode

Monitoring the operating mode
As soon as a target position is transmitted in the parameters PTP.p_absPTP, $35: 1$ or PTP.p_relPTP, $35: 3$, the drive switches to the Profile Position operating mode and starts positioning at the target speed of rotation specified with parameter PTP.v_tarPTP, 35:5.
Positioning can also be started if the drive is not homed.
Procedure for starting absolute positioning:

- Set the target speed of rotation with the parameter PTP.v_tarPTP, 35:5.
- Start absolute positioning by specifying the absolute target position in parameter PTP.p_absPTP, 35:1.

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

A position overrun is indicated in parameter Status.WarnSig, $28: 10$, bit 0 . In addition, bit 5 (ref_ok) in parameter Status.xMode_act, 28:3 is reset.

Procedure for starting relative positioning:

- Set the target speed of rotation with the parameter PTP.v_tarPTP, 35:5.
- Start relative positioning by specifying the relative target position in parameter PTP.p_relPTP, 35:3.

If a positioning process is interrupted by, for example, an external stop signal, the process can be continued via a write access to the parameter PTP. continue, 35:4 so it can be completed. Before you can continue, you must remedy the problem that caused the interruption and execute a "Fault-Reset". The value transmitted with PTP. continue, 35:4 is not evaluated.

The parameter PTP. statePTP, $35: 2$ lets you get the processing status.

- Target position reached and operating mode ended. Not signalled if movement was interrupted. (Bit 13)
- Operating mode terminated (bit 14)

Terminating the operating mode Conditions that terminate the operating mode:

- Target position reached, motor at standstill (Parameter PTP.statePTP, $35: 2$, bit 14)
- In the case of an error the drive is stopped. This is indicated by parameter PTP.statePTP, 35:2, bit 15.
- Fieldbus command "Quick Stop"
(writing of value 4 to parameter Commands.driveCtrl, $28: 1$ ) The drive comes to a stop with "Quick Stop".


### 8.2.4 Operating mode Homing

| WARNING |
| :--- |
| UNINTENDED OPERATION |
| - Note that any changes to the values of these parameters are exe- |
| cuted by the drive controller immediately on receipt of the data |
| set. |
| - Verify that the system is free and ready for movement before |
| changing these parameters. |
| Failure to follow these instructions can result in death, serious |
| injury or equipment damage. |

### 8.2.4.1 Overview

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

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

A reference movement must be completed for the new zero point to be valid. If the reference movement is interrupted, it must be. As opposed to the other operating modes, a reference movement must be completed before you can switch to a new operating mode.
The signals required for the reference movement must be wired. Monitoring signals that are not used must be deactivated.

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

There are 6 standard types of reference movements:

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


Homing is not required for a motor with a multiturn encoder because it provides a valid absolute position immediately after being switched on.

Monitoring reference movements

Terminating a reference movement

The parameter Homing. stateHome, 40:2 lets you get information on the processing status.

The parameter Status.xMode_act, $28: 3$, bit 5 , is set if the reference movement was successful.

Conditions that terminate the reference movement:

- The motor has reached the target position and is at a standstill.
- Error response
- "Quick Stop" via fieldbus command

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

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Homing.startHome 40:1 ( $28: 01_{h}$ ) | Start operating mode Homing <br> Action object: Write access triggers reference movement. <br> Value 1: LIMP <br> Value 2: LIMN <br> Value 3: REF counterclockwise direction of rotation <br> Value 4: REF clockwise direction of rotation <br> Value 5: Index pulse counterclockwise direction of rotation <br> Value 6: Index pulse clockwise direction of rotation | $\begin{aligned} & \hline \text { UINT16 } \\ & 1 . .8 \end{aligned}$ |  | R/W |
| Homing.stateHome 40:2 (28:02h) | Acknowledgement: Homing <br> Assignment of bits: <br> Bit 0: Error LIMP <br> Bit 1: Error LIMN <br> Bit 2: Error HW_STOP <br> Bit 3: Error REF <br> Bit 5: Error SW_LIMP <br> Bit 6: Error SW_LIMN <br> Bit 7: Error SW_STOP <br> Bit 15: ref_err <br> Bit 14: ref_end | UINT16 |  | R/- |
| Homing.startSetp 40:3 (28:03 ${ }_{h}$ ) | Position setting to position setting position <br> Action object: write access triggers position setting Only possible if the motor is at standstill. | INT32 | Inc | R/W |
| Homing.v_Home 40:4 (28:04h) | Speed of rotation for search of switch <br> The maximum speed of rotation is the value of parameter Config.n_maxDrv, 15:18. | UINT16 | $\begin{aligned} & \min ^{-1} \\ & 60 \end{aligned}$ | R/W per. |
| Homing.v_outHome $40: 5\left(28: 05_{h}\right)$ | Speed of rotation for moving away from switch <br> The value of Config.n_maxDrv, $15: 18$ is the maximum speed of rotation. | UINT16 | $\begin{aligned} & \min ^{-1} \\ & 6 \end{aligned}$ | R/W per. |
| Homing.p_outHome 40:6 (28:06 ${ }_{\text {h }}$ ) | Maximum distance for search for switching edge <br> After detection of the switch, the drive starts to search for the defined switching edge. If it is not found within the distance defined here, the reference movement is canceled with an error. | INT32 <br> 1.. <br> 2147483647 | $\begin{aligned} & \text { Inc } \\ & 200000 \end{aligned}$ | R/W per. |
| Homing.p_disHome 40:7 (28:07 $h$ ) | Distance from switching edge to reference point <br> After the drive moves away from the switch, it is positioned into the working range by a defined distance; this is defined as the reference point. | INT32 <br> 1.. <br> 2147483647 | $\begin{aligned} & \text { Inc } \\ & 200 \end{aligned}$ | R/W per. |


| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Homing.RefSwMod 40:9 (28:09 ${ }_{\text {h }}$ ) | Processing sequence during reference movement to REF <br> Bit value 0: In positive direction <br> Bit value 1: In negative direction <br> Assignment of bits: <br> Bit 0: Direction of movement to switching edge <br> Bit 1: Direction of movement to distance from switching edge | $\begin{aligned} & \text { UINT16 } \\ & 0 . .3 \end{aligned}$ | $\overline{0}$ | R/W per. |
| Homing.RefAppPos 40:11 (28:0B ${ }_{h}$ ) | Application position at reference point <br> After a successful reference movement, this position is set at the reference point. <br> This automatically defines the application zero point. | INT32 | $\begin{aligned} & \text { Inc } \\ & 0 \end{aligned}$ | R/W per. |
| Homing.refError 40:13 (28:0D ${ }_{h}$ ) | Cause of error during reference movement <br> Error code during reference movement processing | UINT16 |  | R/- |

### 8.2.4.2 Reference movement to limit switch

The following illustration shows a reference movement to the negative limit switch with distance from the switching edge (Homing.startHome, $40: 1=2$ ).


Figure 8.4 Reference movement to the negative limit switch
(1) Movement to limit switch
(2) Movement to switching edge
(3) Movement to distance from switching edge

Starting the reference movement
Procedure:

- Set the speed of rotation for the search for the switch (parameter Homing.v_Home, 40:4)
- Set the speed of rotation for moving away from the switch. (parameter Homing.v_outHome, 40:5).
- Set the distance from the switching edge. (parameter Homing.p_disHome, 40:7).
- Start the reference movement to the desired limit switch. (parameter Homing. star tHome, $40: 1=1$ or 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.

The following illustration shows reference movements to the reference switch with distance from the switching edge (Homing.startHome, 40:1 = 3).


Figure 8.5 Reference movement to reference switch
(1) Movement to limit switch
(2) Movement to switching edge
(3) Movement to distance from switching edge

If a reference movement was started with the wrong direction of rotation, the motor stops at the limit switch. The reference movement is interrupted and must be restarted with the correct direction of rotation.

Starting the reference movement
Procedure:

- Set the speed of rotation for the search for the switch (parameter Homing.v_Home, 40:4).
- Set the speed of rotation for moving away from the switch. (parameter Homing.v_outHome, 40:5)
- Set the directions. (parameter Homing.RefSwMod, 40:9)
- Set the distance from the switching edge. (parameter Homing.p_disHome, 40:7)
- Start the reference movement to the reference switch with movement at counterclockwise direction of rotation. (parameter Homing.star tHome, $40: 1=3$ or 4 )


### 8.2.4.4 Reference movement to index pulse

During the reference movement to index pulse, the motor directly moves to the virtual index pulse. The virtual index pulse is calculated depending on the direction of rotation of the servo motor. It is at the motor position at which the modulo position Status.p_abs, 31:16 takes the value 0 with reference to one motor revolution.

The drive stops directly at the position of the virtual index pulse; there is no movement to the distance from the switching edge Homing. p_disHome. However, it is possible to move the virtual index pulse with the parameter Commands.SetEncPos, 15:19.

Starting the reference movement Procedure:

- Set the speed of rotation to be used for searching the switch (parameter Homing.v_Home, 40:4).
- Start the reference movement to the index pulse with movement at the desired direction of rotation.
(parameter Homing.startHome, 40:1=5 or 6)


### 8.2.4.5 Position setting

Position setting defines an absolute position reference depending on the current motor position.

The position value is delivered in increments in the parameterHoming.startSetP, 40:3.

Position setting is only possible when the motor is at a standstill.

| Group.Name <br> Index:Subindex <br> dec. (hex.) | Description <br> Bit assgnment | Data type <br> range <br> dec. | Unit <br> Default <br> dec. | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- |
| Homing.startSetp <br> $40: 3\left(28: 03_{h}\right)$ | Position setting to position setting position | INT32 | Inc | R/W |
|  | Action object: write access triggers position setting <br> Only possible if the motor is at standstill. |  | - |  |

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


Figure 8.6 Positioning by 4000 increments with position setting
(1) The motor is positioned by 2000 inc.
(2) By means of position setting to 0 , the current motor position is set to position value 0 which, at the same time, defines a new zero point.
(3) When a new motion command by 2000 inc is triggered, the new target position is 2000 inc.

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

Starting position setting

Monitoring position setting
The parameter Homing. stateHome, $40: 2$ lets you get information on the processing status.

The parameter Status.xMode_act, $28: 3$, bit 5, is set if position setting was successful.

Terminating position setting
Procedure:

- Write the new position setting position. (parameter Homing.startSetP, 40:3)
The command is executed immediately and the operating mode is ended.

The operating mode is terminated immediately upon completion.

### 8.2.5 Operating mode Electronic gear

Description In Electronic Gear operating mode the positioning controller calculates a new reference position for the motor movement on the basis of a defined position and an adjustable gear ratio. This mode is used when one or more motors are to follow the reference signal of an NC controller or an encoder.


Figure 8.7 Electronic gear with three drives, adjustable gear ratio (Z,N)
For the Electronic Gear operating mode, the reference signals must be supplied via CN2, see chapter 6.3.11 "Connection of reference signals for CAN or RS485" or 6.3.12 "Connection of reference signals for PROFIBUS DP".

Availability The operating mode is not available for drives with multiturn encoders.
Starting Electronic Gear The operating mode is started with the parameter Gear . star tGear. If reference pulses are supplied, the positioning controller applies the gear ratio and positions the motor at the new reference position.

Position values are specified in internal increments. If the values change, the positioning controller follows immediately. The Electronic Gear operating mode is not limited by the positioning range limits.

Processing is terminated when gear processing is deactivated and the motor is at a standstill or if the operating mode was interrupted. If the positioning controller switches from the operating state "6 Operation enable" to a different state, gear processing is automatically deactivated, e.g. if the motor is stopped by means of a "Quick Stop". The Gear.stateGear parameter provides information on the processing status.

Synchronization
In Electronic Gear operating mode, the positioning controller operates synchronously with other gears/drives. If the operating mode is terminated, synchronicity with the other drives is lost. When gear processing is restarted, the drive has two ways of re-establishing synchronicity.

- Immediate synchronization: The positioning controller follows reference pulses from the time on at which the gear processing is activated. Reference pulses, offset entries and position changes that have occurred before the operating mode started are not taken into account.
- Synchronization with compensation movement: When gear processing is activated, the drive makes a compensation movement in an attempt to reach the position which it would have moved to if no interruption had taken place.

Synchronization with compensation movement is subject to various conditions; see chapter 8.2.5.2 "Synchronization with compensation movement" for more information.

The type of synchronization is set with the parameter
Gear.startGear which also starts the operating mode.

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { Gear.startGear } \\ & 38: 1\left(26: 01_{h}\right) \end{aligned}$ | Start electronic gear | $\begin{aligned} & \text { UINT16 } \\ & 0 \text { ? } \end{aligned}$ | - | R/W |
|  | Value 0: Deactivated |  |  |  |
|  | Value 1: Immediate synchronization |  |  |  |
|  | Value 2: Synchronization with compensation movement |  |  |  |
| $\begin{aligned} & \text { Gear.stateGear } \\ & 38: 2\left(26: 02_{\mathrm{h}}\right) \end{aligned}$ | Acknowledgement: Electronic gear | UINT16 | - | R/- |
|  | Assignment of bits: Bit 0: Error LIMP |  |  |  |
|  | Bit 1: Error LIMN |  |  |  |
|  | Bit 2: Error STOP |  |  |  |
|  | Bit 3: Error REF |  |  |  |
|  | Bit 7: SW_STOP |  |  |  |
|  | Bit 13: Motor at standstill and reference position reached |  |  |  |
|  | Bit 14: gear_end |  |  |  |
|  | Bit 15: gear_err |  |  |  |

### 8.2.5.1 Gear settings

Overview Settings for the electronic gear which are independent of the type of synchronization, include:

- Gear ratio
- Current limitation for stop via torque ramp
- Magnitude of tracking error
- Release of direction of rotation

Further settings and functions for Electronic Gear operating mode can be found in:

- Setting device and movement monitoring with "monitoring functions" and "standstill window".

Gear ratio The gear ratio is the ratio of motor increments and externally supplied reference increments for motor movement. The gear ratio is defined with the parameters for numerator and denominator. A negative numerator value reverses the motor's direction of rotation. The gear ratio is preset to $1: 1$.


With a setting of 1000 reference increments, the motor is to rotate by 2000 motor increments. This results in a gear ratio of 2:1 or a gear factor of 2 .


A new gear ratio is activated when the numerator value is supplied.

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Gear.numGear 38:7 (26:07h) | Numerator of gear ratio | INT16 | $1$ | R/W per. |
| Gear.denGear 38:8 (26:08h) | Denominator of gear ratio <br> The denominator value does not become effective until you have indicated the numerator value. Therefore, always indicate the denominator first, then the numerator. | $\begin{aligned} & \hline \text { INT16 } \\ & \text { 1... } 32767 \end{aligned}$ | 1 | R/W per. |

The resulting positioning distance depends on the current motor resolution,e.g.

- 16384 pulses/revolution

| Current limitation | No profile generator is active in the operating mode Electronic Gear. The <br>  <br> maximum values for acceleration and deceleration depend on the cur- <br> rent limitation set with the parameters Settings.I_max, $15: 3$ and |
| ---: | :--- |
|  | Settings. ImaxSTOP, 15:4. |
| Limitation of speed of rotation | The maximum speed of rotation is limited by the supplied frequency and <br> the maximum speed of rotation of the drive. |
| Release of direction | Release of direction helps to prevent movements opposed to the desired <br> direction of movement, which may occur, for example, during compen- |
| sation or offset movements. Release of direction is set with the param- <br> eter Gear. dirEnGear, $38: 13$. |  |


| Group.Name <br> Index:Subindex <br> dec. (hex.) | Description <br> Bit assgnment | Data type <br> range <br> dec. | Unit <br> Default <br> dec. | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- |
| Gear.dirEnGear <br> $38: 13\left(26: 0 D_{h}\right)$ | Released movement direction for electronic gear | UINT16 |  |  |
|  | This allows you to activate a function that locks return move- <br> ments. | - | R/W |  |
|  | Value 1: Clockwise direction only <br> Value 2: Counterclockwise direction only <br> Value 3: Both directions | 3 | per. |  |
|  |  |  |  |  |
|  |  |  |  |  |

### 8.2.5.2 Synchronization with compensation movement

Synchronization with compensation motion can be used to briefly interrupt the positioning controller in its operation in the group of gears without losing the synchronism with the group of gears. For the compensation movement, the positioning controller takes into account all reference pulses, position changes and offset inputs that have occurred during the interruption and attempts to move to the precise position to which it had moved without the interruption.

Conditions for a compensation movement

The positioning controller can be uncoupled from the synchronous operation with the following actions:

- Deactivation of the operating mode with Gear.startGear $=0$
- "Quick Stop".

The power stage must remain enabled. If it is disabled, all stored reference pulses will be lost when it is enabled again.

## Starting a compensation movement

The parameter Gear.startGear $=2$ is used to start the operating mode Electronic Gear with compensation movement.

The positioning controller attempts to catch up with reference pulses that were supplied before activation of the operating mode as quickly as possible. It is limited by the maximum current Settings. I_max and the maximum speed of rotation of the drive. When gear processing is activated, the control deviation that is caused by the supplied pulses must be no greater than the tracking error limit value
Settings.p_maxDif2. Otherwise the positioning controller will signal a tracking error.

Specification of the direction Prior to activation of gear processing, the direction of a compensation movement can be specified with the parameter Gear.dirEnGear. To ensure that the direction is correctly enabled, the direction inversion function must be taken into consideration. It can be calculated with the parameter Motion.invertDir

### 8.2.5.3 Position offset

A position offset can be superimposed on positioning operations in electronic gear mode; this is used to alter the reference position position controller by adding the offset value. For example, this can be used to trigger a position offset for continuous processing applications.


Figure 8.8 Offset for bridging an empty space in a printing application
The offset is started as soon as the parameter Gear . gear0ffs 38:5 is transferred. Offset positions are specified as relative values in motor increments.

Settings The offset movement is added to the reference pulses of a running gear processing operation. You can specify whether the offset is added all at once or whether it is continuously distributed over a period.

| Group.Name Index:Subindex dec. (hex.) | Description <br> Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Gear.gearOffs $38: 5\left(26: 05_{h}\right)$ | Position offset for electronic gear <br> The position offset is added to the reference pulses. <br> The addition point is as per the numerator/denominator calculation; the offset is therefore specified in motor increments. | $\begin{aligned} & \text { INT32 } \\ & -28000 \\ & . .28000 \end{aligned}$ | $\begin{aligned} & \text { Inc } \\ & 0 \end{aligned}$ | R/W |
| Gear.gearOffsV 38:6 (26:06h $)$ | Speed limitation for offset processing <br> The addition of the position offset for the electronic gear can be distributed over multiple time intervals. <br> You can specify the maximum number of increments per millisecond that can be added. <br> The value 0 indicates that the complete position offset is added at once. | UINT16 $0 . .10000$ | Inc/ms 0 | R/W |

### 8.3 Functions

### 8.3.1 Definition of the direction of rotation

The direction of rotation can be inverted.
The direction of rotation should be defined only once when you commission the product. The definition of the direction of rotation is not intended to reverse the direction of rotation during operation.

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Motion.invertDir 28:6 (1C:06h $)$ | Definition of direction of rotation | UINT16 | - | R/W |
|  | Value 0: Clockwise direction of rotation With positive reference values, the motor rotates clockwise (as you look at the end of the protruding motor shaft). | $0 . .1$ | 0 | per. |
|  | Value 1: Counterclockwise direction of rotation With positive reference values, the motor rotates counterclockwise (as you look at the end of the protruding motor shaft). |  |  |  |
|  | NOTE: The new value is only activated when the drive is switched on. |  |  |  |

### 8.3.2 Motion profile

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

The following properties can be set for the motion profile:

- Symmetrical and linear acceleration ramp.
- Change of speed of rotation and position during movements.
- Acceleration parameters $\mathrm{min}^{-1} / \mathrm{s}$.

Value range 1 ... $250000 \mathrm{~min}^{-1} / \mathrm{s}$.
Internal resolution approx. $14 \mathrm{~min}^{-1} / \mathrm{s}$.

- Speed values in $\min ^{-1}$.

The maximum speed depends on the motor type; they can be read via the parameter Config.n_maxDrv, 15:18.
Resolution $1 \mathrm{~min}^{-1}$.

- Position values in increments (inc).

Value range $-2^{31} \ldots+2^{31}-1$ inc.
With reference to the motor output shaft, the drive has a resolution of $16384 \mathrm{inc} / \mathrm{rev}$.

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Motion.dec_Stop 28:21 (1C:15h) | Deceleration for "Quick Stop" <br> Deceleration that is used for every "Quick Stop": <br> - "Quick Stop" via control word <br> - "Quick Stop" via external monitoring signal <br> - "Quick Stop" via error of classes 1 and 2 | UINT32 <br> 1... 250000 | $\begin{aligned} & \mathrm{min}^{-1} / \mathrm{s} \\ & 6000 \end{aligned}$ | R/W per. |
| Motion.v_target0 29:23 (1D:17h) | Speed of rotation for parameter PTP.v_tarPTP <br> Speed of rotation for Profile Position operating mode if no value was written to PTP.v_tarPTP. <br> NOTE: This persistent value is only used as a default assignment for PTP.v_tarPTP during switching on. <br> The maximum speed of rotation is the value of parameter Config.n_maxDrv, 15:18. | UINT16 | $\begin{aligned} & \min ^{-1} \\ & 60 \end{aligned}$ | R/W per. |
| Motion.acc 29:26 (1D:1Ah) | Acceleration <br> Value determines acceleration and deceleration. New values do not become effective until after standstill. | UINT32 <br> 1... 250000 | $\begin{aligned} & \min ^{-1} / \mathrm{s} \\ & 600 \end{aligned}$ | R/W per. |

### 8.3.3 Quick Stop

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

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

Events that trigger a "Quick Stop":

- Input signal STOP
(parameter Status.Sign_SR, bit 2)
- Limit switch overtraveled
(parameter Status.Sign_SR, bit 0 and bit 1)
- Error of error classes 1 or 2
- "Quick Stop" triggered via a fieldbus command (parameter Commands.driveCtrl, 28:1, Bit 2)

Settings Depending on the operating mode, the motor deceleration is controlled via a profile-controlled or a torque ramp.

In the following operating modes, motor deceleration is controlled via a profile. The deceleration can be set with the parameter Motion.dec_Stop, 28:21.

- Profile Velocity
- Profile Position
- Homing
- Jog

In the following operating modes, the motor is decelerated with a torque ramp. The motor decelerates with the maximum permissible current (maximum current for stop via torque ramp, parameter Settings.I_maxStop, 15:4).

- Electronic Gear
- Internal reference value (signal generator for controller setting)

The drive absorbs excess braking energy during a "Quick Stop". If the DC bus voltage exceeds the permissible limit value, the drive disables the power stage and signals an "overvoltage error". The motor then coasts down without any braking force.

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

- Reduce the deceleration or the maximum current for stop via the torque ramp.
- Reduce the drive load

Acknowleding a Quick Stop
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 LIMN and LIMP:
- Move the motor 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 states and state transitions" and Chapter 6 "Installation".

### 8.3.4 Programmable inputs and outputs

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

This can be set for each of the 4 signals with the parameters IO.IO0_def to IO.IO3_def.

Programmable input If a signal is configured as a programmable input, the drive monitors this signal continuously and accesses parameters independently whenever it a change of edge is detected. The parameter accesses can be parameterized as follows:

- Evaluation of rising and falling edges
- Parameter to be influenced by specification of index and subindex
- Write value for parameter with rising edge
- Write value for parameter with falling edge
- Bit mask for writing the object

Structure of the parameter access:

- Rising or falling edge detected
- Parameter is read
- Result of AND operation with bit mask
- Result of OR operation with write value for parameter with rising and falling edge
- Write result to parameter


## Shown as pseudo code:

- Rising edge -> object_WriteValue = (object_ReadValue AND bitmask) OR WriteValue_pos
- Falling edge -> object_WriteValue = (object_ReadValue AND bitmask) OR WriteValue_neg


## Special case if bit mask $=\mathbf{0}$ :

- Rising edge -> object_WriteValue= WriteValue_pos
- Falling edge -> object_WriteValue= WriteValue_neg

Programmable output If a signal is defined as a programmable output, the drive accesses (read) parameters cyclically and sets the signal level in accordance with the read value. The accesses can be parameterized with the following parameters:

- Selection of the parameter to be read by specification of index and sub-index
- Comparison value for 1 level at output
- Comparison operator: equal, not equal, less than, greater than
- Bit mask for the comparison

Structure of the parameter access:

- Parameter is read
- Result of AND operation with bit mask
- Compare result with comparison value
- Depending on result, set output to HIGH or LOW


## Shown as pseudo code:

IF (object_ReadValue AND bit mask) <comparison_operator> comparison_value THEN set output=1
ELSE set output=0

| Group.Name Index:Subindex dec. (hex.) | Description <br> Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { ProgIOO.Index } \\ & \text { 800:1 }\left(320: 01_{h}\right) \end{aligned}$ | Index of the control parameter <br> If prog. input: index of parameter to be written <br> If prog. output: index of parameter to be read <br> If prog. input: <br> write(Index,Subindex) = <br> (read(Index,Subindex) BAND BitMask) BOR VALUEx <br> If prog. output: <br> 1 level at output if (read(Index,Subindex) BAND BitMask) =<> VALUE1 | UINT16 | - | R/W per. |
| ProgIO0.Subindex 800:2 (320:02h) | Subindex of control parameter <br> If prog. input: subindex of parameter to be written If prog. output: subindex of parameter to be read | UINT16 | - | R/W per. |
| ProglOO.BitMask 800:3 (320:03 ${ }_{\text {h }}$ ) | Bitmask for the parameter value <br> If programmable input or programmable output: Bit mask used to link the read value (index, subindex) of the parameter with the operator AND before the value is processed. | UINT32 |  | R/W per. |


| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| ProglO0.Switch 800:4 (320:04h) | Edge detection and comparison operator <br> If programmable input: <br> Selection of the edges to be detected <br> Value 0: No response to level change <br> Value 1: Response to rising edge <br> Value 2: Response to falling edge <br> Value 3: Response to both edges <br> If programmable output: <br> Selection of condition for comparison: <br> Value 0: (parameter read value = comparison value) <br> Value 1: (parameter read value <> comparison value) <br> Value 2: (parameter read value < comparison value) <br> Value 0: (parameter read value > comparison value) | UINT16 |  | R/W per. |
| ProglO0.Value1 800:5 (320:05h) | Write Write value at rising edge and comparison value <br> If programmable input: <br> Parameter write value at rising edge <br> If programmable output: <br> Comparison value for condition | INT32 $0 .$. 4294967295 |  | R/W per. |
| ProgIOO.Value2 800:6 $\left(320: 06_{h}\right)$ <br> 800:6 (320:06 ${ }_{\text {h }}$ ) | Write value at falling edge <br> If programmable input: <br> Parameter write value at falling edge <br> If programmable output: <br> no meaning | INT32 $0 .$. 4294967295 |  | R/W per. |

Example Parameterization for a simple manual control

| IO0 as input, | Rising edge $=$ enable power stage | Falling edge $=$ disable power stage + reset error |
| :--- | :--- | :--- |
| IO1 as input, | Rising edge $=$ movement in positive direction | Falling edge $=$ stop |
| IO2 as input, | Rising edge $=$ movement in negative direction | Falling edge $=$ stop |
| IO3 as output, | Output $=1$ if drive ready |  |

Input IOO

| Input | $\mathrm{L}->\mathrm{H}$ | Commands.driveCtrl 2 | (Enable) |
| :--- | :--- | :--- | :--- |
|  | $\mathrm{H}->\mathrm{L}$ | Commands.driveCtrl 9 | (Disable + FaultReset) |


| 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- <br> Reset |

Input IO1

| Input |  | L->H | VEL.velocity 600 |
| :--- | :--- | :--- | :--- |
|  | (positive movement) |  |  |
|  | $\mathrm{H}->\mathrm{L}$ | VEL.velocity 0 | (stop) |


| 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 with rising edge |
| ProgIO1.Value2 | $801: 6$ | 0 | speed value with falling edge |

Input IO2

| Input | $\mathrm{L}->\mathrm{H}$ | VEL.start -600 | (neg. movement) |
| :--- | :--- | :--- | :--- |
|  | $\mathrm{H}->\mathrm{L}$ | VEL.start 0 | (stop) |


| Parameter name | Idx:Six | Value | Remarks |
| :--- | :--- | :--- | :--- |
| /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 with rising edge |
| ProgIO2.Value2 | $802: 6$ | 0 | speed value with falling edge |

Output IO3

| Output | High | if status 6 |  |
| :--- | :--- | :--- | :--- |
|  |  |  |  |
| 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: "="' |
| ProglO3.Value1 | $803: 5$ | 6 | Comparison value: $6=$ Operation <br> Enable |

### 8.3.5 Fast position capture

The function "Fast position capture" serves to detect the current motor position at the time when a digital 24 V signal appears at one of the two capture inputs. For example, this function can be used for detection of registration marks.

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

- IO2 (CAP1)
- IO3 (CAP2)

One of 2 possible functions for capture can be selected for each capture input:

- Position capture with rising or falling edge at capture input.
- One-time or continuous capture in the case of multiple edges at the capture input.

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

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

The motor positions captured during acceleration or deceleration are less precise.

Enable fast position capture
Enable single position capture

- For CAP1: Write value 1 to parameter Capture.CapStart1, 20:15
- For CAP2: Write value 1 to parameter Capture.CapStart2, 20:16

Activate continuous position capture

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

In the case of one-time single position capture, the "fast position capture" function is terminated when the first signal edge is detected.

In the case continuous position capture or if no signal edge is detected, the capture can be stopped by writing the parameter Capture.CapStart1, $20: 15$, value 0 or Capture.CapStart2, 20:16, value 0 .

| Group.Name <br> Index:Subindex <br> dec. (hex.) | Description <br> Bit assgnment | Data type <br> range <br> dec. | Unit <br> Default <br> dec. | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- |
| Capture.CapLevel | Signal level for capture inputs | $\left.\begin{array}{l}\text { UINT16 } \\ \text { 20:14 (14:00E }\end{array}\right)$ | - | R/W |
|  | Bit value 0: Position capture at negative edge <br> Bit value 1: Position capture at rising edge | 3 |  |  |
|  | Assignment of bits: |  |  |  |
|  | Bit 0: Sets the level for CAP1 <br> Bit 1: Sets the level for CAP2 |  |  |  |
|  |  |  |  |  |


| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Capture.CapStart1 20:15 (14:00F $\left.{ }_{h}\right)$ | Start capture on CAP1 <br> Value 0: Cancel capture function <br> Value 1: Start one-time capture <br> Value 2: Start continuous capture <br> In the case of one-time capture, the function is terminated when the first value is captured. <br> In the case of continuous capture, the function continues to run. | $\begin{aligned} & \text { UINT16 } \\ & 0 . .2 \end{aligned}$ | $\overline{0}$ | R/W |
| Capture.CapStart2 20:16 (14:10h) | Start capture on CAP2 As CAP1 | $\begin{aligned} & \text { UINT16 } \\ & 0 . .2 \end{aligned}$ | $\overline{0}$ | R/W |
| Capture.CapStatus 20:17 (14:11 $h$ ) | Status of the capture channels <br> Assignment of bits: <br> Bit 0: position capture via CAP1 carried out <br> Bit 1: position capture via CAP2 carried out | $\begin{aligned} & \text { UINT16 } \\ & 0 . .3 \end{aligned}$ | $\overline{0}$ | R/- |
| Capture.CapPact1 20:18 (14:12h) | Motor position with signal at CAP1 <br> Output of captured position of the encoder <br> In the case of stepper motor devices, this is the commutation position. | INT32 | Inc | R/- |
| Capture.CapPact2 $20: 19\left(14: 13_{h}\right)$ | Motor position with signal at CAP2 <br> As CAP1 | INT32 | Inc | R/- |

### 8.3.6 Standstill window

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

If the control deviation Status.p_dif of the position controller remains in the standstill window after the end of the positioning for the period Settings.p_winTime, the device signals the end of processing (x_end = 0->1).


Figure 8.9 Standstill window
The parameters Settings.p_win and Settings.p_winTime define the size of the window.

The standstill window primarily affects the x_end bit of the operating mode: The corresponding operating mode does not signal x_end=1 unless the is in the standstill window after the end of the movement.

| Group.Name <br> Index:Subindex <br> dec. (hex.) | Description <br> Bit assgnment | Data type <br> range <br> dec. | Unit <br> Default <br> dec. | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- |
| Settings.p_win <br> 15:15 (0F:0F | Standstill window, permissible control deviation | See parameter Settings.p_winTime |  |  |

### 8.3.7 Function of the holding brake

Motors with integrated holding brakes help to avoid unwanted movements of the motor without current.

The holding brake is not available with all product versions.

| A WARNING |
| :--- |
| LOSS OF BRAKING FORCE DUE TO WEAR OR HIGH TEMPERATURE |
| Applying the holding brake while the motor is running will cause ex- |
| cessive wear and loss of the braking force. Heat decreases the brak- |
| ing force. |
| - Do not use the brake as a service brake. |
| - Note that "EMERGENCY STOPS" may also cause wear |
| - At operating temperatures of more than $80^{\circ} \mathrm{C}\left(176^{\circ} \mathrm{F}\right)$, do not |
| exceed a maximum of $50 \%$ of the specified holding torque when |
| using the brake. |
| Failure to follow these instructions can result in death, serious |
| injury or equipment damage. |

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


Figure 8.10 Releasing the holding brake

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

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


Figure 8.11 Applying the holding brake
The delay time is not effective if the power stage is disabled via the STO safety function. Especially in the case of vertical axes it is important to verify whether additional measures are required to avoid lowering of the load.

## 9 Diagnostics and troubleshooting

### 9.1 Error indication and troubleshooting

### 9.1.1 Diagnostics via commissioning software

The commissioning software can be used to display the following diagnostics information

- Indication of current operating state Lets you draw conclusions concerning the reasons for the drive not being ready for operation.
- Status word Indicates which of the 3 following signals is active:
- External monitoring signal
- Internal monitoring signal
- Warning
- Parameter Status.StopFault, 32:7

Cause of last interruption, error number

- Error memory

The error memory contains the last 7 errors. The error memory is not volatile, i.e. it is not cleared when the drive is switched off.

The following information is output for every error:

- Age
- Description of error as text
- Error class
- Error number
- Frequency
- Additional information


### 9.1.2 Diagnostics via fieldbus

Asynchronous errors In fieldbus mode, device errors are signaled as asynchronous errors by the monitoring system of the controller. An asynchronous error is indicated by the status word "fb_statusword". Signal status 1 indicates an error message or a warning message. The parameters allow you to determine details concerning the cause of the error.


Figure 9.1 Evaluation of asynchronous errors
Description of the bits:

- Bit 5, "FltSig"

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

Parameter Status.FltSig_SR, 28:18

- Bit 6, "Sign_SR"

Message from external monitoring signal (e.g. movement interruption by limit switch)
Parameter Status.Sign_SR, 28:15

- Bit 7, "warning"

Warning message (e.g. temperature warning)
Parameter Parameter Status.WarnSig, 28:10

| Group.Name Index:Subindex dec. (hex.) | Description <br> Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Status.p_difPeak 15:13 (0F:OD ${ }_{h}$ ) | Maximum position deviation reached <br> The value is updated an ongoing basis. <br> The parameter value is set to the current position deviation value by writing 0 . | UINT32 0. $214748364$ $7$ | $\begin{aligned} & \text { Inc } \\ & 0 \end{aligned}$ | R/- |
| Status.driveStat 28:2 (1C:02h) | Status word for the operating state <br> LOW-UINT16: <br> Assignment of bits: <br> Bits 0 ... 3: Current operating state <br> Bit 4: reserved <br> Bit 5: Error detected by internal monitoring <br> Bit 6: Error detected by external monitoring <br> Bit 7: Warning active <br> Bits 8 ... 11: Reserved <br> Bits 12 ... 15: Operating-mode specific coding <br> Corresponds to the assignment of bits $12 \ldots 15$ in the operating mode-specific acknowledgement data. <br> HIGH-UINT16: <br> Assignment see parameter Status.xMode_act. | UINT32 | - | R/- |


| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Status.xMode_act 28:3 (1C:03h) | Current operating mode with additional information <br> Assignment of bits: <br> Bits 0..3: Current operating mode (see below) <br> Bit 4: reserved <br> Bit 5: Drive referenced (ref_ok) <br> Bits 6 ... 15: Reserved <br> Values for bits 0 ... 3 : <br> Value 1: Jog <br> Value 2: Homing <br> Value 3: Profile Position <br> Value 4: Profile Velocity <br> Value 5: Electronic Gear position-controlled <br> Value 8: Internal reference value <br> Other numbers are reserved for future extensions. | UINT16 |  | R/- |
| $\begin{aligned} & \text { Status.WarnSig } \\ & \text { 28:10 (1C:0A }) \end{aligned}$ | Warnings <br> Monitoring signals with error class 0 . <br> Assignment of bits: <br> Bit 0: Position overrun profile generator <br> Bit 1: Temperature of power stage $>100^{\circ} \mathrm{C}$ <br> Bit 5 : $I^{2} \mathrm{t}$ limitation active <br> Bit 10: Absolute position not yet read <br> The remaining bits are reserved for later extensions. The remaining bits are reserved for future extensions. | UINT16 |  | R/- |
| Status.Sign_SR $28: 15\left(1 \mathrm{C}: 0 \mathrm{~F}_{\mathrm{h}}\right)$ $28: 15\left(1 \mathrm{C}: 0 \overline{\mathrm{~F}}_{\mathrm{h}}\right)$ | Stored signal status of external monitoring signals <br> Bit value 0: not activated <br> Bit value 1: activated <br> Assignment of bits: <br> Bit 0: LIMP <br> Bit 1: LIMN <br> Bit 2: STOP <br> Bit 3: REF <br> Bit 5: SW_LIMP <br> Bit 6: SW_LIMN <br> Bit 7: SW stop <br> Stored signal status of released external monitoring signals | $\begin{aligned} & \text { UINT16 } \\ & 0 . .15 \end{aligned}$ |  | R/- |
| $\begin{aligned} & \text { Status.FItSig } \\ & \text { 28:17 }\left(1 \mathrm{C}: 11_{\mathrm{h}}\right) \end{aligned}$ | Active monitoring signals <br> The error bits remain set as long as the error persists (i.e. as long as the limit value is exceeded). <br> Assignment as parameter Status.FltSig_SR | UINT32 | - | R/- |


| Group.Name <br> Index:Subindex <br> dec. (hex.) | Description <br> Bit assgnment | Data type <br> range <br> dec. | Unit <br> Default <br> dec. | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- |
| Status.FItSig_SR | Stored monitoring signals | UINT32 | - | R/- |
| 28:18 (1C:12h) |  |  |  |  | |  | Error bits remain set until a FaultReset is executed. |
| :--- | :--- | :--- | :--- |


| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Status.n_act$31: 9\left(1 \mathrm{~F}: 09_{\mathrm{h}}\right)$ | Actual speed of motor | INT16 | $\min ^{-1}$ | R/- |
|  | Corresponds to parameter Status.v_act, but converted to revolutions per minute. |  |  |  |
| Status. 1 act$31: 12\left(1 \mathrm{~F}: 0 \mathrm{C}_{\mathrm{h}}\right)$ | Current motor current | INT16 | A | R/- |
|  | Unit: [0.1A] |  |  |  |
| Status.I2t_act$31: 17\left(1 \mathrm{~F}: 11_{h}\right)$ | $\mathrm{I}^{2} \mathrm{t}$ total | UINT16 | \% | R/- |
|  | If the $I^{2} t$ total is equal to or greater than $100 \%$, the current is limited to the nominal current of the drive I_nomDrv; at the same time, bit 5 is set in Status.WarnSig. |  |  |  |
| Status.UDC_act 31:20 (1F:14 ${ }_{h}$ ) | Voltage power supply | UINT16 | V | R/- |
|  | Unit [0.1V] |  |  |  |
| Status.TPA_act 31:25 ( $1 \mathrm{~F}: 19_{\mathrm{h}}$ ) | Power stage temperature | $\begin{aligned} & \text { UINT16 } \\ & \text { 20.. } 110 \end{aligned}$ | ${ }^{\circ} \mathrm{C}$ | R/- |
| Status.v_pref 31:28 (1F:1Ch) | Speed of reference position Status.p_ref | INT32 | $\mathrm{Inc} / \mathrm{s}$ | R/- |
| Status.p_target 31:30 (1F:1Eh) | Target position of profile generator | INT32 | Inc | R/- |
|  | Absolute position value of the profile generator, calculated on the basis of the relative and absolute position values specified. |  |  |  |
| Status.p_profile 31:31 (1F:1Fh) | Actual position of profile generator | INT32 | Inc | R/- |
|  | Corresponds to the reference position Status.p_ref. |  |  |  |
| Status.p_actusr 31:34 (1F:22h) | Motor position | INT32 | Inc | R/- |
|  | Parameter for improving compatibility with TwinLine. Corresponds to the actual position Status.p_act. |  |  |  |
| Status.n_profile 31:35 (1F:23h) | Actual speed of profile generator | INT16 | $\min ^{-1}$ | R/- |
|  | Corresponds to parameter Status.n_pref. |  |  |  |
| Status.n_target 31:38 (1F:26h) | Target speed of profile generator | INT16 | $\min ^{-1}$ | R/- |
| Status.n pref 31:45 (1F:2D ${ }_{h}$ ) | Speed of rotation of reference position Status.p_ref | INT16 | $\min ^{-1}$ | R/- |
|  | Corresponds to parameter Status.v_pref, but converted to revolutions per minute. |  |  |  |
| Status.StopFault 32:7 (20:07h) | Cause of last interruption, error number | UINT16 | $\overline{-}$ | R/- |

Synchronous errors
In addition to asynchronous errors, synchronous errors are also signaled in fieldbus operation; they are caused by communication problems (e.g. unauthorized access or incorrect command).

Both types of errors are described in the fieldbus manual.

| Error memory | The last 7 error messages are saved in a separate error memory. The er- <br> ror messages are sorted in chronological order and can be read via in- <br> dex and subindex. The last error that caused an interruption is also <br> saved to the parameter Status. StopFault, $32: 7$. |
| :--- | :--- |
| Index:Subindex Meaning <br> $900: 1,900: 2,900: 3 \ldots$ 1st entry, oldest error message <br> $901: 1,901: 2,901: 3 \ldots$ 2nd entry <br> $\ldots$ $\ldots$ <br> $906: 1,906: 2,906: 3$ 7th entry, latest error message |  |

More information on each error message can be obtained via subindices 1 ... 5:

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| ErrMem0.ErrNum 900:1 (384:01 ${ }_{h}$ ) | Coded error number <br> Index 900: First error entry (oldest) <br> Index 901: Next error entry <br> NOTE: Reading this parameter copies the entire error entry ( $9 x x .1$ - $9 x x .5$ ) to an intermediate memory from which all elements are then loaded. | UINT16 | - | R/- |
| $\begin{aligned} & \text { ErrMem0.Class } \\ & 900: 2\left(384: 02_{h}\right) \end{aligned}$ | Error class The error class determines the error response of the controller. | $\begin{aligned} & \text { UINT16 } \\ & 0 . .4 \end{aligned}$ |  | R/- |
| $\begin{aligned} & \text { ErrMem0.Age } \\ & 900: 3\left(384: 03_{h}\right) \end{aligned}$ | Age of the error in device switch-on cycles <br> Value 0: Error occurred since the last switch-on of the device <br> Value 1: Error occurred during last operation <br> Value 2: Error occurred during last but one operation etc. | UINT32 | - | R/- |
| ErrMem0.Repeat 900:4 (384:04h) | Error repetitions <br> Number of consecutive errors with this error number: <br> Value 0: Error occurred only once <br> Value 1: 1 repetition <br> Value 2: 2 repetitions etc. <br> When the maximum number of 255 is reached, the repetition counter is no longer incremented. | $\begin{aligned} & \text { UINT16 } \\ & 0 . .255 \end{aligned}$ |  | R/- |
| ErrMem0.ErrQual 900:5 (384:05h) | Error identifier <br> This entry contains additional information on the error. <br> The meaning depends on the error numer. | UINT16 | - | R/- |

### 9.1.3 Operation state and error indication

Status indication The LED shows error messages and warnings. It indicates the operating states in coded form.


### 9.1.4 Reset error message

To reset the error message are correcting the fault, send a "Fault Reset" command via the fieldbus by writing the value 8 to the control word, parameter Commands.driveCtrl, 28:1. An error message can also be reset with the commissioning software.

### 9.1.5 Error classes and error response

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

| Error <br> class | Reaction | Meaning |
| :--- | :--- | :--- |
| 0 | Warning | Message only, no interruption. |
| 1 | "Quick Stop" | Motor stops with "Quick Stop", power stage and <br> controller remain switched on and enabled. |
| 2 | "Quick Stop" <br> with switch-off | Motor stops with "Quick Stop", power stage and <br> controller are disabled after standstill has been <br> achieved. |
| 3 | Fatal error | Power stage and controller switch off immedi- <br> ately without stopping the motor first. |
| 4 | Uncontrolled <br> operation | Power stage and controller switch off immedi- <br> ately without stopping the motor first. Error <br> response can only be reset by switching off the <br> device. |

### 9.1.6 Causes of errors and troubleshooting

If communication via the fieldbus is impossible, proceed as follows:

- Open the connector housing cover
- Compare the behavior of LED with the information in the table below.

| Error | Error <br> class | Cause of error | Troubleshooting |
| :--- | :--- | :--- | :--- |
| Communication impossible | - | Incorrect communication parameters | Set the parameter switches correctly <br> Set the parameters correctly |
| Communication unreliable | - | Missing terminating resistors <br> Poor shielding of lines | Connect terminating resistors cor- <br> rectly <br> Connect the shield correctly (see <br> chapter 6 "Installation") |
| LED off | - | No supply voltage | Check supply voltage and fuses |
| LED flashes at 6 Hz | 4 | Incorrect flash checksum | Reinstall firmware or replace product |
| LED flashes at 10 Hz | 4 | Hardware error <br> Internal system error <br> Watchdog | Switch drive off and on <br> Drive requires service |

Error messages and warnings can be read out via the fieldbus.
Errors detected by internal monitoring are signaled by the corresponding 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".

| Moni- <br> toring bit | Error | Error <br> class | Cause of error | Troubleshooting |
| :--- | :--- | :--- | :--- | :--- |
| 0 | Undervoltage 1 | 2 | Supply voltage below threshold value <br> for switching off the drive | Check voltage, check connections at <br> the drive |
| 1 | Undervoltage 2 | 3 | Supply voltage below threshold value <br> for switching off the drive | Check voltage, check connections at <br> the drive |
| 2 | Overvoltage | 3 | Overvoltage, regeneration condition | See chapter 5.1 "External power sup- <br> ply units" |
| 5 | Motor overload |  | Load torque too high <br> Motor phase current set too high | Reduce load torque <br> Reduce motor phase current |
| 12 | Power stage over- <br> temperature | 3 | The power stage overheated <br> Ambient temperature too high <br> Poor heat dissipation | Improved heat dissipation via the <br> motor flange |
| 17 | Tracking error |  | Load torque too high <br> Ramp too steep | Reduce load torque or motor torque; <br> check settings for motor phase cur- <br> rent; reduce speed; reduce accelera- <br> tion |
| 18 | Encoderinoperative | 4 | Defective encoder | Drive requires service |
| 21 | CAN/RS485 proto- <br> col error |  |  | Check shield at serial cable <br> Avoid ground loops |
| 22 | Nodeguard error | 2 | Serial connection or fieldbus connec- <br> tion interrupted | Check serial connection |


| Moni- <br> toring bit | Error | Error <br> class | Cause of error | Troubleshooting |
| :--- | :--- | :--- | :--- | :--- |
| 25 | Inputs of the STO <br> safety function have <br> O level | 3 | STO safety function was triggered | Check guard door, cabling |
| 26 | Inputs of the STO <br> safety function have <br> different levels | 4 | Interruption of the signal wires | Check signal cable, check signal con- <br> nection, replace |
| 28 | Hardware error <br> EEPROM | Hardware error | Drive requires service |  |
| 29 | Start-up error | Hardware error | Drive requires service |  |
|  | Drive remains in <br> operating state 2 | Start-up error caused by of improper <br> parameterization; <br> Incorrect EEPROM checksum | Initialization of the parameters with <br> default values (parameter Com- <br> mands.default 11:8). If this does not <br> correct the problem, the drive must be <br> serviced |  |

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

| Error number | Error type | Cause of error/troubleshooting |
| :---: | :---: | :---: |
| $013 \mathrm{~F}_{\mathrm{h}}$ | EEPROM not initialized | Hardware error / send product for service |
| 0140 ${ }_{\text {h }}$ | EEPROM not compatible with current software | Hardware error / send product for service |
| $0141_{\text {h }}$ | EEPROM read error | Hardware error / send product for service |
| $0142^{\text {h }}$ | EEPROM write error | Hardware error / send product for service |
| $0143_{\text {h }}$ | Checksum error in EEPROM | Hardware error / send product for service |
| $0148_{\text {h }}$ | Serial interface: Overrun error | Check shield at serial cable, avoid ground loops |
| 0149 ${ }_{\text {h }}$ | Serial interface: Framing error | Check shield at serial cable, avoid ground loops |
| $014 A_{h}$ | Serial interface: <br> Parity error | Check shield at serial cable, avoid ground loops |
| $014 \mathrm{~B}_{\mathrm{h}}$ | Serial interface: Receive error | Check shield at serial cable, avoid ground loops |
| $014 C_{h}$ | Serial interface: Buffer overflow | Check shield at serial cable, avoid ground loops |
| $014 \mathrm{D}_{\text {h }}$ | Serial interface: Protocol error | Check shield at serial cable, avoid ground loops |
| $014 \mathrm{E}_{\mathrm{h}}$ | Nodeguarding | Serial connection interrupted. |
| 0150h | Impermissible limit switch is active | Reference movement started in wrong direction? Limit switch incorrectly wired? |
| 0151 h | Switch was overtraveled | Parameter value for search speed for reference movement too high? |
| $0152_{\text {h }}$ | Switching edge not found | Parameter value for distance for moving away from switch for reference movement too low? |
| $0153_{h}$ | Index pulse not found | Encoder/Hall sensor defective? |
| 0154h | Reference movement to index pulse cannot be reproduced. Index pulse is too close to switch | Move switch or slightly turn motor shaft and re-mount motor |


| Error <br> number | Error type | Cause of error/troubleshooting |
| :--- | :--- | :--- |
| $0155_{\mathrm{h}}$ | Switch still active after movement <br> away from switch | Switch may bounce <br> Set longer distance for moving away from switch |
| $0157_{\mathrm{h}}$ | Interruption/QuickStopActive by <br> LIMP | Limit switch was activated <br> $0158_{\mathrm{h}}$ |
| Interruption or QuickStopActive by <br> LIMN | Limit switch was activated |  |
| $0159_{\mathrm{h}}$ | Interruption or QuickStop Active by <br> REF | Reference switch was activated and is parameterized as interruption <br> input |
| $015 \mathrm{~A}_{\mathrm{h}}$ | Interruption or QuickStopActive by <br> STOP | Stop input was activated and is parameterized as interrupt input |

### 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 |
| 0102h | 258 | 3 | Overvoltage power supply |
| 0105h | 261 | 3 | Motor overload |
| $010 C_{h}$ | 268 | 2 | Power stage overtemperature |
| $\underline{0110_{h}}$ | 272 | 3 | Motor blocked or stalled |
| $0111_{\text {h }}$ | 273 | 3 | Tracking error |
| $0112_{\text {h }}$ | 274 | 4 | Encoder defective |
| 0115 h | 277 | 1 | Protocol error fieldbus |
| 0116 ${ }_{\text {h }}$ | 278 | 2 | Fieldbus: Nodeguarding/Watchdog or Clear |
| $0117_{\text {h }}$ | 279 | 3 | Frequency at pulse/direction input too high |
| $0118_{\text {h }}$ | 280 | 3 | Short circuit digital outputs |
| $0119_{\text {h }}$ | 281 | 3 | STO safety function triggered |
| $011 \mathrm{~A}_{\mathrm{h}}$ | 282 | 4 | Inputs of the STO safety function have different levels (>1s) |
| $011 C_{h}$ | 284 | 4 | EEPROM hardware error |
| $011 \mathrm{D}_{\mathrm{h}}$ | 285 | 4 | Start-up error |
| $011 \mathrm{E}_{\mathrm{h}}$ | 286 | 4 | Internal system error |
| $011 \mathrm{~F}_{\mathrm{h}}$ | 287 | 4 | Watchdog |
| $0120_{\text {h }}$ | 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 |
| $0132_{\text {h }}$ | 306 | 0 | Communication protocol: Unknown service |
| $0133_{h}$ | 307 | 0 | Writing of parameter not permissible |
| 0134h | 308 | 0 | Parameter value out of permissible range |
| $0135_{\text {h }}$ | 309 | 0 | Segment service not initialized |
| $0136_{\text {h }}$ | 310 | 0 | Error during recording function |
| $0137_{h}$ | 311 | 0 | State is not Operation Enable |
| $0^{0138_{h}}$ | 312 | 0 | Processing in current operating state not possible |
| $\underline{0139}{ }_{\text {h }}$ | 313 | 0 | Generation of reference position interrupted |
| $\underline{013 A_{h}}$ | 314 | 0 | Switching impossible while operating mode is active |
| $013 B_{h}$ | 315 | 0 | Command not allowed during processing (xxxx_end=0) |
| $013 C_{h}$ | 316 | 0 | Error in selection parameter |
| $013 \mathrm{D}_{\mathrm{h}}$ | 317 | 0 | Position overrun |
| $013 \mathrm{E}_{\mathrm{h}}$ | 318 | 0 | Actual position is not yet defined |
| $013 \mathrm{~F}_{\mathrm{h}}$ | 319 | 4 | EEPROM not initialized |
| $0140_{h}$ | 320 | 4 | EEPROM not compatible with current software |
| $0141_{h}$ | 321 | 4 | EEPROM read error |


| hex | dec | Error class | Description |
| :---: | :---: | :---: | :---: |
| 0142h | 322 | 4 | EEPROM write error |
| $0143_{\text {h }}$ | 323 | 4 | Checksum error in EEPROM |
| 0144 ${ }_{\text {h }}$ | 324 | 0 | Value cannot be calculated |
| 0145h | 325 | 0 | Function only allowed at standstill |
| $0146_{\text {h }}$ | 326 | 0 | Reference movement is active |
| $0147_{\text {h }}$ | 327 | 0 | Command not allowed during processing (xxx_end=0) |
| $0148_{\text {h }}$ | 328 | 1 | RS485 interface: Overrun error |
| $0149_{h}$ | 329 | 1 | RS485 interface: Framing error |
| $014 \mathrm{~A}_{\mathrm{h}}$ | 330 | 1 | RS485 interface: Parity error |
| $014 \mathrm{~B}_{\mathrm{h}}$ | 331 | 1 | RS485 interface: Receive error |
| $014 \mathrm{C}_{\mathrm{h}}$ | 332 | 1 | RS485 interface: Buffer overflow |
| $014 \mathrm{D}_{\mathrm{h}}$ | 333 | 1 | RS485 interface: Protocol error |
| $014 \mathrm{E}_{\mathrm{h}}$ | 334 | 1 | Nodeguarding, interface no longer serviced |
| $014 \mathrm{~F}_{\mathrm{h}}$ | 335 | 0 | "Quick Stop" state activated |
| 0150h | 336 | 1 | Impermissible limit switch is active |
| 0151 h | 337 | 1 | Switch was overtraveled, moving away from switch impossible |
| 0152h | 338 | 1 | Switching edge not found in distance for search for switching edge during movement away from switch |
| $0153_{\text {h }}$ | 339 | 1 | Index pulse not found |
| 0154h | 340 | 1 | Unreliable reproducibility of the index pulse movement, index pulse too close to the switch |
| 0155h | 341 | 1 | Switch still active after movement away from switch |
| 0156h | 342 | 1 | Input not parameterized as LIMP/LIMN/REF |
| $0157_{\text {h }}$ | 343 | 1 | Interruption / "Quick Stop" by LIMP |
| $0158{ }_{\text {h }}$ | 344 | 1 | Interruption / "Quick Stop" by LIMN |
| $0159{ }_{\text {h }}$ | 345 | 1 | Interruption / "Quick Stop" by REF |
| $015 \mathrm{~A}_{\mathrm{h}}$ | 346 | 1 | Interruption / "Quick Stop" by STOP |
| $015 \mathrm{~B}_{\mathrm{h}}$ | 347 | 1 | Limit switch not released |
| $015 C_{h}$ | 348 | 0 | Processing not allowed in current operating mode |
| $015 \mathrm{D}_{\mathrm{h}}$ | 349 | 0 | Parameter not available with this device |
| $015 \mathrm{E}_{\mathrm{h}}$ | 350 | 0 | Function not available with this device |
| $015 \mathrm{~F}_{\mathrm{h}}$ | 351 | 0 | Access denied |
| 0160 ${ }_{\text {h }}$ | 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 |
| $0163_{h}$ | 355 | 0 | CAN interface: COB-ID incorrect |
| 0164h | 356 | 0 | CAN interface: Incorrect request |
| 0165h | 357 | 0 | CAN interface: Overrun error |
| $0166_{h}$ | 358 | 0 | CAN interface: Telegram could not be saved |
| $0167_{\text {h }}$ | 359 | 0 | CAN interface: General error CAN stack |
| 0168 h | 360 | 0 | Fieldbus: Data type and parameter length do not match |


| hex | dec | Error class | Description |
| :--- | :--- | :--- | :--- |
| $0169_{h}$ | 361 | 0 | Blocking detection is switched off |
| $016 A_{h}$ | 362 | 0 | Connection to DSP boot loader not successful |
| $016 B_{h}$ | 363 | 0 | Error in communication with DSP boot loader |
| $016 C_{h}$ | 364 | 0 | Error initializing SPC3 memory |
| $016 \mathrm{D}_{\mathrm{h}}$ | 365 | 0 | Error in calculation of the length of input/output data |
| $016 \mathrm{E}_{\mathrm{h}}$ | 366 | 0 | Specified Profibus address is outside permissible range |
| $016 \mathrm{~F}_{\mathrm{h}}$ | 367 | 0 | Impermissible use of parameter 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 | Parameterization of oscilloscope function incomplete |
| $0175_{h}$ | 373 | 1 | Internal communication |
| $0177_{h}$ | 375 | 1 | Interruption / "Quick Stop" by software limit switch clockwise rotation |
| $0178_{h}$ | 376 | 1 | Interruption / "Quick Stop" by software limit switch counterclockwise rotation |

## 10 Parameters

### 10.1 Representation of parameters

The way parameters are shown provides information required for unique identification of a parameter. In addition, information is provided on possible settings, defaults and parameter properties.

Parameters are represented as shown below:

| Group.Name <br> Index:Subindex <br> dec. (hex.) | Description <br> Bit assgnment |  | Data type <br> range <br> dec. | Unit <br> Default <br> dec. | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Example.Name | Example | UlNT16 | - | R/W |  |
| $12: 34\left(\mathrm{C}: 22_{\mathrm{h}}\right)$ |  | $1 . .127$ | 127 | 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 setting.
Data type The data type determines the valid range of values, especially if minimum and maximum values are not explicitly indicated for a parameter.

| Data type | Byte | Min value | Max value |
| :--- | :--- | :--- | :--- |
| INT8 | 1 Byte / 8 Bit | -128 | 127 |
| UINT8 | 1 Byte / 8 Bit | 0 | 255 |
| INT16 | 2 Byte / 16 Bit | -32768 | 32767 |
| UINT16 | 2 Byte / 16 Bit | 0 | 65535 |
| INT32 | 4 Byte / 32 Bit | -2147483648 | 2147483647 |
| UINT32 | 4 Byte / 32 Bit | 0 | 4294967295 |

Unit The unit of the value.
$R / W$ Indicates read and/or write values
"R/" values can only be read
"R/W" values can be read and written.
Persistent "per." indicates whether the value of the parameter is persistent, i.e.
whether it remains in the memory after the device is switched off. When changing a value via commissioning software or fieldbus, the user must explicitly store the changed value in the persistent memory.

### 10.2 Overview Parameters

| CAN | Settings CAN bus |
| ---: | :--- |
| Capture | Function "Fast position capture" |
| Commands | State change |
|  | Save parameters to EEPROM |
| Initialize default parameters |  |
| Config | Drive configuration |
| Control | Controller settings |
| ErrMem0 | Error memory |
| Gear | Operating mode "Electronic Gear" |
| Homing | Operating mode "Homing" |
| I/O | Status and definition of inputs and outputs |
| Manual | Operating mode "Jog" |
| Motion | Function "Definition of the direction of rotation" |
|  | Function "Quick Stop" |
|  | Default reference speed |
| Profibus | Settings Profibus |
| ProgIOO.. 3 | Function "Programmable inputs/outputs" |
| PTP | Operating mode "Profile Position" |
| RS485 | Setting RS485 bus |
| Settings | User-defined device name |
|  | Phase currents |
| Status | Status information and read values |
| VEL | Operating mode "Profile Velocity" |

### 10.3 Parameter groups

### 10.3.1 Parameter group "CAN"

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| CAN.canAddr 23:2 (17:02h) | Address CAN Bus | $\begin{aligned} & \text { UINT16 } \\ & \text { 1.. } 127 \end{aligned}$ | $127$ | R/W per. |
|  | Permissible values 1..127 |  |  |  |
| CAN.canBaud 23:3 (17:03 ${ }_{\text {h }}$ ) | Baud rate CAN bus | UINT16$50 . .1000$ | $125$ | R/W per. |
|  | The following values are permitted: |  |  |  |
|  | Value 50: 50 kBaud |  |  |  |
|  | Value 100: 100 kBaud |  |  |  |
|  | Value 125-125 kBaud |  |  |  |
|  | Value 250: 250 kBaud |  |  |  |
|  | Value 500: 500 kBaud |  |  |  |
|  | Value 800: 800 kBaud |  |  |  |
|  | Value 1000: 1 MBaud |  |  |  |
| CAN.pdo4msk1 | 32 bit mask for process data change part 1 | UINT32 | - | R/W |
| $30: 9$ (1E:09h) | 32 bit mask for event-controlled PDO4: |  | $\begin{aligned} & 4294967 \\ & 295 \end{aligned}$ |  |

This value allows you to mask bytes 1..4. In the case of eventcontrolled transmission, a message is sent whenever the TPDO data changes. This mask lets you specify the transmission of messages in more detail or limit it. Changes for event-controlled transmission are ignored at all bits at which the mask contains a 0 .

Assignment of bits:
Bits 0 ... 7 : ioSignals
Bits 8 ...15: modeStat
Bits 16 ... 23: warn Sig_SR FItSig cos
Bits 24 ... 31: x_end x_err x_info
The default value 4294967295 corresponds to FFFFFFFFF $_{h}$.
$\left.\begin{array}{lllll}\hline \text { CAN.pdo4msk2 } & 32 \text { nit mask for process data change part 2 } & \text { UINT32 } & - & \text { R/W } \\ \text { 30:10 (1E:0A }\end{array}\right)$

32 bit mask for event-controlled PDO4:
Mask for bytes 5..8.
For a description see parameter CAN . pdo4msk1.

### 10.3.2 Parameter group "Capture"

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Capture.CapLevel 20:14 (14:00E $\mathrm{E}_{\mathrm{h}}$ ) | Signal level for capture inputs | UINT16 | - | R/W |
|  | Bit value 0: Position capture at negative edge | $0 . .3$ | 3 |  |
|  | Bit value 1: Position capture at rising edge |  |  |  |
|  | Assignment of bits: |  |  |  |
|  | Bit 0: Sets the level for CAP1 |  |  |  |
|  | Bit 1: Sets the level for CAP2 |  |  |  |


| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Capture.CapStart1 20:15 (14:00F ${ }_{\mathrm{h}}$ ) | Start capture on CAP1 <br> Value 0: Cancel capture function <br> Value 1: Start one-time capture <br> Value 2: Start continuous capture <br> In the case of one-time capture, the function is terminated when the first value is captured. <br> In the case of continuous capture, the function continues to run. | $\begin{aligned} & \text { UINT16 } \\ & 0 . .2 \end{aligned}$ | $\overline{0}$ | R/W |
| Capture.CapStart2 20:16 (14:10h) | Start capture on CAP2 <br> As CAP1 | $\begin{aligned} & \text { UINT16 } \\ & 0 . .2 \end{aligned}$ | $\overline{0}$ | R/W |
| Capture.CapStatus 20:17 (14:11h) | Status of the capture channels <br> Assignment of bits: <br> Bit 0: position capture via CAP1 carried out <br> Bit 1: position capture via CAP2 carried out | $\begin{aligned} & \text { UINT16 } \\ & 0 . .3 \end{aligned}$ | $0$ | R/- |
| Capture.CapPact1 20:18 (14:12h) | Motor position with signal at CAP1 <br> Output of captured position of the encoder <br> In the case of stepper motor devices, this is the commutation position. | INT32 | Inc | R/- |
| Capture.CapPact2 20:19 (14:13h) | Motor position with signal at CAP2 As CAP1 | INT32 | Inc | R/- |

### 10.3.3 Parameter group "Commands"

$\left.\begin{array}{lllll}\hline \begin{array}{l}\text { Group.Name } \\ \text { Index:Subindex } \\ \text { dec. (hex.) }\end{array} & \begin{array}{l}\text { Description } \\ \text { Bit assgnment }\end{array} & \begin{array}{l}\text { Data type } \\ \text { range } \\ \text { dec. }\end{array} & \begin{array}{l}\text { Unit } \\ \text { Default } \\ \text { dec. }\end{array} & \begin{array}{l}\text { R/W } \\ \text { per. }\end{array} \\ \hline \begin{array}{l}\text { Com- } \\ \text { mands.eeprSave } \\ \text { 11:6 (0B:06 })\end{array} & \begin{array}{ll}\text { Save parameter values to EEPROM } \\ \text { Value 1: Save user-defined parameters }\end{array} & \text { UINT16 } & - & \text { R/W } \\ & \begin{array}{l}\text { The currently set parameters are saved to the EEPROM } \\ \text { The saving process is completed when the parameter } \\ \text { Commands. stateSave, 11:7 returns 1. }\end{array} & - & \\ \hline & \text { NOTE: Saving is only possible when the drive is at standstill. }\end{array}\right)$

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Commands.SetEnc Pos $15: 19\left(0 \mathrm{~F}: 13_{h}\right)$ | Directly set the encoder position <br> During writing, the current motor position Status.p_act and the absolute position Status.p_abs are adjusted immediately. <br> Permissible values: <br> Singleturn encoder: 0 ... 16384-1 <br> Multiturn encoder: 0 ... (4096 * 16384) -1 <br> NOTE: <br> This command automatically disables the power stage. Changing the value also changes the position of the virtual index pulse. | INT32 <br> See text left | $\begin{aligned} & \text { Inc } \\ & 0 \end{aligned}$ | R/W |
| Commands.driveC- <br> trl <br> 28:1 (1C:01h) | Control word <br> Assignment of bits: <br> Bit 0: Disable power stage <br> Bit 1: Enable power stage <br> Bit 2: Quicktop <br> Bit 3: FaultReset <br> Bit 4: QuickStop-Release <br> Bits 5..15: Reserved <br> Default bits 0 ... 4: 0 <br> A write access automatically triggers processing of the operating states. | $\begin{aligned} & \text { UINT16 } \\ & 0 . .31 \end{aligned}$ | $0$ | R/W |
| Commands.del_err 32:2 (20:02h) | Delete error memory <br> Write value 1: <br> Delete all entries in error memory | $\begin{aligned} & \hline \text { UINT16 } \\ & 1.1 . \end{aligned}$ | $\overline{1}$ | R/W |
| $\begin{aligned} & \text { Commands.Brake } \\ & 33: 7\left(21: 07_{\mathrm{h}}\right) \end{aligned}$ | Holding brake control <br> Value 0: automatic <br> Value 1: Releasing holding brake manually <br> NOTE: If the power stage is enabled, the value 0 is automatically set. | $\begin{aligned} & \text { UINT16 } \\ & 0 . .1 \end{aligned}$ | $\overline{-}$ | R/W |

### 10.3.4 Parameter group "Config"



| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Config.SerialNo1$1: 20\left(01: 14_{h}\right)$ | Serial number of the drive art 1 | UINT16 | - | R/- |
|  | Digits 10-13 of the serial number To be represented as a decimal number. |  |  |  |
| $\begin{aligned} & \text { Config.SerialNo2 } \\ & \text { 1:21 (01:15h) } \end{aligned}$ | Serial number of the drive art 2 | UINT32 | - | R/- |
|  | Digits 1-9 of the serial number To be represented as a decimal number. |  |  |  |
| Config.OptPrgNo 13:11 (0D:0B ${ }_{h}$ ) | Firmware number in option module | UINT32 | - | R/- |
|  | Identifies the program number of the internal Profibus interface of drives with Profibus |  |  |  |
| Config.OptPrgVer 13:12 (0D:0Ch) | Firmware version in option module | UINT32 | - | R/- |
|  | Identifies the program version of the internal Profibus interface of drives with Profibus |  |  |  |
| Config.GearNum 13:14 (0D:0E ${ }_{h}$ ) | Numerator of gear ratio | INT32 | - | R/- |
|  | Gear ratio of gearbox mounted |  |  |  |
|  | Note: The value is only correct if the gearbox was installed by the manufacturer. |  |  |  |
| Config.GearDen 13:15 (0D:0F h ) | Denominator of gear ratio | INT32 | - | R/- |
|  | Gear ratio of gearbox mounted |  |  |  |
|  | Note: The value is only correct if the gearbox was installed by the manufacturer. |  |  |  |
| Config.STO_con 13:16 (0D:10 ${ }_{h}$ ) | Status of signal inputs STO_A (PWRR_A) and STO_B (PWRR_B) of the STO safety function | $\begin{aligned} & \text { UINT16 } \\ & 0 . .3 \end{aligned}$ |  | R/- |
|  | Value 0: Inputs not available <br> Value 1: Jumper plugged in (safety function inactive) <br> Value 3: Current at inputs (safety function active) |  |  |  |
| Config.I_nomDrv 15:1 ( $0 \mathrm{~F}: 01_{\mathrm{h}}$ ) | Nominal current of drive | $\begin{aligned} & \text { UINT16 } \\ & 0 . .100 \end{aligned}$ | A | R/- |
|  | Current that can flow continuously without overheating or damaging the drive. <br> Unit: [0.1A] |  |  |  |
| Config.I_maxDrv 15:2 (0F:02h) | Maximum current of drive | $\begin{aligned} & \text { UINT16 } \\ & 0 . .100 \end{aligned}$ | A | R/- |
|  | Maximum current that may only flow for a short period of time. This is monitored by $\mathrm{I}^{2} \mathrm{t}$ monitoring. <br> Unit: [0.1A] |  |  |  |
| Config.n_maxDrv 15:18 (0F:12h) | Maximum speed of drive | UINT16 | $\min ^{-1}$ | R/- |
| Config.ResolutM 29:2 (1D:02h) | Positioning resolution of the drive <br> Read value for the resolution of the drive in increments per revolution. <br> Value is applicable directly at the motor shaft (without gearbox). | UINT16 | $\begin{aligned} & \text { Inc } \\ & 16384 \end{aligned}$ | R/- |

### 10.3.5 Parameter group "Control"

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Control.KPn 15:8 (0F:08h $)$ | Speed controller P term | $\begin{aligned} & \text { UINT16 } \\ & 0 . .32767 \end{aligned}$ | $\mathrm{A} / \mathrm{min}^{-1}$ | R/W per. |
|  | Unit: [0.0001 A/min ${ }^{-1}$ ] |  |  |  |
| Control.TNn 15:9 (0F:09h $)$ | Speed controller integral action time | UINT16$100.32767$ | ms | R/W per. |
|  | Unit: [0.01 ms] |  |  |  |
| Control.KPp 15:10 (0F:0A ${ }_{h}$ ) | Position controller P term | $\begin{aligned} & \hline \text { UINT16 } \\ & 0 . .1250 \end{aligned}$ | 1/s | R/W per. |
|  | Unit: [0.1 1/s] |  |  |  |
| $\begin{aligned} & \hline \text { Control.KFPp } \\ & \text { 15:11 }\left(0 \mathrm{FF}: \mathrm{OB}_{\mathrm{h}}\right) \end{aligned}$ | Speed feed-forward control position controller | UINT16 0.. 32767 | $32767$ | R/W per. |
|  | Value 32767: 100\% compensation |  |  |  |
| Control.pscDamp 15:20 ( $0 \mathrm{~F}: 14_{h}$ ) | Posicast filter for speed controller: attenuation | $\begin{aligned} & \text { UINT16 } \\ & 51 . .100 \end{aligned}$ | $\begin{aligned} & \% \\ & 100 \end{aligned}$ | R/W per. |
| Control.pscDelay 15:21 ( $0 \mathrm{~F}: 15_{h}$ ) | Posicast filter for speed controller: delay | $\begin{aligned} & \text { UINT16 } \\ & 0 . .320 \end{aligned}$ | $\begin{aligned} & \mathrm{ms} \\ & 0 \end{aligned}$ | R/W per. |
|  | Value 0: Posicast inactive Unit: [0.1 ms] |  |  |  |

### 10.3.6 Parameter group "ErrMem0"

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| ErrMem0.ErrNum 900:1 (384:01 ${ }_{h}$ ) | Coded error number <br> Index 900: First error entry (oldest) <br> Index 901: Next error entry <br> NOTE: Reading this parameter copies the entire error entry ( $9 x x .1$ - $9 x x .5$ ) to an intermediate memory from which all elements are then loaded. | UINT16 |  | R/- |
| ErrMem0.Class 900:2 (384:02h) | Error class <br> The error class determines the error response of the controller. | $\begin{aligned} & \text { UINT16 } \\ & 0 . .4 \end{aligned}$ |  | R/- |
| ErrMem0.Age 900:3 (384:03 ${ }_{\text {h }}$ ) | Age of the error in device switch-on cycles <br> Value 0: Error occurred since the last switch-on of the device <br> Value 1: Error occurred during last operation <br> Value 2: Error occurred during last but one operation etc. | UINT32 |  | R/- |
| ErrMem0.Repeat 900:4 (384:04h) | Error repetitions <br> Number of consecutive errors with this error number: <br> Value 0: Error occurred only once <br> Value 1: 1 repetition <br> Value 2: 2 repetitions etc. <br> When the maximum number of 255 is reached, the repetition counter is no longer incremented. | $\begin{aligned} & \text { UINT16 } \\ & 0 . .255 \end{aligned}$ | - | R/- |


| Group.Name <br> Index:Subindex <br> dec. (hex.) | Description <br> Bit assgnment | Data type <br> range <br> dec. | Unit <br> Default <br> dec. | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- |
| ErrMem0.ErrQual <br> $900: 5(384: 05 \mathrm{~h})$ | Error identifier | Uhis entry contains additional information on the error. | - | R/- |
|  | The meaning depends on the error numer. |  | - |  |

### 10.3.7 Parameter group "Gear"

| Group.Name <br> Index:Subindex <br> dec. (hex.) | Description <br> Bit assgnment | Data type <br> range <br> dec. | Unit <br> Default <br> dec. | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- |
| Gear.pulsSrc | Type of pulse source for electronic gear | UINT16 | - | R/- |
| 21:5 (15:05 $)$ | Read-only value, setting with DIP switch S3.3. | 0 |  |  |
|  | Value 0: S3.3=OFF (pulse/direction signals) <br> Value 1: S3.3=ON (A/B encoder signals) |  |  |  |
| Gear.startGear | Start electronic gear | $0 . .2$ | 0 | R/W |
| $38: 1\left(26: 01_{h}\right)$ | Value 0: Deactivated <br> Value 1: Immediate synchronization <br> Value 2: Synchronization with compensation movement |  | - |  |
|  |  |  |  |  |


| Gear.stateGear $38: 2\left(26: 02_{h}\right)$ | Acknowledgement: Electronic gear <br> Assignment of bits: <br> Bit 0: Error LIMP <br> Bit 1: Error LIMN <br> Bit 2: Error STOP <br> Bit 3: Error REF <br> Bit 7: SW_STOP <br> Bit 13: Motor at standstill and reference position reached <br> Bit 14: gear_end <br> Bit 15: gear_err | UINT16 | - | R/- |
| :---: | :---: | :---: | :---: | :---: |
| Gear.gearOffs 38:5 (26:05h) | Position offset for electronic gear <br> The position offset is added to the reference pulses. <br> The addition point is as per the numerator/denominator calculation; the offset is therefore specified in motor increments. | $\begin{aligned} & \text { INT32 } \\ & -28000 \\ & . .28000 \end{aligned}$ | $\begin{aligned} & \text { Inc } \\ & 0 \end{aligned}$ | R/W |
| Gear.gearOffsV 38:6 (26:06h) | Speed limitation for offset processing <br> The addition of the position offset for the electronic gear can be distributed over multiple time intervals. <br> You can specify the maximum number of increments per millisecond that can be added. | $\begin{aligned} & \text { UINT16 } \\ & 0 . .10000 \end{aligned}$ | $\begin{aligned} & \text { Inc/ms } \\ & 0 \end{aligned}$ | R/W |

The value 0 indicates that the complete position offset is added at once.

| Gear.numGear <br> 38:7 (26:07 | Numerator of gear ratio | INT16 | - | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- |
| Gear.denGear | Denominator of gear ratio |  | 1 | INT16 |
| 38:8 (26:08 $)$ | The denominator value does not become effective until you | $1 \ldots 32767$ | 1 | R/W |
|  | per. |  |  |  | have indicated the numerator value. Therefore, always indicate the denominator first, then the numerator.


| Group.Name <br> Index:Subindex <br> dec. (hex.) | Description <br> Bit assgnment | Data type <br> range <br> dec. | Unit <br> Default <br> dec. | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- |
| Gear.dirEnGear <br> $38: 13\left(26: 0 D_{\mathrm{h}}\right)$ | Released movement direction for electronic gear <br> This allows you to activate a function that locks return move- <br> ments. | UINT16 | -3 | R/W |
|  | Value 1: Clockwise direction only <br> Value 2: Counterclockwise direction only <br> Value 3: Both directions | 3 | per. |  |
|  |  |  |  |  |

### 10.3.8 Parameter group "Homing"

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Homing.startHome 40:1 ( $28: 01_{h}$ ) | Start operating mode Homing <br> Action object: Write access triggers reference movement. <br> Value 1: LIMP <br> Value 2: LIMN <br> Value 3: REF counterclockwise direction of rotation <br> Value 4: REF clockwise direction of rotation <br> Value 5: Index pulse counterclockwise direction of rotation <br> Value 6: Index pulse clockwise direction of rotation | $\begin{aligned} & \text { UINT16 } \\ & 1.8 \end{aligned}$ |  | R/W |
| Homing.stateHome 40:2 (28:02h) | Acknowledgement: Homing <br> Assignment of bits: <br> Bit 0: Error LIMP <br> Bit 1: Error LIMN <br> Bit 2: Error HW_STOP <br> Bit 3: Error REF <br> Bit 5: Error SW_LIMP <br> Bit 6: Error SW_LIMN <br> Bit 7: Error SW_STOP <br> Bit 15: ref_err <br> Bit 14: ref_end | UINT16 |  | R/- |
| Homing.startSetp 40:3 (28:03 ${ }_{\text {h }}$ ) | Position setting to position setting position <br> Action object: write access triggers position setting Only possible if the motor is at standstill. | INT32 | Inc | R/W |
| Homing.v_Home 40:4 (28:04h) | Speed of rotation for search of switch <br> The maximum speed of rotation is the value of parameter Config.n_maxDrv, 15:18. | UINT16 | $\begin{aligned} & \min ^{-1} \\ & 60 \end{aligned}$ | R/W per. |
| Homing.v_outHome 40:5 (28:05h) | Speed of rotation for moving away from switch <br> The value of Config.n_maxDrv, $15: 18$ is the maximum speed of rotation. | UINT16 | $\begin{aligned} & \min ^{-1} \\ & \hline \end{aligned}$ | R/W per. |
| Homing.p_outHome 40:6 (28:06h) | Maximum distance for search for switching edge <br> After detection of the switch, the drive starts to search for the defined switching edge. If it is not found within the distance defined here, the reference movement is canceled with an error. | INT32 <br> 1.. <br> 2147483647 | $\begin{aligned} & \text { Inc } \\ & 200000 \end{aligned}$ | R/W per. |
| Homing.p_disHome 40:7 ( $28: 07_{\mathrm{h}}$ ) | Distance from switching edge to reference point <br> After the drive moves away from the switch, it is positioned into the working range by a defined distance; this is defined as the reference point. | INT32 <br> 1.. <br> 2147483647 | $\begin{aligned} & \text { Inc } \\ & 200 \end{aligned}$ | R/W per. |


| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Homing.RefSwMod 40:9 (28:09 ${ }_{\text {h }}$ ) | Processing sequence during reference movement to REF <br> Bit value 0: In positive direction <br> Bit value 1: In negative direction <br> Assignment of bits: <br> Bit 0: Direction of movement to switching edge <br> Bit 1: Direction of movement to distance from switching edge | $\begin{aligned} & \text { UINT16 } \\ & 0 . .3 \end{aligned}$ | $\overline{0}$ | R/W per. |
| Homing.RefAppPos 40:11 (28:0B ${ }_{h}$ ) | Application position at reference point <br> After a successful reference movement, this position is set at the reference point. <br> This automatically defines the application zero point. | INT32 | $\begin{aligned} & \text { Inc } \\ & 0 \end{aligned}$ | R/W per. |
| Homing.refError 40:13 (28:0D ${ }_{h}$ ) | Cause of error during reference movement <br> Error code during reference movement processing | UINT16 | - | R/- |

### 10.3.9 Parameter group "I/O"

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { I/O.IO_act } \\ & 33: 1\left(21: 01_{h}\right) \end{aligned}$ | Status of digital inputs and outputs <br> Assignment of bits: <br> Bit 0: IOO <br> Bit 1: 101 <br> Bit 2: 102 <br> Bit 3: 103 <br> Bit 4: STO_A (PWRR_A) <br> Bit 5: STO_B (PWRR_B) <br> Reading returns the status of the inputs and outputs. Writing only changes the status of outputs. | $\begin{aligned} & \text { UINT16 } \\ & 0 . .15 \end{aligned}$ | $\overline{0}$ | R/W |
| 1/O.IO0_def $34: 1\left(22: 01_{h}\right)$ | Configuration of IOO <br> Value 0: Input freely usable <br> Value 1: Input LIMP (only with IOO) <br> Value 2: Input LIMN (only with IO1) <br> Value 3: Input STOP <br> Value 4: Input REF <br> Value 5: Input programmable <br> Value 128: Output freely usable <br> Value 130: Output programmable | $\begin{aligned} & \text { UINT16 } \\ & 0 . .255 \end{aligned}$ | $1$ | R/W per. |
| I/O.IO1 def 34:2 (22:02 ${ }^{\text {h }}$ ) | Configuration of IO1 <br> See parameter IOO_def | $\begin{aligned} & \text { UINT16 } \\ & 0 . .255 \end{aligned}$ | $2$ | R/W per. |
| I/O.IO2 def $34: 3\left(22: 03_{h}\right)$ | Configuration of IO2 <br> See parameter IOO_def | $\begin{aligned} & \text { UINT16 } \\ & 0 . .255 \end{aligned}$ | $3$ | R/W per. |
| I/O.IO3_def $34: 4\left(22: 04_{\mathrm{h}}\right)$ | Configuration of IO3 <br> See parameter IOO_def | $\begin{aligned} & \text { UINT16 } \\ & 0 . .255 \end{aligned}$ | $4$ | R/W per. |


| Group.Name <br> Index:Subindex <br> dec. (hex.) | Description <br> Bit assgnment | Data type <br> range <br> dec. | Unit <br> Default <br> dec. | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- |
| 1/O.progDelay | Delay time for programmed I/O processing | UINT16 | Sec | R/W |
| $34: 7\left(22: 07_{\mathrm{h}}\right)$ | After the drive is switched on, the function "programmable <br> inputs and outputs" is only activated after the delay time set <br> here. | $0 . .60$ | 0 | per. |

### 10.3.10 Parameter group "Manual"

| Group.Name <br> Index:Subindex <br> dec. (hex.) | Description <br> Bit assgnment | Data type <br> range <br> dec. | Unit <br> Default <br> dec. | R/W <br> per. |
| :--- | :--- | :--- | :--- | :--- |
| Manual.startMan Starting a jog UINT16 - R/W <br> $41: 1\left(29: 01_{\mathrm{h}}\right)$     | Assignment of bits: | 0.15 | 0 |  |
|  | Bit 0.15 |  |  |  |

Bit 0: Clockwise direction of rotation
Bit 1: Counterclockwise direction of rotation
Bit 2: $0=$ slow $1=$ fast
Bit 3: Automatic processing of power stage
If bit 3 is set to 1 , a jog movement can be started even if the power stage is switched off: If the drive is in state 4 (ReadyToSwitchOn), the power stage is automatically switched on when the jog movement is started and switched off when the movement is finished.

| Manual.stateMan 41:2 (29:02h) | Acknowledgement: Jog | UINT16 | - | R/- |
| :---: | :---: | :---: | :---: | :---: |
|  | Assignment of bits: <br> Bit 0: Error LIMP <br> Bit 1: Error LIMN <br> Bit 2: Error HW_STOP <br> Bit 3: Error REF <br> Bit 5: Error SW_LIMP <br> Bit 6: Error SW_LIMN <br> Bit 7: Error SW_STOP <br> Bit 14: manu_end <br> Bit 15: manu_err |  |  |  |
| Manual.n_slowMan 41:4 (29:04h) | Speed for slow jog <br> The maximum speed of rotation is the value of parameter Config.n_maxDrv, 15:18. | UINT16 | $\begin{aligned} & \min ^{-1} \\ & 60 \end{aligned}$ | R/W per. |
| Manual.n_fastMan 41:5 (29:05h) | Speed for fast jog <br> The maximum speed of rotation is the value of parameter Config.n_maxDrv, 15:18. | UINT16 | $\begin{aligned} & \min ^{-1} \\ & 600 \end{aligned}$ | R/W per. |
| Manual.step_Man 41:7 (29:07h) | Jogging distance at jog start <br> Value 0: Direct activation of continuous movement | UINT16 | $\begin{aligned} & \text { Inc } \\ & 20 \end{aligned}$ | R/W per. |
| Manual.time_Man $41: 8\left(29: 08_{h}\right)$ | Waiting time until continuous movement starts Only effective if jog distance is not set to equal 0 . | UINT16 $\text { 1.. } 10000$ | $\begin{aligned} & \mathrm{ms} \\ & 500 \end{aligned}$ | R/W per. |

### 10.3.11 Parameter group "Motion"

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Motion.invertDir 28:6 (1C:06h) | Definition of direction of rotation | UINT16$0 . .1$ | $\overline{0}$ | R/W per. |
|  | Value 0: Clockwise direction of rotation With positive reference values, the motor rotates clockwise (as you look at the end of the protruding motor shaft). |  |  |  |
|  | Value 1: Counterclockwise direction of rotation With positive reference values, the motor rotates counterclockwise (as you look at the end of the protruding motor shaft). |  |  |  |
|  | NOTE: The new value is only activated when the drive is switched on. |  |  |  |
| Motion.dec_Stop 28:21 (1C:15h) | Deceleration for "Quick Stop" | UINT32 <br> 1... 250000 | $\begin{aligned} & \mathrm{min}^{-1} / \mathrm{s} \\ & 6000 \end{aligned}$ | R/W per. |
|  | Deceleration that is used for every "Quick Stop": <br> - "Quick Stop" via control word <br> - "Quick Stop" via external monitoring signal <br> - "Quick Stop" via error of classes 1 and 2 |  |  |  |
| Motion.v_target0 29:23 (1D:17h) | Speed of rotation for parameter PTP.v_tarPTP | UINT16 | $\begin{aligned} & \min ^{-1} \\ & 60 \end{aligned}$ | R/W per. |
|  | Speed of rotation for Profile Position operating mode if no value was written to PTP.v_tarPTP. |  |  |  |
|  | NOTE: This persistent value is only used as a default assignment for PTP.v_tarPTP during switching on. |  |  |  |
|  | The maximum speed of rotation is the value of parameter Config.n_maxDrv, 15:18. |  |  |  |
| $\begin{aligned} & \text { Motion.acc } \\ & \text { 29:26 (1D:1A } \left.A_{h}\right) \end{aligned}$ | Acceleration | $\begin{aligned} & \text { UINT32 } \\ & \text { 1... } 250000 \end{aligned}$ | $\begin{aligned} & \min ^{-1} / \mathrm{s} \\ & 600 \end{aligned}$ | R/W per. |
|  | Value determines acceleration and deceleration. New values do not become effective until after standstill. |  |  |  |

### 10.3.12 Parameter group "Profibus"

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Profibus.MapOut 24:2 (18:02h) | Value in PZD5+6 to product | UINT32 | See text left | R/W per. |
|  | Index and subindex of the object that is mapped to the PPO2 during data transfer from the master to the vproduct. By default, the reference acceleration is mapped. |  |  |  |
|  | Possible values: |  |  |  |
|  | $00000000_{h}$ : Mapping not active |  |  |  |
|  | $001 \mathrm{AOO1D}_{\text {d }}$ : reference acceleration (29:26) |  |  |  |
|  | $00010021_{h}$ : digital outputs (33:1) |  |  |  |
|  | Low word: index mapped object |  |  |  |
|  | High word: subindex mapped object |  |  |  |

$\left.\begin{array}{lllll}\hline \begin{array}{l}\text { Group.Name } \\ \text { Index:Subindex } \\ \text { dec. (hex.) }\end{array} & \begin{array}{l}\text { Description } \\ \text { Bit assgnment }\end{array} & \begin{array}{l}\text { Data type } \\ \text { range } \\ \text { dec. }\end{array} & \begin{array}{l}\text { Unit } \\ \text { Default } \\ \text { dec. }\end{array} & \begin{array}{l}\text { R/W } \\ \text { per. }\end{array} \\ \hline \text { Profibus.MapIn } & \text { Value in PZD5+6 to master } & \text { UINT32 } & - & \text { R/W } \\ \text { 24:3 (18:03 })\end{array} \quad \begin{array}{l}\text { Index and subindex of the object that is mapped during data }\end{array}\right)$

|  | Possible values: <br> $00000000_{\mathrm{h}}$ : Mapping not active <br> $00070020_{\mathrm{h}}$ : Error number (32:7) <br> $0009001 \mathrm{~F}_{\mathrm{h}}$ : Actual speed of rotation (31:9) <br> $0019001 \mathrm{~F}_{\mathrm{h}}$ : Temperature power stage (31:25) <br> $0^{0014001 F_{h}}$ : Supply voltage (31:20) <br> $000 \mathrm{C} 001 \mathrm{~F}_{\mathrm{h}}$ : Current motor current (31:12) <br> Low word: index mapped object <br> High word: subindex mapped object |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Profibus.PkInhibit 24:4 (18:04h) | Update cycle for static read requests | $\begin{aligned} & \text { UINT32 } \\ & \text { 1.. } 60000 \end{aligned}$ | $\begin{aligned} & \mathrm{ms} \\ & 1000 \end{aligned}$ | R/W per. |
|  | In the case of a static read request, the read value is cyclically updated according to the time defined with this parameter. |  |  |  |
| Profibus.SafeState 24:5 (18:05h) | Response to 'Clear' and watchdog | $\begin{aligned} & \text { UINT32 } \\ & 0 . .1 \end{aligned}$ | $\overline{1}$ | R/W per. |
|  | Response of the drive in state 'Clear' of the ProfibusDP master and response to termination of the watchdog. |  |  |  |
|  | Value 0: No response <br> Value 1: Error of class 2, drive switches to FAULT if the power stage was active. |  |  |  |
| Profibus.profiAddr 24:13 (18:00D ${ }_{h}$ ) | Profibus address | UINT32 | - | R/- |
|  | Address set with the parameter switches |  |  |  |

### 10.3.13 Parameter group "ProgIO0"



The meanings for parameter groups "ProgIOO" (Index 800), "ProgIO1" (Index 801), "ProgIO2" (Index 802), "ProgIO3" (Index 803) are identical.

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { ProgIO0.Index } \\ & \text { 800:1 }\left(320: 01_{h}\right) \end{aligned}$ | Index of the control parameter <br> If prog. input: index of parameter to be written <br> If prog. output: index of parameter to be read <br> If prog. input: <br> write(Index,Subindex) = <br> (read(Index,Subindex) BAND BitMask) BOR VALUEx <br> If prog. output: <br> 1 level at output if <br> (read(Index,Subindex) BAND BitMask) =<> VALUE1 | UINT16 |  | R/W per. |
| ProglO0.Subindex 800:2 (320:02h) | Subindex of control parameter <br> If prog. input: subindex of parameter to be written If prog. output: subindex of parameter to be read | UINT16 |  | R/W per. |


| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| ProglO0.BitMask 800:3 (320:03 $)$ 800:3 (320:03 ) | Bitmask for the parameter value <br> If programmable input or programmable output: Bit mask used to link the read value (index, subindex) of the parameter with the operator AND before the value is processed. | UINT32 |  | R/W per. |
| ProglOO.Switch 800:4 (320:04h) | Edge detection and comparison operator <br> If programmable input: <br> Selection of the edges to be detected <br> Value 0: No response to level change <br> Value 1: Response to rising edge <br> Value 2: Response to falling edge <br> Value 3: Response to both edges <br> If programmable output: <br> Selection of condition for comparison: <br> Value 0: (parameter read value = comparison value) <br> Value 1: (parameter read value <> comparison value) <br> Value 2: (parameter read value < comparison value) <br> Value 0: (parameter read value > comparison value) | UINT16 |  | R/W per. |
| ProgIO0.Value1 800:5 (320:05h) | Write Write value at rising edge and comparison value <br> If programmable input: <br> Parameter write value at rising edge <br> If programmable output: <br> Comparison value for condition | INT32 <br> 0.. <br> 4294967295 |  | R/W per. |
| ProglO0.Value2 800:6 (320:06 ) | Write value at falling edge <br> If programmable input: <br> Parameter write value at falling edge <br> If programmable output: <br> no meaning | INT32 <br> $0 .$. <br> 4294967295 | - | R/W per. |

### 10.3.14 Parameter group "PTP"

$\left.\begin{array}{llllll}\hline \begin{array}{l}\text { Group.Name } \\ \text { Index:Subindex } \\ \text { dec. (hex.) }\end{array} & \begin{array}{l}\text { Description } \\ \text { Bit assgnment }\end{array} & \begin{array}{l}\text { Data type } \\ \text { range } \\ \text { dec. }\end{array} & \begin{array}{l}\text { Unit } \\ \text { Default } \\ \text { dec. }\end{array} & \begin{array}{l}\text { R/W } \\ \text { per. }\end{array} \\ \hline \text { PTP.p_absPTP } & \text { Target position for absolute positioning and start of positioning } & \text { INT32 } & \text { Inc } & \text { R/W } \\ 35: 1\left(23: 01_{h}\right)\end{array} \quad \begin{array}{l}\text { Action object: write access triggers absolute positioning in } \\ \text { increments }\end{array}\right)$

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { PTP.p_reIPTP } \\ & 35: 3 \text { (23:03 }) \end{aligned}$ | Target position for relative positioning and start of positioning Action object: write access triggers relative positioning in increments | INT32 | Inc | R/W |
| PTP.continue $35: 4\left(23: 04_{h}\right)$ | Continue interrupted positioning <br> The target position was specified with the previous positioning command. <br> The value indicated here is not relevant for positioning. | UINT16 | $0$ | R/W |
| $\begin{aligned} & \text { PTP.v_tarPTP } \\ & 35: 5\left(23: 05_{\mathrm{h}}\right) \end{aligned}$ | Target speed of rotation for positioning <br> Positioning can be temporarily stopped with value 0. <br> The default value is the value of parameter <br> Motion.v_target0. <br> The maximum speed of rotation is the value of parameter Config.n_maxDrv, 15:18. | UINT16 | $\begin{aligned} & \min ^{-1} \\ & 60 \end{aligned}$ | R/W |

### 10.3.15 Parameter group "RS485"

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| RS485.timeout <br> 1:11 (01:00B ${ }_{h}$ ) | Node Guard Timer <br> Value 0 : Connection monitoring active <br> Value >0: Connection monitoring active, time in milliseconds <br> Value is automatically set to 0 after a nodeguard error. | UINT16 <br> $0 . .10000$ | $\begin{aligned} & \mathrm{ms} \\ & 0 \end{aligned}$ | R/W |
| $\begin{aligned} & \text { RS485.serBaud } \\ & \text { 22:1 }\left(16: 01_{h}\right) \end{aligned}$ | Baud rate <br> The following values are permitted: <br> Value 9600: 9600 Baud <br> Value 19200: 19200 Baud <br> Value 38400: 38400 Baud | UINT16 <br> $0 . .38400$ | $9600$ | R/W per. |
| $\begin{aligned} & \text { RS485.serAdr } \\ & \text { 22:2 (16:02h }) \end{aligned}$ | Address <br> Permissible values 1... 31 | $\begin{aligned} & \text { UINT16 } \\ & 1 . .31 \end{aligned}$ | $1$ | R/W per. |
| $\begin{aligned} & \text { RS485.serFormat } \\ & \text { 22:3 }\left(16: 03_{h}\right) \end{aligned}$ | Data format <br> Assignment of bits: <br> Bit 0: $0=$ no parity, $1=$ parity on <br> Bit 1: $0=$ parity even, $1=$ parity odd <br> Bit 2: $0=7$ data bits, $1=8$ data bits <br> Bit 3: $0=1$ stop bit, $1=2$ stop bits <br> Default is $0=7-\mathrm{E}-1$ | $\begin{aligned} & \text { UINT16 } \\ & 0 . .15 \end{aligned}$ | $\overline{0}$ | R/W per. |

### 10.3.16 Parameter group "Settings"

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Settings.name1 11:1 (0B:01 ${ }_{h}$ ) | User device name part 1 <br> Default $=538976288=20202020_{h}=4$ spaces <br> User-programmable designation in the form of a text with a length of 8 characters | UINT32 | $5389762$ $88$ | R/W per. |
| Settings.name2 11:2 (0B:02h) | User device name part 2 <br> Default $=538976288=20202020_{h}=4$ spaces <br> User-programmable designation in the form of a text with a length of 8 characters | UINT32 | $\begin{aligned} & 5389762 \\ & 88 \end{aligned}$ | R/W per. |
| $\begin{aligned} & \text { Settings.I_max } \\ & \text { 15:3 (0F:03 }) \end{aligned}$ | Maximum current for normal operation <br> The current limitation can be set as required by the system. The default value is the maximum current of the parameter Config.I_maxDrv. <br> Unit: [0.1A] | $\begin{aligned} & \text { UINT16 } \\ & 0 . .100 \end{aligned}$ | A | R/W per. |
| Settings.I_maxStop $15: 4\left(0 \mathrm{~F}: 04_{h}\right)$ | Maximum current for stop via torque ramp <br> Current limitation for stop via torque ramp Only for operating modes without profile generator. Can be set as required by the system. Unit: [0.1A] | UINT16 |  | R/W per. |
| Settings.p_win 15:15 ( $0 \mathrm{~F}: 0 \mathrm{~F}_{\mathrm{h}}$ ) | Standstill window, permissible control deviation See parameter Settings.p_winTime | $\begin{aligned} & \text { UINT16 } \\ & 0 . .32767 \end{aligned}$ | 16 | R/W per. |
| Settings.p_winTime $15: 16\left(0 F: 10_{h}\right)$ | Standstill window, time <br> The control deviation p_dif must be within the position window for this period of time for the movement to be detected as finished. This is signalled by the x_end bit in the status word. Value 0: Standstill window deactivated | $\begin{aligned} & \text { UINT16 } \\ & 0 . .32767 \end{aligned}$ | 0 | R/W per. |
| $\begin{aligned} & \text { Settings.p_maxDif2 } \\ & 15: 17\left(0 \mathrm{~F}: 11_{\mathrm{h}}\right) \end{aligned}$ | Maximum permissible tracking error of the position controller Maximum value corresponds to 8 motor revolutions | $\begin{aligned} & \text { UINT32 } \\ & 0 . .131072 \end{aligned}$ | $\begin{aligned} & \text { Inc } \\ & 16384 \end{aligned}$ | R/W per. |
| Settings.WarnOvrun 28:11 (1C:0B ${ }_{h}$ ) | Response to position overtravel <br> Value 0: Set warning bit in status word <br> Value 1: Do not set warning bit in status word | $\begin{aligned} & \text { UINT16 } \\ & 0 . .1 \end{aligned}$ | $\overline{-}$ | R/W per. |
| $\begin{aligned} & \text { Settings.SignEnabl } \\ & \text { 28:13 }\left(1 \mathrm{C}: 0 \mathrm{D}_{\mathrm{h}}\right) \end{aligned}$ | Activation of monitoring inputs <br> Bit value 0 : Monitoring is not active <br> Bit value 1: Monitoring is active <br> Assignment of bits: <br> Bit 0: LIMP (positive limit switch) <br> Bit 1: LIMN (negative limit switch) <br> Bit 2: STOP (STOP switch) <br> Bit 3: REF (reference switch) <br> NOTE: Monitoring is only active if the I/O port is configured as the corresponding function (parameter I/O.IO0_def to IO3_def) | $\begin{aligned} & \hline \text { UINT16 } \\ & 0 . .15 \end{aligned}$ | $3$ | R/W per. |


| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Settings.SignLevel 28:14 ( $1 \mathrm{C}: 0 \mathrm{E}_{\mathrm{h}}$ ) | Signal level for monitoring inputs <br> Used to define whether errors are triggered at 0 or 1 level. <br> Bit value 0: Response at 0 level <br> Bit value 1: Response at 1 level <br> Assignment of bits: <br> Bit 0: LIMP <br> Bit 1: LIMN <br> Bit 2: STOP <br> Bit 3: REF | $\begin{aligned} & \text { UINT16 } \\ & 0 . .15 \end{aligned}$ | $\overline{0}$ | R/W per. |
| Settings. Flt_pDif 28:24 (1C:18 ${ }_{h}$ ) | Error response to tracking error <br> Value 1: Error class 1 <br> Value 2: Error class 2 <br> Value 3: Error class 3 | $\begin{aligned} & \text { UINT16 } \\ & 0 . .3 \end{aligned}$ | $3$ | R/W per. |

### 10.3.17 Parameter group "Status"

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Status.p_difPeak 15:13 ( $0 \mathrm{~F}: 0 \mathrm{D}_{\mathrm{h}}$ ) | Maximum position deviation reached <br> The value is updated an ongoing basis. The parameter value is set to the current position deviation value by writing 0 . | UINT32 <br> 0. <br> 2147483647 | $\begin{aligned} & \text { Inc } \\ & 0 \end{aligned}$ | R/- |
| Status.f_pulsin $21: 1\left(15: 01_{h}\right)$ | Current frequency at CN2 with operating mode Electronic Gear. <br> NOTE: The counter only works if you have set the operating mode "Electronic gear". However, it does not make a difference whether the gear is enabled or disabled. | INT32 | $\mathrm{Hz}$ | R/- |
| Status.p_pulsIn 21:6 (15:06 ${ }_{h}$ ) | Counted increments at CN2 in operating mode Electronic Gear. <br> NOTE: The counter only works if you have set the operating mode "Electronic gear". However, it does not make a difference whether the gear is enabled or disabled. | INT32 | Inc | R/- |
| Status.driveStat $28: 2\left(1 \mathrm{C}: 02_{h}\right)$ | Status word for the operating state <br> LOW-UINT16: <br> Assignment of bits: <br> Bits 0 ... 3: Current operating state <br> Bit 4: reserved <br> Bit 5: Error detected by internal monitoring <br> Bit 6: Error detected by external monitoring <br> Bit 7: Warning active <br> Bits 8 ... 11: Reserved <br> Bits 12 ... 15: Operating-mode specific coding <br> Corresponds to the assignment of bits 12 ... 15 in the operating mode-specific acknowledgement data. <br> HIGH-UINT16: <br> Assignment see parameter Status.xMode_act. | UINT32 | - | R/- |


| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Status.xMode_act 28:3 (1C:03h) | Current operating mode with additional information <br> Assignment of bits: <br> Bits 0..3: Current operating mode (see below) <br> Bit 4: reserved <br> Bit 5: Drive referenced (ref_ok) <br> Bits 6 ... 15: Reserved <br> Values for bits 0 ... 3 : <br> Value 1: Jog <br> Value 2: Homing <br> Value 3: Profile Position <br> Value 4: Profile Velocity <br> Value 5: Electronic Gear position-controlled <br> Value 8: Internal reference value <br> Other numbers are reserved for future extensions. | UINT16 |  | R/- |
| Status.WarnSig $28: 10\left(1 \mathrm{C}: 0 \mathrm{~A}_{\mathrm{h}}\right)$ | Warnings <br> Monitoring signals with error class 0 . <br> Assignment of bits: <br> Bit 0: Position overrun profile generator <br> Bit 1: Temperature of power stage $>100^{\circ} \mathrm{C}$ <br> Bit 5: $1^{2}$ t limitation active <br> Bit 10: Absolute position not yet read <br> The remaining bits are reserved for later extensions. The remaining bits are reserved for future extensions. | UINT16 |  | R/- |
| Status.Sign_SR 28:15 (1C:0F ${ }_{h}$ ) | Stored signal status of external monitoring signals <br> Bit value 0: not activated <br> Bit value 1: activated <br> Assignment of bits: <br> Bit 0: LIMP <br> Bit 1: LIMN <br> Bit 2: STOP <br> Bit 3: REF <br> Bit 5: SW_LIMP <br> Bit 6: SW_LIMN <br> Bit 7: SW stop <br> Stored signal status of released external monitoring signals | $\begin{aligned} & \text { UINT16 } \\ & 0 . .15 \end{aligned}$ |  | R/- |
| Status.FItSig 28:17 (1C:11h) | Active monitoring signals <br> The error bits remain set as long as the error persists (i.e. as long as the limit value is exceeded). <br> Assignment as parameter Status.FltSig_SR | UINT32 | - | R/- |


| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Status.FItSig_SR $28: 18\left(1 \mathrm{C}: 12_{h}\right)$ | Stored monitoring signals <br> Error bits remain set until a FaultReset is executed. <br> Assignment of bits: <br> Bit 0: Undervoltage 1 power supply <br> Bit 1: Undervoltage 2 power supply <br> Bit 2: Overvoltage power supply <br> Bit 5: Motor overload <br> Bit 12: Overtemperature power stage $\left(\geq 105^{\circ} \mathrm{C}\right)$ <br> Bit 16: Blocking error <br> Bit 17: Tracking error <br> Bit 18: Encoder inoperative <br> Bit 21: Protocol error fieldbus <br> Bit 22: Nodeguard error <br> Bit 23: Pulse/directing input timing <br> Bit 25: STO safety function triggered <br> Bit 26: Signals of the STO safety function have different levels <br> Bit 28: Hardware error EEPROM <br> Bit 29: Start-up error <br> Bit 30: Internal system error <br> Bit 31: Watchdog | UINT32 |  | R/- |
| $\begin{aligned} & \text { Status.action_st } \\ & \text { 28:19 (1C:13h }) \end{aligned}$ | Action word <br> Assignment of bits: <br> Bit 0: Bit latched error class 0 <br> Bit 1: Bit latched error class 1 <br> Bit 2: Bit latched error class 2 <br> Bit 3: Bit latched error class 3 <br> Bit 4: Bit latched error class 4 <br> Bit 5: reserved <br> Bit 6: Motor at standstill: actual speed of rotation is zero <br> Bit 7: Motor rotates clockwise <br> Bit 8: Motor rotates counterclockwise <br> Bit 9: reserved <br> Bit 10: reserved <br> Bit 11: Motor at standstill: reference speed of rotation is 0 <br> Bit 12: Motor decelerates <br> Bit 13: Motor accelerates <br> Bit 14: Motor moves at constant speed <br> Bit 15: reserved | UINT16 |  | R/- |
| Settings.SwLimP 29:4 (1D:04h) | Positive position limit for software limit switch | INT32 | $\begin{aligned} & \text { Inc } \\ & 0 \end{aligned}$ | R/W per. |
| $\begin{aligned} & \text { Settings.SwLimN } \\ & \text { 29:5 (1D:05h) } \end{aligned}$ | Negative position limit for software limit switch | INT32 | $\begin{aligned} & \text { Inc } \\ & 0 \end{aligned}$ | R/W per. |
| Status.SwLimEna 29:6 (1D:06h) | Monitoring of software limit switches <br> Value 0: None <br> Value 1: Enable software limit switch clockwise direction of rotation <br> Value 2: Enable software limit switch counterclockwise direction of rotation <br> Value 3: Enable software limit switches both directions of rotation <br> The software limit switches are only available for drives with multiturn encoders. | $\begin{aligned} & \text { UINT16 } \\ & 0 . .3 \end{aligned}$ | $0$ | R/W per. |


| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Status.ModeError 30:11 (1E:0B ${ }_{h}$ ) | Manufacturer-specific error code that caused the ModeError flag to be set. | UINT16 | $\overline{0}$ | R/- |
|  | Usually, this is an error that was caused by the activation of an operating mode. |  |  |  |
| Status.v_ref 31:1 ( $1 \mathrm{~F}: 01_{\mathrm{h}}$ ) | Reference speed | INT32 | Inc/s | R/- |
|  | Reference value of speed controller |  |  |  |
| Status.v_act$31: 2\left(1 \mathrm{~F}: 02_{\mathrm{h}}\right)$ | Actual speed of motor | INT32 | $\mathrm{Inc} / \mathrm{s}$ | R/- |
|  | The speed captured by the encoder. |  |  |  |
| Status.p_ref$31: 5\left(1 \mathrm{~F}: 05_{\mathrm{h}}\right)$ | Reference position | INT32 | Inc | R/- |
|  | Reference value of position controller. |  |  |  |
| Status.p_act$31: 6\left(1 \mathrm{~F}: 06_{\mathrm{h}}\right)$ | Actual position of motor | INT32 | Inc | R/- |
|  | The motor position captured by the encoder. |  |  |  |
| Status.p_dif $31: 7\left(1 \mathrm{~F}: 07_{\mathrm{h}}\right)$ | Position deviation of position controller | INT32 | Inc | R/- |
| Status.n_ref$31: 8\left(1 \mathrm{~F}: 08_{h}\right)$ | Reference speed | INT16 | $\mathrm{min}^{-1}$ | R/- |
|  | Reference value of speed controller |  |  |  |
| Status.n_act$31: 9\left(1 \mathrm{~F}: 09_{h}\right)$ | Actual speed of motor | INT16 | $\mathrm{min}^{-1}$ | R/- |
|  | Corresponds to parameter Status.v_act, but converted to revolutions per minute. |  |  |  |
| $\begin{aligned} & \text { Status.I_act } \\ & 31: 12\left(1 \mathrm{~F}: 0 \mathrm{C}_{\mathrm{h}}\right) \end{aligned}$ | Current motor current | INT16 | A | R/- |
|  | Unit: [0.1A] |  |  |  |
| $\begin{aligned} & \text { Status.p_abs } \\ & 31: 16\left(1 \mathrm{~F}: 10_{h}\right) \end{aligned}$ | Absolute position per motor revolution (modulo value) | $\begin{aligned} & \hline \text { UINT16 } \\ & 0 . .16383 \end{aligned}$ | Inc | R/- |
| $\begin{aligned} & \text { Status.I2t_act } \\ & 31: 17\left(1 F: 11_{h}\right) \end{aligned}$ | $\mathrm{I}^{2} \mathrm{t}$ total | UINT16 | \% | R/- |
|  | If the $I^{2} t$ total is equal to or greater than $100 \%$, the current is limited to the nominal current of the drive I_nomDrv; at the same time, bit 5 is set in Status.WarnSig. | . | - |  |
| Status.UDC_act 31:20 ( $1 \mathrm{~F}: 14_{\mathrm{h}}$ ) | Voltage power supply | UINT16 | V | R/- |
|  | Unit [0.1V] |  |  |  |
| Status.TPA_act 31:25 (1F:19h) | Power stage temperature | $\begin{aligned} & \text { UINT16 } \\ & \text { 20.. } 110 \end{aligned}$ | ${ }^{\circ} \mathrm{C}$ | R/- |
| Status.v_pref $31: 28\left(1 \mathrm{~F}: 1 \mathrm{C}_{\mathrm{h}}\right)$ | Speed of reference position Status.p_ref | INT32 | $\mathrm{Inc} / \mathrm{s}$ | R/- |
| Status.p_target$31: 30\left(1 \mathrm{~F}: 1 \mathrm{E}_{\mathrm{h}}\right)$ | Target position of profile generator | INT32 | Inc | R/- |
|  | Absolute position value of the profile generator, calculated on the basis of the relative and absolute position values specified. |  |  |  |
| Status.p_profile 31:31 (1F:1Fh) | Actual position of profile generator | INT32 | Inc | R/- |
|  | Corresponds to the reference position Status.p_ref. |  | - |  |
| $\begin{aligned} & \text { Status.p_actusr } \\ & 31: 34\left(1 \mathrm{~F}: 22_{\mathrm{h}}\right) \end{aligned}$ | Motor position | INT32 | Inc | R/- |
|  | Parameter for improving compatibility with TwinLine. Corresponds to the actual position Status.p_act. |  | - |  |
| Status.n_profile 31:35 (1F:23h) | Actual speed of profile generator | INT16 | $\mathrm{min}^{-1}$ | R/- |
|  | Corresponds to parameter Status.n_pref. |  | - |  |


| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| Status.n_target $31: 38\left(1 \bar{F}: 26_{h}\right)$ | Target speed of profile generator | INT16 | $\min ^{-1}$ | R/- |
| Status.n_pref$31: 45\left(1 \overrightarrow{\mathrm{~F}}: 2 \mathrm{D}_{\mathrm{h}}\right)$ | Speed of rotation of reference position Status.p_ref | INT16 | $\mathrm{min}^{-1}$ | R/- |
|  | Corresponds to parameter Status.v_pref, but converted to revolutions per minute. |  | - |  |
| Status.StopFault 32:7 (20:07 ${ }_{h}$ ) | Cause of last interruption, error number | UINT16 | $\overline{-}$ | R/- |
| Status.Brake$33: 8\left(21: 08_{h}\right)$ | Status of holding brake | UINT16 | - | R/- |
|  | Value 0 : Holding brake applied <br> Value 1: Holding brake released | $0 . .1$ | - |  |

### 10.3.18 Parameter group "VEL"

| Group.Name Index:Subindex dec. (hex.) | Description Bit assgnment | Data type range dec. | Unit Default dec. | R/W per. |
| :---: | :---: | :---: | :---: | :---: |
| VEL.velocity 36:1 (24:01 $h$ ) | Start with target speed | INT16 | $\min ^{-1}$ | R/W |
|  | Action object: write access triggers a movement |  |  |  |
|  | The value of Config.n_maxDrv, $15: 18$ is the maximum speed of rotation. |  |  |  |
| $\begin{aligned} & \text { VEL.stateVEL } \\ & 36: 2\left(24: 02_{h}\right) \end{aligned}$ | Acknowledgement: Profile Velocity | UINT16 | - | R/- |
|  | Assignment of bits: Bit 0: Error LIMP |  |  |  |
|  | Bit 1: Error LIMN |  |  |  |
|  | Bit 2: Error STOP |  |  |  |
|  | Bit 3: Error REF |  |  |  |
|  | Bit 5: Error SW_LIMP |  |  |  |
|  | Bit 6: Error SW_LIMN |  |  |  |
|  | Bit 7: SW_STOP |  |  |  |
|  | Bit 13: Target speed reached |  |  |  |
|  | Bit 14: vel_end |  |  |  |
|  | Bit 15: vel_err |  |  |  |

## 11 Accessories and spare parts

### 11.1 Accessories

Source commissioning software

Source EPLAN Macros

The latest version of the commissioning software is available for download from the internet:
http://www.schneider-electric.com
For easier engineering, macro files and product master data are available for download from the Internet at:
http://www.schneider-electric.com

| Designation | Order no. |
| :---: | :---: |
| Braking Resistor Controller UBC60 | ACC3EA001 |
| Installation kit | VW3L10111 |
| Insert with cable entry (2 pcs) | VW3L10100N2 |
| Insert with cable entry (10 pcs) | VW3L10100N10 |
| Cable entry for commissioning | VW3L10222 |
| Insert for sealing (10 pcs) | VW3L10000N10 |
| Insert for sealing (20 pcs) | VW3L10000N20 |
| Insert for sealing (50 pcs) | VW3L10000N50 |
| Cable for commissioning interface, 3m | VW3L1R000R30 |
| Insert kit for commissioning | VW3L1R000 |
| Cable kit, power supply, CANopen, 3m | VW3L2F001R30 |
| Cable kit, power supply, RS485, 3m | VW3L2R001R30 |
| Cable kit, power supply, PROFIBUS DP, 3m | VW3L2B001R30 |
| Cable kit, STO, 3m | VW3L20010R30 |
| Cable kit, STO, 5 m | VW3L20010R50 |
| Cable kit, STO, 10 m | VW3L20010R100 |
| Cable kit, STO, 15 m | VW3L20010R150 |
| Cable kit, STO, 20 m | VW3L20010R200 |
| Cable, power supply, 3m | VW3L30001R30 |
| Cable, power supply, 5 m | VW3L30001R50 |
| Cable, power supply, 10 m | VW3L30001R100 |
| Cable, power supply, 15 m | VW3L30001R150 |
| Cable, power supply, 20 m | VW3L30001R200 |
| Cable, STO, 3m | VW3L30010R30 |
| Cable, STO, 5 m | VW3L30010R50 |
| Cable, STO, 10 m | VW3L30010R100 |
| Cable, STO, 15 m | VW3L30010R150 |
| Cable, STO, 20 m | VW3L30010R200 |
| Connector kit, PROFIBUS DP (2 pcs) | VW3L5B000 |
| Connector kit, CANopen/RS485 (2 pcs) | VW3L5F000 |


| Designation | Order no. |
| :--- | :--- |
| Connector kit, $2 \times$ I/O | VW3L50200 |
| Connector kit, $3 \times$ I/O | VW3L50300 |
| Connector, STO output | VW3L50010 |
| Insert kit, $3 \times$ I/O | VW3L40300 |
| Insert kit, $2 \times$ I/O, $1 \times$ STO input | VW3L40210 |
| Insert kit, $1 \times$ STO input, $1 \times$ STO output | VW3L40020 |
| Insert kit, $4 \times$ I/O, $1 \times$ STO input, $1 \times$ STO output | VW3L40420 |

Cable Supplier recommendations:

- Profibus cable, both ends pre-assembled, 5 poles, B-coded Male M12 to female M12 Vendor: Lumberg, www.lumberg.de Order no.: 0975254101 / ... M
- Profibus cable, both ends pre-assembled, 5 poles, B-coded Female M12 to SubD connector 9 poles with activatable terminating resistor Vendor: Lumberg, www.lumberg.de Order no.: 0975254104 / ... M
- Profibus cable, both ends pre-assembled, 5 poles, B-coded Male M12 to SubD connector 9 poles with activatable terminating resistor Vendor: Lumberg, www.lumberg.de Order no:: 0975254105 / ... M

Tool The tools required for cable assembly must be ordered directly from the manufacturer.

- Crimping tool for CN1: AMP 654174-1
- Crimping tool for CN2, CN4 and CN5: Molex 69008-0982
- Crimping tool for CN3: Molex 69008-0724
- Extraction tool for CN2, CN4 and CN5: Molex 11-03-0043
- Extraction tool for CN3: Molex 11-03-0044

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

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


### 11.2 Gearboxes

| Designation | Order no. |
| :--- | :--- |
| Planetary gear for Lexium Integrated Drive ILAxx571, ratio 3/1 | GBX060003A571L |
| Planetary gear for Lexium Integrated Drive ILAxx571, ratio 5/1 | GBX060005A571L |
| Planetary gear for Lexium Integrated Drive ILAxx571, ratio 8/1 | GBX060008A571L |
| Planetary gear for Lexium Integrated Drive ILAxx571, ratio 16/1 | GBX060016A571L |
| Planetary gear for Lexium Integrated Drive ILAxx571, ratio 40/1 | GBX060040A571L |

## 12 Service, maintenance and disposal

## A CAUTION

DAMAGE TO SYSTEM COMPONENTS AND LOSS OF CONTROL
Interruptions of the negative connection of the controller supply voltage can cause excessively high voltages at the signal connections.

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

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

## A CAUTION

## RISK OF INJURY WHEN REMOVING CIRCUIT BOARD PLUGS

- When removing them note that the connectors must be unlocked.
- Supply voltage VDC:

Unlock by pulling at the plug housing

- Miscellaneous:

Unlock by pressing the locking lever

- Always hold the plug to remove it (not the cable).

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


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

### 12.1 Service address

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

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

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


If you have any questions please contact your sales office. Your sales office staff will be happy to give you the name of a customer service office in your area.
http://www.schneider-electric.com

### 12.2 Maintenance

Check the product for pollution or damage at regular intervals, depending on the way you use it.

### 12.2.1 Lifetime STO safety function

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

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

Do not use the safety function after this date.
Example The DOM on the nameplate of the device is shown in the format DD.MM.YY, e.g. 31.12.07. (December 31, 2007). This means: Do not use the safety function after December 31, 2027.

### 12.3 Replacing units

## A WARNING <br> UNINTENDED BEHAVIOR <br> The behavior of the drive system is governed by numerous stored data or settings. Unsuitable settings or data may trigger unexpected movements or responses to signals and disable monitoring functions. <br> - Do NOT operate the drive system with unknown settings or data. <br> - Verify that the stored data and settings are correct. <br> - When commissioning, carefully run tests for all operating states and potential fault situations. <br> - Verify the functions after replacing the product and also after making changes to the settings or data. <br> - Only start the system if there are no persons or obstructions in the hazardous area. <br> Failure to follow these instructions can result in death, serious injury or equipment damage.

Observe the following procedure when replacing devices.

- Save all parameter settings to your PC using the commissioning software, see chapter 7.3 "Lexium CT commissioning software".
- Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- Label all connections and uninstall the product.
- Note the identification number and the serial number shown on the product nameplate for later identification.
- Install the new product as per chapter 6 "Installation"
- Commission the product as per chapter 7 "Commissioning".


### 12.4 Shipping, storage, disposal

Removal Removal procedure:
Sisconnect the power supply.
Pull out all plugs.
Remove the product from the system.

## 13 Glossary

### 13.1 Units and conversion tables

The value in the specified unit (left column) is calculated for the desired unit (top row) with the formula (in the field).

Example: conversion of 5 meters [m] to yards [yd] $5 \mathrm{~m} / 0.9144=5.468 \mathrm{yd}$

### 13.1.1 Length

|  | in | $\mathbf{f t}$ | yd | $\mathbf{m}$ | $\mathbf{c m}$ | $\mathbf{m m}$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| $\mathbf{i n}$ | - | $/ 12$ | $/ 36$ | ${ }^{*} 0.0254$ | ${ }^{*} 2.54$ | ${ }^{*} 25.4$ |
| $\mathbf{f t}$ | ${ }^{*} 12$ | - | $/ 3$ | ${ }^{*} 0.30479$ | ${ }^{*} 30.479$ | ${ }^{*} 304.79$ |
| $\mathbf{y d}$ | ${ }^{*} 36$ | ${ }^{*} 3$ | - | ${ }^{*} 0.9144$ | ${ }^{*} 91.44$ | ${ }^{*} 914.4$ |
| $\mathbf{m}$ | $/ 0.0254$ | $/ 0.30479$ | $/ 0.9144$ | - | ${ }^{*} 100$ | ${ }^{*} 1000$ |
| $\mathbf{c m}$ | $/ 2.54$ | $/ 30.479$ | $/ 91.44$ | $/ 100$ | - | ${ }^{*} 10$ |
| $\mathbf{m m}$ | $/ 25.4$ | $/ 304.79$ | $/ 914.4$ | $/ 1000$ | $/ 10$ | - |

### 13.1.2 Mass

|  | $\mathbf{l b}$ | $\mathbf{o z}$ | slug | $\mathbf{k g}$ | $\mathbf{g}$ |
| :--- | :--- | :--- | :--- | :--- | :--- |
| $\mathbf{l b}$ | - | ${ }^{*} 16$ | ${ }^{*} 0.03108095$ | ${ }^{*} 0.4535924$ | ${ }^{*} 453.5924$ |
| $\mathbf{o z}$ | $/ 16$ | - | ${ }^{*} 1.942559^{*} 10^{-3}$ | ${ }^{*} 0.02834952$ | ${ }^{*} 28.34952$ |
| slug | $/ 0.03108095$ | $/ 1.9425599^{*} 10^{-3}$ | - | ${ }^{*} 14.5939$ | ${ }^{*} 14593.9$ |
| $\mathbf{k g}$ | $/ 0.453592370$ | $/ 0.02834952$ | $/ 14.5939$ | - | ${ }^{*} 1000$ |
| $\mathbf{g}$ | $/ 453.592370$ | $/ 28.34952$ | $/ 14593.9$ | $/ 1000$ | - |

### 13.1.3 Force

|  | $\mathbf{l b}$ | $\mathbf{o z}$ | $\mathbf{p}$ | $\mathbf{d y n e}$ | $\mathbf{N}$ |
| :--- | :--- | :--- | :--- | :--- | :--- |
| $\mathbf{l b}$ | - | ${ }^{*} 16$ | ${ }^{*} 453.55358$ | ${ }^{*} 444822.2$ | ${ }^{*} 4.448222$ |
| $\mathbf{o z}$ | $/ 16$ | - | ${ }^{*} 28.349524$ | ${ }^{*} 27801$ | ${ }^{*} 0.27801$ |
| $\mathbf{p}$ | $/ 453.55358$ | $/ 28.349524$ | - | ${ }^{*} 980.7$ | ${ }^{*} 9.807^{*} 10^{-3}$ |
| $\mathbf{d y n e}$ | $/ 444822.2$ | $/ 27801$ | $/ 980.7$ | - | $/ 100^{*} 10^{3}$ |
| $\mathbf{N}$ | $/ 4.448222$ | $/ 0.27801$ | $/ 9.807 * 10^{-3}$ | ${ }^{*} 100 * 10^{3}$ | - |

### 13.1.4 Power

|  | HP | W |
| :--- | :--- | :--- |
| HP | - | ${ }^{*} 745.72218$ |
| $\mathbf{W}$ | $/ 745.72218$ | - |

### 13.1.5 Rotation

|  | $\boldsymbol{m i n}^{-1}$ (RPM) | rad/s | deg./s |
| :--- | :--- | :--- | :--- |
| $\boldsymbol{m i n}^{\mathbf{- 1}}$ (RPM) | - | ${ }^{*} \pi / 30$ | ${ }^{*} 6$ |
| rad/s | ${ }^{*} 30 / \pi$ | - | ${ }^{*} 57.295$ |
| deg./s | $/ 6$ | $/ 57.295$ | - |

### 13.1.6 Torque

|  | lb-in | lb.ft | oz.in | Nm | kp.m | kp.cm | dyne.cm |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| lb.in | - | / 12 | * 16 | * 0.112985 | * 0.011521 | * 1.1521 | * $1.129 * 10^{6}$ |
| lb.ft | * 12 | - | * 192 | * 1.355822 | * 0.138255 | * 13.8255 | * $13.558 * 10^{6}$ |
| oz-in | / 16 | / 192 | - | * 7.0616*10-3 | * 720.07* $10^{-6}$ | * $72.007 * 10^{-3}$ | * 70615.5 |
| Nm | / 0.112985 | / 1.355822 | $17.0616^{*} 10^{-3}$ | - | * 0.101972 | * 10.1972 | * $10 \times 10^{6}$ |
| kp.m | / 0.011521 | / 0.138255 | $1720.07 * 10^{-6}$ | / 0.101972 | - | * 100 | * 98.066* $10^{6}$ |
| kp.cm | / 1.1521 | / 13.8255 | $172.007 * 10^{-3}$ | / 10.1972 | / 100 | - | * $0.9806{ }^{*} 10^{6}$ |
| dyne.cm | / $1.129 * 10^{6}$ | / $13.558 * 10^{6}$ | / 70615.5 | / $10 * 10^{6}$ | / 98.066* $10^{6}$ | $10.9806^{*} 10^{6}$ | - |

### 13.1.7 Moment of inertia

|  | lb.in ${ }^{2}$ | lb.ft ${ }^{2}$ | kg.m ${ }^{2}$ | $\mathrm{kg} \cdot \mathrm{cm}^{2}$ | kp.cm.s ${ }^{2}$ | oz. $\mathrm{in}^{2}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| lb.in ${ }^{2}$ | - | / 144 | / 3417.16 | / 0.341716 | / 335.109 | * 16 |
| lb.ft ${ }^{2}$ | * 144 | - | * 0.04214 | * 421.4 | * 0.429711 | * 2304 |
| $\mathrm{kg} \cdot \mathrm{m}^{2}$ | * 3417.16 | / 0.04214 | - | * $10{ }^{*} 10^{3}$ | * 10.1972 | * 54674 |
| $\mathrm{kg} \cdot \mathrm{cm}^{2}$ | * 0.341716 | / 421.4 | / $10 \times 10^{3}$ | - | / 980.665 | * 5.46 |
| kp.cm. $\mathrm{s}^{2}$ | * 335.109 | / 0.429711 | / 10.1972 | * 980.665 | - | * 5361.74 |
| oz. $\mathrm{in}^{2}$ | / 16 | / 2304 | / 54674 | / 5.46 | / 5361.74 | - |

### 13.1.8 Temperature

|  | ${ }^{\circ} \mathbf{F}$ | ${ }^{\circ} \mathbf{C}$ | $\mathbf{K}$ |
| :--- | :--- | :--- | :--- |
| ${ }^{\circ} \mathbf{F}$ | - | $\left({ }^{\circ} \mathrm{F}-32\right){ }^{*} 5 / 9$ | $\left({ }^{\circ} \mathrm{F}-32\right){ }^{*} 5 / 9+273.15$ |
| ${ }^{\circ} \mathbf{C}$ | ${ }^{\circ} \mathbf{C} * 9 / 5+32$ | - | ${ }^{\circ} \mathrm{C}+273,15$ |
| $\mathbf{K}$ | $(\mathrm{~K}-273.15){ }^{*} 9 / 5+32$ | $\mathrm{~K}-273.15$ | - |

### 13.1.9 Conductor cross section

| AWG | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| $\mathbf{m m}^{2}$ | 42.4 | 33.6 | 26.7 | 21.2 | 16.8 | 13.3 | 10.5 | 8.4 | 6.6 | 5.3 | 4.2 | 3.3 | 2.6 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| AWG | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| $\mathbf{m m}^{2}$ | 2.1 | 1.7 | 1.3 | 1.0 | 0.82 | 0.65 | 0.52 | 0.41 | 0.33 | 0.26 | 0.20 | 0.16 | 0.13 |

### 13.2 Terms and Abbreviations

| $A C$ | Alternating current |
| :---: | :---: |
| ASCII | American Standard Code for Information Interchange. Standard for coding of characters |
| CAN | (Controller Area Network), standardized open fieldbus as per ISO 11898, allows drives and other devices from different manufacturers to communicate. |
| $D C$ | Direct current |
| Default value | Factory setting. |
| Direction of rotation | Rotation of the motor shaft in a clockwise or counterclockwise direction of rotation. Clockwise rotation is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft. |
| DOM | The Date of manufacturing on the nameplate of the device is shown in the format DD.MM.YY, <br> e.g. 31.12.06 (December 31, 2006). |
| EMC | Electromagnetic compatibility |
| Encoder | Sensor for detection of the angular position of a rotating component. The motor encoder shows the angular position of the rotor. |
| Error class | Classification of errors into groups. The different error classes allow for specific responses to faults, e.g. by severity. |
| Fatal error | In the case of fatal error, the drive is not longer able to control the motor, so that an immediate switch-off of the drive is necessary. |
| Fault | Operating state of the drive caused as a result of a discrepancy between a detected (computed, measured or signaled) value or condition and the specified or theoretically correct value or condition. |
| Fault reset | A function used to restore the drive to an operational state after a detected fault is cleared by removing the cause of the fault so that the fault is no longer active (transition from state "Fault" to state "Operation Enable"). |
| Forcing | Forcing switching states of inputs/outputs.Forcing switching states of inputs/outputs. |
| 1/O | Inputs/outputs |
| $I^{2}$ t monitoring | Anticipatory temperature monitoring. The expected temperature rise of components is calculated in advance on the basis of the motor current. If a limit value is exceeded, the drive reduces the motor current. |
| Inc | Increments |
| Index pulse | Signal of an encoder to reference the rotor position in the motor. The encoder returns one index pulse per revolution. |
| Limit switch | Switch that signals overtravel of the permissible range of travel. |
| Node guarding | Monitoring of the connection with the slave at an interface for cyclic data traffic. |
| Parameter | Device data and values that can be set by the user. |
| Parameter switch | Small switches adjacent to each other |


| Persistent | Indicates whether the value of the parameter remains in the memory after the device is switched off. |
| :---: | :---: |
| PLC | Programmable logic controller |
| Profibus | Standardized open fieldbus as per EN 50254-2 which allows drives and other devices from different manufacturers to communicate. |
| Power stage | The power stage controls the motor. The power stage generates currents for controlling the motor on the basis of the positioning signals from the controller. |
| PWM | Pulse width modulation |
| Quick Stop | Function used to enable fast deceleration of the motor via a command or in the event of a malfunction. |
| RS485 | Fieldbus interface as per EIA-485 which enables serial data transmission with multiple devices. |
| Torque ramp | Deceleration of 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 recovered up depending on the coupled load, the voltage may increase to excessively high values. In this case the maximum permissible current must be reduced. |
| Virtual index pulse | At every motor revolution, the virtual index pulse is at the same angle position of the motor. The virtual index pulse can be shifted with a parameter. |
| Warning | If not used within the context of safety instructions, a warning alerts to a potential problem detected by a monitoring function. A warning is not a fault and does not cause a transition of the operating state. Warnings belong to error class 0. |
| Watchdog | Unit that monitors cyclic basic functions in the product. Power stage and outputs are switched off in the event of faults. |
| o voltage window | Voltage range that is interpreted as 0 V . |

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[^0]:    1) Not available in combination with the holding brake option
    2) Not available in combination with the servo multiturn option.

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

    Example: IL••••••S1234--

