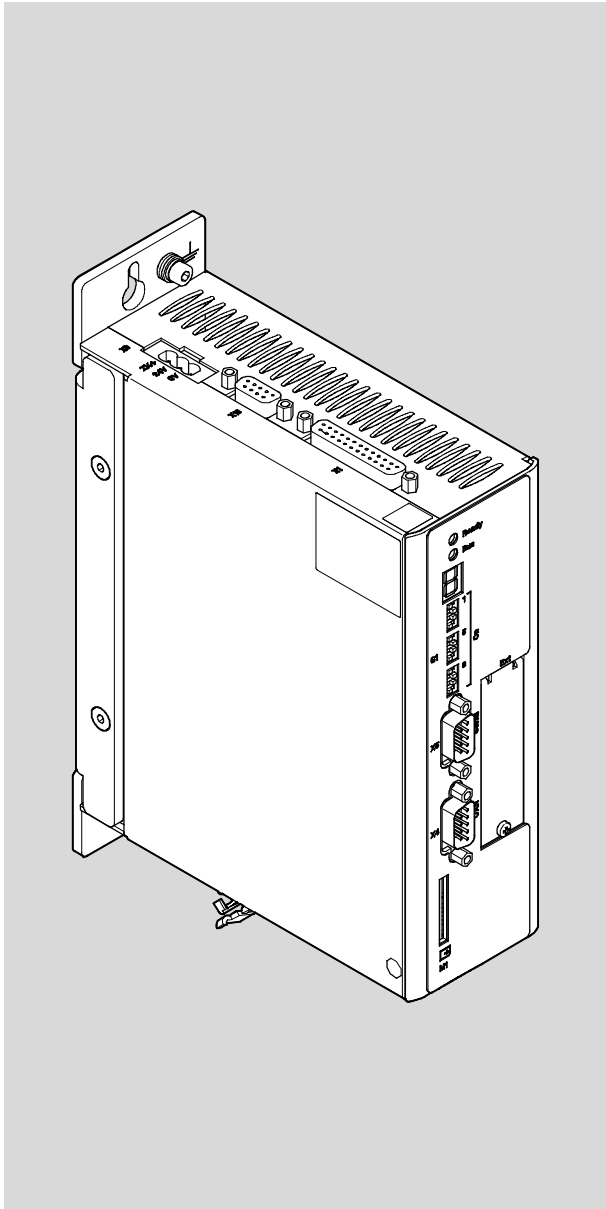


Motor controller

CMMS-ST-C8-7-G2



FESTO

Description

Mounting and installation

8040101
1404NH
[8034456]

Translation of the original instructions
GDCP-CMMS-ST-G2-HW-EN

CANopen®, DeviceNet®, PHOENIX®, PROFIBUS® are registered trademarks of the respective trademark owners in certain countries.

Identification of hazards and instructions on how to prevent them:



Warning

Hazards that can cause death or serious injuries.



Caution

Hazards that can cause minor injuries or serious material damage.

Other symbols:



Note

Material damage or loss of function.



Recommendations, tips, references to other documentation.



Essential or useful accessories.



Information on environmentally sound usage.

Text designations:

- Activities that may be carried out in any order.
- 1. Activities that should be carried out in the order stated.
- General lists.

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Notes on this documentation

This documentation is intended to help you safely work with the motor controller CMMS-ST-C8-7-G2 and describes the functions, commissioning and error messages.

Target group

This documentation is intended exclusively for technicians trained in control and automation technology, who have experience in installation, commissioning, programming and diagnostics of positioning systems.

Versions



This documentation refers to the following versions:
 – Motor controller CMMS-ST-C8-7-G2: from Rev 05



Please note

Before using a newer firmware version, check whether a newer version of the FCT plug-in or user documentation is available for it (➔ www.festo.com/sp).

servicing

Please consult your regional Festo contact if you have any technical problems.

Product identification

| Rating plate CMMS-ST-C8-7-G2 | Function |
|---|------------------|
| <p>CMMS-ST-C8-7-G2 572211 Rev 06 CN98 P0021912</p> <p>CE ...</p> <p>In: 1 --- 48V DC 5.5A Out: 2 --- (0...to Input Voltage) V DC (0...10)kHz 8A</p> | Type designation |
| | CMMS-ST-C8-7-G2 |
| | Part number |
| | e.g. 572211 |
| | Revision status |
| | e.g. Rev 06 |
| Serial number | |
| e.g. CN98 P0021912 | |
| Input (In) | |
| 1-phase 48 V DC, 5.5 A | |
| Output (Out) | |
| 2-phase 0 ... Input voltage V DC 0 ... 10 kHz, 8 A | |

Tab. 1 Rating plate CMMS-ST-C8-7-G2 (example)

Issue status of the specified standards

| Standard: issue status | |
|----------------------------|---------------------------------|
| EN 60204-1:2006/A1:2009-02 | EN 61800-3:2004-12 + A1:2012-03 |
| EN 61800-2:1998-04 | EN 61800-5-1:2007-09 |

Tab. 2 Issue statuses

Production time period

On the type plate, the first 2 characters of the serial number indicate the production time period in encrypted form (→ Tab. 1) The letter specifies the manufacturing year and the character behind it (number or letter) indicates the month of production.

| Manufacturing year | | | | | |
|--------------------|----------|----------|----------|----------|----------|
| X = 2009 | A = 2010 | B = 2011 | C = 2012 | D = 2013 | E = 2014 |
| F = 2015 | H = 2016 | J = 2017 | K = 2018 | L = 2019 | M = 2020 |

Tab. 3 Manufacturing year (20-year cycle)

| Manufacturing month | |
|---------------------|-----------|
| 1 | January |
| 3 | March |
| 5 | May |
| 7 | July |
| 9 | September |
| N | November |
| 2 | February |
| 4 | April |
| 6 | June |
| 8 | August |
| O | October |
| D | December |

Tab. 4 Manufacturing month

Type codes

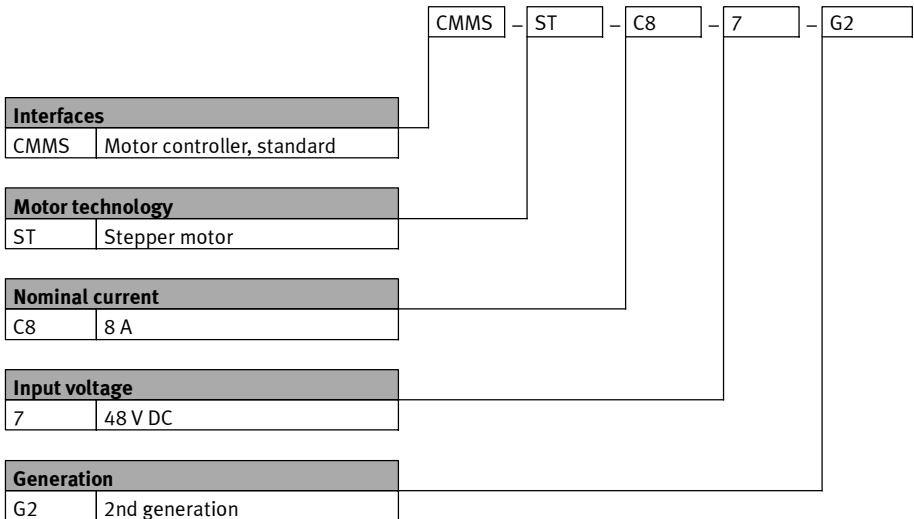


Fig. 1 Type codes

Documentation

Additional information on the motor controllers can be found in the following documentation:

| Documentation | | Type of equipment | Table of contents |
|-----------------------------|------------------------------|-------------------------------|--|
| Mounting and installation | GDCP-CMMS-AS-G2-HW-... | CMMS-AS | <ul style="list-style-type: none"> - Mounting - Installation (pin allocation) - Error messages - technical data |
| | GDCP-CMMD-AS-HW-... | CMMD-AS | |
| | GDCP-CMMS-ST-G2-HW-... | CMMS-ST | |
| Functions and commissioning | GDCP-CMMS/D-FW-... | CMMS-AS CMMD-AS CMMS-ST | <ul style="list-style-type: none"> - Control interfaces - Operating modes/operational functions - Commissioning with FCT - Error messages |
| STO safety function | GDCP-CMMS-AS-G2-S1-... | CMMS-AS | <ul style="list-style-type: none"> - Functional safety engineering with the safety function STO (safe torque off)) |
| | GDCP-CMMD-AS-S1-... | CMMD-AS | |
| | GDCP-CMMS-ST-G2-S1-... | CMMS-ST | |
| Device profile FHPP | GDCP-CMMS/D-C-HP-... | CMMS-AS CMMD-AS CMMS-ST | <ul style="list-style-type: none"> - Description of the interfaces: <ul style="list-style-type: none"> - CAN bus (CANopen) - Interface CAMC-PB (PROFIBUS) - Interface CAMC-DN (DeviceNet) - Control and parameterisation via the device profile FHPP (Festo profile for handling and positioning) with PROFIBUS, DeviceNet or CANopen. |
| Device profile CiA 402, | GDCP-CMMS/D-C-CO-... | CMMS-AS CMMD-AS CMMS-ST | <ul style="list-style-type: none"> - Description of the interface: <ul style="list-style-type: none"> - CAN bus (CANopen, DriveBus) - Control and parameterisation via device profile CiA 402 (DS 402). |
| Software help | Help on the CMMS-AS plug-in | CMMS-AS | <ul style="list-style-type: none"> - Surface and functions in the Festo Configuration Tool for the plug-in |
| | Help on the CMMD-AS plug-in | CMMD-AS | |
| | Help for the CMMS-ST plug-in | CMMS-ST | |

Tab. 5 Documentation on the motor controllers



The documentation is available on the following media:

- CD-ROM (scope of delivery)
- Support portal: www.festo.com/sp

1 Safety and requirements for product use

1.1 Security

1.1.1 Safety instructions



Caution

Risk of damage to equipment or injury to people from unexpected discharge of condensers in motor controller (power approx. 1 Ws). Short circuits can cause sudden discharge of intermediate circuit condensers and energy buildup:

- When the module or cover plate is not mounted on the card slot [EXT]
- When cables are not mounted to the plugs [X6] and [X9]
- When connecting cables are disconnected when powered.

The product must be installed in a control cabinet. The product must not be used until all safeguardings have been introduced.

Before maintenance, repair and cleaning work and when there have been long service interruptions:

1. Switch off power to the electrical equipment via the mains switch and secure it against being switched on again.
2. After switch-off, wait at least 1 minute discharge time and check that power is turned off before accessing the controller.



Caution

Danger of burns from hot surfaces

Dependent on the load of the motor controller, housing temperatures $> 80\text{ °C}$ are possible in operation.

- Protect hot surfaces from contact in operation.
- Touch them only in a switched-off, cooled-off status.



Note

Danger from unexpected movement of the motor or axis

- Make sure that the movement does not endanger anyone.
- Perform a risk assessment in accordance with the EC machinery directive.
- Based on this risk assessment, design the safety system for the entire machine, taking into account all integrated components. This also includes the electric drives. Bypassing of safety equipment is impermissible.

1.1.2 Intended use

The motor controller CMMS-ST-C8-7-G2. is intended for use as a controller for two-phase step motors of the EMMS-ST and MTR-ST series. It enables closed loop control of torque (current), speed and position, as well as positioning control with stored positioning records. The motor controller is designed for installation in a control cabinet.

The product is intended for use in industrial environments. Outside of industrial environments, e.g. in commercial and mixed-residential areas, actions to suppress interference may have to be taken.

Use exclusively:

- In faultless technical condition
- In original status without unauthorised modifications; only the expansions described in the documentation supplied with the product are permitted.
- Within the limits of the product defined by the technical data (→ Appendix A.1)
- in an industrial environment
- In a control cabinet.

In the event of damage caused by unauthorised manipulation or other than intended use, the guarantee is invalidated and the manufacturer is not liable for damages.

The motor controller supports the following safety function:

- Safe Torque Off – “Safe Torque Off” (STO)



Additional information → STO safety function description, GDGP-CMMS-ST-S1-....

1.2 Requirements for product use

- Make this documentation available to the design engineer, installer and personnel responsible for commissioning the machine or system in which this product is used.
- Make sure that the specifications of the documentation are always complied with. Also consider the documentation for the other components and modules.
- Take into consideration the legal regulations applicable for the destination, as well as:
 - Regulations and standards,
 - regulations of the testing organizations and insurers,
 - National specifications.

1.2.1 Transport and storage conditions

- Protect the product during transport and storage from impermissible burdens, such as:
 - mechanical loads
 - impermissible temperatures
 - moisture
 - aggressive atmospheres
- Store and transport the product in its original packaging. The original packaging offers sufficient protection from typical stresses.

1.2.2 Technical prerequisites

For correct and safe use of the product:

- Comply with the connection and environmental conditions of the product (→ Appendix A) and all connected components specified in the technical data. Compliance with the limit values and load limits permits operation of the product in compliance with the relevant safety regulations.
- Observe the notes and warnings in this documentation.

1.2.3 Qualification of trained personnel

The product may only be placed in operation by a qualified electrotechnician who is familiar with:

- the installation and operation of electrical control systems,
- the applicable regulations for operating safety-engineered systems,
- the applicable regulations for accident protection and occupational safety, and
- the documentation for the product.

1.2.4 Range of application and certifications

The motor controller with integrated STO safety function is a safety-related part of the control systems.

The motor controller carries the CE marking; for standards and test values → Appendix A.1.

The product-relevant EU directives can be found in the declaration of conformity.



For certificates and the declaration of conformity for this product please refer to
→ www.festo.com/sp.

2 Product overview

2.1 The entire system for the CMMS-ST-C8-7-G2

- 1 Power switch
- 2 Fuse – dependent on 3 and 4
- 3 24 V power supply unit for control voltage
- 4 Power supply unit for power supply
- 5 Motor controller CMMS-ST-C8-7-G2
- 6 PC with serial connecting cable for parameterisation and commissioning with the Festo Configuration Tool (FCT), CMMS-ST plug-in
- 7 Motor – here EMMS-ST with encoder (motor and encoder cable NEBM)

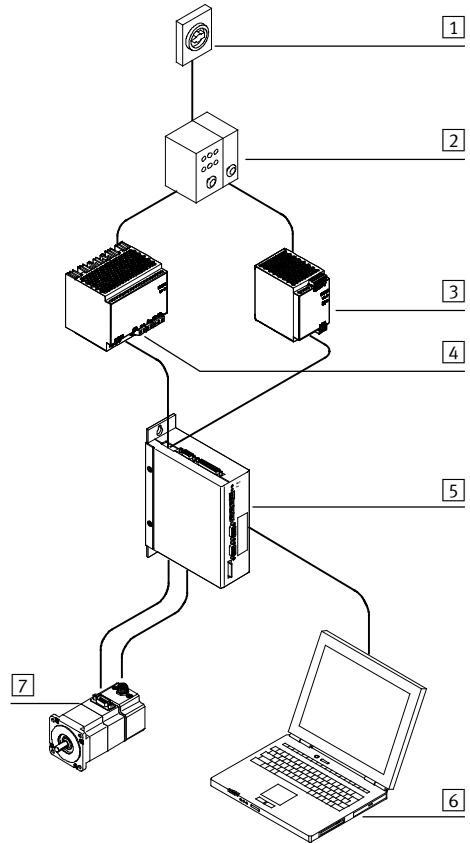


Fig. 2.1 Complete structure CMMS-ST-C8-7-G2 – example

2.2 Scope of delivery

| Number | Component |
|--------|---|
| 1 | Motor controller CMMS-ST-C8-7-G2 |
| 1 | Operator package <ul style="list-style-type: none"> – Brief description – CD-ROM with following contents: <ul style="list-style-type: none"> – Parameterisation software “Festo Configuration Tool” (FCT) – Documentation on the product – S7 module – Configuration files for the supported bus systems (e.g. device core data for PROFIBUS (GSD), electronic data sheet (EDS) for DeviceNet, etc.) – Firmware |
| 1 | Assortment of plugs (plugged into connections) |

Tab. 2.1 Scope of delivery



Accessories → www.festo.com/catalogue

2.3 Device view

- 1 LED status display
- 2 Seven-segment display
- 3 [S1]: DIL switches for fieldbus settings and firmware update
- 4 [EXT]: Slot for optional control interfaces (PROFIBUS DP, DeviceNet)
- 5 [M1]: card slot for SD memory card
- 6 [X4]: CAN bus
- 7 [X5]: RS232/RS485
- 8 Earthing screw (central FU connection)

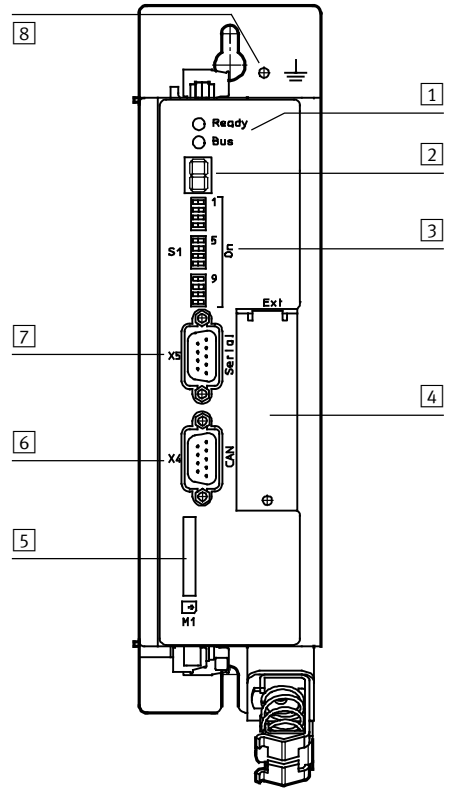


Fig. 2.2 Front view CMMS-ST-C8-7-G2 front

- 1 [X9] Power supply
- 2 [X10] Master/slave (bi-directional interface)
- 3 [X1] I/O interface

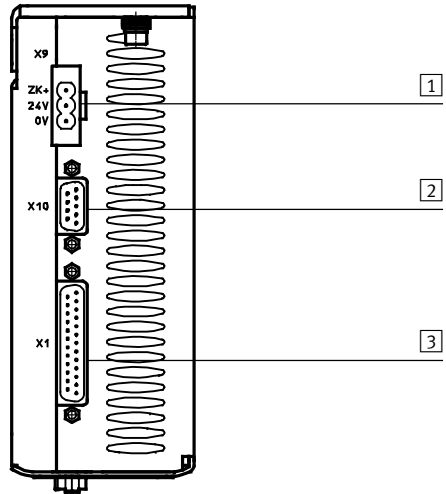


Fig. 2.3 Top CMMS-ST-C8-7-G2 view

- 1 [X3] STO interface
- 2 [X2] Encoder
- 3 [X6] Motor
- 4 Shield connection terminal

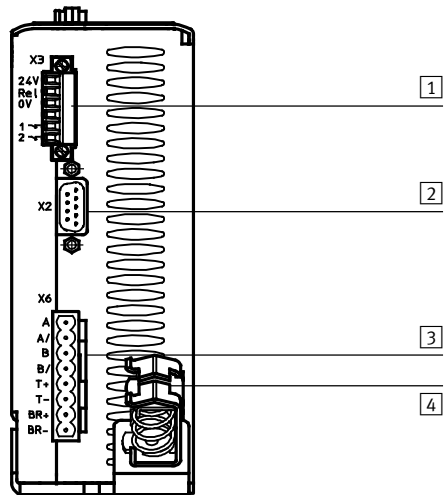








Fig. 2.4 Bottom CMMS-ST-C8-7-G2 view

2.4 Display and control elements

2.4.1 Seven-segment display

| Display ¹⁾ | | Meaning |
|---|---------------------------|---|
| Starting program | | |
|  | Point | Start programme (Bootloader) active |
| | Flashing point | – Firmware file (memory card) is being read |
| Operating modes | | |
|  | P x x x | Positioning mode, record number x x x |
| | 000 | – No positioning record active |
| | 001...063 | – Positioning record 001 ... 063 active |
| | 064 | – Manual travel via FCT or FHPP direct record (direct operation) |
| | 070/071 | – Jog+/jog- |
| | PH x | Homing phase x |
| | 0 | – Searching travel to the primary destination (limit switch or stop) |
| | 1 | – Crawl to the reference point |
| | 2 | – Travel to the axis zero point |
|  | Rotating outside segments | Speed mode (speed adjustment): Display changes in response to rotor position and speed. |
| | Middle segment | Controller enable active (motor is energised). |
|  | I | Force/torque mode (current control) |
| Safety function | | |
|  | H | Two-channel safety function requested (DIN4 [X1.21] and Rel [X3.2]) |
| Error/warning messages | | |
|  | E x x y | Error (E = error) Number: Two-position main index (x x), single-position sub-index (y) Example: E 0 1 0 → Appendix B. |
| | - x x y - | Warning Number: Two-position main index (x x), single-position subindex (y). Example: - 1 7 0 - → Appendix B. |

1) Several characters are displayed one after the other.

Tab. 2.2 Seven-segment operation and error display (→ Fig. 2.2 [2])



Warnings are automatically acknowledged when the cause is no longer present. Error messages are acknowledged via:

- the parameterisation software FCT
- the fieldbus (control word)
- or a decreasing edge at [X1] DIN5.

2.4.2 LED displays

| LED | LED colour | Function |
|-------|----------------|---|
| Ready | Green | Operating status/controller enable |
| | Flashing green | Parameter file *.DCO (memory card) is being read/written |
| Bus | Yellow | Bus status display lights up whenever CAN communication is taking place |

Tab. 2.3 LED status display (→ Fig. 2.2 [1])

2.4.3 DIL switch

| DIP switch | Function |
|-------------|---|
| S1.1 ... 7 | Bus address or MAC-ID → Example Tab. 2.5 |
| S1.8 | Automatic loading of a new firmware file from the memory card by the starting program (Bootloader): ¹⁾ <ul style="list-style-type: none"> - ON: download from the SD memory card to the motor controller - OFF: no download. |
| S1.9 ... 10 | Setting the bus transmission rate → Example Tab. 2.6 |
| S1.11 | Activation of the CAN-bus interface |
| S1.12 | Terminating resistor for CAN-bus |

1) Additional information can be found in the firmware download → Description of functions and commissioning, GDPC-CMMS/D-FW-....

Tab. 2.4 Function of the DIL switches (→ Fig. 2.2 [3])

| S1.1 ... 7 | ON/OFF (example) | Significance ¹⁾ |
|------------|------------------|---|
| 1 | ON 1 | DIP switch S1.1 is the low-order bit. Example: address = 1011011 = 91 |
| 2 | ON 1 | |
| 3 | OFF 0 | |
| 4 | ON 1 | |
| 5 | ON 1 | |
| 6 | OFF 0 | |
| 7 | ON 1 | |

1) Additional information → Description of functions and commissioning, GDPC-CMMS/D-FW-....

Tab. 2.5 CAN bus address or MAC-ID

| S1.9 ... 10 | ON/OFF (example) | Significance ¹⁾ |
|-------------|------------------|--|
| 9 | ON 1 | DIP switch S1.9 is the low-order bit. 00: 125 kBit/s |
| 10 | OFF 0 | 01: 250 kBit/s (example) 10: 500 kBit/s 11: 1000 kBit/s |

1) Additional information → Description of functions and commissioning, GDPC-CMMS/D-FW-....

Tab. 2.6 CAN-bus transmission rate

2.4.4 Slot [EXT]

The slot (→ Fig. 2.2 [4]) enables the option of expanding CMMS-ST-C8-7-G2 by other interfaces, e.g.:

- CAMC-PB: interface for PROFIBUS DP
- CAMC-DN: interface for DeviceNet.



For mounting, please observe the mounting instructions for the CAMC interface. If the interface is mounted, it is automatically activated the next time the motor controller is switched on. Information about function can be found in the FHPP device profile description, GDPC-CMMS/D-C-HP-....

2.4.5 Card slot [M1] for SD memory card



A parameter set can be loaded from/saved onto the memory card by using the FCT software. You can find additional information in the Help file of the CMMP-ST FCT plug-in and in the functions and commissioning description, GDPC-CMMS/D-FW-....

| SD memory card | Description |
|------------------------|---|
| Functions | Copying/loading a parameter set from the memory card to the CMMS-ST-C8-7-G2. |
| | Copying/saving a parameter set from the CMMS-ST-C8-7-G2 to the memory card. |
| | Copying (loading) firmware from the memory card to the CMMS-ST-C8-7-G2 (Bootloader) |
| Design on the device | 1x12-pin SD card slot |
| Supported card types | SD ¹⁾ (version 1 and 2) |
| Supported file systems | FAT16 |
| Format filename | 8.3 |

1) Recommended are industry-suitable memory cards from the Festo accessories programme.

Tab. 2.7 Characteristics of the memory card (→ Fig. 2.2 [5])

3 Mechanical installation

3.1 Installation dimensions

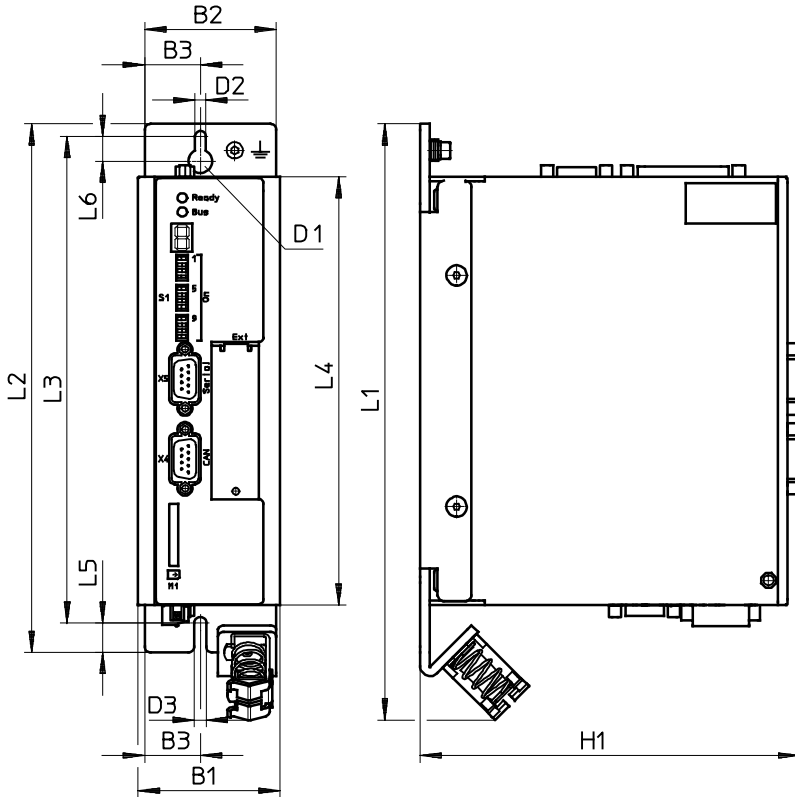


Fig. 3.1 Installation dimensions

| Dim. | B1 | B2 | B3 | D1 ø | D2 ø | D3 ø | H1 |
|------|------------|------------|----|------|------|------|-------------|
| [mm] | Approx. 60 | Approx. 56 | 24 | 10 | 4.5 | 5 | Approx. 161 |

| Dim. | L1 | L2 | L3 | L4 | L5 | L6 |
|------|-------------|-------------|----------------|-------------|------|------|
| [mm] | Approx. 257 | Approx. 224 | Approx. 206.25 | Approx. 181 | 12.5 | 10.5 |

Tab. 3.1 CMMS-ST-C8-7-G2: Installation dimensions

3.2 Mounting



Caution

Motor controller contains condensers (energy storage)

Do not disconnect connecting cables when powered. Before mounting and installation work:

1. Switch off power to the electrical equipment via the mains switch and secure it against being switched on again.
2. After switch-off, wait at least 1 minute discharge time and check that power is turned off before accessing the controller.



Caution

Danger of burns from hot surfaces

Dependent on the load of the motor controller, housing temperatures > 80 °C are possible in operation.

- Touch them only in a switched-off, cooled-off status.



Please note

Make sure that no metal shavings, metal dust or mounting parts (screws, nuts, pieces of wire) fall into the motor controller when mounting and during operation.

For vertical mounting onto a control cabinet mounting plate:
 For the motor controller CMMS-ST-C8-7-G2 no mounting brackets are required. The back wall has mounting options. The back wall is part of the radiator profile and transfers heat to the mounting plate.

The motor controllers of the CMMx family are designed in such a way that they can be mounted on a heat-dissipating mounting plate if used as intended and installed correctly.

- Mount motor controller in the control cabinet as follows:
 - The mounting position is vertical with the power supply lines [X9] leading upwards
 - Mounting to retaining bores with 2 M4 screws.

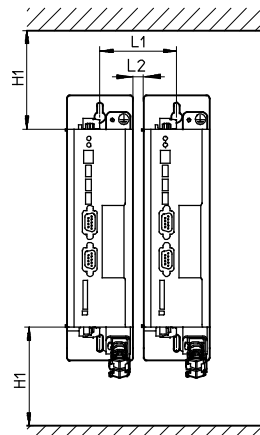


Fig. 3.2 Installation clearance

**Please note**

An excessive temperature increase results in premature aging or damage to the motor controller.

- Observe the specified installation clearances to ensure sufficient ventilation (→ Tab. 3.2).

| CMMS-ST | H1 ¹⁾ | L1 | L2 |
|-------------------------------|------------------|----|----|
| – Installation clearance [mm] | 100 | 69 | 9 |

1) Recommendation for optimum wiring of the motor and encoder cable: Installation clearance H1 at the bottom = 150 mm.

Tab. 3.2 Installation clearance CMMS-ST

3.3 Disassembly

**Caution****Motor controller contains condensers (energy storage)**

Do not disconnect connecting cables when powered. Before mounting and installation work:

1. Switch off power to the electrical equipment via the mains switch and secure it against being switched on again.
2. After switch-off, wait at least 1 minute discharge time and check that power is turned off before accessing the controller.

**Caution****Danger of burns from hot surfaces**

Dependent on the load of the motor controller, housing temperatures > 80 °C are possible in operation.

- Touch them only in a switched-off, cooled-off status.



4 Electrical installation

4.1 Safety instructions



Caution

Risk of damage to equipment or injury to people from unexpected discharge of condensers in motor controller. Short circuits can cause sudden discharge of intermediate circuit condensers and energy buildup:

- When the module or cover plate is not mounted on the card slot [EXT]
- When cables are not mounted to the plugs [X6] and [X9]
- When connecting cables are disconnected when powered.

Before maintenance, repair and cleaning work and when there have been long service interruptions:

1. Switch off power to the electrical equipment via the mains switch and secure it against being switched on again.
2. After switch-off, wait at least 1 minute discharge time and check that power is turned off before accessing the controller.



Caution

Danger from unexpected movement

Faulty pre-assembled lines may destroy the electronics and trigger unexpected movements of the motor.

- When wiring the system, use only the supplied plug connectors and preferably the cables listed in the catalogue as accessories.
→ www.festo.com/catalogue
- Lay all flexible lines so that they are free of kinks and free of mechanical stress; if necessary use chain link trunking.



Please note

ESD (electrostatic discharge) can cause damage to the device or other system parts at plug connectors that are not used.



- Before installation: Earth the system parts and use appropriate ESD equipment (e.g. shoes, earthing straps etc.).
- After installation: Seal unassigned D-sub plug connectors with protective caps (available at authorized dealers).
- Observe the handling specifications for electrostatically sensitive devices.

4.2 Instructions for safe and EMC-compliant installation



The CMMS-ST-C8-7-G2 motor controllers have been approved in accordance with product standard EN 61800-3 that is applicable to electric drives. Components from Festo have been used for this purpose (e.g. motor/encoder cables).

The declaration of conformity for the EMC directive (electromagnetic compatibility) is available at → www.festo.com.

4.2.1 Interference emission and interference immunity

In order to increase the resistance to interference and decrease the emitted interference, the CMMS-ST-C8-7-G2 motor controller already has integrated supply side suppression filters, which means that the motor controller can be operated without additional shielding and filters in most applications. If installed correctly and if all connecting cables are wired correctly (→ Chap. 4.2.2), the motor controller fulfils product standard EN 61800-3 for the following range of application:

| Permissible range of application | |
|----------------------------------|---|
| Emitted interference | Second environment (industrial) ¹⁾ |
| Resistance to interference | Second environment (industrial) ¹⁾ |

1) Locations outside of the residential area, or industrial areas that are supplied from the medium-voltage power supply network through their own transformer.

Tab. 4.1 Permissible range of application in accordance with EN 61800-3



Please note

- The maximum permitted length of the motor cable is 25 m.
- With motor cables with a length of > 15 m, only use cables with a capacity lining of < 200 pF/m.

4.2.2 EMC-compliant wiring



Routing cables:

- Make motor and encoder cables as short as possible
- Do not run signal cables parallel to power cables
- The distance between signal cables and power cables should be at least 25 cm
- Avoided crossing power cables or running them at a 90° angle.

Screening:

- Always run motor and encoder cables so they are screened
- Twist unscreened signal cables
- When using screened cables with an unscreened plug housing: the maximum length of the unscreened wires at the end of the cable is 35 mm.

- Observe the permissible cable lengths and the required screening for the cables → Tab. 4.2.

| Port | Interface | Cable length [m] | Screening |
|-------|------------------------------------|--------------------|--|
| [X1] | I/O interface | ≤ 5 | Recommendation: screened |
| [X2] | Encoder (incremental sensor input) | ≤ 25 | <ul style="list-style-type: none"> - Screened - Apply the cable screening of the encoder cable flat on the plug housing of the encoder connection [X2] → Chapter 4.4 |
| [X3] | STO interface | ≤ 30 | When wiring outside the control cabinet: <ul style="list-style-type: none"> - Use screened cable - Guide screening into the control cabinet and attach to the side of the control cabinet. |
| [X4] | CAN | ≤ 40 ¹⁾ | - |
| [X5] | RS232/RS485 | ≤ 5 | Screened |
| [X6] | Motor | ≤ 25 ²⁾ | <ul style="list-style-type: none"> - Screened - Apply cable screening to the shield connection terminal of the corresponding motor controller → Chapter 4.8.2 |
| [X9] | Power supply | ≤ 2 | - |
| [X10] | Master/slave: | | Screened |
| | as input (slave) | ≤ 30 | |
| | as output (master) | ≤ 5 | |

1) Permitted total line length of field bus at a bit rate of 1 Mbit/s. Observe details in the documentation of your control system or bus interface.

2) With motor cables with a length of > 15 m, only use cables with a capacity lining of < 200 pF/m.

Tab. 4.2 EMC-compliant wiring

When using motor cables from other manufacturers:

- Recommendation: Only use motor cables on which the cables for the temperature sensor (M_{T-} , M_{T+}) and the cable for the holding brake ($BR-$, $BR+$) are in twisted pairs and screened (→ Tab. 4.19). Twisting the individual pairs of cables reduces electromagnetic interference factors.

4.2.3 Protective earthing of the motor controller

The motor controller is there to supply power with low-voltage protection (PELV).

- Ensure that your power supply complies with the corresponding requirements of the specification EN 60204-1 fully.

The motor controller has a shared reference potential (0 V) to supply power to the logic unit and the intermediate circuit.

- Ensure that the reference potentials of the power supply are connected to the mains power unit and are earthed.

4.2.4 Protective earthing of the motor



Caution

Interference caused by electromagnetic factors

The connected motor and the motor cable carry increased leakage current. Improper earthing can result in hazardous voltage levels and EMC interference.

- Apply the cable screening of the motor cable to the shield connection terminal of the motor controller → Chapter 4.8.2.
- Apply the cable screening of the encoder cable flat on the plug housing of the connection [X2] → Chapter 4.4.

4.3 I/O interface [X1]

| Port | version |
|------------------------------|---------------------------------------|
| [X1] on the motor controller | Sub-D plug connector, 25-pin, sockets |
| Counterplug | Sub-D plug connector, 25-pin, pins |

Tab. 4.3 Connection I/O interface [X1]

Available as accessories: Screened control cable and sub-D connector
 → www.festo.com/catalogue.

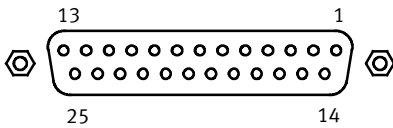


Fig. 4.1 Connection [X1] on the motor controller

Configuration of the I/O interface:

The I/O interface is configured in positioning mode for the following functions via the digital inputs DIN9 (=mode bit 1) and DIN12 (=mode bit 0):

| Mode | Function | DIN 9 | DIN 12 | Pin allocation |
|------|---|-------|--------|----------------|
| 0 | Positioning (single record) ¹⁾ | 0 | 0 | → Tab. 4.5 |
| 1 | Jog/teach | 0 | 1 | → Tab. 4.6 |
| 2 | Record linking | 1 | 0 | → Tab. 4.7 |
| 3 | Synchronisation | 1 | 1 | → Tab. 4.8 |

1) Standard allocation of the I/O interface

Tab. 4.4 Function-dependent configuration of digital inputs

| Pin | Value | Mode 0 – positioning (single record) | |
|-----|-----------|--------------------------------------|--|
| 1 | SGND | 0 V | Screening for analogue signals |
| 2 | DIN 12 | – | Mode bit 0 = “0” |
| | AIn0 | max. 30 V | Differential analogue input (setpoint input 0) ²⁾ |
| 3 | DIN 10 | – | Record selection bit 4 (high active) |
| 4 | +VREF | +10 V ±4 % | Reference output for setpoint value potentiometer |
| 5 | – | – | – |
| 6 | GND24 | – | Reference potential for digital I/O modules |
| 7 | DIN 1 | – | Record selection bit 1 (high active) |
| 8 | DIN 3 | – | Record selection bit 3 (high active) |
| 9 | DIN 5 | – | Controller enable (high active) |
| 10 | DIN 7 | – | Limit switch 1 |
| 11 | DIN 9 | – | Mode bit 1 = “0” |
| | DIN 9 | – | High-speed input (sample) ³⁾ |
| 12 | DOU1 | 24 V 100 mA | Motion complete (high active) ¹⁾ |
| 13 | DOU3 | 24 V 100 mA | Common error (low active) ¹⁾ |
| 14 | AGND | 0 V | Reference potential for analogue signals |
| 15 | DIN 13 | Ri = 20 kΩ | Stop (low active) |
| | #AIN0 | | Reference potential for setpoint input 0 ²⁾ |
| 16 | DIN 11 | – | Record selection bit 5 (high active) |
| 17 | AMON0 | 0 ... 10 V ±4 % | Output: analogue monitor 0 |
| 18 | + 24 V DC | 24 V 100 mA | Output: 24 V DC, looped through from [X9.2] |
| 19 | DIN 0 | – | Record selection bit 0 (high active) |
| 20 | DIN 2 | – | Record selection bit 2 (high active) |
| 21 | DIN 4 | – | Output stage enable (high active) |
| 22 | DIN 6 | – | Limit switch 0 |
| 23 | DIN 8 | – | Start for the positioning procedure (high active) |
| 24 | DOU0 | 24 V 100 mA | Output: Controller ready for operation (high active) |
| 25 | DOU2 | 24 V 100 mA | Start acknowledged (low active) ¹⁾ |

1) Default setting, configurable in the Festo Configuration Tool (FCT).

2) Pin allocation with control via analogue input

3) Pin allocation for flying measurement

Tab. 4.5 Pin allocation of the I/O interface [X1], positioning (single record)

| Pin | | Value | Mode = 1 - jog/teach |
|-----|--------|-----------------|---|
| 1 | SGND | 0 V | Screening for analogue signals |
| 2 | DIN 12 | – | Mode bit 0 = “1” |
| 3 | DIN 10 | – | Jog: jog + (high active) Teach: record selection bit 4 |
| 4 | +VREF | +10 V ±4 % | Reference output for setpoint value potentiometer |
| 5 | – | – | – |
| 6 | GND24 | – | Reference potential for digital inputs and outputs |
| 7 | DIN 1 | – | Record selection bit 1 (high active) |
| 8 | DIN 3 | – | Record selection bit 3 (high active) |
| 9 | DIN 5 | | Controller enable (high active) Teaching: Final saving of the taught positions in the permanent memory takes place with falling edge at DIN5 |
| 10 | DIN 7 | – | Limit switch 1 |
| 11 | DIN 9 | – | Mode bit 1 = “0” |
| 12 | DOUT1 | 24 V 100 mA | Motion complete (high active) ¹⁾ |
| 13 | DOUT3 | 24 V 100 mA | Common error (low active) ¹⁾ |
| 14 | AGND | 0 V | Reference potential for analogue signals |
| 15 | DIN 13 | – | Stop (low active) |
| 16 | DIN 11 | – | Jog: jog - (high active) Teach: record selection bit 5 |
| 17 | AMONO | 0 ... 10 V ±4 % | Analogue monitor output 0 |
| 18 | +24 V | 24 V 100 mA | Output: 24 V DC, looped through from [X9.2] |
| 19 | DIN 0 | – | Record selection bit 0 (high active) |
| 20 | DIN 2 | – | Record selection bit 2 (high active) |
| 21 | DIN 4 | – | Output stage enable (high active) |
| 22 | DIN 6 | – | Limit switch 0 |
| 23 | DIN 8 | – | Teach (high active) |
| 24 | DOUT0 | 24 V 100 mA | Output: Controller ready for operation (high active) |
| 25 | DOUT2 | 24 V 100 mA | Teach confirmed |

¹⁾ Default setting, configurable in the Festo Configuration Tool (FCT).

Tab. 4.6 Pin allocation: I/O interface [X1], jog/teach

| Pin | | Value | Mode = 2 - record linking |
|-----|--------|----------------------|--|
| 1 | SGND | 0 V | Screening for analogue signals |
| 2 | DIN 12 | – | Mode bit 0 = “0” |
| 3 | DIN 10 | – | Next 1 |
| 4 | +VREF | +10 V \pm 4 % | Reference output for setpoint value potentiometer |
| 5 | – | – | – |
| 6 | GND24 | – | Reference potential for digital inputs and outputs |
| 7 | DIN 1 | – | Record selection bit 1 (high active) |
| 8 | DIN 3 | – | Halt record sequence |
| 9 | DIN 5 | – | Controller enable (high active) |
| 10 | DIN 7 | – | Limit switch 1 |
| 11 | DIN 9 | | Mode bit 1 = “1” |
| 12 | DOUT1 | 24 V 100 mA | Motion complete (high active) ¹⁾ |
| 13 | DOUT3 | 24 V 100 mA | Common error (low active) ¹⁾ |
| 14 | AGND | 0 V | Reference potential for analogue signals |
| 15 | DIN 13 | – | Stop (low active) |
| 16 | DIN 11 | – | Next 2 |
| 17 | AMON0 | 0 ... 10 V \pm 4 % | Analogue monitor output 0 |
| 18 | 24 V | 24 V 100 mA | Output 24 V DC, looped through from [X9.2] |
| 19 | DIN 0 | – | Record selection bit 0 (high active) |
| 20 | DIN 2 | – | Record selection bit 2 (high active) |
| 21 | DIN 4 | – | Output stage enable (high active) |
| 22 | DIN 6 | – | Limit switch 0 |
| 23 | DIN 8 | – | Start record sequence |
| 24 | DOUT0 | 24 V 100 mA | Output: Controller ready for operation (high active) |
| 25 | DOUT2 | 24 V 100 mA | Start confirmed (high active) ¹⁾ |

1) Default setting, configurable in the Festo Configuration Tool (FCT).

Tab. 4.7 Pin allocation: I/O interface [X1], record linking

| Pin | | Value | Mode = 3 - synchronisation |
|-----|--------|----------------------|--|
| 1 | SGND | 0 V | Screening for analogue signals |
| 2 | DIN 12 | – | Mode bit 0 = “1” |
| 3 | DIN 10 | – | – |
| 4 | +VREF | +10 V \pm 4 % | Reference output for setpoint value potentiometer |
| 5 | – | – | – |
| 6 | GND24 | – | Reference potential for digital inputs and outputs |
| 7 | DIN 1 | – | – |
| 8 | DIN 3 | 24 V 20 kHz (max) | Direction DIR/control signal CCW |
| 9 | DIN 5 | – | Controller enable (high active) |
| 10 | DIN 7 | – | Limit switch 1 |
| 11 | DIN 9 | | Mode bit 1 = “1” |
| 12 | DOUT1 | 24 V 100 mA | Output: standstill reached (high active) |
| 13 | DOUT3 | 24 V 100 mA | Output: common error (low active) ¹⁾ |
| 14 | AGND | 0 V | Reference potential for analogue signals |
| 15 | DIN 13 | – | Stop (low active) |
| 16 | DIN 11 | – | – |
| 17 | AMONO | 0 ... 10 V \pm 4 % | Output: analogue monitor 0 |
| 18 | 24 V | 24 V 100 mA | Output 24 V DC, looped through from [X9.2] |
| 19 | DIN 0 | – | – |
| 20 | DIN 2 | 24 V 20 kHz (max) | Pulse CLK/control signal CW |
| 21 | DIN 4 | – | Output stage enable (high active) |
| 22 | DIN 6 | – | Limit switch 0 |
| 23 | DIN 8 | – | Start synchronization |
| 24 | DOUT0 | 24 V 100 mA | Output: Controller ready for operation (high active) |
| 25 | DOUT2 | 24 V 100 mA | Output: position synchronous (high active) |

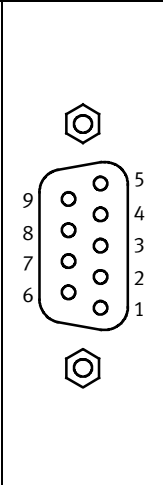
1) Default setting, configurable in the Festo Configuration Tool (FCT).

Tab. 4.8 Pin allocation: I/O interface [X1], synchronisation

4.4 Encoder [X2]

| Process valve | version |
|------------------------------|--------------------------------------|
| [X2] on the motor controller | Sub-D plug connector, 9-pin, sockets |
| Counterplug | Sub-D plug connector, 9-pin, pins |

Tab. 4.9 Encoder connection

| [X2] | Pin | | Value ¹⁾ | Description |
|--|-----|-----|---------------------|--|
|  | 1 | A+ | 5 V, Ri = 120 Ohm | Increment generator signal A, positive polarity |
| | 2 | B+ | 5 V, Ri = 120 Ohm | Increment generator signal B, positive polarity |
| | 3 | N+ | 5 V, Ri = 120 Ohm | Increment generator zero pulse N, positive polarity |
| | 4 | GND | - | Reference GND for the encoder |
| | 5 | VCC | +5 V +-5 % 100 mA | Auxiliary supply, max. load 100 mA, short-circuit proof. |
| | 6 | A- | 5 V, Ri = 120 Ohm | Increment generator signal A, negative polarity |
| | 7 | B- | 5 V, Ri = 120 Ohm | Increment generator signal B, negative polarity |
| | 8 | N- | 5 V, Ri = 120 Ohm | Increment generator zero pulse N, negative polarity |
| | 9 | GND | - | Internal screen for the connecting cable |

1) Ri = Internal resistance

Tab. 4.10 Pin allocation: encoder [X2]

The motor controller supports the activation of Festo two-phase hybrid step motors with an encoder mounted on the motor shaft (see → www.festo.com/catalogue). The encoder is used to control current, speed and position. Commutation of the motor is also controlled with the encoder. Supply voltage for the encoders is taken from the internal +5 V logic supply. (current intake max. 100 mA). The supply voltage tolerance is limited downwards. Voltage drops on the connecting cable are not compensated.



Use of third-party cables

- Double wiring of power supply line:

The voltage loss between motor controller and encoder must be $< 0.25\text{ V}$.

- Check the cable cross section of your encoder cable and if necessary, route the power supply through a double cable.

Example:

when using encoder wiring that exhibits a cable diameter of 0.25 mm^2 , a cable length of 25 m (50 m supply and return), and a current consumption of 100 mA, the voltage drop for a single wiring configuration is $U_{\text{diff}} \sim 0.36\text{ V}$. → A double wiring configuration is required ($U_{\text{diff}} \sim 0.18\text{ V}$).

- Screening:

- Run the encoder cable so it is screened
- Apply the screening to the plug housing on the motor and controller side.

For maximum resistance to interference:

- Use cables with individually twisted and screened pairs
- Ensure that cable screens on screened pairs (inner screens) are galvanically isolated from the outer screens and only place on controller side of connection [X2.9]
- Apply the complete screening to the plug housing on the motor and controller side.

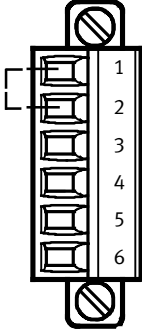


4.5 STO interface [X3]

4.5.1 Pin allocation

| Process valve | version |
|---------------------------------|---------------------------------------|
| [X3] on the motor controller | Phoenix Contact - MC 1.5/6-GF3.81 BK |
| Counterplug (plug set NEKM-C-1) | Phoenix Contact - MC 1.5/6-STF3.81 BK |

Tab. 4.11 Connection: STO interface [X3]

Ex-factory, pin 1 and pin 2 on connection X3 are bridged (circuitry without use of the STO safety function). That means that the motor controller is prepared ex-factory for use **without** the STO safety function (→ Section 4.5.2).

| Plug [X3] | Pin | Designation | Value | Description |
|--|-----|---|-------------------------------|--|
|  | 1 | 24 V | +24 V DC | Voltage output (24 V DC logic supply carried out as auxiliary voltage) |
| | 2 | Rel | 0V / 24V | Driver supply relay control. |
| | 3 | 0V | 0V | Reference potential for digital inputs and outputs. |
| | 4 | – | – | – |
| | 5 | 1  (NC1) | Max. 25 V AC, 30 V DC, 2 A | Acknowledgment contact for the status “Safe Torque Off” (STO) |
| | 6 | 2  (NC2) | | |

Tab. 4.12 Pin allocation: Interface [X3] (Circuitry without use of the STO safety function)

4.5.2 Circuitry without use of the STO safety function [X3]



If you do **not** need the integrated STO safety function in your application, you must bridge Pin 1 and Pin 2 at the X3 interface to operate the motor controller → Tab. 4.12.

This deactivates the integrated safety function!

When using this circuitry for the CMMS-ST-C8-7-G2, safety in the application must be ensured through other appropriate measures.

4.5.3 Circuitry with use of the STO safety function [X3]



The safety function only provides protection against hazardous movements. For intended use of the safety function STO – “Safe Torque Off” (→ Description of STO safety function, GDPC-CMMS-ST-G2-S1-...).

If you need the integrated STO safety function in your application, you must remove the bridge between Pin 1 and Pin 2 at the X3 interface to operate the motor controller → Tab. 4.12.

Recommendation for first commissioning without safety engineering:

Minimum circuitry with emergency stop switching device and two-channel switch-off via the control ports:

- REL [X3.2]
- DIN4 [X1.21].



Please note

Loss of the safety function.

Lack of the safety function can result in serious, irreversible injuries, e.g. due to uncontrolled movements of the connected actuator technology. Bypassing of safety equipment is impermissible.

- Make sure that no jumpers or the like can be used parallel to the safety wiring, e.g. through the use of the maximum wire cross sections or appropriate wire end sleeves with insulating collars.
- Use twin wire end sleeves for looping through lines between neighbouring devices.

4.6 CAN [X4]

| Process valve | version |
|------------------------------|--------------------------------------|
| [X4] on the motor controller | Sub-D plug connector, 9-pin, pins |
| Counterplug | Sub-D plug connector, 9-pin, sockets |

Tab. 4.13 CAN connection

| [X4] | Pin | Value | Description | |
|------|-----|-----------|----------------|------------------------------------|
| | 1 | – | – | |
| | 2 | CANL | 5 V, Ri = 60 Ω | CAN low, signal line |
| | 3 | GND | – | CAN GND, not galvanically isolated |
| | 4 | – | – | – |
| | 5 | Screening | – | Connection for the cable screening |
| | 6 | GND | – | CAN GND, not galvanically isolated |
| | 7 | CANH | 5 V, Ri = 60 Ω | CAN high signal line |
| | 8 | – | – | – |
| | 9 | – | – | – |

Tab. 4.14 Pin allocation: CAN [X4]

4.7 Serial interface RS232/RS485 [X5]

| Process valve | version |
|------------------------------|--------------------------------------|
| [X5] on the motor controller | Sub-D plug connector, 9-pin, pins |
| Counterplug | Sub-D plug connector, 9-pin, sockets |

Tab. 4.15 Connection: RS232/RS485 [X5]



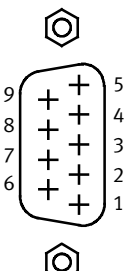
Please note

Transmission fault during simultaneous access.

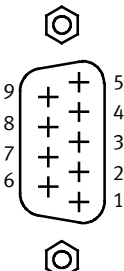
When RS 485 communication is activated, RS232 and RS485 interfaces on the motor controller can be accessed at the same time.

To prevent transmission faults caused by signal overlap:

- When communicating via the serial interface only use separate lines that are configured according to the specified pin allocation for RS485 or RS232.

| [X5] RS232 | Pin | Value | Description | |
|---|-----|-----------|---------------------------------|---|
|  | 1 | – | – | |
| | 2 | RS232_RxD | 10 V, $R_i > 2 \text{ k}\Omega$ | Receive signal |
| | 3 | RS232_TxD | 10 V, $R_a < 2 \text{ k}\Omega$ | Transmission signal |
| | 4 | RS485_A | Do not connect! | |
| | 5 | GND | 0V | Reference potential 0 V DC, not galvanically isolated |
| | 6 | – | – | – |
| | 7 | – | – | – |
| | 8 | – | – | – |
| | 9 | RS485_B | Do not connect! | |

Tab. 4.16 Pin allocation RS232 [X5]

| [X5] RS485 | Pin | Value | Description | |
|---|-----|-----------|-----------------|---|
|  | 1 | – | – | |
| | 2 | RS232_RxD | Do not connect! | |
| | 3 | RS232_TxD | Do not connect! | |
| | 4 | RS485_A | – | Positive transmission and reception signal |
| | 5 | GND | 0V | Reference potential 0 V DC, not galvanically isolated |
| | 6 | – | – | – |
| | 7 | – | – | – |
| | 8 | – | – | – |
| | 9 | RS485_B | – | Negative transmission and reception signal |

Tab. 4.17 Pin allocation RS485 [X5]

4.8 Motor [X6]

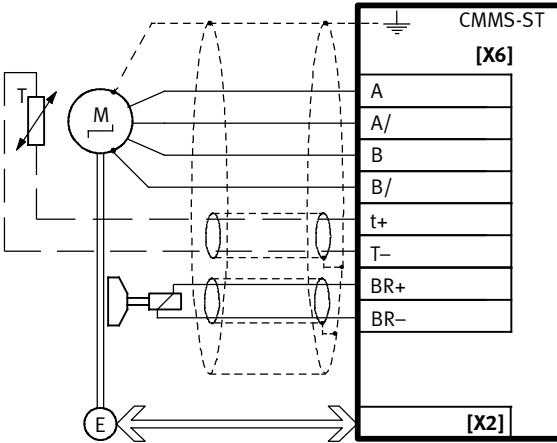


Fig. 4.2 Connection to motor (example of motor without temperature sensor)

4.8.1 Pin allocation

| Process valve | version |
|---------------------------------|--|
| [X6] on the motor controller | Phoenix Contact - MSTB 2.5/8-G-5.08 BK |
| Counterplug (plug set NEKM-C-1) | Phoenix Contact - MSTB 2.5/8-ST5.08 BK |

Tab. 4.18 Motor connection

| [X6] | Pin | Value | Description | |
|------|-----|-------|--|---|
| | 1 | A | 4 x 0 ... 58 V max. 12 A _{eff} | Connection to motor line A |
| | 2 | A/ | | |
| | 3 | B | | Connection to motor line B |
| | 4 | B/ | | |
| | 5 | t+ | + 3.3 V, 5 mA | Motor temperature sensor ¹⁾²⁾ either N/C contact / PTC (R _{cold} < 1 kΩ, R _{hot} > 10 kΩ) or Si temperature sensor in series KTY81 thru KTY84 (R ₂₅ = 1 kΩ or R ₂₅ = 2 kΩ) |
| | 6 | T- | 0V | |
| | 7 | BR+ | 24V | Motor holding brake ²⁾ |
| | 8 | Br- | 0V | |

1) Optional with 3rd party motors

2) Recommendation: When using cables made by other manufacturers, only use motor cables on which the cables for the temperature sensor (T-, T+) and the cable for the holding brake (BR-, BR+) are in twisted pairs and screened.

Tab. 4.19 Pin allocation: Motor [X6]

4.8.2 Connecting the screening of the motor cable



If third-party cables are used: Place the complete screening of the motor-side cable flat on the plug or motor housing. Maximum length 40 mm.

- Place the complete screening of the motor cable at the screening connection terminal of the related motor controller so that the leaked current can flow back into the controller causing it.
- Do not use the complete screening as strain relief.

For further instructions regarding EMC-compliant wiring of the motor → Chapter 4.2.2.

4.8.3 Connection of a holding brake



Holding brakes are not appropriate for braking the motor. They only serve functional holding of the motor shaft. Additional measures are required for use in safety-oriented applications.



Warning

The holding brake integrated in the motor, or an external holding brake controlled by the motor controller, is not suitable for protecting personnel!

- Provide additional support to protect vertical axes from falling or slipping down when the motor is switched off through
 - mechanical locking of the vertical axis
 - an external brake/catch/clamping device or
 - sufficient counterbalance of the axis.

- Connect the holding brake to the terminals BR+ [X6.7] and BR- [X6.8]. The brake is supplied from the logic supply of the motor controller.



Please note

If the motor is warm and there is an insufficient supply voltage (outside tolerance values), the holding brake cannot open fully. Result: premature wearing of the brake.

- Make sure the nominal voltage tolerances are maintained at the terminals of the holding brake (→ Tab. A.8, logic supply).
- Observe the maximum output current provided by the motor controller (→ Tab. A.8).

4.9 Power supply [X9]

4.9.1 Protective Extra-Low Voltage (PELV) to protect against electric shock



Warning

Danger of electric shock

- Use only PELV (protective extra-low voltage) circuits to EN 60204-1 for the electric logic supply.
- Use for the electrical power circuits only PELV circuits in accordance with EN 60204-1 (Protective Extra-Low Voltage, PELV).
- Also observe the general requirements for PELV circuits as per EN 60204-1.
- Ensure that the reference potential for logic and power supply are connected to a central location with FE.
- Use only voltage sources that ensure a reliable electric separation of operating voltage in accordance with EN 60204-1.

Through the use of PELV circuits, protection from electric shock (protection from direct and indirect contact) in accordance with EN 60204-1 is ensured (Electrical equipment of machines. General requirements). A 24 V power supply unit used in the system must meet the requirements of EN 60204-1 for DC power supply units (behaviour in case of voltage interruptions, etc.).

4.9.2 Pin allocation

| Process valve | version |
|---------------------------------|---|
| [X9] on the motor controller | Phoenix Contact - MSTB 2.5/3-G-5.08 BK |
| Counterplug (plug set NEKM-C-1) | Phoenix Contact - MSTB 2.5/3-ST-5.08 BK |

Tab. 4.20 Connection, power supply

| [X9] | Pin | Value | Description | |
|------|-----|-------|---------------------|---|
| | 1 | ZK+ | 12 V DC ... 58 V DC | Intermediate circuit voltage (power) |
| | 2 | 24V | 24 V DC ± 20% | Power supply to control unit (logic) |
| | 3 | 0 V | - | Common reference potential for the intermediate circuit and the control section |

Tab. 4.21 Pin allocation: voltage supply [X9]

4.9.3 Connection to the supply voltage

- Before establishing the connection make sure the power supply is switched off.
- Before commissioning, also for brief measuring and test purposes, connect the PE protective conductor to the earthing screw on the motor controller housing (→ Fig. 2.2, 8).

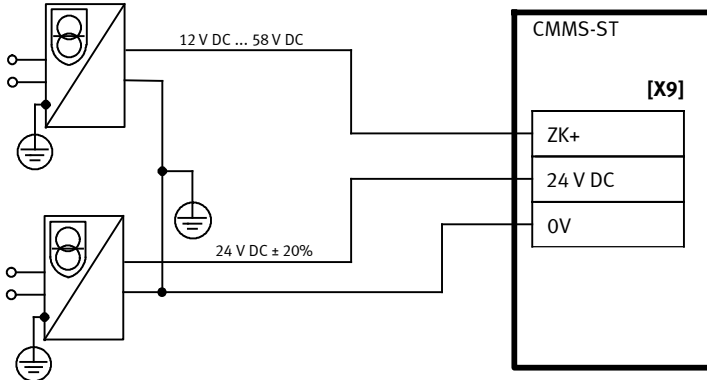


Fig. 4.3 Connection of power supplies



Please note

Note the following if the load (ZK+) and logic are to receive power from a shared 24 V mains source:

- The power unit must be protected against feedback because when braking the axis, power can feed back into the intermediate circuit causing the intermediate circuit voltage to rise.
- Ensure that the intermediate circuit voltage does not continue to rise beyond the level stipulated for logic power supply in the technical data.

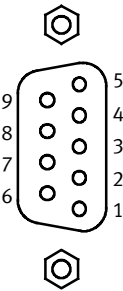
4.10 Master/slave interface [X10]

The master/slave interface is bi-directional and can be configured with the FCT software as an input or as an output for master/slave operation:

- Master (incremental encoder emulation): Output of tracking signals A/B/N of an incremental encoder for actuating a slave controller
- Slave (synchronisation): Input for tracking signals A/B, pulse/direction signals CLK/DIR or forward/backward signals CW/CCW for synchronisation with a master controller.

| Process valve | version |
|-------------------------------|--------------------------------------|
| [X10] on the motor controller | Sub-D plug connector, 9-pin, sockets |
| Counterplug | Sub-D plug connector, 9-pin, pins |

Tab. 4.22 Connection of master/slave interface

| [X10] | Pin | Designation | Value | Description |
|---|-----|--------------------|--|---|
|  | 1 | A CLK CW | 5 V DC $R_i = 120 \Omega$ max. 150 kHz | <ul style="list-style-type: none"> – Tracking signal A – Pulse CLK – Pulses clockwise CW – Positive polarity in accordance with RS422 |
| | 2 | B DIR CCW | 5 V $R_i = 120 \Omega$ max. 150 kHz | <ul style="list-style-type: none"> – Tracking signal B – Direction DIR – Pulses counterclockwise CCW – Positive polarity in accordance with RS422 |
| | 3 | N | 5 V $R_i = 120 \Omega$ max. 150 kHz | <ul style="list-style-type: none"> – Incremental encoder zero pulse N – Positive polarity in accordance with RS422 |
| | 4 | GND ¹⁾ | – | Reference GND for incremental encoder |
| | 5 | VCC | +5 V $\pm 5 \%$, 100 mA | Auxiliary supply, max. load 100 mA, short-circuit proof |
| | 6 | #A #CLK #CW | 5 V $R_i = 120 \Omega$ max. 150 kHz | <ul style="list-style-type: none"> – Tracking signal A – Pulse CLK – Pulses clockwise CW – Negative polarity in accordance with RS422 |
| | 7 | #B #DIR #CCW | 5 V $R_i = 120 \Omega$ max. 150 kHz | <ul style="list-style-type: none"> – Tracking signal B – Direction DIR – Pulses counterclockwise CCW – Negative polarity in accordance with RS422 |
| | 8 | #N | 5 V $R_i = 120 \Omega$ max. 150 kHz | <ul style="list-style-type: none"> – Zero pulse N – Negative polarity in accordance with RS422 |
| | 9 | GND ¹⁾ | – | Screening for the connecting cable |

1) Pin 4 and pin 9 are connected internally

Tab. 4.23 Pin allocation: Master/slave interface [X10]

5 Commissioning



Note

Danger from unexpected movement of the motor or axis

- Make sure that the movement does not endanger anyone.
- Parameterise the motor controller with the Festo Configuration Tool (FCT) before enabling the controller via DIN5 [X1.9].
- Bypassing of safety equipment is impermissible.
Recommendation for first commissioning without safety equipment:
 - Minimum circuitry with emergency stop switching device at [X3]
 - Two-channel switch-off via control ports REL [X3.2] and DIN4 [X1.21].



Please note

Damage to the motor controller

The motor controller is damaged in case of

- excessive operating voltage
- polarity reversal of the operating voltage connections
- interchange of operating voltage and motor connections
- short circuits in the motor circuit between the motor phases and FE.
- Comply with the specified values for the supply voltage.
- Before switching on, check connections [X9] and [X6].
- Check to ensure there is no FE short in the motor connection circuit.

Before switching on the power supply:

Check the installation of the motor controller:

- Check all connections (→ **Chapter 4**).
- Connect all FE protective conductors, even for brief measuring and test purposes.
- Mounted module or cover plate on the card slot [EXT]. Mounted line on [X9] and [X6].

If activation via a bus connection requires a terminating resistor:

- Check the connection of the terminating resistor.

Implement the following settings:

- Make sure that controller enable is not present at DIN 5 [X1.9]. The I/O interface [X1] is activated when switched on.
- DIP switch [S1.8]:
 - OFF: No firmware download, standard setting
 - ON: Firmware download from the SD memory card to the motor controller.



Additional steps regarding preparation for commissioning → Description, functions and commissioning, GDCP-CMMS/D-FW-....

6 Maintenance, updating, repair and replacement

6.1 Maintenance and care



Caution

Motor controller contains condensers (energy storage)

Do not disconnect connecting cables when powered. Before mounting and installation work:

1. Switch off power to the electrical equipment via the mains switch and secure it against being switched on again.
2. After switch-off, wait at least 1 minute discharge time and check that power is turned off before accessing the controller.



Caution

Danger of burns from hot surfaces

Dependent on the load of the motor controller, housing temperatures $> 80\text{ }^{\circ}\text{C}$ are possible in operation.

- Touch them only in a switched-off, cooled-off status.



If used as intended in the operating instructions, the device will be maintenance-free.

- Clean the outside of the product with a soft cloth.

6.2 Repair



Repair or maintenance of the product is not permissible. If necessary, replace the complete product.

6.3 Replacement and disposal

Observe the disassembly instructions in section . 3.3.

6.3.1 Disassembly and installation



Information on removing and installing can be found here:

- Mounting → Section 3.2
- Disassembly → Section 3.3.
- Commissioning → Section 5.

6.3.2 Disposal



Observe the local regulations for environmentally appropriate disposal of electronic modules. The product is RoHS-compliant.

A Technical appendix

A.1 Technical data

| General technical data | |
|---|--|
| Type of mounting | Screwed to a mounting plate |
| Fault signal | 7-segment display (error code) |
| Parameterisation interface | RS232 (9600 ... 115 000 bit/s) |
| Parameterisation software | Festo Configuration Tool (FCT) |
| Control interfaces | |
| fieldbus, | <ul style="list-style-type: none"> – integrated: CANopen, RS485 – optional: PROFIBUS DP, DeviceNet |
| Digital I/O | – DINO ... 13, DOUTO ... 3 |
| Analogue I/O | – AMON/AGND, AINO/#AINO |
| Protective functions | <ul style="list-style-type: none"> – I²t monitoring – Following error monitoring – Voltage failure detection – Current monitoring – Temperature monitoring |
| Dimensions and weight | |
| Dimensions | → Fig. 3.1 and Tab. 3.1 |
| Weight [kg] | approx. 1 |
| Product conformity and certifications | |
| CE marking (Declaration of conformity → www.festo.com) | In accordance with EU Machinery Directive 2006/42/EC |
| | In accordance with EU EMC Directive 2004/108/EC ¹⁾ |
| Additional certifications | UL/RCM mark/BIA |

1) The device is intended for use in an industrial environment. Outside of industrial environments, e.g. in commercial and mixed-residential areas, actions to suppress interference may have to be taken.

Tab. A.1 Technical data, general

| Operating and Environmental Conditions | | |
|---|------|--|
| Permissible setup altitude above sea level | | |
| with rated output | [m] | 1000 |
| with power reduction: 10 % every 1000 m | [m] | 1000 ... 3000 (max.) |
| Relative air humidity | [%] | 0 ... 90 (non-condensing) |
| Degree of protection | | IP20 |
| Electrical protection class | | III |
| Overvoltage category | | III |
| Degree of contamination | | 2 |
| Ambient temperature | | |
| with nominal power | [°C] | 0 ... +40 |
| with power reduction: 4 % per [K] | [°C] | +40 ... +50 |
| Storage temperature | [°C] | -25 ... +70 |
| Cooling | | Passive |
| Switch-off temperature, heat sink | [°C] | ≥ 85 |
| Power section | | |
| Vibration and shock resistance | | |
| Operation | | in accordance with EN 61800-5-1, section 5.2.6.4 |
| Transport | | in accordance with EN 61800-2, section 4.3.3 |

Tab. A.2 Technical data: Operating and ambient conditions

A.2 Connection data

A.2.1 I/O interface [X1]

| I/O interface [X1] | | |
|---|--------|---|
| cable | [m] | l < 5, recommendation: screened |
| Digital inputs | | |
| Number | | 14 |
| Nominal voltage | [V DC] | 24 (related to 0V) |
| Voltage range | [V DC] | 19.2 ... 28.8 |
| Signal level | [V DC] | 0 ... 28.8 (PNP logic) |
| Nominal current | [mA] | typical: 2.5 maximum: 3 |
| Voltage threshold | | |
| High | [V DC] | ≥ 13.1 |
| Low | [V DC] | ≤ 3.4 |
| Input impedance | [kΩ] | 10.5 ... 13.5 |
| Reaction time to input | [ms] | < 5 |
| Reaction time to sample input | [μs] | < 100 |
| Response time DIN2 and DIN3 (CLK/DIR) in the operating mode Synchronize | [μs] | < 500; f _{max} < 20 kHz |
| Protective function | | Against polarity reversal |
| Digital outputs | | |
| Number | | 4 |
| Signal level | [V DC] | 24 (from logic supply) |
| Nominal current | [mA] | ≤ 100 |
| Voltage threshold | | |
| High | [V DC] | > (U _{Logic} – 1.0) |
| Low | [V DC] | < 0.8 |
| Output reaction time | [ms] | ≤ 3 |
| Protective function | | Against polarity reversal, feedback, automatic shutdown of the output in the event of an overload; automatic restart when the short circuit has been remedied |

| I/O interface [X1] | | |
|---------------------------|------------|----------------------------|
| Analogue input | | |
| Number | | 1 |
| Signal level | [V] | -10 ... +10 |
| version | | Differential input |
| Resolution | [bit] | 12 |
| Input reaction time | [μ s] | < 250 |
| Protective function | | Overvoltage to ± 30 V |
| Analogue output | | |
| Number | | 1 |
| Signal level | [V DC] | 0 ... 10 |
| version | | Single-ended against AGND |
| Resolution | [bit] | 9 |
| Output reaction time | [μ s] | < 250 |
| Protective function | | Short circuit against AGND |

Tab. A.3 Connection data: I/O interface [X1]

A.2.2 Encoder [X2]

| Encoder [X2] | | |
|--|--------|-------------------------|
| cable | [m] | $l \leq 25$ m, screened |
| Signal level of tracking signals A, B, N | [V] | 5 V differential, RS422 |
| Angle resolution | [bit] | Max. 12 |
| Number of lines | | 1000, 500, 400, 200 |
| Critical frequency | [kHz] | > 100 |
| Encoder supply (from the controller) | | |
| Voltage | [V DC] | 5 (-5 % ... +5 %) |
| Current | [mA] | ≤ 100 |

Tab. A.4 Connection data: Encoder [X2] (input)

A.2.3 STO interface [X3]



Technical data for interface STO [X3] → Description safety functions STO, GDCP-CMMS-ST-G2-S1-....

A.2.4 CAN [X4]

| CAN [X4] | |
|--|---|
| Communication profile | CANopen CiA 301, CiA 402 and FHPP Rev.13 |
| Bus connection | 9-pin, pin, sub-D |
| Cable length - dependent on the bit rate [m] | ≤ 40 at 1 Mbit/S ≤ 130 at 500 Kbit/s ≤ 270 at 250 Kbit/s ≤ 530 at 125 Kbit/s |
| Max. fieldbus transmission rate [Mbit/s] | 1 |
| Terminating resistor [Ω] | 120 (active via DIP switch) |

Tab. A.5 Connection data: CAN-Bus [X4]

A.2.5 RS232/RS485 [X5]

| Serial interface [X5] | |
|------------------------------|--|
| cable [m] | l ≤ 5, screened |
| Signal level | In accordance with RS232/RS485 specification |
| Transmission rate [bps] | 9600...115200 |
| Factory setting | |
| Transmission rate [bps] | 9600 |
| Data bits | 8 |
| Parity | none |
| Stop bit | 1 |
| ESD protection | Driver protected against electrostatic discharge up to 16 kV |

Tab. A.6 Connection data: RS232/RS485 [X5]

A.2.6 Motor [X6]

| Motor [X6] | | |
|--|--------------------|---------------|
| Cabling | | |
| Thermal rated value | [°C] | 60/75 class 1 |
| cable | | Screened |
| without external filters | [m] | $l \leq 25$ |
| Cable capacitance of one phase against screen or between two lines | [pF/m] | ≤ 200 |
| Conductor cross-section (plug connector) | | |
| Flexible conductor | [mm ²] | 0.25 ... 2.5 |
| – Wire end sleeve without insulating collar | [mm ²] | 0.25 ... 2.5 |
| – Wire end sleeve with insulating collar | [mm ²] | 0.25 ... 2.5 |
| Terminal tightening torque | [Nm] | 0.5 ... 0.6 |
| Output data | | |
| Nominal current I_{eff} | [A] | 8 |
| Peak current I_{eff} | [A] | 12 |
| Max. peak current duration | [s] | 2 |
| Output frequency | [Hz] | 0 ... 2000 |
| PWM frequency | [kHz] | 50 |
| Holding brake | | |
| Voltage range | [V DC] | 18 ... 30 |
| Output current | [A] | 1 A |
| Voltage loss | [V] | ≤ 1 |
| Short circuit/overcurrent protection | [A] | > 4 |
| Temperature protection T_j | [°C] | > 150 |
| Load | | |
| Ohmic | [Ω] | > 24 |
| Inductive | [H] | 10 (typical) |
| Capacitive | [nF] | < 10 |
| Switching delay | [ms] | < 1 |
| Motor temperature monitoring | | |
| Digital sensor (N/C contact) | | |
| R_{Cold} | [kΩ] | < 1 |
| R_{Hot} | [kΩ] | > 10 |
| Analogue sensor (Silicon temperature sensor, e.g. KTY81 ... 84) | | |
| R25 | [kΩ] | 1 or 2 |

Tab. A.7 Connection data: Motor connection [X6]

A.2.7 Power supply [X9]

| Power supply [X9] | | |
|---|--------------------|--|
| Cabling | | |
| cable | [m] | $l \leq 2$, unshielded |
| Conductor cross-section (plug connector) | | |
| Flexible conductor | | |
| – Wire end sleeve without insulating collar | [mm ²] | 0.25 ... 2.5 |
| – Wire end sleeve with insulating collar | [mm ²] | 0.25 ... 2.5 |
| Terminal tightening torque | [Nm] | 0.5 ... 0.6 |
| Load supply | | |
| Nominal voltage, load supply | [V DC] | 48 |
| Alternative load voltage | [V DC] | 24, 48 (Nominal value can be parametrised via FCT) |
| Voltage range | [V DC] | 12 ... 58 |
| Nominal current | [A] | 8 (with nominal motor current) |
| End stage power loss | [W] | approx. 15 ... 20 |
| Own power loss control section | [W] | approx. 5 ... 7 |
| PWM switching frequency | [kHz] | 50 (permanently set) |
| Logic supply | | |
| Nominal voltage | [V DC] | $24 \pm 20\%$ |
| Max. ripple in input voltage | [V] | 1.0 at 100 Hz |
| Nominal current | [A] | 0.2 |
| – Outputs load-free | | |
| – Without current for holding brake | | |
| Max. current (incl. holding brake) | [A] | 1.5 |

Tab. A.8 Connection data: Power supply [X9]

| Brake-Chopper and braking resistor | | |
|---|--------|-----------|
| Brake chopper | | |
| Response threshold ¹⁾ | | |
| at FCT settings load voltage 48 V | [V DC] | ≤ 58 |
| at FCT settings load voltage 24 V | [V DC] | ≤ 33 |
| Maximum current | [A] | < 4 |
| Hysteresis | [V] | Approx. 3 |
| Integrated braking resistor | | |
| Braking resistor | [Ω] | 17 |
| Pulse power (for 50 ms) | [W] | 500 |
| Rated output | [W] | 10 |

1) If the threshold is exceeded by more than 10%, a corresponding error message is displayed.

Tab. A.9 Technical data: braking resistor



The connection of an additional external braking resistor is not provided.

A.2.8 Master/slave interface [X10]

| Master/slave interface | | |
|----------------------------------|-------|---|
| Bi-directional operation | | |
| as input | | Slave function (synchronisation) |
| as output | | Master function (incremental encoder emulation) |
| cable | | Screened |
| Slave function | [m] | l ≤ 30 |
| Master function | [m] | l ≤ 5 |
| Interface | | According to RS422 standard |
| Input signals | | A/B, CW/CCW, CLK/DIR |
| Output signals | | A/B/N |
| Angle resolution/number of lines | | 1 ... 2048 |
| Output impedance | [Ω] | 120 |
| Critical frequency | [kHz] | > 150 |

Tab. A.10 Connection data: Master/slave interface [X10]

B Diagnostic messages

B.1 Explanations of the diagnostic messages

The following table summarises the significance of the diagnostic messages and the actions to be taken in response to them:

| Terms | Meaning |
|----------|--|
| no. | Main index (error group) and sub-index of the diagnostic message. Indication via the 7-segments display, in FCT or in the diagnostic memory via FHPP. |
| Code | The Code column includes the error code (Hex) via CiA 301. |
| Message | Message that is displayed in the FCT. |
| Cause | Possible causes for the message. |
| Action | Action by the user. |
| Reaction | The Reaction column includes the error response (default setting, partially configurable): <ul style="list-style-type: none"> – PS off (block output stage), – MCStop (fast stop with maximum current), – QStop (fast stop with parameterised edge), – Warn (warning), – Entry (entry in diagnostic memory), – Ignore. |

Tab. B.1 Explanations of the diagnostic messages

For a complete list of the diagnostic messages that correspond to the firmware versions used at the time of printing this document, please refer to section B.2.

Under section B.3, you will find the error codes in accordance with CiA301/402 and the error bit numbers with allocation to the error numbers of the diagnostic messages.

Under section B.4, you will find the PROFIBUS diagnostic bits with allocation to the error numbers of the diagnostic messages.

B.2 Diagnostic messages with instructions for fault clearance

| Error group 01 | | Internal faults | |
|----------------|-------|--|--|
| no. | Code | Message | Reaction |
| 01-0 | 6180h | Stack overflow (internal error) | |
| | | Cause | <ul style="list-style-type: none"> – Incorrect firmware? – Sporadic high processor load due to special compute-bound processes (save parameter set, etc.). |
| | | Action | <ul style="list-style-type: none"> • Load approved firmware. • Contact Technical Support. |

| Error group 02 | | Intermediate circuit | |
|----------------|-------|---|--|
| No. | Code | Message | Reaction |
| 02-0 | 3220h | Undervoltage in intermediate circuit | |
| | | Cause | – Intermediate circuit voltage falls below the parameterised threshold. |
| | | Action | <ul style="list-style-type: none"> • Quick discharge due to switched-off mains supply. • Check mains voltage (mains voltage level or network impedance too high?). • Check intermediate circuit voltage (measure). • Check undervoltage monitor (threshold value). • Check travel profile: If travel with lower acceleration and/or travel speeds is possible, this reduces power consumption from the mains. |

| Error group 03 | | Temperature monitoring, motor | |
|----------------|-------|--------------------------------------|--|
| no. | Code | Message | Reaction |
| 03-1 | 4310h | Temperature monitoring, motor | |
| | | Cause | Motor overloaded, temperature too high. <ul style="list-style-type: none"> – Motor too hot. – Sensor defective? |
| | | Action | <ul style="list-style-type: none"> • Check parameters (current regulator, current limits). If the error persists when the sensor is bypassed: Device defective. |

| Error group 04 | | Temperature monitoring, electronics | |
|-----------------------|-------|--|--|
| no. | Code | Message | Reaction |
| 04-0 | 4210h | Excess/low temperature of power electronics | |
| | | Cause | Motor controller is overheated. – Motor controller overloaded? – Temperature display plausible? |
| | | Action | <ul style="list-style-type: none"> • Check installation conditions, cooling through the housing surface, integrated heat sink and back wall. • Check the drive layout (due to possible overloading in continuous operation). |
| | | | configurable |

| Error group 05 | | Internal power supply | |
|-----------------------|-------|--------------------------------------|---|
| no. | Code | Message | Reaction |
| 05-0 | 5114h | 5 V electronics supply fault | |
| | | Cause | Monitoring of the internal power supply has recognised under-voltage. This is either due to an internal defect or an overload/short circuit caused by connected peripherals. |
| | | Action | <ul style="list-style-type: none"> • Separate device from the entire peripheral equipment and check whether the error is still present after reset. If so, an internal defect is present → Repair by the manufacturer. |
| | | | PS off |
| 05-1 | 5115h | Error in 24 V supply | |
| | | Cause | Monitoring of the internal power supply has recognised under-voltage. |
| | | Action | <ul style="list-style-type: none"> • Check 24 V logic supply. • Separate device from the entire peripheral equipment and check whether the error is still present after reset. If so, an internal defect is present → Repair by the manufacturer. |
| | | | PS off |
| 05-2 | 5116h | 12 V electronics supply fault | |
| | | Cause | Monitoring of the internal power supply has recognised under-voltage. This is either due to an internal defect or an overload/short circuit caused by connected peripherals. |
| | | Action | <ul style="list-style-type: none"> • Separate device from the entire peripheral equipment and check whether the error is still present after reset. If so, an internal defect is present → Repair by the manufacturer. |
| | | | PS off |

| Error group 06 | | Intermediate circuit | |
|-----------------------|-------|--|--|
| No. | Code | Message | Reaction |
| 06-0 | 2320h | Over-current of the intermediate circuit/output stage | |
| | | Cause | <ul style="list-style-type: none"> – Motor defective. – Short circuit in the cable. – Output stage defective. |
| | | Action | <ul style="list-style-type: none"> • Check motor, cable and motor controller. |

| Error group 07 | | Intermediate circuit | |
|-----------------------|-------|--|--|
| No. | Code | Message | Reaction |
| 07-0 | 3210h | Overvoltage in intermediate circuit | |
| | | Cause | Braking resistor is overloaded; too much braking energy which cannot be dissipated quickly enough. |
| | | Action | <ul style="list-style-type: none"> • Check application |

| Error group 08 | | Angle encoder | |
|-----------------------|-------|--------------------------------|---|
| no. | Code | Message | Reaction |
| 08-0 | 7380h | Error in encoder supply | |
| | | Cause | Encoder supply outside the allowed range (too high/too low). |
| | | Action | <ul style="list-style-type: none"> • Test with another encoder. • Test with another encoder cable. • Test with another motor controller. |

| Error group 11 | | Homing | |
|-----------------------|-------|---------------------|---|
| no. | Code | Message | Reaction |
| 11-1 | 8A81h | Homing error | |
| | | Cause | Homing was interrupted, e.g. by: <ul style="list-style-type: none"> – withdrawal of controller enable. – reference switch located beyond the limit switch. – external stop signal (termination of a homing phase). |
| | | Action | <ul style="list-style-type: none"> • Check homing sequence. • Check arrangement of the switches. • If applicable, lock the STOP input during homing if it is not desired. |

| Error group 12 | | CAN | |
|----------------|-------|-------------------------------------|--|
| no. | Code | Message | Reaction |
| 12-0 | 8181h | CAN: general error | |
| | | Cause | Other CAN error. Triggered by the CAN controller itself and is used as a common error for all further CAN errors. |
| | | Action | <ul style="list-style-type: none"> • Re-start CAN controller. • Check CAN configuration in the controller. • Check wiring. |
| 12-1 | 8181h | CAN: error bus off | |
| | | Cause | Errors can occur if the CAN control malfunctions or is deliberately requested by the controller of the bus-off status. |
| | | Action | <ul style="list-style-type: none"> • Re-start CAN controller. • Check CAN configuration in the controller. • Check wiring. |
| 12-2 | 8181h | CAN: Error when transmitting | |
| | | Cause | Error when sending a message (e.g. no bus connected). |
| | | Action | <ul style="list-style-type: none"> • Re-start CAN controller • Check CAN configuration in the controller • Check wiring |
| 12-3 | 8181h | CAN: Error when receiving | |
| | | Cause | Error receiving a message. |
| | | Action | <ul style="list-style-type: none"> • Re-start CAN controller. • Check CAN configuration in the controller. • Check wiring: Cable specification adhered to, broken cable, maximum cable length exceeded, correct terminating resistors, cable screening earthed, all signals terminated? |
| 12-4 | 8130h | CAN: Time-out nodeguarding | |
| | | Cause | Node guarding telegram not received within the parametrised time. Signals corrupted? |
| | | Action | <ul style="list-style-type: none"> • Compare cycle time of the remote frames with that of the controller. • Check: Failure of the controller? |
| 12-5 | 8181h | CAN: Error in the IPO mode | |
| | | Cause | Over a period of 2 SYNC intervals, the SYNC telegram or the PDO of the controller has failed. |
| | | Action | <ul style="list-style-type: none"> • Re-start CAN controller. • Check CAN configuration in the controller (SYNC telegram must be parameterised). • Check wiring. |

| Error group 14 | | Motor identification | |
|-----------------------|-------|------------------------------------|---|
| no. | Code | Message | Reaction |
| 14-9 | 6197h | Error, motor identification | |
| | | Cause | Error in automatic determination of the motor parameters. |
| | | Action | <ul style="list-style-type: none"> • Ensure sufficient intermediate circuit voltage. • Encoder cable connected to the right motor? • Motor blocked, e.g. holding brake does not release? |

| Error group 16 | | Initialization | |
|-----------------------|--------|--|---|
| no. | Code | Message | Reaction |
| 16-2 | 6187 h | Initialization fault | |
| | | Cause | Error in initialising the default parameters. |
| | | Action | <ul style="list-style-type: none"> • In case of repetition, load firmware again. If the error occurs repeatedly, the hardware is defective. |
| 16-3 | 6183h | Unexpected status / programming error | |
| | | Cause | The software has taken an unexpected status. For example, unknown status in the FHPP state machine. |
| | | Action | <ul style="list-style-type: none"> • In case of repetition, load firmware again. If the error occurs repeatedly, the hardware is defective. |

| Error group 17 | | Following error monitoring | |
|-----------------------|-------|-----------------------------------|--|
| no. | Code | Message | Reaction |
| 17-0 | 8611h | Following error monitoring | |
| | | Cause | Comparison threshold for the limit value of the following error exceeded. |
| | | Action | <ul style="list-style-type: none"> • Enlarge error window. • Parameterise acceleration to be less. • Motor overloaded (current limiter from the I²t monitoring active?). |

| Error group 18 | | Output stage temperature monitoring | |
|-----------------------|-------|--|---|
| no. | Code | Message | Reaction |
| 18-1 | 4280h | Output stage temperature 5 °C below maximum | |
| | | Cause | The output stage temperature is greater than 90 °C. |
| | | Action | <ul style="list-style-type: none"> • Check installation conditions, cooling through the housing surface, integrated heat sink and back wall. |

| Error group 19 | | I²t monitoring | |
|-----------------------|-------|----------------------------------|--|
| no. | Code | Message | Reaction |
| 19-0 | 2380h | I²t at 80 % | |
| | | Cause | Of the maximum I ² t workload of the controller or motor, 80 % has been achieved. |
| | | Action | <ul style="list-style-type: none"> • Check whether motor/mechanics are blocked or sluggish. |

| Error group 21 | | Current measurement | |
|-----------------------|-------|--|---|
| no. | Code | Message | Reaction |
| 21-0 | 5210h | Error, offset current measurement | |
| | | Cause | The controller performs offset compensation of the current measurement. Tolerances that are too large result in an error. |
| | | Measure | If the error occurs repeatedly, the hardware is defective. <ul style="list-style-type: none"> • Send motor controller to the manufacturer. |

| Error group 22 | | PROFIBUS | |
|-----------------------|-------|---|---|
| no. | Code | Message | Reaction |
| 22-0 | 7500h | Error in PROFIBUS initialization | |
| | | Cause | Fieldbus interface defective. |
| | | Action | <ul style="list-style-type: none"> • Please contact Technical Support. |
| 22-2 | 7500h | PROFIBUS communication error | |
| | | Cause | <ul style="list-style-type: none"> – Faulty initialisation of the Profibus interface. – Interface defective. |
| | | Action | <ul style="list-style-type: none"> • Check the set slave address. • Check bus termination. • Check wiring. |

| Error group 25 | | Firmware | |
|-----------------------|--------|---------------------------|--|
| no. | Code | Message | Reaction |
| 25-1 | 6081 h | Incorrect firmware | |
| | | Cause | Motor controller and firmware are not compatible. |
| | | Action | <ul style="list-style-type: none"> • Update the firmware. |

| Error group 26 | | Data flash | |
|-----------------------|-------|-----------------------|--|
| no. | Code | Message | Reaction |
| 26-1 | 5581h | Checksum error | |
| | | Cause | Checksum error of a parameter set. |
| | | Action | <ul style="list-style-type: none"> • Load factory setting. • If the error is still present, the hardware is defective. |

| Error group 29 | | SD card | |
|-----------------------|-------|--------------------------------|--|
| no. | Code | Message | Reaction |
| 29-0 | 7680h | No SD available | |
| | | Cause | An attempt was made to access a missing SD card. |
| | | Action | Check: <ul style="list-style-type: none"> • whether the SD card is inserted properly, • whether the SD card is formatted, • whether a compatible SD card is plugged in. |
| 29-1 | 7681h | SD initialization error | |
| | | Cause | <ul style="list-style-type: none"> – Error during initialization. – Communication not possible. |
| | | Action | <ul style="list-style-type: none"> • Plug card back in. • Check card (file format FAT 16). • If necessary, format card. |
| 29-2 | 7682h | SD parameter set error | |
| | | Cause | <ul style="list-style-type: none"> – Checksum incorrect. – File not present. – File format incorrect. – Error saving the parameter file on the SD card. |
| | | Action | <ul style="list-style-type: none"> • Check content (data) of the SD card. |

| Error group 31 | | I²t monitoring | |
|-----------------------|-------|---|--|
| no. | Code | Message | Reaction |
| 31-0 | 2312h | I²t error motor (I²t at 100%) | |
| | | Cause | I ² t monitoring of the controller has been triggered. <ul style="list-style-type: none"> – Motor/mechanical system blocked or sluggish. – Motor under-sized? |
| | | Action | <ul style="list-style-type: none"> • Check motor and mechanical system. |
| 31-1 | 2311h | I²t error controller (I²t at 100%) | |
| | | Cause | I ² t monitoring of the controller has been triggered. |
| | | Action | <ul style="list-style-type: none"> • Check power dimensioning of drive package. |

| Error group 32 | | Intermediate circuit | |
|-----------------------|-------|--|---|
| No. | Code | Message | Reaction |
| 32-8 | 3285h | Power supply failure during controller enable | |
| | | Cause | interruption/power failure while the controller enable was active. |
| | | Action | <ul style="list-style-type: none"> • Check mains voltage/power supply. |

| Error group 35 | | Fast stop | |
|-----------------------|-------|--------------------------------|---|
| no. | Code | Message | Reaction |
| 35-1 | 6199h | Time out with fast stop | PS off |
| | | Cause | The parameterised time for fast stop was exceeded. |
| | | Action | <ul style="list-style-type: none"> • Check parameterisation. |

| Error group 40 | | Software limit | |
|-----------------------|-------|---|---|
| sorNo. | Code | Message | Reaction |
| 40-0 | 8612h | Negative software limit switch reached | configurable |
| | | Cause | The position setpoint value has reached or exceeded the negative software limit switch. |
| | | Action | <ul style="list-style-type: none"> • Check the target data. • Check positioning area. |
| 40-1 | 8612h | Positive software limit switch reached | configurable |
| | | Cause | The position setpoint value has reached or exceeded the positive software limit switch. |
| | | Action | <ul style="list-style-type: none"> • Check the target data. • Check positioning area. |
| 40-2 | 8612h | Target position lies behind the negative software limit switch | configurable |
| | | Cause | Start of a positioning task was suppressed because the target lies behind the negative software limit switch. |
| | | Action | <ul style="list-style-type: none"> • Check the target data. • Check positioning area. |
| 40-3 | 8612h | Target position lies behind the positive software limit switch | configurable |
| | | Cause | The start of a positioning task was suppressed because the target lies behind the positive software limit switch. |
| | | Action | <ul style="list-style-type: none"> • Check the target data. • Check positioning area. |

| Error group 41 | | Path program | |
|-----------------------|-------|---|---|
| no. | Code | Message | Reaction |
| 41-8 | 6193h | Path program error, unknown command | configurable |
| | | Cause | Unknown command found during record continuation. |
| | | Action | <ul style="list-style-type: none"> • Check parameterisation. |
| 41-9 | 6192h | Error in path program jump destination | configurable |
| | | Cause | Jump to a positioning record outside the permitted range. |
| | | Action | <ul style="list-style-type: none"> • Check parameterisation. |

| Error group 42 | | Positioning | |
|-----------------------|-------|--|---|
| no. | Code | Message | Reaction |
| 42-1 | 8681h | Positioning: Error in pre-computation | |
| | | Cause | Positioning cannot be reached through the options of the positioning (e.g. final speed) or parameters. |
| | | Action | <ul style="list-style-type: none"> • Check parameterisation of the position records in question. |
| 42-4 | 8600h | Message, homing required | |
| | | Cause | <ul style="list-style-type: none"> – Positioning not possible without homing. – Homing must be carried out. |
| | | Action | <ul style="list-style-type: none"> • Reset optional parameterisation "Homing required". • Carry out a new homing run after acknowledgement of an angle encoder error. |
| 42-9 | 6191h | Error in position data record | |
| | | Cause | <ul style="list-style-type: none"> – An attempt is being made to start an unknown or deactivated position record. – The set acceleration is too small for the permissible maximum speed. – (Danger of a calculation overflow in the trajectory calculation). |
| | | Action | <ul style="list-style-type: none"> • Check parameterisation and sequence control and correct, if necessary. |

| Error group 43 | | Limit switch error | |
|-----------------------|-------|------------------------------------|--|
| no. | Code | Message | Reaction |
| 43-0 | 8612h | Negative limit switch error | |
| | | Cause | Negative hardware limit switch reached. |
| | | Action | <ul style="list-style-type: none"> • Check parameterisation, wiring and limit switches. |
| 43-1 | 8612h | Positive limit switch error | |
| | | Cause | Positive hardware limit switch reached. |
| | | Action | <ul style="list-style-type: none"> • Check parameterisation, wiring and limit switches. |
| 43-9 | 8612h | Error in limit switch | |
| | | Cause | Both hardware limit switches are active simultaneously. |
| | | Action | <ul style="list-style-type: none"> • Check parameterisation, wiring and limit switches. |

| Error group 45 | | STO error | |
|-----------------------|-------|--------------------------------|---|
| no. | Code | Message | Reaction |
| 45-0 | 8000h | Error in driver supply | |
| | | Cause | Driver supply is still active despite the STO requirement. |
| | | Action | The internal logic for the STO requirement may be disturbed due to high-frequency switching operations at the input. <ul style="list-style-type: none"> • Check activation; the error must not recur. • If the error occurs repeatedly when the STO is called: • Check firmware (approved version?). If all the above options have been excluded, the hardware of the motor controller is defective. |
| 45-1 | 8000h | Error in driver supply | |
| | | Cause | The driver supply is active again, although STO is still required. |
| | | Action | The internal logic for the STO requirement may be disturbed due to high-frequency switching operations at the input. <ul style="list-style-type: none"> • Check activation; the error must not recur. • If the error occurs repeatedly when the STO is called: • Check firmware (approved version?). If all the above options have been excluded, the hardware of the motor controller is defective. |
| 45-2 | 8000h | Error in driver supply | |
| | | Cause | The driver supply is not active again, although STO is no longer required. |
| | | Action | If the error occurs again after the STO requirement is ended, the hardware of the motor controller is defective. |
| 45-3 | 8087h | DIN4 plausibility error | |
| | | Cause | Output stage no longer switches off → Hardware defective. |
| | | Action | Repair by the manufacturer. |

| Error group 64 | | DeviceNet error | |
|-----------------------|-------|--------------------------------------|---|
| no. | Code | Message | Reaction |
| 64-0 | 7582h | DeviceNet communication error | |
| | | Cause | Node number exists twice. |
| | | Action | <ul style="list-style-type: none"> • Check the configuration. |
| 64-1 | 7584h | DeviceNet general error | |
| | | Cause | The 24 V bus voltage is missing. |
| | | Action | <ul style="list-style-type: none"> • In addition to the motor controller, the DeviceNet interface must also be connected to 24 V DC. |
| 64-2 | 7582h | DeviceNet communication error | |
| | | Cause | <ul style="list-style-type: none"> – Receive buffer overflow. – Too many messages received within a short period. |
| | | Action | <ul style="list-style-type: none"> • Reduce the scan rate. |

| Error group 64 | | DeviceNet error | |
|-----------------------|-------|--------------------------------------|---|
| no. | Code | Message | Reaction |
| 64-3 | 7582h | DeviceNet communication error | |
| | | Cause | <ul style="list-style-type: none"> – Send buffer overflow. – Insufficient free space on the CAN bus to transmit messages. |
| | | Action | <ul style="list-style-type: none"> • Increase the baud rate. • Reduce the number of nodes. • Reduce the scan rate. |
| 64-4 | 7582h | DeviceNet communication error | |
| | | Cause | IO-message could not be sent |
| | | Action | <ul style="list-style-type: none"> • Check that the network is connected correctly and does not malfunction. |
| 64-5 | 7582h | DeviceNet communication error | |
| | | Cause | Bus off. |
| | | Action | <ul style="list-style-type: none"> • Check that the network is connected correctly and does not malfunction. |
| 64-6 | 7582h | DeviceNet communication error | |
| | | Cause | Overflow in the CAN controller. |
| | | Action | <ul style="list-style-type: none"> • Increase the baud rate. • Reduce the number of nodes. • Reduce the scan rate. |

| Error group 65 | | DeviceNet error | |
|-----------------------|-------|--------------------------------------|---|
| no. | Code | Message | Reaction |
| 65-0 | 7584h | DeviceNet general error | |
| | | Cause | <ul style="list-style-type: none"> – Communication is activated, even though no interface is plugged in. – The DeviceNet interface is attempting to read an unknown object. – Unknown DeviceNet error. |
| | | Action | <ul style="list-style-type: none"> • Check whether the DeviceNet interface is plugged in correctly. • Check that the network is connected correctly and does not malfunction. |
| 65-1 | 7582h | DeviceNet communication error | |
| | | Cause | I/O connection timeout. No I/O message received within the expected time. |
| | | Action | <ul style="list-style-type: none"> • Please contact Technical Support. |

| Error group 70 | | Operating mode error | |
|-----------------------|-------|---------------------------------|--|
| no. | Code | Message | Reaction |
| 70-2 | 6195h | General arithmetic error | |
| | | Cause | The fieldbus factor group cannot be calculated correctly. |
| | | Action | <ul style="list-style-type: none"> • Check the factor group. |
| 70-3 | 6380h | Operating mode error | |
| | | Cause | This operating mode change is not supported by the motor controller. |
| | | Action | <ul style="list-style-type: none"> • Check your application. Not every change is permissible. |

| Error group 79 | | RS232 error | |
|-----------------------|-------|----------------------------------|--|
| no. | Code | Message | Reaction |
| 79-0 | 7510h | RS232 communication error | |
| | | Cause | Overflow when receiving RS232 commands. |
| | | Action | <ul style="list-style-type: none"> • Check wiring. • Check the transmitted data. |

B.3 Error codes via CiA 301/402

| Diagnostic messages | | | | |
|---------------------|------|---------|--|--------------|
| Code | no. | No. Bit | Message | Reaction |
| 2311h | 31-1 | 19 | I ² t error controller (I ² t at 100%) | configurable |
| 2312h | 31-0 | 18 | I ² t error motor (I ² t at 100%) | configurable |
| 2320h | 06-0 | 13 | Over-current of the intermediate circuit/output stage | PS off |
| 2380h | 19-0 | 25 | I ² t at 80 % | configurable |
| 3210h | 07-0 | 15 | Overvoltage in intermediate circuit | PS off |
| 3220h | 02-0 | 14 | Undervoltage in intermediate circuit | configurable |
| 3285h | 32-8 | 17 | Power supply failure during controller enable | PS off |
| 4210h | 04-0 | 3 | Excess/low temperature of power electronics | configurable |
| 4280h | 18-1 | 27 | Output stage temperature 5 °C below maximum | configurable |
| 4310h | 03-1 | 2 | Temperature monitoring, motor | configurable |
| 5114h | 05-0 | 8 | 5 V electronics supply fault | PS off |
| 5115h | 05-1 | 10 | Error in 24 V supply | PS off |
| 5116h | 05-2 | 9 | 12 V electronics supply fault | PS off |
| 5210h | 21-0 | 12 | Error, offset current measurement | PS off |
| 5581h | 26-1 | 62 | Checksum error | PS off |
| 6081h | 25-1 | 11 | Incorrect firmware | PS off |
| 6180h | 01-0 | 61 | Stack overflow (internal error) | PS off |
| 6183h | 16-3 | 60 | Unexpected status / programming error | PS off |
| 6187h | 16-2 | 63 | Initialization fault | PS off |
| 6191h | 42-9 | 56 | Error in position data record | PS off |
| 6192h | 41-9 | 42 | Error in path program jump destination | configurable |
| 6193h | 41-8 | 43 | Path program error, unknown command | configurable |
| 6195h | 70-2 | 58 | General arithmetic error | PS off |
| 6197h | 14-9 | 39 | Error, motor identification | PS off |
| 6199h | 35-1 | 34 | Time out with fast stop | PS off |
| 6380h | 70-3 | 57 | Operating mode error | configurable |
| 7380h | 08-0 | 4 | Error in encoder supply | PS off |
| 7500h | 22-0 | 47 | Error in PROFIBUS initialization | PS off |
| | 22-2 | 53 | PROFIBUS communication error | configurable |
| 7510h | 79-0 | 55 | RS232 communication error | configurable |

| Diagnostic messages | | | | |
|----------------------------|------|---------|--|--------------|
| Code | no. | No. Bit | Message | Reaction |
| 7582h | 64-0 | 52 | DeviceNet communication error | PS off |
| | 64-2 | 52 | DeviceNet communication error | PS off |
| | 64-3 | 52 | DeviceNet communication error | PS off |
| | 64-4 | 52 | DeviceNet communication error | PS off |
| | 64-5 | 52 | DeviceNet communication error | PS off |
| | 64-6 | 52 | DeviceNet communication error | PS off |
| | 65-1 | 52 | DeviceNet communication error | configurable |
| 7584h | 64-1 | 44 | DeviceNet general error | PS off |
| | 65-0 | 44 | DeviceNet general error | configurable |
| 7680h | 29-0 | 48 | No SD available | configurable |
| 7681h | 29-1 | 49 | SD initialization error | configurable |
| 7682h | 29-2 | 50 | SD parameter set error | configurable |
| 8087h | 45-3 | 22 | DIN4 plausibility error | PS off |
| 8130h | 12-4 | 23 | CAN: Time-out nodeguarding | configurable |
| 8181h | 12-0 | 54 | CAN: general error | configurable |
| | 12-1 | 54 | CAN: error bus off | configurable |
| | 12-2 | 54 | CAN: Error when transmitting | configurable |
| | 12-3 | 54 | CAN: Error when receiving | configurable |
| | 12-5 | 54 | CAN: Error in the IPO mode | configurable |
| 8600h | 42-4 | 29 | Message, homing required | configurable |
| 8611h | 17-0 | 28 | Following error monitoring | configurable |
| 8612h | 40-0 | 31 | Negative software limit switch reached | configurable |
| | 40-1 | 31 | Positive software limit switch reached | configurable |
| | 40-2 | 31 | Target position lies behind the negative software limit switch | configurable |
| | 40-3 | 31 | Target position lies behind the positive software limit switch | configurable |
| | 43-0 | 30 | Negative limit switch error | configurable |
| | 43-1 | 30 | Positive limit switch error | configurable |
| | 43-9 | 30 | Error in limit switch | configurable |
| 8681h | 42-1 | 59 | Positioning: Error in pre-computation | configurable |
| 8A81h | 11-1 | 35 | Homing error | PS off |

B.4 Profibus diagnostics

| Diagnostic messages | | | | | |
|----------------------------|------|-----------------------------|---------|--|--------------|
| Unit_Diag_Bit | | no. | Message | Reaction | |
| 00 | E429 | “Position dataset” | 42-9 | Error in position data record | PS off |
| 01 | E703 | “Operating mode” | 70-3 | Operating mode error | configurable |
| 02 | E702 | “Arithmetic error” | 70-2 | General arithmetic error | PS off |
| 03 | E421 | “Position precomputation” | 42-1 | Positioning: Error in pre-computation | configurable |
| 04 | E163 | “Unexpected state” | 16-3 | Unexpected status / programming error | PS off |
| 05 | E010 | “Stack overflow” | 01-0 | Stack overflow (internal error) | PS off |
| 06 | E261 | “Checksum error” | 26-1 | Checksum error | PS off |
| 07 | E162 | “Initialization” | 16-2 | Initialization fault | PS off |
| 08 | E290 | “No SD available” | 29-0 | No SD available | configurable |
| 09 | E291 | “SD initialization” | 29-1 | SD initialization error | configurable |
| 10 | E292 | “SD parameter set” | 29-2 | SD parameter set error | configurable |
| 13 | E222 | “PROFIBUS communication” | 22-2 | PROFIBUS communication error | configurable |
| 14 | - | “unknown” | 12-0 | CAN: general error | configurable |
| | | | 12-1 | CAN: error bus off | configurable |
| | | | 12-2 | CAN: Error when transmitting | configurable |
| | | | 12-3 | CAN: Error when receiving | configurable |
| | | | 12-5 | CAN: Error in the IPO mode | configurable |
| 15 | E790 | “RS232 communication error” | 79-0 | RS232 communication error | configurable |
| 18 | E418 | “Record seq. Unknown cmd” | 41-9 | Error in path program jump destination | configurable |
| 19 | E419 | Record seq. Invalid dest.” | 41-8 | Path program error, unknown command | configurable |
| 20 | | “unknown” | 64-1 | DeviceNet general error | PS off |
| | | | 64-2 | DeviceNet communication error | PS off |
| | | | 64-3 | DeviceNet communication error | PS off |
| | | | 64-4 | DeviceNet communication error | PS off |
| | | | 64-5 | DeviceNet communication error | PS off |
| | | | 64-6 | DeviceNet communication error | PS off |
| | | | 65-0 | DeviceNet general error | configurable |
| | | | 65-1 | DeviceNet communication error | configurable |
| 23 | E220 | “PROFIBUS assembly” | 22-0 | Error in PROFIBUS initialization | PS off |
| 26 | E351 | “Time out: Quick stop” | 35-1 | Time out with fast stop | PS off |
| 27 | E111 | “Error during homing” | 11-1 | Homing error | PS off |
| 31 | E149 | “Motor identification” | 14-9 | Error, motor identification | PS off |
| 33 | E190 | “I2t at 80 %” | 19-0 | I2t at 80 % | configurable |

| Diagnostic messages | | | | | |
|----------------------------|------|-------------------------------|---------|--|--------------|
| Unit_Diag_Bit | | no. | Message | Reaction | |
| 35 | E181 | “Outp. stage temp. 5 < max.” | 18-1 | Output stage temperature 5 °C below maximum | configurable |
| 36 | E170 | “Following error” | 17-0 | Following error monitoring | configurable |
| 37 | E424 | “Enforce homing run” | 42-4 | Message, homing required | configurable |
| 38 | E43x | “limit switches” | 43-0 | Negative limit switch error | configurable |
| | | | 43-1 | Positive limit switch error | configurable |
| | | | 43-9 | Error in limit switch | configurable |
| 39 | E40x | “Software limit” | 40-0 | Negative software limit switch reached | configurable |
| | | | 40-1 | Positive software limit switch reached | configurable |
| | | | 40-2 | Target position lies behind the negative software limit switch | configurable |
| | | | 40-3 | Target position lies behind the positive software limit switch | configurable |
| 41 | E328 | “Fail. power supply ctr.ena.” | 32-8 | Power supply failure during controller enable | PS off |
| 42 | E310 | “I2t-error motor” | 31-0 | I ² t error motor (I ² t at 100%) | configurable |
| 43 | E311 | “I2t-error controller” | 31-1 | I ² t error controller (I ² t at 100%) | configurable |
| 46 | E453 | “Plausibility DIN 4” | 45-3 | DIN4 plausibility error | PS off |
| 47 | E124 | “Time out Nodeguarding” | 12-4 | CAN: Time-out nodeguarding | configurable |
| 49 | E052 | “12V - Internal supply” | 05-2 | 12 V electronics supply fault | PS off |
| 48 | E050 | “5V - Internal supply” | 05-0 | 5 V electronics supply fault | PS off |
| 50 | E051 | “24V - Internal supply” | 05-1 | Error in 24 V supply | PS off |
| 51 | E251 | “Hardware error” | 25-1 | Incorrect firmware | PS off |
| 52 | E210 | “Offset current metering” | 21-0 | Error, offset current measurement | PS off |
| 53 | E060 | “Overcurrent output stage” | 06-0 | Over-current of the intermediate circuit/output stage | PS off |
| 54 | E020 | “Undervoltage power stage” | 02-0 | Undervoltage in intermediate circuit | configurable |
| 55 | E070 | “Overvoltage output stage” | 07-0 | Overvoltage in intermediate circuit | PS off |
| 58 | E03x | “Overheating error (motor)” | 03-1 | Temperature monitoring, motor | configurable |
| 59 | E040 | “Overtemperature power stage” | 04-0 | Excess/low temperature of power electronics | configurable |
| 60 | E080 | “Encoder supply” | 08-0 | Error in encoder supply | PS off |

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Copyright:
Festo AG & Co. KG
Postfach
73726 Esslingen
Germany

Phone:
+49 711 347-0

Fax:
+49 711 347-2144

e-mail:
service_international@festo.com

Internet:
www.festo.com

Original: de

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