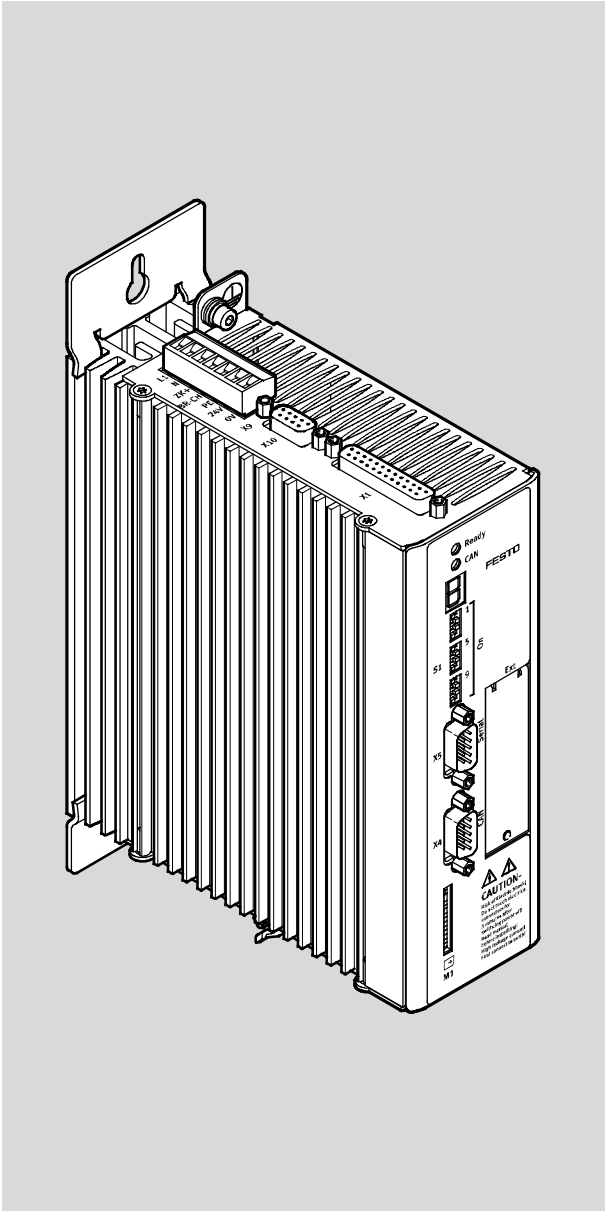
Motor controller

CMMS-AS-C4-3A-G2



FESTO

Description

Mounting and installation

8040105
1404a
[8034504]

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

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.

Table of Contents – CMMS-AS-C4-3A-G2

Instructions on this documentation

This documentation is intended to help you safely work with the motor controller CMMS-AS-...-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-AS-C4-3A-G2: from Rev 02 (➔ Type plate).

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Before using a newer firmware version, check whether a newer version of the FCT plug-in or user documentation is available for it (➔ www.festo.com/sp).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-AS-C4-3A-G2	**Function**	
CMMS-AS-C4-3A-G2 572986 Rev 02 CN98 P0021912 CE ... In: 1~(95...250)V AC (50...60)Hz 4 A Out: 3~(0...Input Voltage)V AC (0...1000)Hz 4 A	Type designation	CMMS-AS-C4-3A-G2
	Part number	e.g. 572986
	Revision status	e.g. Rev 02
	Serial number	e.g. CN98 P0021912
	Input (In)	1-phase 95 ... 250 V AC 50 ... 60 Hz, 4 A
	Output (Out)	3-phase 0 ... Input voltage V AC 0 ... 1000 Hz, 4 A

Tab. 1 Rating plate CMMS-AS-C4-3A-G2 (example)

Issue status of the specified standards

Standard: issue status		
EN 60034-1:2010-10	EN 60204-1:2006/A1:2009-02	EN 61800-5-1:2007-09
EN 61800-2:1998-04	EN 61800-3:2004-12 + A1:2012-03	

Tab. 2 Issue statuses

Production time period

On the type plate, the first 2 characters of the serial number indicate the production 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	2	February	
3	March	4	April	
5	May	6	June	
7	July	8	August	
9	September	O	October	
N	November	D	December	

Tab. 4 Manufacturing month

Type codes

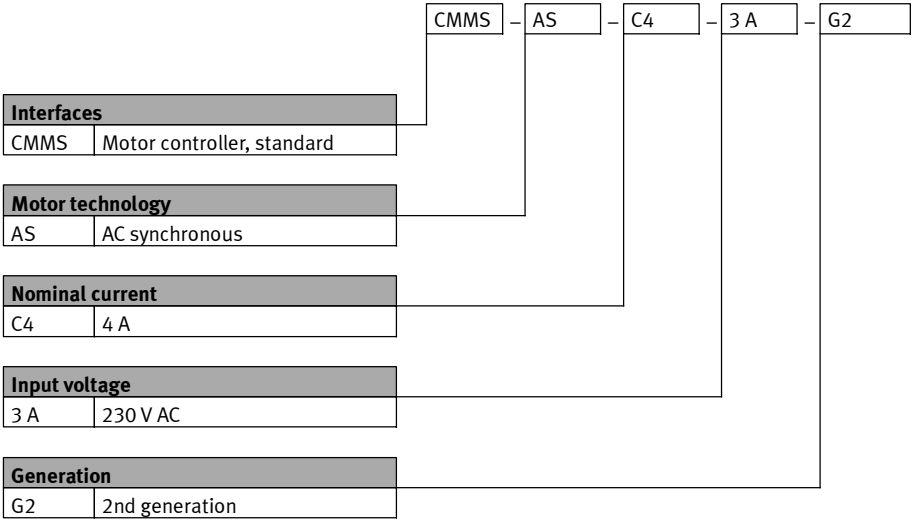


Fig. 1 Type codes

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	– 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	– Control interfaces – Operating modes/operational functions – Commissioning with FCT – Error messages
STO safety function	GDCP-CMMS-AS-G2-S1-...	CMMS-AS	– 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	– Description of the interfaces: – 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	– Description of the interface: – 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	– 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

Warning
Danger of electric shock
Touching live parts causes severe injuries and can lead to death:
– 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 and may only be used if all safeguarding has been initiated.
Before touching live parts during 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 5 minutes discharge time and check that power is turned off before accessing the controller.

Warning
Danger of electric shock
This product can cause a DC current in the protective ground conductor. In cases where an error current protection unit (RCD) or an error current protective device (RCM) is used to protect against direct or indirect contact, only the Type B kind of RCD or RCM is permitted on the power supply side of this product.

Caution
Danger of burns from hot surfaces
Dependent on the load of the motor controller, housing temperatures › 80 °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-AS-C4-3A-G2. is intended for use as a controller for servo motors of the EMMS-AS 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
– as an installed device 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, GDCP-CMMS-AS-G2-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 requirements

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 instructions 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 operational reliability, 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-AS-C4-3A-G2

1 Power switch
2 Fuse ➔ A.2.1
3 24 V power supply unit for the control voltage
4 Motor controller CMMS-AS-C4-3A-G2
5 PC with serial connecting cable for parameterisation and commissioning with the Festo Configuration Tool (FCT), CMMS-AS plug-in
6 Motor EMMS-AS with encoder, cable set (motor and encoder cable NEBM)

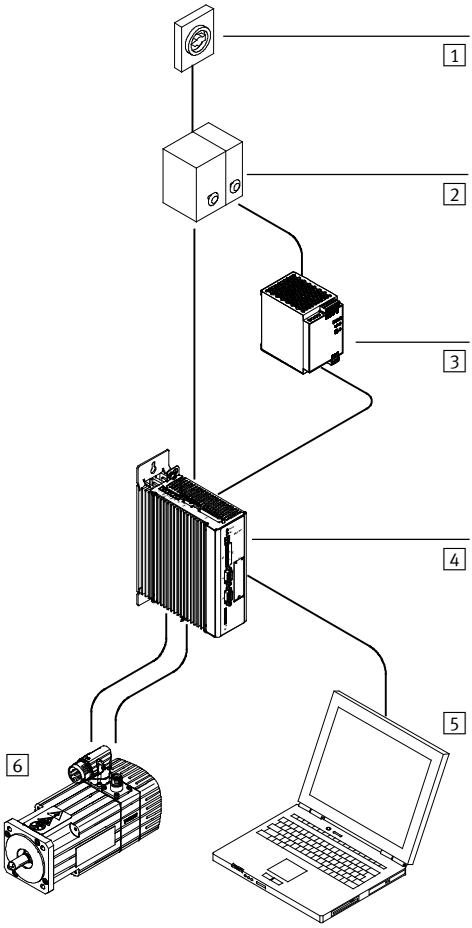


Fig. 2.1 Complete structure CMMS-AS-C4-3A-G2

2.2 Scope of delivery

Number	Component
1	Motor controller CMMS-AS-C4-3A-G2

1	Operator package
	– Brief description
	– CD-ROM with following contents:
	  – 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 NEKM-C-4 (plugged onto connections)
2	Mounting bracket

Tab. 2.1 Scope of delivery

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 PE connection)

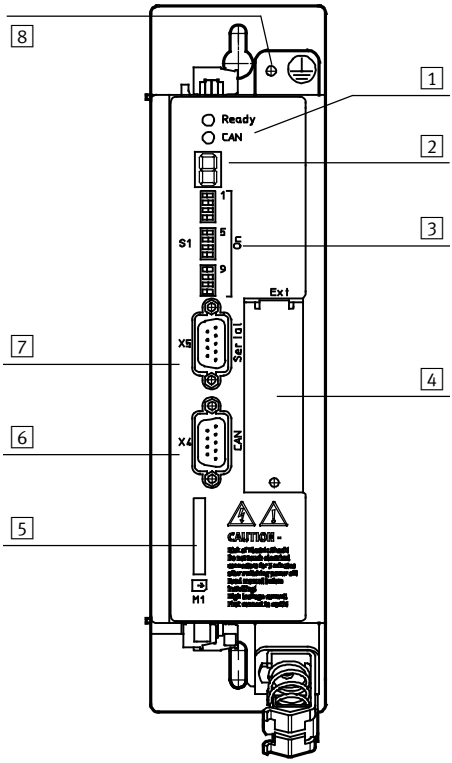


Fig. 2.2 Front view CMMS-AS-C4-3A-G2 front

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

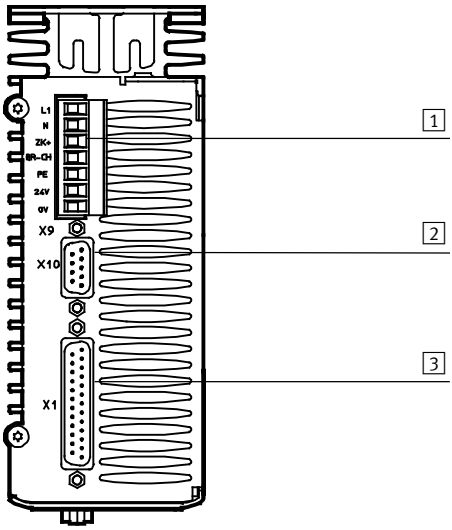


Fig. 2.3 Top CMMS-AS-C4-3A-G2 view

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

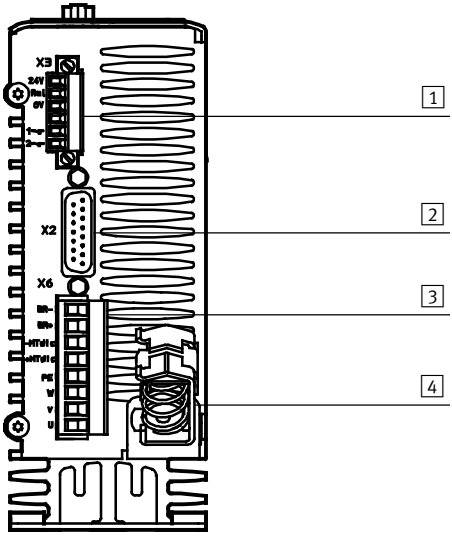


Fig. 2.4 Bottom CMMS-AS-C4-3A-G2 view

2.4 Display and control elements

2.4.1 Seven-segment display

Display [1]		Meaning
Starting program		
	Point	Starting program (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 sets active
	001...063	– Positioning record 001 ... 063 active
	064	– Manual travel via FCT or FHPP direct record (direct operation)
	070/071	– Jog+/jog–
	P H 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 corresponding 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 subindex (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 indicators

LED	LED colour	Function
Ready	Green	Operating status/controller enable
	Flashing green	Parameter file xxx.DCO (memory card) is being read/written
CAN	Yellow	Status display of CAN bus illuminates if CAN communication takes place

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

2.4.3 DIL switch

DIL switch	Function
S1.1 ... 7	CAN 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)] – ON: Download from the SD memory card to the controller – OFF: No download.
S1.9 ... 10	Setting the CAN-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, GDCP-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	DIL 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, GDCP-CMMS/D-FW-....

Tab. 2.5 CAN-bus address or MAC-ID

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

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

Tab. 2.6 CAN-bus transmission rate

2.4.4 Slot [EXT]

The slot (➔ Fig. 2.2 4) enables the CMMS-AS-C4-3A-G2 to be expanded by the following optional interfaces:

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

For assembly, please observe the notes in the assembly instructions for the CAMC interface. If the interface is installed, 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, GDCP-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. Additional information ➔ Help for CMMD-AS FCT plug-in and functions and commissioning description, GDCP-CMMS/D-FW-....

SD memory card	Description
Functions	Copying/loading a parameter set from the memory card to the CMMS-AS-C4-3A-G2.
	Copying/saving a parameter set from the CMMS-AS-C4-3A-G2 to the memory card.
	Copying (loading) firmware from the memory card to the CMMS-AS-C4-3A-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

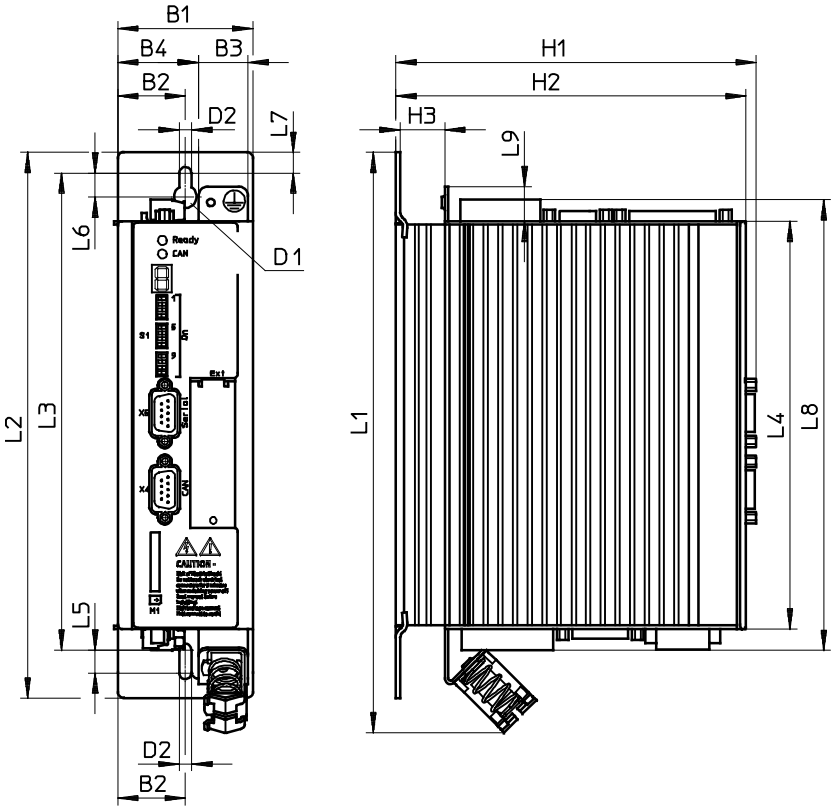


Fig. 3.1 Installation dimensions

Dim.	B1	B2	B3	B4	D1 ⌀	D2 ⌀	H1	H2	H3
[mm]	60.1	30	22	35.8	10	5.5	160	155	19.7

Dim.	L1	L2	L3	L4	L5	L6	L7	L8	L9
[mm]	257	242	211.85	181	10	10.5	9.25	201	15.3

Tab. 3.1 CMMS-AS-C4-3A-G2: Installation dimensions

3.2 Mounting

Warning
Danger of electric shock.
Touching live parts causes severe injuries and can lead to death. 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 5 minutes 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:
- Mount the accompanying mounting bracket to the motor controller.

The two mounting brackets are part of the radiator profile and transfer 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 the mounting brackets with M5 screws.

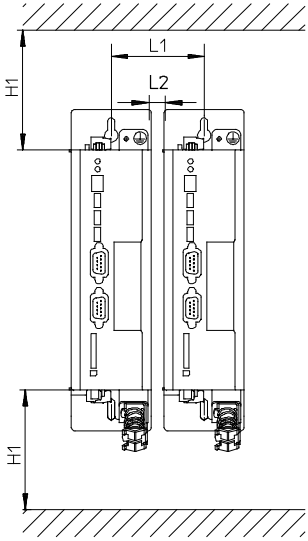


Fig. 3.2 Installation clearance

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).

Installation clearance		H1 [1]	L1	L2
– at an output of 400 W	[mm]	100	70	10
– at a rated output of 600 W	[mm]	100	140	80

1) Recommendation for optimum wiring of the motor and encoder cable: 150 mm installation clearance H1 on the underside.

Tab. 3.2 Installation clearance

The specified installation clearance L1 = 70 mm relates to an average motor output in continuous operation (S1 operation according to EN 60034-1). When subjected to a higher output, the clearance L1 = 70 mm is sufficient under the following conditions:
– The motor is operated at a higher peak load in intermittent operation (S3/S4 operation according to EN 60034-1: acceleration, constant movement with a low load, braking).
– An excessive temperature increase of the motor controller is prevented by forced ventilation.

3.3 Disassembly

Warning
Danger of electric shock.
Touching live parts causes severe injuries and can lead to death. 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 5 minutes 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

Warning
Danger of electric shock
Motor controllers are devices with increased leakage current (> 10 mA). If wiring is incorrect or the device is defective, high voltage can occur on the housing, which can result in serious injury or even death if the housing is touched.

- Before commissioning, and also for brief measuring and test purposes, connect the PE protective conductor ➔ Fig. 4.4:
  - to the earthing screw of the controller housing
  - to pin PE [X9.5], power supply.
    The cross section of the protective conductor at PE [X9.5] must correspond at least to the cross section of the external conductor L [X9.1].
- Observe the regulations of the EN 60204-1 for the protective earthing.

Warning
Danger of electric shock

- 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]
- if connecting cables are disconnected when powered.

Touching live parts causes severe injuries and can lead to death. 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 5 minutes discharge time and check that power is turned off before accessing the controller.

Warning
Danger of electric shock
This product can cause a DC current in the protective ground conductor. In cases where an error current protection unit (RCD) or an error current protective device (RCM) is used to protect against direct or indirect contact, only the Type B kind of RCD or RCM is permitted on the power supply side of this product.

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-AS-C4-3A-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-AS-C4-3A-G2 motor controller already has integrated motor chokes and mains 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 built-in filter can be thermally overloaded if an application involves long motor cables (15 ... 25 m) or motor cables with an impermissible high cable capacity:
- Use additional filters for cables 15 ... 25 m long (see Tab. 4.2).
- Only use cables with a capacitance per unit length of < 200 ... 150 pF/m between the motor phase and screening; contact the cable supplier if necessary.

Category EN 61800-3	**Motor cable length [m]**	**Filter (at the output)**
C3 [1)]	< 15	None
	15 ... 25	Ferrite core via motor cable (Ferroxcube TX26/15/20 3C90) • Feed each of the 3 motor phases through the ferrite core twice in the same direction ➔ 3 x 2 windings on the inside of the ring core. • Do not feed the PE wire through the ferrite core.

1) C3: Power drive systems with nominal voltages < 1000 V for exclusive use in the second environment.

Tab. 4.2 Additional EMC filter

4.2.2 EMC-compliant wiring

Routing cables:
- 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. 4.3.

Port	Interface	Cable length [m]	Screening
[X1]	I/O interface	≤ 5	Recommendation: screened
[X2]	Encoder	≤ 25	– 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: – 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	≤ 15[2)]	– 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 additional EMC filter: cable length up to 25 m ➔ Tab. 4.2.

Tab. 4.3 EMC-compliant wiring

When using motor cables from other manufacturers:

- 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. 4.20).

4.2.3 Protective earthing of the motor controller

Warning
Danger of electric shock
Motor controllers are devices with increased leakage current (> 10 mA). If wiring is incorrect or the device is defective, high voltage can occur on the housing, which can result in serious injury or even death if the housing is touched.

- Before commissioning, and also for brief measuring and test purposes, connect the PE protective conductor ➔ Fig. 4.4:
  - to the earthing screw of the controller housing
  - to pin PE [X9.5], power supply.
    The cross section of the protective conductor at PE [X9.5] must correspond at least to the cross section of the external conductor L [X9.1].
- Observe the regulations of the EN 60204-1 for the protective earthing.

4.2.4 Protective earthing of the motor

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

- Connect the PE wire of the motor cable to connection PE [X6.5] ➔ Chapter 4.8.2
- 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. 4.4 Connection I/O interface [X1]

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

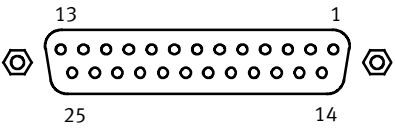


Fig. 4.1 Connection [X1] on the motor controller

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. 4.6
1	Jog/teach	0	1	➔ Tab. 4.7
2	Record linking	1	0	➔ Tab. 4.8
3	Synchronisation	1	1	➔ Tab. 4.9

1) Standard allocation of the I/O interface

Tab. 4.5 Function-dependent configuration of the 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	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	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 [X9.6]
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	DOUT0	24 V 100 mA	Output: Controller ready for operation (high active)
25	DOUT2	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. 4.6 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	AMON0	0 ... 10 V ±4 %	Analogue monitor output 0
18	+24 V	24 V 100 mA	Output: 24 V DC, looped through from [X9.6]
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. 4.7 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 ±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 ±4 %	Analogue monitor output 0
18	24 V	24 V 100 mA	Output 24 V DC, looped through from [X9.6]
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. 4.8 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 ±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	AMON0	0 ... 10 V ±4 %	Output: analogue monitor 0
18	24 V	24 V 100 mA	Output 24 V DC, looped through from [X9.6]
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)

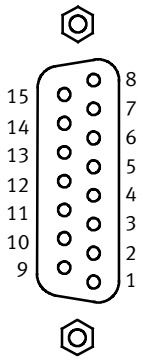
1) Default setting, configurable in the Festo Configuration Tool (FCT).

Tab. 4.9 Pin allocation: I/O interface [X1], synchronisation

4.4 Encoder [X2]

Process valve	version
[X2] on the motor controller	Sub-D plug connector, 15-pin, sockets
Counterplug	Sub-D plug connector, 15-pin, pins

Tab. 4.10 Encoder connection

[X2]	Pin		Value	Description
	1	M_{T+}	+3.3 V / 3 mA	Temperature sensor, motor temperature. Not occupied with NEBM lines.
	2	–U_SENS	0 V	Connected internally with pin 3
	3	GND	0 V	Reference potential of encoder power supply and motor temperature sensor
	4	–	–	–
	5	#DATA	U_{SS} = 5 V 1) Ri = 120 Ω 2)	RS485 data transmission line (differential)
	6	#SCLK	U_{SS} = 5 V 1) Ri = 120 Ω 2)	Cycle output RS485 (differential) for data transfer via the EnDat interface
	7	–	–	–
	8	–	–	–
	9	+U_SENS	5 V (–0 % ... +5 %) I_{max} = 200 mA	Connected internally with pin 10
	10	US	5 V (–0 % ... +5 %) I_{max} = 200 mA	Operating voltage for EnDat encoder
	11	–	–	–
	12	DATA	U_{SS} = 5 V 1) Ri = 120 Ω 2)	RS485 data transmission line (differential)
	13	SCLK	U_{SS} = 5 V 1) Ri = 120 Ω 2)	Cycle output RS485 (differential) for data transfer via the EnDat interface
	14	–	–	–
	15	–	–	–

1) U_{pp} = Peak-to-peak voltage

2) R_i = Internal resistance

Tab. 4.11 Pin allocation: encoder [X2]

The shaft encoder mounted on the motor shaft is used for commutation of a 3-phase synchronous motor and as an actual-value recorder for the built-in speed and position controller. The following encoders are supported depending on the motor type:

– Absolute encoder (single-turn, multi-turn)
– Digital EnDat 2.1 or 2.2 interface, digital angle information only (analogue SIN-COS signals from the encoders are not supported)
– Maximum current consumption of 200 mA.

Supply voltage for the encoders is taken from the internal +5 V logic supply. The supply voltage tolerance is limited downwards. Voltage drops on the connecting cable are not compensated.

Use of third-party cables

– Double wiring of the supply cable:
  The wiring used for the supply cables is to be doubled depending on current consumption and cable length. Example:
  when using encoder wiring that exhibits a cable diameter of 0.5 mm^2, a cable length of 25 m (50 m supply and return), and a current consumption of 200 mA, the voltage drop for a single wiring configuration is Udiff ~ 0.36 V. ➔ A double wiring configuration is required (Udiff ~ 0.18 V).
– Screening:
  - Run the encoder cable so it is screened
  - Twist differential (unscreened) signal cables in pairs (DATA/#DATA, SCLK/#SCLK, +5 V/0 V)
  - 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
  - Provide cable screens on the screened pairs (internal screens) that are galvanically isolated from the outer screen, and only place on controller side of connection [X2.3]
  - Apply the complete screening to the plug housing on the motor and controller side.

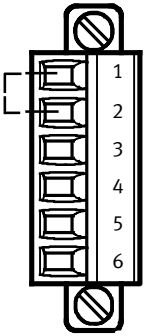
4.5 STO interface [X3]

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-4)	Phoenix Contact - MC 1.5/6-STF3.81 BK

Tab. 4.12 Connection: STO interface [X3]

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

[X3]	Pin		Value	Description
	1	24 V	+24 V DC	Voltage output (24 V DC logic supply carried out as auxiliary voltage)
	2	Rel	0 V / 24 V	Driver supply relay control.
	3	0 V	0 V	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. 4.13 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. 4.13.

This deactivates the integrated safety function!

When using this circuitry for the CMMS-AS-C4-3A-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 does not provide protection against electric shock, only against hazardous movements. For intended use of the safety function STO – “Safe Torque Off” (➔ Description of STO safety function, GDCP-CMMS-AS-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. 4.13.

Recommendation for first commissioning without safety equipment:

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.

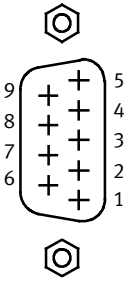
Lack of the safety function can result in serious, irreversible injuries, e.g. due to uncontrolled movements of the connected actuator technology. Bypassing of safety equipment is impermissible.

- 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. 4.14 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	Screen-ing	–	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. 4.15 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. 4.16 Connection: RS232/RS485 [X5]

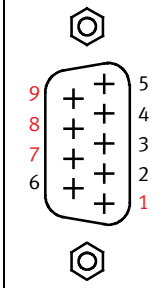
Please note

Transmission fault during simultaneous access.

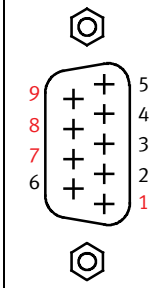
The RS232 and RS485 interfaces can be used to access the controller at the same time RS485 communication is active.

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, Ri > 2 kΩ	Receive signal
	3	RS232_TxD	10 V, Ra < 2 kΩ	Transmission signal
	4	RS485_A	Do not connect!	
	5	GND	0 V	Reference potential 0 V DC, not galvanically isolated
	6	–	–	–
	7	–	–	–
	8	–	–	–
	9	RS485_B	Do not connect!	

Tab. 4.17 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 receive signal
	5	GND	0 V	Reference potential 0 V DC, not galvanically isolated
	6	–	–	–
	7	–	–	–
	8	–	–	–
	9	RS485_B	–	Negative transmission and reception signal

Tab. 4.18 Pin allocation RS485 [X5]

4.8 Motor [X6]

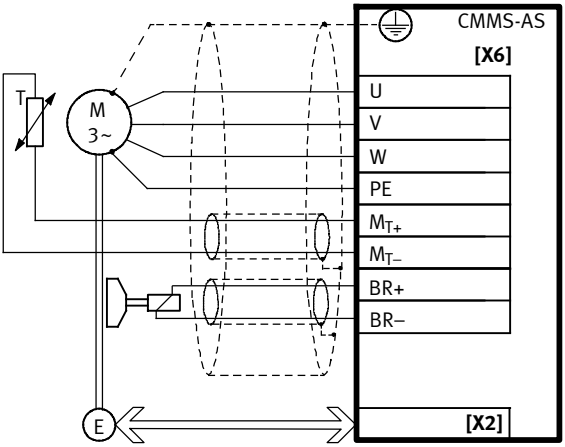
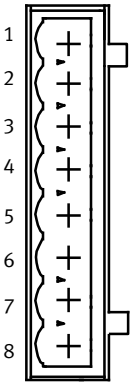


Fig. 4.2 Connection to the motor

4.8.1 Pin allocation

Process valve	version
[X6] on the motor controller	Phoenix Contact - MSTBA 2.5/8-G5.08 BK
Counterplug (plug set NEKM-C-4)	Phoenix Contact - MSTB 2.5/8-ST5.08 BK

Tab. 4.19 Motor connection

[X6]	Pin		Value	Description
	1	BR–	0 V	For motors EMMS-AS-...- TS**B**/TM**B**: holding brake (motor)[2]
	2	BR+	24 V	
	3	M_{T-}	0 V	– Temperature sensor[1][2] – Optional N/C contact, N/O contact, PTC or KTY[2] – For EMMS-AS motors: PTC[2]
	4	M_{T+}	+ 3.3 V 5 mA	
	5	PE	–	PE connection of the motor cable
	6	W	3 x 0 ... Max. input voltage 10 A_{eff}	Connection of the three motor phases ➔ Appendix A.2.7
	7	V		
	8	U		

1) In the motor and connecting cable, reliable separation of the motor temperature sensor from the motor circuit must be ensured.

2) Use cables with individually twisted and screened pairs.

Tab. 4.20 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 4.2.1.

4.8.3 Connection of a holding brake

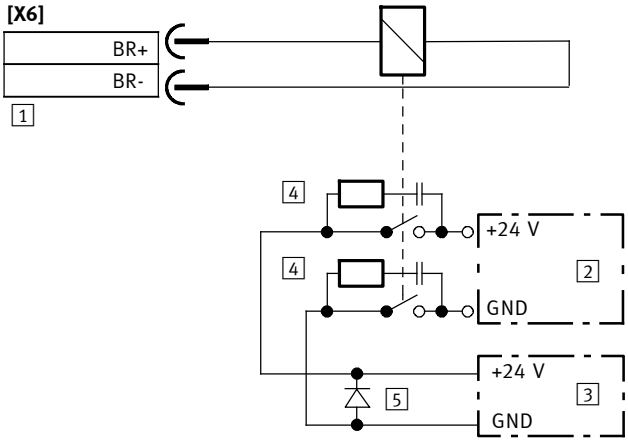
Holding brakes are not appropriate for braking the motor. They only serve functional holding of the motor shaft. Additional measures are required for use in safety-oriented applications.

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+ [X6.2] and BR- [X6.1]. 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.9, logic supply).

- Observe the maximum output current provided by the motor controller (➔ Tab. A.9).
  In the event of a high power requirement, a relay must be connected between the controller and holding brake.



1 Motor controller
2 Power pack
3 Motor (brake)
4 RC element for spark arresting
5 Freewheeling diode

Fig. 4.3 Connection of a holding brake with high power requirement

High voltages with spark formation are created when inductive direct currents are connected via relays.

Recommendation:

Use an integrated RC interference suppressor, e. g.

- Company: Evox RIFA
- RC element: 22 Ω in series with 0.47 µF
- Designation: PMR205AC6470M022

4.9 Power supply [X9]

4.9.1 Logic power supply – protective extra-low voltage (PELV)

Warning
Danger of electric shock

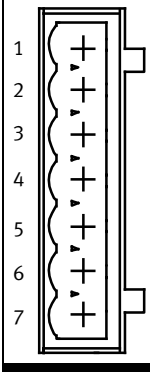
- Use for the electrical power supply only PELV circuits in accordance with EN 60204-1 (Protective Extra-Low Voltage, PELV).
  Also observe the general requirements for PELV circuits as per EN 60204-1.
- Use only voltage sources that ensure a reliable electric separation of operating voltage in accordance 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 - MSTBA 2.5/7-G-5.08 BK
Counterplug (plug set NEKM-C-4)	Phoenix Contact - MSTB 2.5/7-ST-5.08 BK

Tab. 4.21 Connection, power supply

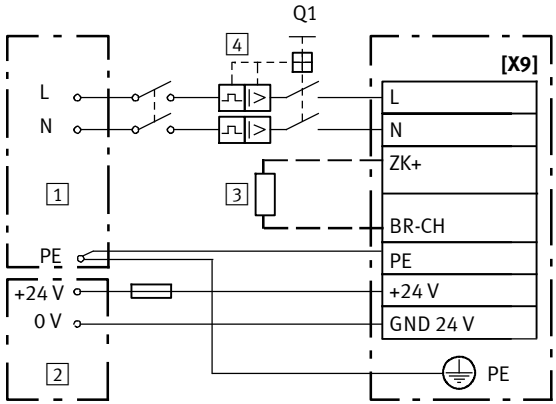
[X9]	Pin		Value	Description
	1	L1	single-phase	Mains voltage connection for
	2	N	95 ... 250 V AC	intermediate circuit voltage
	3	IC +	320 V DC (max. 400 V DC)	Connection for the external braking resistor R_{BR} › 100 Ω, parallel to the
	4	BR-CH	0 V/400 V, Max. 4 A	internal braking resistor, Not short-circuit proof against L1, N, PE
	5	PE	PE	Mains-side PE connection
	6	24 V	+24 V/1.7 A	Supply for the control section, with DCDC converter, DOUT0 to DOUT3 and holding brake, max. 1.7 A
	7	0 V	GND	Common reference potential for the logic power supply and control section

Tab. 4.22 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, and also for brief measuring and test purposes, connect the PE protective conductor ➔ Fig. 4.4:
  – to the earthing screw of the controller housing
  – to pin PE [X9.5], power supply.

  The cross section of the protective conductor at PE [X9.5] must correspond at least to the cross section of the external conductor L [X9.1].



1 Mains voltage 95 ... 250 V AC
2 24 V power pack
3 External braking resistor
4 Fuse ➔ Chapter A.2.1

Fig. 4.4 Connection to the supply voltage

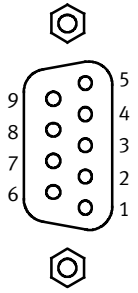
4.10 Master/slave interface [X10]

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, bush
Counterplug	Sub-D plug connector, 9-pin, pins

Tab. 4.23 Connection of master/slave interface

[X10]	Pin	Designation	Value	Description
	1	A CLK CW	5 V DC Ri = 120 Ω max. 150 kHz	– Tracking signal A – Pulse CLK – Pulses clockwise CW – Positive polarity in accordance with RS422
	2	B DIR CCW	5 V Ri = 120 Ω max. 150 kHz	– Tracking signal B – Direction DIR – Pulses counterclockwise CCW – Positive polarity in accordance with RS422
	3	N	5 V Ri = 120 Ω max. 150 kHz	– Incremental encoder zero pulse N – Positive polarity in accordance with RS422
	4	GND [1]	–	Reference GND for incremental encoder
	5	VCC	+5 V ±5 %, 100 mA	Auxiliary supply, max. load 100 mA, short-circuit proof
	6	#A #CLK #CW	5 V Ri = 120 Ω max. 150 kHz	– Tracking signal A – Pulse CLK – Pulses clockwise CW – Negative polarity in accordance with RS422
	7	#B #DIR #CCW	5 V Ri = 120 Ω max. 150 kHz	– Tracking signal B – Direction DIR – Pulses counterclockwise CCW – Negative polarity in accordance with RS422
	8	#N	5 V Ri = 120 Ω max. 150 kHz	– 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. 4.24 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 PE.

- Comply with the specified values for the supply voltage.
- Before switching on, check connections [X9] and [X6].
- Check to ensure there is no PE 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 PE 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].
- DeviceNet/RS485: Check the connection of the terminating resistor.

Implement the following settings:

- Make sure that controller enable is not present at DIN5 [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 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

Warning
Danger of electric shock.
Touching live parts causes severe injuries and can lead to death. Do not disconnect connecting cables when powered.
Before touching live parts during 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 5 minutes 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.

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,		– integrated: CANopen, RS485 – optional: PROFIBUS DP, DeviceNet
Digital I/O Analogue I/O		– DIN0 ... 13, DOUT0 ... 3 – AMON/AGND, AIN0/#AIN0
Protective functions		– Short circuit in output stage – Intermediate circuit over/undervoltage – Temperature monitoring for motor and power section – I^2t monitoring with early reduction in current when motor shaft is blocked
Dimensions and weight		
Dimensions (H*W*D)	[mm]	➔ Fig. 3.1 and Tab. 3.1
Weight	[kg]	1.5
Product conformity and certifications		
CE marking (Declaration of conformity ➔ www.festo.com)		In accordance with EU Machinery Directive 2006/42/EC
		To EC Low Voltage Directive 2006/95/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 ... 2000 (max.)
Relative air humidity	[%]	0 ... 90 (non-condensing)
Degree of protection		IP20
Protection class		I
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 Power section	[°C]	≥ 95
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 Mains fuse

Mains fuse	
Automatic circuit breaker	1-phase
Nominal current	16 A
Characteristic	B, slow-blow

Tab. A.3 Connection data: Mains fuse

A.2.2 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 0 V)
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
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	[µs]	< 250
Protective function		Overvoltage to ±30 V
Analogue output		
Number		1
Signal level	[V DC]	0 ... 10
version		Single-ended against AGND
Resolution	[bit]	8
Output reaction time	[µs]	< 250
Protective function		Short circuit against AGND

Tab. A.4 Connection data: I/O interface [X1]

A.2.3 Encoder [X2]

Encoder [X2]		
Communication protocol		Heidenhain EnDat 2.1 and 2.2
cable	[m]	l ≤ 25 m, screened Design in accordance with Heidenhain specification
Signal level DATA, SCLK	[V]	5 V (differential, RS422, RS485)
Angle resolution/number of lines	[Bit/U]	16
Limit frequency SCLK	[MHz]	2
Encoder supply (from the controller)		
Voltage	[V DC]	5 (-0 % ... +5 %)
Current	[mA]	≤ 200
Sense line for power supply		not supported

Tab. A.5 Connection data: Encoder [X2] (input)

A.2.4 STO interface [X3]

Technical data for STO interfaces [X3] ➔ Description of STO safety function, GDCP-CMMS-AS-G2-S1-....

A.2.5 CAN [X4]

CAN		
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 (can be activated via DIP switches)

Tab. A.6 Connection data: CAN-Bus [X4]

A.2.6 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 15 kV

Tab. A.7 Connection data: RS232/RS485 [X5]

A.2.7 Motor [X6]

Motor [X6]		
Cabling		
Thermal rated value	[°C]	60/75 class 1
cable		Screened
without external filters	[m]	l ≤ 15
with ferrite core via motor line (Ferroxcube TX26/15/20 3C90)	[m]	l≤ 25
Cable capacitance of one phase against screen or between two lines	[pF/m]	≤ 200
Conductor cross-section (plug connector)		
Flexible conductor	[mm²]	0.25 ... 2.5
– Wire end sleeve without insulating collar	[mm²]	0.25 ... 2.5
– Wire end sleeve with insulating collar	[mm²]	0.25 ... 2.5
Terminal tightening torque	[Nm]	0.5 ... 0.6
Output data		
Output voltage range	[V AC]	0 ... input voltage
Nominal output current I_{eff}	[A]	4
Peak current I_{eff}	[A]	10
Peak current duration		
with running motor	[s]	2
with stopped motor	[s]	0.5
Output frequency	[Hz]	1 ... 1000
PWM frequency	[kHz]	10
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)[1)]		
R_{Cold}	[kΩ]	< 1
R_{Hot}	[kΩ]	> 10

1) In the motor and connecting cable, reliable separation of the motor temperature sensor from the motor circuit must be ensured.

Tab. A.8 Connection data: Motor connection [X6]

A.2.8 Power supply and braking resistor [X9]

Power supply [X9]		
Cabling		
cable	[m]	l ≤ 2, unshielded
Conductor cross-section (plug connector)		
Flexible conductor		
– Wire end sleeve without insulating collar	[mm²]	0.25 ... 2.5
– Wire end sleeve with insulating collar	[mm²]	0.25 ... 2.5
Terminal tightening torque	[Nm]	0.5 ... 0.6
Load supply		
Nominal operating voltage	[V AC]	230
Input voltage range	[V AC]	95 ... 250
Nominal operating voltage phases		1-phase
Nominal current	[A]	5
Rated output (intermediate circuit)		
Mounting grid 70 mm Equipment clearance 10 mm	[W]	400
Mounting grid 140 mm Equipment clearance 80 mm	[W]	600
Intermediate circuit voltage	[V DC]	320
Max. intermediate circuit voltage	[V DC]	400
End stage power loss	[W]	30 ... 35
Own power loss control section	[W]	8
Mains frequency	[Hz]	50 ... 60
Surge resistance	[kV]	4
Logic supply		
Nominal voltage	[V DC]	24 ± 20%
Max. ripple in input voltage	[V]	1.0 at 100 Hz
current consumption – Outputs load-free – Without current for holding brake	[A]	0.35
Max. current (incl. holding brake)	[A]	1.7

Tab. A.9 Connection data: Power supply [X9]

Braking resistor		
Operating voltage range	[V DC]	380 ... 400
Integrated braking resistor		
Braking resistor	[Ω]	230
Pulse power (for 100 ms)	[W]	700
Rated output	[W]	15
Rated trigger level	[V]	390
Hysteresis	[V]	10
Connection for external braking resistor		
Braking resistor	[Ω]	≥ 100
Pulse power (for 500 ms)	[W]	≤ 1600
Nominal power	[W]	≤ 100
Operating voltage	[V DC]	400

Tab. A.10 Technical data: braking resistor

Please note

- Make sure the external braking resistor is provided with sufficient pulse power (> 1600 Watt). The resistance value of the connected braking resistor must be at least 100 Ω.

The required impulse power must be calculated as follows: $P_{peak} = \frac{U_{dc}^2}{R_{br}}$

whereby: P_{peak} = pulse power; U_{dc} = max. response voltage; R_{br} = external brake resistor

A.2.9 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.11 Connection data: Master/slave interface [X10]

B Diagnostic messages

B.1 Explanations on the diagnostic messages

The subsequent error tables include the following information:

Column	Significance
no.	Main index and sub-index of the diagnostic message
Code	The Code column includes the error code (Hex) via CiA 402.
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): – PS off (block output stage), – QStop (quick stop with parametrised ramp) – Warn (Warning) – Ignore.

Tab. B.1 Explanations of the error tables

The Reaction column includes the error responses of the default parameter set. After configuration of the motor controller with FCT, the standard values defined in the FCT or the configured reactions apply.

A complete list of the diagnostic messages corresponding to the firmware statuses at the time of printing of this document can be found in section B.2

B.2 Diagnostic messages with instructions for fault clearance

Error group 01		**Internal faults**	
No.	Code	Message	Reaction
01-0	6180 h	**Stack overflow**	PS off
		Cause	– Incorrect firmware? – Sporadic high processor load due to special compute-bound processes (save parameter set, etc.).
		Action	• Load approved firmware. • Contact Technical Support.

Error group 02		**Intermediate circuit**	
No.	Code	Message	Reaction
02-0	3220 h	**Undervoltage in intermediate circuit**	configurable
		Cause	– Intermediate circuit voltage falls below the parameterised threshold.
		Action	• 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	4310 h	**Temperature monitoring, motor**	configurable
		Cause	Motor overloaded, temperature too high. – Motor too hot. – Sensor defective?
		Action	• 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	4210 h	**Excess/low temperature of power electronics**		configurable
		Cause	Motor controller is overheated. – Motor controller overloaded? – Temperature display plausible?	
		Action	• 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).	

Error group 05		**Internal power supply**		
No.	Code	Message		Reaction
05-0	5114 h	**5 V electronics supply fault**		PS off
		Cause	Monitoring of the internal power supply has recognised undervoltage. This is either due to an internal defect or an overload/ short circuit caused by connected peripherals.	
		Action	• Separate device from the entire peripheral equipment and check whether the error is still present after reset. If yes, then there is an internal defect ➔ Repair by the manufacturer.	
05-1	5115 h	**Error in 24 V supply**		PS off
		Cause	Monitoring of the internal power supply has recognised undervoltage.	
		Action	• Check 24 V logic supply. • Separate device from the entire peripheral equipment and check whether the error is still present after reset. If yes, then there is an internal defect ➔ Repair by the manufacturer.	
05-2	8000 h	**Error in driver supply**		PS off
		Cause	Error in the plausibility check of the driver supply (safe torque off)	
		Action	• Separate device from the entire peripheral equipment and check whether the error is still present after reset. If yes, then there is an internal defect ➔ Repair by the manufacturer.	

Error group 06		**Intermediate circuit**		
No.	Code	Message		Reaction
06-0	2320 h	**Over-current of the intermediate circuit/output stage**		PS off
		Cause	– Motor defective. – Short circuit in the cable. – Output stage defective.	
		Action	• Check motor, cable and motor controller.	

Error group 07		**Intermediate circuit**		
No.	Code	Message		Reaction
07-0	3210 h	**Overvoltage in intermediate circuit**		PS off
		Cause	Braking resistor is overloaded; too much braking energy, which cannot be dissipated quickly enough. – Resistor capacity is incorrect? – Resistor not connected correctly? – Check design (application)	
		Action	• Check the design of the braking resistor (positioning drives); resistance value may be too great. • Check the connection to the braking resistor (internal/external).	

Error group 08		**Angle encoder**		
No.	Code	Message		Reaction
08-6	7386 h	**Angle encoder communication fault**		PS off
		Cause	Communication to serial angle encoders is disrupted (EnDat encoders). – Angle encoder connected? – Angle encoder cable defective? – Angle encoder defective?	
		Action	• Check whether encoder signals are faulty. • Test with another encoder. • Check angle encoder cable. For operation with long motor cables: • Observe notes on EMC-compliant installation! Additional anti-interference measures required from 15 m cable length.	
08-8	7388 h	**Internal angle encoder error**		PS off
		Cause	Internal monitoring of the angle encoder has detected an error and forwarded it via serial communication to the controller. Possible causes: – Excess rotational speed. – Angle encoder defective.	
		Measure	If the error occurs repeatedly, the encoder is defective. ➔ Replace encoder including encoder cable.	

Error group 11		**Homing**		
No.	Code	Message		Reaction
11-1	8A81 h	**Homing error**		PS off
		Cause	Homing was interrupted, e.g. by: – withdrawal of controller enable. – reference switch located beyond the limit switch. – external stop signal (termination of a homing phase).	
		Action	• 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	8181 h	**CAN: general error**		configurable
		Cause	Other CAN error. Triggered by the CAN controller itself and is used as a common error for all further CAN errors.	
		Action	• Re-start CAN controller. • Check CAN configuration in the controller. • Check wiring.	
12-1	8181 h	**CAN: error bus off**		configurable
		Cause	Errors can occur if the CAN control malfunctions or is deliberately requested by the controller of the bus-off status.	
		Action	• Re-start CAN controller. • Check CAN configuration in the controller. • Check wiring.	
12-2	8181 h	**CAN: Error when transmitting**		configurable
		Cause	Error when sending a message (e.g. no bus connected).	
		Action	• Re-start CAN controller • Check CAN configuration in the controller • Check wiring	
12-3	8181 h	**CAN: Error when receiving**		configurable
		Cause	Error receiving a message.	
		Action	• 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?	

Error group 12		**CAN**		
No.	Code	Message		Reaction
12-4	8130 h	**CAN: Time-out Nodeguarding**		configurable
		Cause	Node guarding telegram not received within the parametrised time. Signals corrupted?	
		Action	• Compare cycle time of the remote frames with that of the controller. • Check: Failure of the controller?	
12-5	8181 h	**CAN: Error in the IPO mode**		configurable
		Cause	Over a period of 2 SYNC intervals, the SYNC telegram or the PDO of the controller has failed.	
		Action	• 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	6197 h	**Error, motor identification**		PS off
		Cause	Error in automatic determination of the motor parameters.	
		Action	• 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**		PS off
		Cause	Error in initialising the default parameters.	
		Action	• In case of repetition, load firmware again. If the error occurs repeatedly, the hardware is defective.	
16-3	6183 h	**Unexpected status / programming error**		PS off
		Cause	The software has taken an unexpected status. For example, unknown status in the FHPP state machine.	
		Action	• 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	8611 h	**Following error monitoring**	configurable
		Cause: Comparison threshold for the limit value of the following error exceeded.	
		Action: • 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	4280 h	**Output stage temperature 5 °C below maximum**	configurable
		Cause: The output stage temperature is greater than 90 °C.	
		Action: • 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	2380 h	**I²t at 80 %**	configurable
		Cause: Of the maximum I²t workload of the controller or motor, 80 % has been achieved.	
		Action: • Check whether motor/mechanics are blocked or sluggish.	

Error group 21		**Current measurement**	
No.	Code	Message	Reaction
21-0	5210 h	**Error, offset current measurement**	PS off
		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. • Send motor controller to the manufacturer.	

Error group 22		**PROFIBUS**	
No.	Code	Message	Reaction
22-0	7500 h	**Error in PROFIBUS initialization**	PS off
		Cause: Fieldbus interface defective.	
		Action: • Please contact Technical Support.	

Error group 22		**PROFIBUS**		
No.	Code	Message		Reaction
22-2	7500 h	**PROFIBUS communication error**		PS off
		Cause	– Faulty initialization of the PROFIBUS interface. – Interface defective.	
		Action	• Check the set slave address. • Check bus termination. • Check wiring.	

Error group 25		**Firmware**		
No.	Code	Message		Reaction
25-1	6081 h	**Incorrect firmware**		PS off
		Cause	Motor controller and firmware are not compatible.	
		Action	• Update the firmware.	

Error group 26		**Data flash**		
No.	Code	Message		Reaction
26-1	5581 h	**Checksum error**		PS off
		Cause	Checksum error of a parameter set.	
		Action	• Load factory setting. • If the error is still present, the hardware is defective.	

Error group 29		**SD card**		
No.	Code	Message		Reaction
29-0	7680 h	**No SD available**		configurable
		Cause	An attempt was made to access a missing SD card.	
		Action	Check: • whether the SD card is inserted properly, • whether the SD card is formatted, • whether a compatible SD card is plugged in.	
29-1	7681 h	**SD initialization error**		configurable
		Cause	– Error during initialization. – Communication not possible.	
		Action	• Plug card back in. • Check card (file format FAT 16). • If necessary, format card.	

Error group 29		**SD card**	
No.	Code	Message	Reaction
29-2	7682 h	**SD parameter set error**	configurable
		Cause	– Checksum incorrect. – File not present. – File format incorrect. – Error saving the parameter file on the SD card.
		Action	• Check content (data) of the SD card.

Error group 31		**I²t monitoring**	
No.	Code	Message	Reaction
31-0	2312 h	**I²t-error motor (I²t at 100%)**	configurable
		Cause	I²t monitoring of the controller has been triggered. – Motor/mechanical system blocked or sluggish. – Motor under-sized?
		Action	• Check motor and mechanical system.
31-1	2311 h	**I²t error controller (I²t at 100%)**	configurable
		Cause	I²t monitoring of the controller has been triggered.
		Action	• Check power dimensioning of drive package.

Error group 32		**Intermediate circuit**	
No.	Code	Message	Reaction
32-0	3280 h	**Intermediate circuit charging time exceeded**	PS off
		Cause	The intermediate circuit could not be charged after the mains voltage was applied. – Fuse possibly defective. – Internal braking resistor defective. – In operation with external braking resistor, the resistor is not connected
		Action	• Check mains voltage (intermediate circuit voltage < 150 V) • Check interface to the external braking resistor. • If the interface is correct, the internal braking resistor or the built-in fuse is presumably faulty ➔ Repair by the manufacturer.
32-8	3285 h	**Power supply failure during controller enable**	PS off
		Cause	Interruption/power failure while the controller enable was active.
		Action	• Check mains voltage/power supply.

Error group 35		**Fast stop**		
No.	Code	Message		Reaction
35-1	6199 h	**Time out with fast stop**		PS off
		Cause	The parameterised time for fast stop was exceeded.	
		Action	• Check parameterisation.	

Error group 40		**Software limit**		
No.	Code	Message		Reaction
40-0	8612 h	**Negative software limit switch reached**		configurable
		Cause	The position setpoint value has reached or exceeded the negative software limit switch.	
		Action	• Check the target data. • Check positioning area.	
40-1	8612 h	**Positive software limit switch reached**		configurable
		Cause	The position setpoint value has reached or exceeded the positive software limit switch.	
		Action	• Check the target data. • Check positioning area.	
40-2	8612 h	**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	• Check the target data. • Check positioning area.	
40-3	8612 h	**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	• Check the target data. • Check positioning area.	

Error group 41		**Path program**		
No.	Code	Message		Reaction
41-8	6193 h	**Path program error, unknown command**		configurable
		Cause	Unknown command found during record continuation.	
		Action	• Check parameterisation.	
41-9	6192 h	**Error in path program jump destination**		configurable
		Cause	Jump to a positioning record outside the permitted range.	
		Action	• Check parameterisation.	

Error group 42		**Positioning**	
No.	Code	Message	Reaction
42-1	8681 h	**Positioning: Error in pre-computation**	configurable
		Cause	Positioning cannot be reached through the options of the positioning (e.g. final speed) or parameters.
		Action	• Check parametrisation of the position records in question.
42-4	8600 h	**Message, homing required**	configurable
		Cause	– Positioning not possible without homing. – Homing must be carried out.
		Action	• Reset optional parameterisation “Homing required”. • Carry out a new homing run after acknowledgement of an angle encoder error.
42-9	6191 h	**Error in position data record**	PS off
		Cause	– 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	• Check parameterisation and sequence control and correct, if necessary.

Error group 43		**Limit switch error**	
No.	Code	Message	Reaction
43-0	8612 h	**Negative limit switch error**	configurable
		Cause	Negative hardware limit switch reached.
		Action	• Check parameterisation, wiring and limit switches.
43-1	8612 h	**Positive limit switch error**	configurable
		Cause	Positive hardware limit switch reached.
		Action	• Check parameterisation, wiring and limit switches.
43-9	8612 h	**Error in limit switch**	configurable
		Cause	Both hardware limit switches are active simultaneously.
		Action	• Check parameterisation, wiring and limit switches.

Error group 45		**STO error**		
No.	Code	Message		Reaction
45-0	8000 h	**Error in driver supply**		PS off
		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. • 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	8000 h	**Error in driver supply**		PS off
		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. • 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	8000 h	**Error in driver supply**		PS off
		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	8087 h	**DIN4 plausibility error**		PS off
		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	7582 h	**DeviceNet communication error**		PS off
		Cause	Node number exists twice.	
		Action	• Check the configuration.	
64-1	7584 h	**DeviceNet general error**		PS off
		Cause	The 24 V bus voltage is missing.	
		Action	• In addition to the motor controller, the DeviceNet interface must also be connected to 24 V DC.	

Error group 64		**DeviceNet error**	
No.	Code	Message	Reaction
64-2	7582 h	**DeviceNet communication error**	PS off
		Cause	– Receive buffer overflow. – Too many messages received within a short period.
		Action	• Reduce the scan rate.
64-3	7582 h	**DeviceNet communication error**	PS off
		Cause	– Send buffer overflow. – Insufficient free space on the CAN bus to transmit messages.
		Action	• Increase the baud rate. • Reduce the number of nodes. • Reduce the scan rate.
64-4	7582 h	**DeviceNet communication error**	PS off
		Cause	IO-message could not be sent
		Action	• Check that the network is connected correctly and does not malfunction.
64-5	7582 h	**DeviceNet communication error**	PS off
		Cause	Bus off.
		Action	• Check that the network is connected correctly and does not malfunction.
64-6	7582 h	**DeviceNet communication error**	PS off
		Cause	Overflow in the CAN controller.
		Action	• Increase the baud rate. • Reduce the number of nodes. • Reduce the scan rate.

Error group 65		**DeviceNet error**	
No.	Code	Message	Reaction
65-0	7584 h	**DeviceNet general error**	configurable
		Cause	– Communication is activated, even though no interface is plugged in. – The DeviceNet interface is attempting to read an unknown object. – Unknown DeviceNet error.
		Action	• Check whether the DeviceNet interface is plugged in correctly. • Check that the network is connected correctly and does not malfunction.
65-1	7582 h	**DeviceNet communication error**	configurable
		Cause	I/O connection timeout. No I/O message received within the expected time.
		Action	• Please contact Technical Support.

Error group 70		**Operating mode error**		
No.	Code	Message		Reaction
70-2	6195 h	**General arithmetic error**		PS off
		Cause	The fieldbus factor group cannot be calculated correctly.	
		Action	• Check the factor group.	
70-3	6380 h	**Operating mode error**		configurable
		Cause	This operating mode change is not supported by the motor controller.	
		Action	• Check your application. Not every change is permissible.	

Error group 79		**RS232 error**		
No.	Code	Message		Reaction
79-0	7510 h	**RS232 communication error**		configurable
		Cause	Overflow when receiving RS232 commands.	
		Action	• Check wiring. • Check the transmitted data.	

B.3 Error codes via CiA 301/402

Diagnostic messages			
Code	no.	Message	Reaction
2311 h	31-1	I²t error controller (I²t at 100%)	configurable
2312 h	31-0	I²t-error motor (I²t at 100%)	configurable
2320 h	06-0	Over-current of the intermediate circuit/output stage	PS off
2380 h	19-0	I²t at 80 %	configurable
3210 h	07-0	Overvoltage in intermediate circuit	PS off
3220 h	02-0	Undervoltage in intermediate circuit	configurable
3280 h	32-0	Intermediate circuit charging time exceeded	PS off
3285 h	32-8	Power supply failure during controller enable	PS off
4210 h	04-0	Excess/low temperature of power electronics	configurable
4280 h	18-1	Output stage temperature 5 °C below maximum	configurable
4310 h	03-1	Temperature monitoring, motor	configurable
5114 h	05-0	5 V electronics supply fault	PS off
5115 h	05-1	Error in 24 V supply	PS off
5210 h	21-0	Error, offset current measurement	PS off
5581 h	26-1	Checksum error	PS off
6081 h	25-1	Incorrect firmware	PS off
6180 h	01-0	Stack overflow	PS off
6183 h	16-3	Unexpected status / programming error	PS off
6187 h	16-2	Initialization fault	PS off
6191 h	42-9	Error in position data record	PS off
6192 h	41-9	Error in path program jump destination	configurable
6193 h	41-8	Error in path program jump destination	configurable
6195 h	70-2	General arithmetic error	PS off
6197 h	14-9	Error, motor identification	PS off
6199 h	35-1	Time out with fast stop	PS off
6380 h	70-3	Operating mode error	configurable
7386 h	08-6	Angle encoder communication error	PS off
7388 h	08-8	Internal angle encoder error	PS off
7500 h	22-0	Error in PROFIBUS initialization	Configurable
	22-2	PROFIBUS communication error	configurable
7510 h	79-0	RS232 communication error	configurable
7582 h	64-0	DeviceNet communication 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
	65-1	DeviceNet communication error	configurable
7584 h	64-1	DeviceNet general error	PS off

Diagnostic messages			
Code	no.	Message	Reaction
	65-0	DeviceNet general error	configurable
7680 h	29-0	No SD available	configurable
7681 h	29-1	SD initialization error	configurable
7682 h	29-2	SD parameter set error	configurable
8000 h	45-0	Error in driver supply	PS off
	45-1	Error in driver supply	PS off
	45-2	Error in driver supply	PS off
	05-2	Error in driver supply	PS off
8087 h	45-3	DIN4 plausibility error	PS off
8130 h	12-4	CAN: Time-Out Nodeguarding	configurable
8181 h	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
8600 h	42-4	Message, homing required	configurable
8611 h	17-0	Following error monitoring	configurable
8612 h	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
	43-0	Negative limit switch error	configurable
	43-1	Positive limit switch error	configurable
	43-9	Error in limit switch	configurable
8681 h	42-1	Positioning: Error in pre-computation	configurable
8A81 h	11-1	Homing error	PS off

B.4 PROFIBUS diagnostics

Diagnostic messages					
Unit_Diag_Bit			no.	Message	Reaction
00	E429	Position data set	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 pre-computation	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	PS off
06	E261	Checksum error	26-1	Checksum error	PS off
07	E162	Initialisation	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-x	Unknown error (CAN)	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	Error in path program jump destination	configurable
20	-	unknown	64-x	Unknown error (DeviceNet)	PS off
			65-x	Unknown error (DeviceNet)	Configurable
23	E220	PROFIBUS assembly	22-0	Error in PROFIBUS initialization	Configurable
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
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

Diagnostic messages

Unit_Diag_Bit			no.	Message	Reaction
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
40	E320	Loading time link overflow	32-0	Intermediate circuit charging time exceeded	PS off
41	E328	Fail. power supply ctr.ena.	32-8	Power supply failure during controller enable	PS off
42	E310	I2t-error motor	31-0	I²t-error motor (I²t at 100%)	configurable
43	E311	I2t-error controller	31-1	I²t error controller (I²t at 100%)	configurable
45	E052	Driver supply	45-0	Error in driver supply	PS off
			45-1	Error in driver supply	PS off
			45-2	Error in driver supply	PS off
			05-2	Error in driver supply	PS off
46	E453	Plausibility DIN 4	45-3	DIN4 plausibility error	PS off
47	E124	Time out Nodeguarding	12-4	CAN: Time-out Nodeguarding	configurable
48	E050	5 V - Internal supply	05-0	5 V electronics supply fault	PS off
50	E051	24 V - 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
61	E086	SINCOS-RS485 communication	08-6	Angle encoder communication error	PS off
62	E088	SINCOS track signals	08-8	Internal angle encoder error	PS off

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