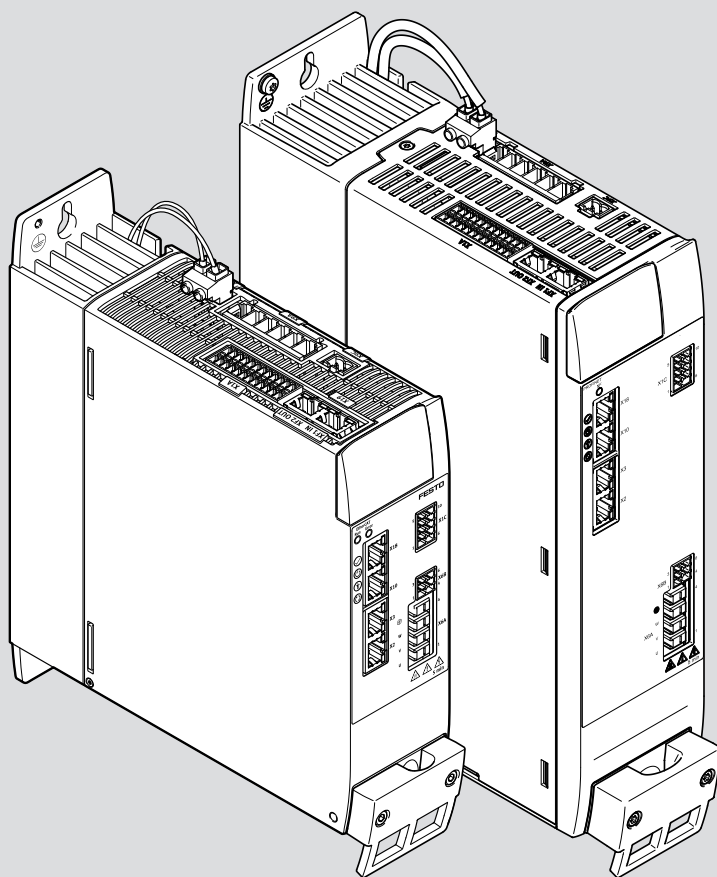


CMMT-AS-C2/3/5/7/12/18/25-11A-P3-...

Servo drive

FESTO

Manual | Assembly, Installation



8250689

8250689
2026-02j
[8250691]

Original instructions

BiSS, CiA, EnDat, EtherCAT®, EtherNet/IP, HEIDENHAIN, Hiperface, MODBUS, Nikon, PHOENIX CONTACT, PI PRO-FIBUS PROFINET, PROFIdrive, TORX are registered trademarks of the respective trademark owners in certain countries.

Table of contents

1	About this document	6
1.1	Target group	6
1.2	Applicable documents	6
1.3	Product variants	6
1.4	Product labelling	7
1.5	Specified standards	8
2	Safety	9
2.1	Safety instructions	9
2.2	Intended use	10
2.2.1	Application areas	10
2.2.2	Permissible components	10
2.3	Training of qualified personnel	11
2.4	Product conformity	11
2.5	Safety engineering approval	11
2.6	UL/CSA certification	11
2.7	Cyber security measures	11
3	Additional information	11
4	Product overview	12
4.1	Scope of delivery	12
4.2	System structure	12
4.2.1	Product design	14
4.2.2	Overview of connection technology	16
4.3	Setting bus protocol	17
5	Transport and storage	18
6	Assembly	19
6.1	Mounting clearances	20
6.2	Mounting	21
7	Installation	23
7.1	Safety	23
7.2	Residual current device	24
7.3	Mains fuse	25
7.4	Permissible and impermissible mains types of system earthing	26
7.5	Connection of the mains side PE conductor	29
7.6	Information on EMC-compliant installation	30
7.7	Connection examples	33
7.8	Interfaces	34
7.8.1	[X1A], inputs and outputs for the higher-order PLC	34
7.8.2	[X1C], inputs and outputs for the axis	40

7.8.3	[X2], encoder interface 1	41
7.8.4	[X3], encoder interface 2	46
7.8.5	[X10], SYNC IN/OUT	49
7.8.6	[X18], standard Ethernet	52
7.8.7	[X19], Real-time Ethernet (RTE) port 1 and port 2	53
7.9	Motor connection	54
7.9.1	[X6A], motor phase connection	54
7.9.2	[X6B], motor auxiliary connection	56
7.9.3	Electronic overload and over temperature protection for the motor	57
7.9.4	Shield support of the motor cable	58
7.10	Power and logic voltage supply	61
7.10.1	[X9A], power supply and DC link connection	61
7.10.2	[X9C], logic voltage supply	62
7.10.3	[X9B], connection for braking resistor	63
7.11	Cross-wiring	65
7.11.1	Cross-wiring of the I/O signals at the connection [X1A]	65
7.11.2	Cross-wiring of the mains and logic voltage supply	67
8	Malfunctions	72
8.1	Diagnostics via LED	72
8.1.1	Device status displays	73
8.1.2	Interface status [X2], [X3], [X10], [X18]	75
8.1.3	Device and interface status, EtherCAT	76
8.1.4	Device and interface status, PROFINET	77
8.1.5	Device and interface status, EtherNet/IP	78
9	Disassembly	79
10	Technical data	79
10.1	General technical data	79
10.2	Technical data, electrical	82
10.2.1	Load voltage supply [X9A]	82
10.2.2	Logic voltage supply [X9C]	83
10.2.3	Electrical data for braking resistor (internal/external) [X9B]	84
10.2.4	Motor connection power specifications [X6A]	85
10.2.5	Motor auxiliary connection [X6B]	87
10.2.6	Encoder interfaces [X2], [X3]	88
10.2.7	Inputs, outputs, ready contact at [X1A]	92
10.2.8	Inputs and outputs for the axis [X1C]	98
10.2.9	SYNC IN/OUT [X10]	100
10.2.10	Standard Ethernet [X18], parameterisation interface	101
10.2.11	Real-time Ethernet [X19] ([XF1 IN], [XF2 OUT])	101
10.3	Technical data of UL/CSA certification	101
10.4	Operation of the servo drive in the system	104
10.4.1	Cable lengths in combination with Festo motors	104
10.4.2	Power loss	106

1 About this document

1.1 Target group

The document is targeted towards individuals who perform assembly, installation and service work on the product.

1.2 Applicable documents



All available documents for the product → www.festo.com/sp.

The user documentation for the product also includes the following documents:

Identifier	Content
Operating instructions for the product	Installation, safety sub-function
Manuals for the product	Detailed description for assembly and installation
	Detailed description of safety sub-function
Manual/online help plug-in	Cyber security measures. Plug-in: – Functions and operation of the software – Initial commissioning wizard Firmware functions: – Configuration and parameterisation – Operating modes and operational functions – Diagnostics and optimisation Bus protocol/control: – Device profile – Controller and parameterisation
Festo Automation Suite online help	– Function of the Festo Automation Suite – Management and integration of device-specific plug-ins
Operating instructions CDSB	General functions of the operator unit

Tab. 1: User documentation for the product

1.3 Product variants

The product is available in a range of variants. The order code indicates the equipment features of the product variant (order code → Further information). This documentation describes the following product variants:

Characteristics	Order code	Type
Servo drive	CMMT-	Servo drive, series T
Motor type	AS-	AC synchronous
Nominal current	C2-	2 A
	C3-	3 A
	C5-	5 A
	C7-	7 A
	C12-	12 A
	C18-	18 A ¹⁾
	C25-	25 A ¹⁾
Nominal input voltage	11A-	400 V AC, 50 ... 60 Hz
Number of phases	P3-	3-phase
Bus protocol/control	MP-	Multi-protocol
	EC-	EtherCAT
	EP-	EtherNet/IP

Characteristics	Order code	Type
Bus protocol/control	PN-	PROFINET
Safety function	S1	Standard safety
Cooling method	–	Integrated cooling element
Firmware type	–	Basic type
	C..-	Customer variant ...
	S..-	Sales variant ...
Firmware version	–	Basic version
	V..-	Version ...
Certification	–	CE-compliant basic version

1) Only available as a multi-protocol device

Tab. 2: Product variants CMMT-AS-...-11A-P3 (e.g. CMMT-AS-C3-11A-P3-MP-S1)

This documentation refers to the following version:

– Servo drive CMMT-AS-...-S1, revision R01 and higher, see product labelling.

This is the first available revision.

- For later revisions of the product, check whether updated documentation is available → 3 Additional information.

1.4 Product labelling

– Observe the specifications on the product.

The product labelling is located on the right side of the device. The product labelling enables identification of the product and shows the following information, for example:

Product labelling (example)	Meaning
CMMT-AS-C2-11A-P3-MP-S1	Order code
5340821 MM-YYYY : 02 Rev 00	Part number, serial number (MM = production month, YYYY = production year, plant number), revision (Rev)
Main input: 3 x 200 V AC - 10% ... 480 V AC + 10% 48 ... 62 Hz 2 A _{RMS}	Technical data on power supply (alternating current supply connection)
Motor out: 3 x 0 ... Input V AC 0 ... 599 Hz 1.7 A _{RMS} 0.8 kW	Technical data for the motor output (output voltage, max. output frequency, nominal current, nominal output power)
T _{AMB} : max. 40-50°C	Ambient temperature (T _{AMB})
IP10/20 OVC III PD2	Degree of protection, without mating plug/with mating plug X9A connected; overvoltage category; pollution degree
SCCR: 10 kA cUL restriction: only for use in WYE 480 V/277 V supply sources ¹⁾	SCCR (short circuit current rating) Operation on power supply systems with SCCR ≤ 10 kA → 10.3 Technical data of UL/CSA certification Specification of the permissible SCCR value; depending on the product variant, additional specifications or restrictions may apply
R-R-FTO-KC-2018-1054	KC mark certificate (test mark for Korea)
MAC: XX-XX-XX-XX-XX-XX	first MAC address of the device for Ethernet communication
See manual for additional information	Reference to the existing user documentation, which contains information on overload protection and the necessary external circuit breaker.
Data matrix code 123456789AB	Product Key as a data matrix code and an 11-character alphanumeric code

Product labelling (example)	Meaning
Festo SE & Co. KG	Manufacturer
DE-73734 Esslingen	Manufacturer's address
Made in Germany	Country of origin Germany

1) Only for product versions with corresponding restrictions

Tab. 3: Product labelling (example)

Warning symbols on the front of the product

Warning symbol	Meaning with the CMMT-AS-...
	Attention! Hot surface Metallic housing parts of the device can reach high temperatures during operation. In the event of a fault, internal components may become overloaded. Overloading of components can result in high temperatures and the release of hot gases.
	Attention! General danger point The touch current in the protective earthing conductor can exceed an alternating current of 3.5 mA or a direct current of 10 mA. Always connect both protective earthing connections to the mains-side PE connection, the PE pin of [X9A] and PE earthing screw on the housing. The minimum cross section of the protective earthing conductor must comply with the local safety regulations for protective earthing conductors for equipment with high leakage current.
 5 min	Attention! Dangerous voltage The product is equipped with DC link capacitors, which store dangerous voltage for up to 5 minutes after the power supply is switched off. Do not touch power connections for 5 minutes after the power supply is switched off. After the power supply is switched off, wait at least 5 minutes until the DC link capacitors have discharged.

Tab. 4: Meaning of the warning symbols

Warnings on the product

The following warnings are attached to the right side of the device:

Warnings on the product (en, fr)	Meaning
CAUTION Risk of Electric Shock! Do not touch electrical connectors for 5 minutes after switching power off! Read manual before installing! High leakage current! First connect to earth!	Caution Risk of electric shock! Do not touch electrical connections for 5 minutes after switching power off! Read manual before installing! High leakage current after PE! First connect device to PE!
AVERTISSEMENT Risque du choc électrique! Une tension dangereuse peut être présente jusqu'à 5 minutes après avoir coupé l'alimentation ! Lire le manuel avant installation ! Courant de défaut élevée ! Relier tout d'abord à la terre !	
DANGER Risk of Electric Shock! Disconnect power and wait 5 minutes before servicing.	Danger Risk of electric shock! Disconnect power and wait 5 minutes before servicing.
Risque du choc électrique! Débranchez l'alimentation et attendez 5 min. avant de procéder à l'entretien.	
WARNING Hot surface - Risk of burn!	Warning Hot surface – danger of burns!
ATTENTION Risque de température élevée en surface!	

Tab. 5: Warnings on the product

1.5 Specified standards

Version	
IEC 60364-1:2005	EN 61131-2:2007
EN 61800-5-1:2007+A1:2017	EN 61800-2:2015

Version		
EN 60204-1:2018		EN IEC 61800-3:2018
EN 60529:1991+A1:2000+A2/AC:2019		EN 61800-5-2:2017

Tab. 6: Standards specified in the document

2 Safety

2.1 Safety instructions

General safety instructions

- Assembly and installation are only to be carried out by qualified personnel.
- Only use the product if it is in perfect technical condition.
- Only use the product in its original condition without unauthorised modifications.
- Do not carry out repairs on the product. If defective, replace the product immediately.
- Observe the identifications on the product.
- Take into account the ambient conditions at the location of use.
The safety function might fail and malfunctions might occur if you do not comply with the parameters required for the ambient and connection conditions.
- The product may generate high frequency interference, which may require interference suppression measures in residential areas.
- Wear the prescribed personal protective equipment for transport, assembly and disassembly of product version with a high weight.
- Never remove or insert a plug connector when the power is switched on.
- Do not loosen any screws on the product other than the following:
 - Earthing screw on the cooling element for mounting the PE connection on the mains side
 - Retaining screws of the shield clamp on the housing front
 - For applications in IT networks only: screw for connecting the internal mains filter with PE
- Install the product in a suitable control cabinet. The minimum degree of protection required for the control cabinet is IP54.
- Operate the product only in an installed condition when all required protective measures have been taken (→ EN 60204-1).
- Fully insulate all conducting lines on the product. We recommend plastic wire end sleeves for wiring power connections. During wiring, please observe the necessary strip lengths.
- Ensure correct protective earthing and shield connection.
- Prior to commissioning, ensure that the resulting movements of the connected actuator technology cannot endanger anyone.
- During commissioning: systematically check all control functions and the communication and signal interface between controller and servo drive.
- The product is equipped with DC link capacitors, which store dangerous voltage for up to 5 minutes after the power supply is switched off. Before working on the product, switch off the power supply via the main switch and secure it against being switched on again unintentionally. Do not touch the power connections for at least 5 minutes.
- Take the legal regulations for the installation location into account.
- Keep the documentation in a safe place for the duration of the product lifecycle.

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

In the event of damage caused by using unauthorised software or firmware with the device, the warranty will be invalidated, and the manufacturer will not be liable for damages.



Safety instructions for the safety sub-functions of the product → 1.2 Applicable documents, Manual Safety sub-function.

2.2 Intended use

The servo drive CMMT-AS is intended for the power supply and control of AC servo motors. The integrated electronics enable regulation of torque (current), rotational speed and position.

Use exclusively:

- in perfect technical condition
- in original condition without unauthorised modifications; only the extensions described in the documentation supplied with the product are permitted
- within the limits of the product as defined by the technical data → 10 Technical data
- in an industrial environment

The safety function might fail and malfunctions might occur if you do not comply with the parameters required for the ambient and connection conditions.



Intended use of the safety sub-functions for the product → 1.2 Applicable documents, Manual Safety sub-function.

2.2.1 Application areas

The device is intended for use in an industrial environment and with appropriate measures in commercial, residential and mixed areas.

The device is intended for installation in a control cabinet. The minimum degree of protection required for the control cabinet is IP54.

The device can be operated in TN, TT and IT systems if certain requirements are met. Detailed information on allowed and prohibited mains types of system earthing → 7.4 Permissible and impermissible mains types of system earthing.

2.2.2 Permissible components

In addition to the requirements of EN 60204-1, the components of the drive system must comply with the requirements for fault exclusions from EN 61800-5-2:

- Annex D.3.5 and D.3.6 for motors
- Annex D.3.1 for motor and brake cables
- Annex D.3.4 for mating plugs
- Annex D.3.16 for motion and position feedback sensors in the case of safety sub-functions with motion monitoring.

Further requirements for the approved components depend on the applied safety sub-functions → Manual Safety sub-functions. The suitability of components without certification for the safety-related application in question must be determined by a risk assessment.

2.3 Training of qualified personnel

The product may be installed and commissioned only by a qualified electrical engineer who is familiar with:

- Installation and operation of electrical control systems
- Applicable regulations for operating safety-related systems

Work on safety engineering systems may only be carried out by qualified personnel trained in safety engineering.

2.4 Product conformity

The product-relevant directives are listed in the declaration of conformity

→ www.festo.com/sp.

Product conformity	
	in accordance with EU EMC Directive in accordance with EU Machinery Directive in accordance with EU RoHS Directive
	to UK EMC Regulations to UK Supply of Machinery Regulations to UK RoHS Regulations

Tab. 7: Product conformity



The protection objectives of the Low Voltage Directive are fulfilled in accordance with the requirements of the EC Machinery Directive. The requirements of the Low Voltage Directive are based on the product standard EN 61800-5-1. The valid version of the product standard is listed in the declaration of conformity.

2.5 Safety engineering approval

The product is a safety device in accordance with the Machinery Directive. For details of the safety-oriented standards and test values with which the product complies and fulfils, see → Manual Safety sub-function, Technical data, safety engineering.

2.6 UL/CSA certification

Technical data and environmental conditions may be subject to change in order to comply with Underwriters Laboratories Inc. (UL) certification requirements for the USA and Canada.

Deviating values → 10.3 Technical data of UL/CSA certification.

2.7 Cyber security measures

For information on required measures, see the manual/online help plug-in → 1.2 Applicable documents.

For CMMT-AS-...-S3, observe the additional measures in the Safety Sub-functions manual.

3 Additional information

- Contact the regional Festo contact if you have technical problems
→ www.festo.com.
- Accessories and spare parts → www.festo.com/catalogue.
- Cyber security information → www.festo.com/psirt.



Firmware, software or configuration files → www.festo.com/sp.

4 Product overview

4.1 Scope of delivery

Components	Number
Servo drive CMMT-AS-...	1
Operating instructions CMMT-AS-...	1
Only for CMMT-AS-...-MP: assortment of plugs NEKM-C6-...	1

Tab. 8: Scope of delivery

Below are some examples of the available accessories:

- Plug connector set for single wiring connection NEKM-C6-...-S
- Plug connector set for double wiring connection NEKM-C6-...-D
- external braking resistor CACR-...
- Motor cable NEBM-... , e.g. for the motor series EMMS-AS, EMME-AS and EMMT-AS
- Encoder cable, e.g. for the motor series EMMS-AS and EMME-AS
- Patch cable NEBC-..., e.g. for linkage of the RTE interface [X19A/B]
- Operator unit CDSB-...
- Mains filter CAMF-C6-F
- Line choke CAMF-C6-FD



Up-to-date information on the accessories → www.festo.com/catalogue.

4.2 System structure

The servo drive CMMT-AS is a single-axis servo drive. Depending on the product variant, the following components, which are required for standard applications, are integrated into the device or into the cooling profile of the device:

- Mains filter (guarantees immunity to interference and limits conducted emissions)
- Electronics for DC link voltage conditioning
- Power stage (for motor control)
- Braking resistor (integrated into the cooling element)
- Brake chopper (switches the braking resistor in the DC link as and when required)
- Temperature sensors (for monitoring the temperature of the power module and the air in the device)
- Fan in the cooling profile (depending on product variant)

The device has separate connections for the logic and load voltage supply. The load voltage supply comes directly from the low-voltage network. The logic supply must be provided by a PELV fixed power supply (+24 V DC).

The servo drive includes the option of connecting 2 encoders. In addition, the device has 1 switching output for direct connection of the holding brake in the motor and 1 output for control of an external clamping unit.

An external braking resistor can be connected instead of the internal braking resistor, if necessary.

The servo drive features a real-time Ethernet interface for process control. Various bus protocols are supported depending on the product design, e. g., EtherCAT, EtherNet/IP, Modbus TCP or PROFINET.

The device can be parameterised with a PC using either the real-time Ethernet interface or the separate standard Ethernet interface.

If required, the operator unit CDSB can be plugged in at the top of the front panel of the device. For example, the CDSB displays diagnostic information, as well as setpoint and actual values in plain text.

The DC links of several devices can be coupled for operation of multiple servo drives in a device compound, and the power supplies and I/O signals of the devices can be linked by cross-wiring. The DC link coupling can increase the energy efficiency of the device compound.



Festo recommends use of servo motors, electromechanical drives, lines and accessories from the Festo accessory programme.

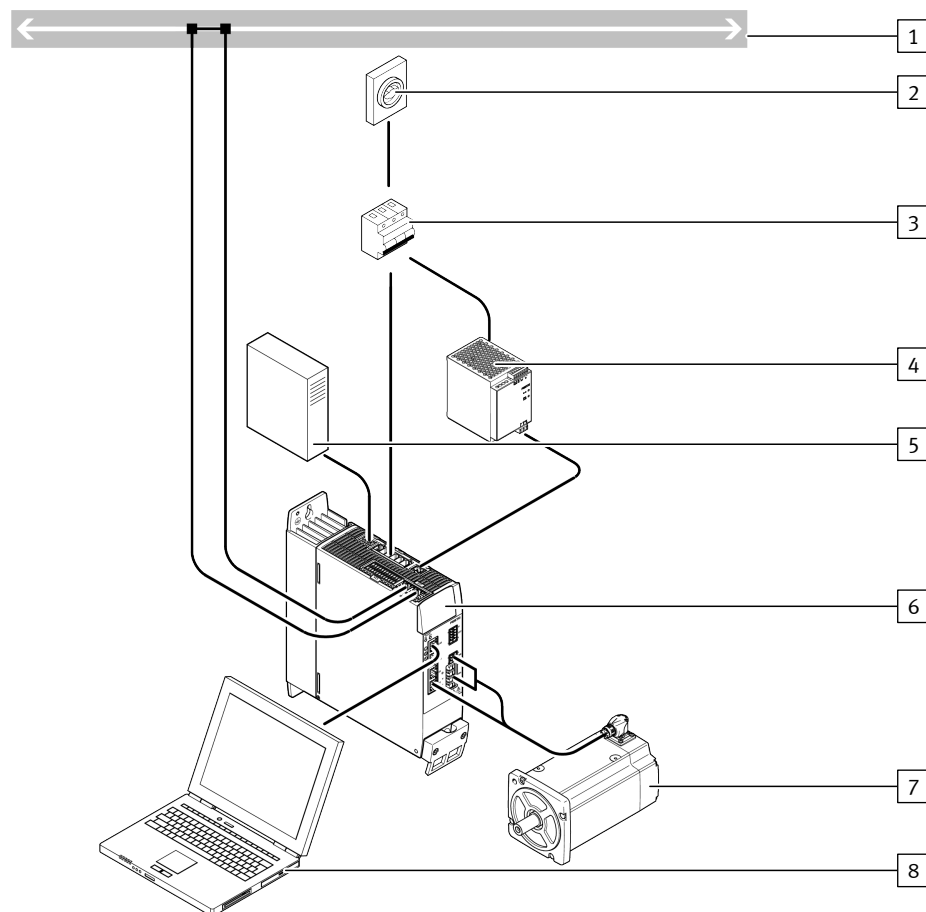


Fig. 1: System structure (example)

- | | |
|---|---|
| 1 Bus/network | 5 External braking resistor (optional) |
| 2 Main switch | 6 Servo drive CMMT-AS |
| 3 Automatic circuit breaker/fuses and all-current-sensitive RCD (residual current device) (optional) | 7 Servo motor (in this case EMMT-AS-...-RMY) |
| 4 Fixed power supply for logic voltage supply 24 V DC (PELV) | 8 PC with Ethernet connection for parameterisation |

4.2.1 Product design

The device has a compact design. The connections are on the front and top of the device as pin header, socket strip or RJ45 bushing. The shield clamp and strain relief for the motor cable are situated in the lower section of the front panel.

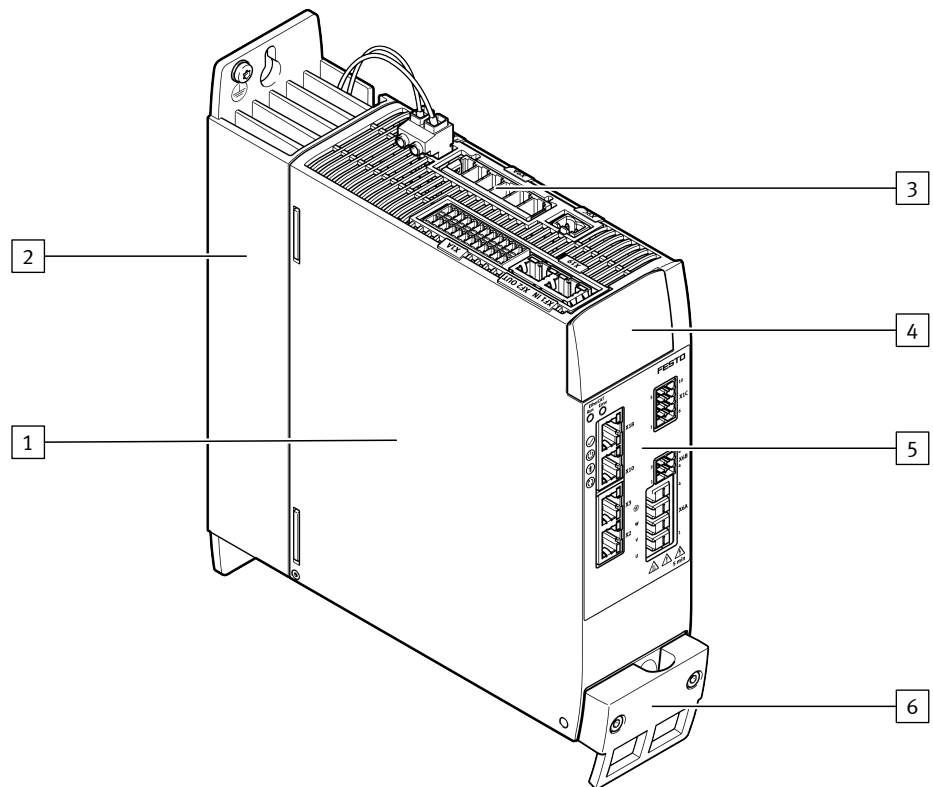


Fig. 2: Servo drive CMMT-AS-C2/C3/C5-11A-P3 (example)

- 1

Hood
- 2

Cooling element
- 3

Top of device
- 4

Blind plate
- 5

Front panel
- 6

Shield clamp and strain relief for motor cable

The cooling element on the back of the device serves to dissipate the heat from internal components to the ambient air. The cooling element has one slot each on the top and bottom for mounting the device on the rear wall of the control cabinet. If an operator unit is not required, the upper section is covered with a blind plate. The back of the device is part of the cooling element. The braking resistor is integrated in the air duct of the cooling element. The connecting cable for the braking resistor comes from the cooling profile, emerges from the top of the cooling profile and is attached to the connection [X9B].

CMMT-AS	C2/C3-11A-P3	C5-11A-P3	C7/C12/C18/C25-11A-P3
Fan	—	x	x
Internal braking resistor mounted in profile	x	x	x

Tab. 9: Cooling element variant

Some devices have a fan in the air duct of the cooling element. Some devices also have a fan in the interior. The device controls the fans automatically. The fans are only switched on briefly when the device is switched on, and as needed. The fans draw in cold ambient air from beneath and blow the air upward through the profile. The air picks up heat from the profile in the process.

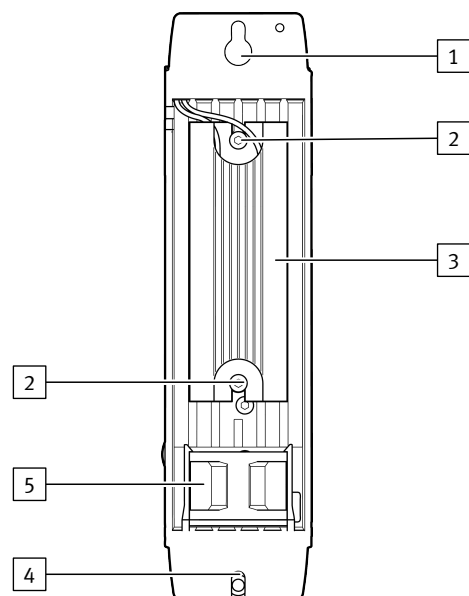


Fig. 3: Back

- | | |
|---|---|
| 1 Top slot (keyhole shape) | 4 Bottom slot |
| 2 Retaining screw for braking resistor (2x) | 5 Fan, depending on the product variant |
| 3 Braking resistor | |

4.2.2 Overview of connection technology

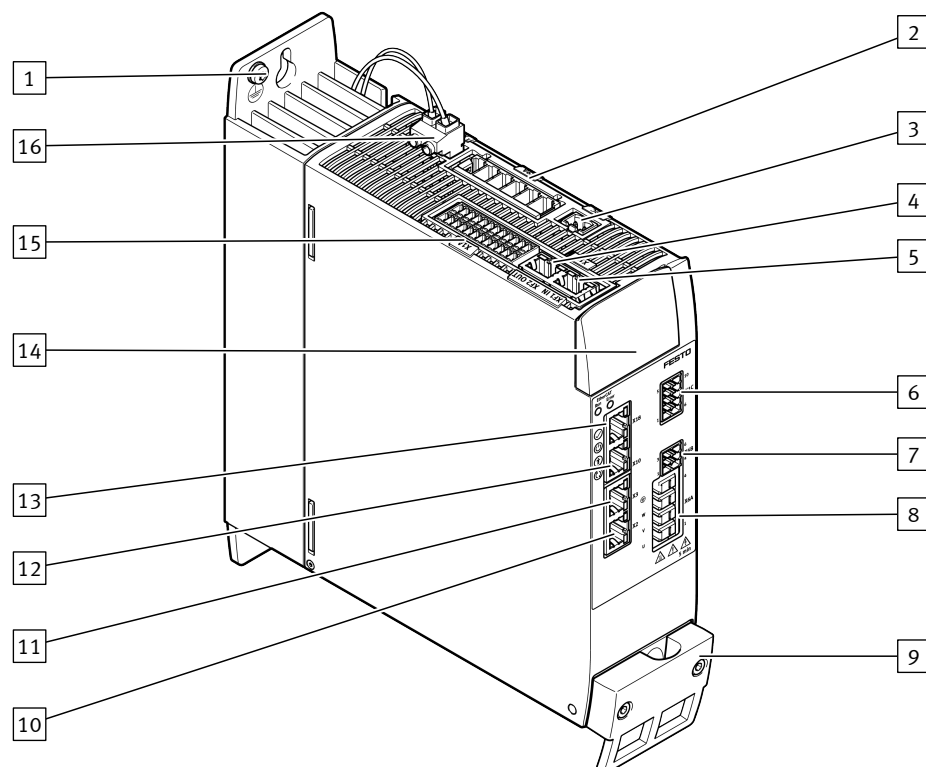


Fig. 4: Connections of the CMMT-AS-C2/C3/C5-11A-P3 (example)

- | | |
|--|-------------------------------------|
| 1 PE connection, housing | 5 [XF1 IN] RTE interface port 1 |
| 2 [X9A] Mains and DC link circuit connection | 6 [X1C] inputs/outputs for the axis |
| 3 [X9C] logic voltage | 7 [X6B] motor auxiliary connection |
| 4 [XF2 OUT] RTE interface port 2 | 8 [X6A] motor phase connection |
| | 9 Shield clamp of motor cable |

- | | |
|---|--|
| 10 [X2] encoder connection 1 | 15 [X1A] I/O interface |
| 11 [X3] encoder connection 2 | 16 [X9B] connection for braking resistor |
| 12 [X10] device synchronisation | |
| 13 [X18] standard Ethernet | |
| 14 [X5] connection for operator unit (behind the blind plate) | |

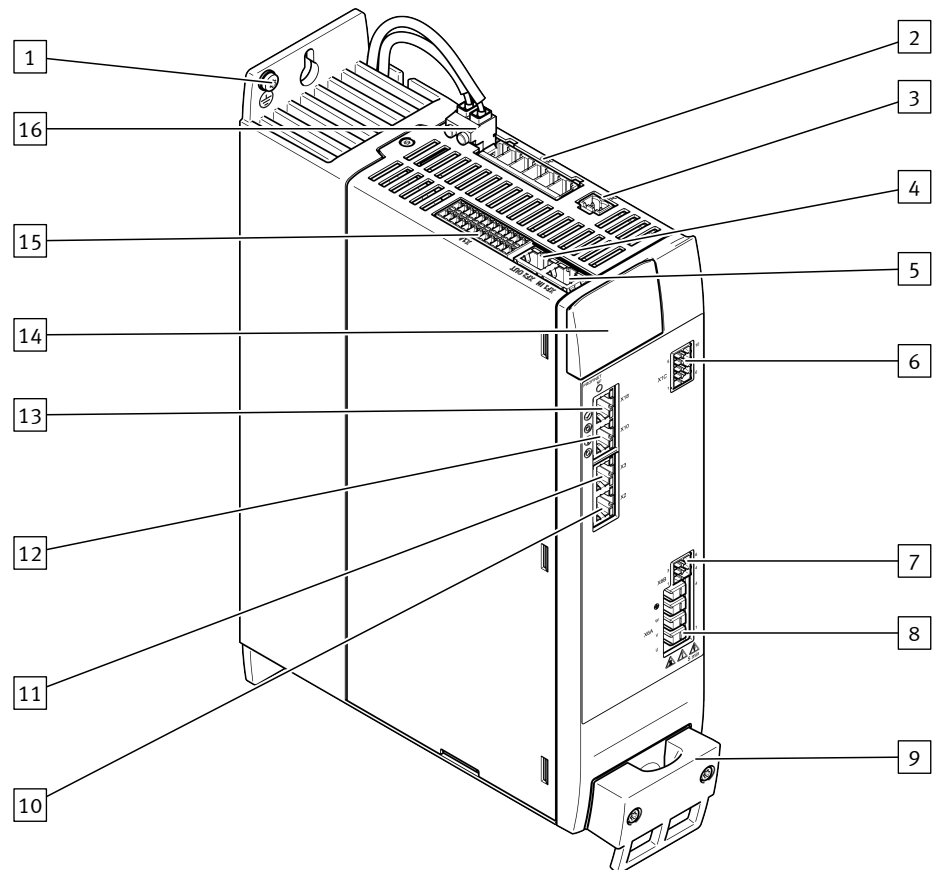


Fig. 5: Connections of the CMMT-AS-C7/C12/C18/C25-11A-P3 (example)

- | | |
|--|---|
| 1 PE connection, housing | 10 [X2] encoder connection 1 |
| 2 [X9A] Mains and DC link circuit connection | 11 [X3] encoder connection 2 |
| 3 [X9C] logic voltage | 12 [X10] device synchronisation |
| 4 [XF2 OUT] RTE interface port 2 | 13 [X18] standard Ethernet |
| 5 [XF1 IN] RTE interface port 1 | 14 [X5] connection for operator unit (behind the blind plate) |
| 6 [X1C] inputs/outputs for the axis | 15 [X1A] I/O interface |
| 7 [X6B] motor auxiliary connection | 16 [X9B] connection for braking resistor |
| 8 [X6A] motor phase connection | |
| 9 Shield clamp of motor cable | |

The blind plate can be removed by hand without tools. The operator unit CDSB can be plugged into the free space → Documentation on the CDSB. If an operator unit is not used, the upper area must be sealed with the blind plate.

4.3 Setting bus protocol

The CMMT-AS-...-MP product variant supports several bus protocols.

- The following options are available for setting the protocol:
- Configuration in the CMMT-AS plug-in
 - Direct setting with DIL switches SW1 to SW3.

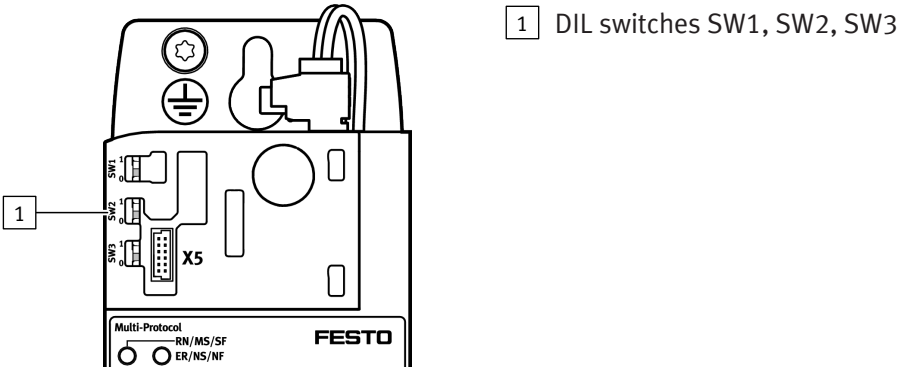


Fig. 6: DIL switches SW1, SW2, SW3 on the CMMT-AS-...-MP

The switches can be adjusted with a small slotted head screwdriver. The switch position is evaluated once when the device is started. A change in the switch position therefore only takes effect after the device has been restarted.



Protocols supported by the firmware version used → Manual/online help plug-in, software, function, fieldbus, device profile.

Protocol	SW3	SW2	SW1
Parameterisation	0	0	0
PROFINET	0	0	1
EtherCAT	0	1	0
EtherNet/IP, Modbus TCP	0	1	1
Parameterisation	1	1	1

Tab. 10: Bus protocol switch setting

5 Transport and storage

- Protect the product during transport and storage from excessive stress factors. Excessive stress factors include:
 - mechanical stresses
 - impermissible temperatures
 - moisture
 - aggressive atmospheres
- Store and transport the product in its original packaging. The original packaging offers sufficient protection from typical stresses.

6 Assembly

Dimensions CMMT-AS-C2/C3/C5-11A-P3...

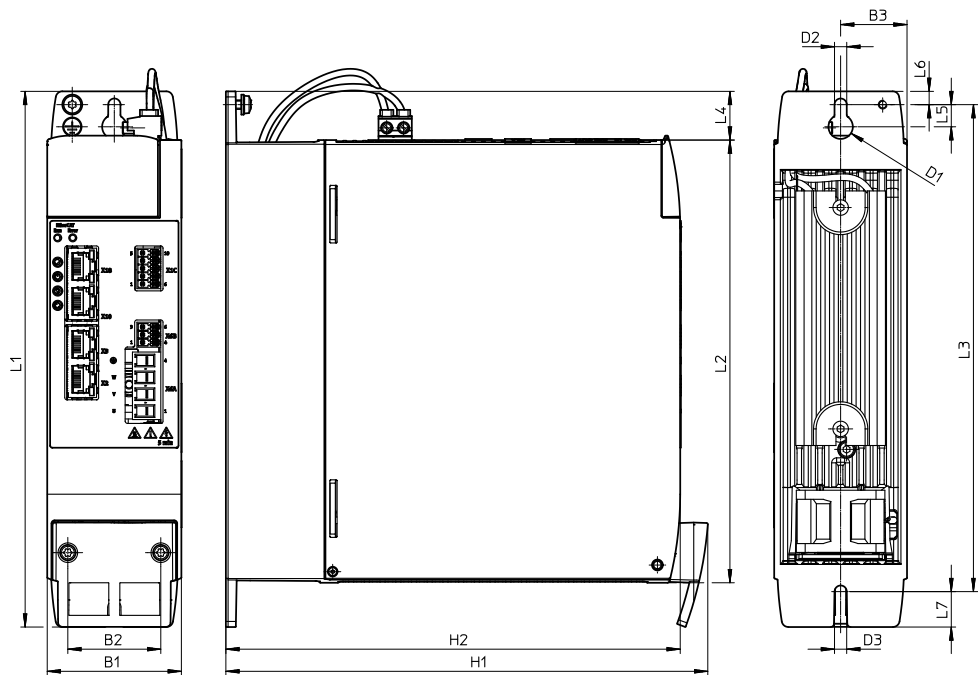


Fig. 7: Dimensions

Dimensions CMMT-AS-C2/C3/C5-11A-P3...								
Dimension	L1	L2	L3	L4	L5	L6	L7	
[mm]	approx. 242	200	220	22	10	6	16	
Dimension	H1	H2	B1	B2	B3	D1	D2	D3
[mm]	approx. 218	approx. 205	approx. 60	42	B1/2	R5.5	5.5	5.5

Tab. 11: Dimensions CMMT-AS-C2/C3/C5-11A-P3...

Dimensions
CMMT-AS-C7/C12/C18/
C25-11A-P3...

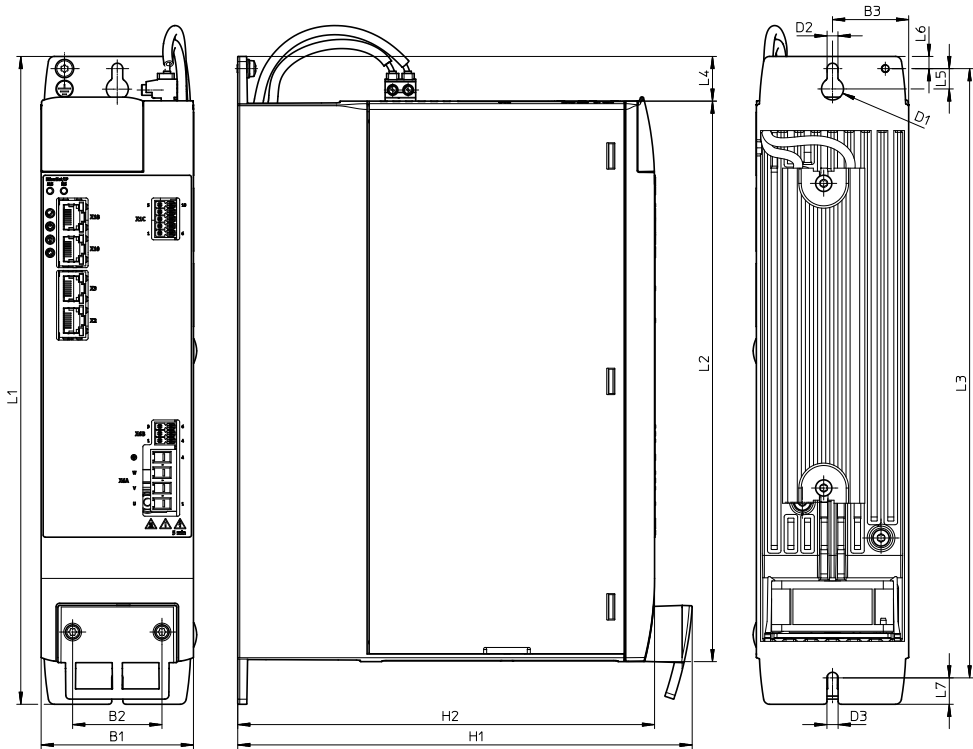


Fig. 8: Dimensions

Dimensions CMMT-AS-C7/C12/C18/C25-11A-P3...								
Dimension	L1	L2	L3	L4	L5	L6	L7	
[mm]	approx. 319	276	300	22	10	6	13	
Dimension	H1	H2	B1	B2	B3	D1	D2	D3
[mm]	approx. 224	approx. 205	approx. 75	44	B1/2	R5.5	5.5	5.5

Tab. 12: Dimensions CMMT-AS-C7/C12/C18/C25-11A-P3...

6.1 Mounting clearances

The servo drives of the CMMT-AS series can be connected in series. When arraying devices, the required minimum distance must be maintained so that the heat generated during operation can be dissipated by allowing sufficient air flow.

Mounting dis-
tances CMMT-AS-C2/C3/
C5-11A-P3

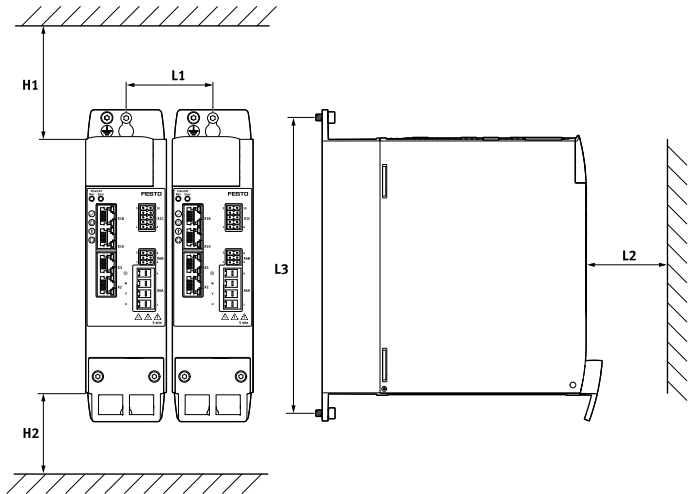


Fig. 9: Mounting distances and installation clearance for CMMT-AS-C2/C3/C5-11A-P3

Servo drive		H1	H2 ¹⁾	L1	L2	L3
CMMT-AS-C2-11A-P3	[mm]	100	70	62	70	220
CMMT-AS-C3-11A-P3	[mm]					
CMMT-AS-C5-11A-P3	[mm]					

1) An installation clearance of 150 mm is recommended for compliance with clearance H2 and for optimum routing of the motor and encoder cables on the underside of the housing!

Tab. 13: Mounting distances and installation clearance for CMMT-AS-C2/C3/C5-11A-P3

This means that a minimum lateral distance of 2 mm (62 mm ... 60 mm) must be observed in relation to neighbouring CMMT-AS devices.

For adjacent third-party devices, Festo recommends a distance of at least 10 mm (surface temperature of third-party device max. 40°C). The double mating plug for cross-wiring of the connection [X9A] protrudes by approx. 45...mm over the right side of the device. However, this is not an obstacle to the addition of additional CMMT-AS.

Mounting distances CMMT-AS-C7/C12/C18/ C25-11A-P3

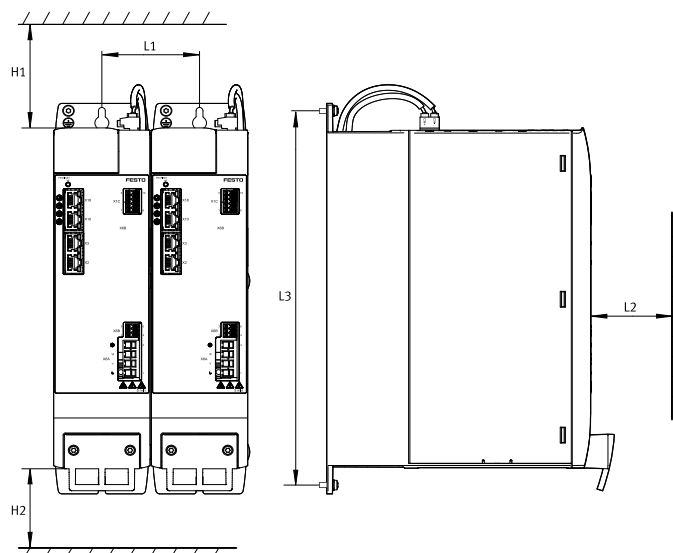


Fig. 10: Mounting distances and installation clearance for CMMT-AS-C7/C12/C18/C25-11A-P3

Servo drive		H1	H2 ¹⁾	L1	L2	L3
CMMT-AS-C7/C12/C18/C25-11A-P3	[mm]	100	70	78	70	300

1) An installation clearance of 150 mm is recommended for compliance with clearance H2 and for optimum routing of the motor and encoder cables on the underside of the housing!

Tab. 14: Mounting distances and installation clearance

This means that a minimum lateral distance of approx. 3 mm (78 mm - 75 mm) must be observed in relation to neighbouring CMMT-AS devices.

For adjacent third-party devices, Festo recommends a distance of at least 10 mm (surface temperature of third-party device max. 40°C). The double mating plug for cross-wiring of the connection [X9A] protrudes by approx. 6 ... 7 mm over the right side of the device. However, this is not an obstacle to the addition of additional CMMT-AS.

6.2 Mounting

The CMMT-AS servo drive controller is intended for installation in a control cabinet.

Assembly instructions

- Use a control cabinet with degree of protection IP54 or higher.
- Always install device vertically in the control cabinet on a closed surface (mains supply lines [X9A] point upwards).
- Screw device flat to a sufficiently stable mounting surface so that good heat transfer from the cooling element to the mounting surface is ensured (e.g. on the rear wall of the control cabinet).
- Maintain minimum distances and installation clearance to guarantee sufficient air flow. The ambient air in the control cabinet must be able to flow through the device from bottom to top without hindrance.
- Take into account the required clearance for the wiring (connecting cables of the device must be routed from above and from the front).
- Do not mount any temperature-sensitive components near the device. The device can become very hot during operation (switch-off temperature of the temperature monitoring function → Technical data).
- When installing several devices in a device compound, observe the general rules for cross-wiring. For DC link coupling, higher-power devices must be placed closer to the mains supply.
- If there is a voltage supply to the device when the control cabinet is open, vertical access to the bottom and top of the device must be prevented.

The cooling element of the servo drive controller has a keyhole-shaped slot at the top and a simple slot at the bottom for mounting with the rear wall of the control cabinet.

Mounting the servo drive

⚠ WARNING

Danger of burns by hot escaping gases and hot surfaces.

In case of faults, incorrect circuitry or incorrect polarity of the connections [X9A], [X9B] and [X6A], internal components can be overloaded. High temperatures can develop and hot gases can be released.

- Have an authorised electrician perform the installation according to the documentation.

⚠ WARNING

Danger of burns from hot housing surfaces.

Metallic housing parts can accept high temperatures in operation. In particular, the braking resistor installed in the profile on the back side can become very hot.

Contact with metal housing parts can cause burn injuries.

- Do not touch metallic housing parts.
- After the power supply is switched off, let the device cool off to room temperature.

- Mount the servo drive on the backwall of the control cabinet with suitable screws while complying with the assembly instructions.
- The cooling element can reach temperatures of > 90 °C in the mounting area. The mounting surface must not contain any combustible or heat-sensitive parts.

7 Installation

7.1 Safety

⚠ WARNING

Risk of injury from electric shock.

Contact with live parts at the power connections [X6A], [X9A] and [X9B] can result in severe injuries or death.

- Do not pull out power supply plugs while live.
- Before touching, wait at least 5 minutes after switching off the load voltage to allow the intermediate circuit to discharge.

⚠ WARNING

Risk of injury from electric shock.

The leakage current of the device to earth (PE) is > 3.5 mA AC or 10 mA DC. Touching the device housing if there is a fault can result in serious injuries or death.

Before commissioning, also for brief measuring and test purposes:

- Connect PE connection on the mains side at the following positions:
 - Protective earth connection (earthing screw) of the housing
 - PE pin of the connection [X9A] (power supply)

The cross section of the PE conductors must be at least equal to the cross section of the mains conductor L at [X9A].
- Connect motor cable to connection [X6A] and the shield of the motor cable on the front side to PE via the shield clamp of the servo drive.
- Observe the regulations of EN 60204-1 for the protective earthing.

⚠ WARNING

Danger of burns by hot escaping gases and hot surfaces.

In case of faults, incorrect circuitry or incorrect polarity of the connections [X9A], [X9B] and [X6A], internal components can be overloaded. High temperatures can develop and hot gases can be released.

- Have an authorised electrician perform the installation according to the documentation.

⚠ WARNING

Risk of injury from electric shock in the event of incomplete insulation at the power connections [X6A], [X9A] and [X9B].

Before operating, plugging in or unplugging the operator unit CDSB or a connector from a hot-plug-capable interface, the following points must be fulfilled:

- The conducting lines at the device are completely insulated.
- The protective earthing (PE) and the shield connection are correctly connected to the device.
- The housing is free of damage.

⚠ WARNING**Risk of injury due to overheating and electric shock with faulty live components**

Closing the branch-circuit protective device with faulty live components may cause fire or electric shock.

- The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electric shock, current-carrying parts and other components of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.

Earthing the motor housing**⚠ WARNING****Risk of injury from electric shock.**

If the cable shield of the motor cable is not connected to protective earthing by the shield clamp, dangerous voltages on the motor housing may cause serious injury or death.

- Connect the cable shield of the motor cable to the earthed device with the shield clamp.
- In addition, always earth the machine bed close to the motor with electrical continuity to the motor flange.

7.2 Residual current device**⚠ WARNING****Risk of injury from electric shock.**

This product can cause a DC current in the residual-current conductor in case of error. In cases where a residual current device (RCD) or a residual current monitor (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.

The touch current in the protective earthing conductor can exceed an alternating current of 3.5 mA or a DC current of 10 mA. Always connect both protective earthing connections to the mains-side PE connection, the PE pin of [X9A] and PE earthing screw on the housing. The minimum cross section of the protective earthing conductor must comply with the local safety regulations for protective earthing conductors for equipment with high leakage current.

A residual current circuit breaker with 30 mA tripping current may be suitable for a separately wired servo drive CMMT-AS, depending on the configuration. As a rule, residual current devices with a rated residual current > 30 mA are required for a device compound consisting of several servo drives.

Festo recommends using a residual current device with a tripping delay, as high leakage currents occur during switch-on. Residual current devices with a tripping delay prevent unintended tripping during switch-on.

7.3 Mains fuse

The CMMT-AS does not have an integrated fuse at the mains input or in the DC link circuit. An external fuse is required at the power connection of the device. A device compound coupled in the DC link circuit must be protected by a common mains fuse.

- Use only circuit breakers and fuses that have the relevant approval and meet the specifications and protection requirements stated below.

Requirements for circuit breakers (automatic circuit breakers) and fuses		
Type of fuse	Circuit breaker	Class J Fuse only CMMT-AS-C2/C3/C5-11A-P3
max. permissible rated current [A]	40	25
	Restrictions concerning line protection → Tab. 16 Line protection requirements	
Short circuit current rating SCCR of mains fuse [kA]	min. 10	min. 100
Approvals	IEC 60947-2	CE certification
Rated voltage [V AC]	min. 400	600
Overvoltage category	III	
Pollution degree	2	
Characteristic	C	slow-blowing

Tab. 15: Requirements for circuit breakers and fuses

In the case of electricity networks with SCCR > 10 kA, only class J fuses are permitted.

The circuit breaker is used for line protection. The rated current of the circuit breaker must be less than or equal to the approved current rating of the selected conductor cross section. The circuit breaker must also take into account the overload case and must not trip (overload case: a 3-fold increase in the input current for 2 s).

Line protection requirements					
Description	Cable cross section at [X9A] in [mm²]	Mains fuse [A] ¹⁾			
CMMT-AS-		C2-11A-P3	C3-11A-P3	C5-11A-P3	
Minimum fuse protection	1.5	6			
CMMT-AS-		C7-11A-P3	C12-11A-P3	C18-11A-P3	C25-11A-P3
Minimum fuse protection	1.5 ²⁾	10	16	–	–
	4	–	–	25	32
Maximum fuse protection of an individual device or a device compound					
without heat-resistant cable	4	25			
	6	32			
with heat-resistant cable ³⁾	4	32			
	6	40			

1) Specifications according to DIN VDE 0298-4:2013, permissible currents according to EN 60204-1 may differ (depending on installation type and temperature)

2) depending on the type of installation of the cables, wiring with min. 2.5 mm² may be required for the CMMT-AS-C12-11A-P3.

3) no derating up to an ambient temperature of 50 °C and a cable temperature higher than 70 °C (max. cable temperature 90 °C)

Tab. 16: Line protection requirements

Fuse protection when load circuit is supplied with DC power

The CMMT-AS allows the load circuit to be supplied with DC power. With DC power, external fuse protection is once again required in the form of short circuit protection and line protection. The fuse that is used must be capable of reliably disconnecting the maximum DC supply voltage that could occur and the potential short circuit current ($SCCR_{DC}$).

Maximum fuse protection: 40 A



If fuse protection is to be avoided on the DC side, check whether the fuse protection could alternatively be installed on the AC side upstream of the DC fixed power supply.

7.4 Permissible and impermissible mains types of system earthing

TN systems

TN systems	Reference ¹⁾	Information
TN-S system with separate neutral conductor and PE conductor in overall system	Fig. 31A1	System is supported. Connect device to the distribution network of the current source as follows: – Connect L1, L2, L3. – Do not connect N. For DC link coupling, connect only one device directly to the distribution network of the current source. Connect the coupled devices to the 3 mains phases using cross-wiring. ²⁾
TN-S system with separate earthed mains conductor and PE conductor in overall system	Fig. 31A2	System is not supported because one phase is earthed.
TN-S system with earthed PE conductor without neutral conductor in overall system	Fig. 31A3	System is supported. Connect device to the distribution network of the current source as follows: – Connect L1, L2, L3. – Do not connect N. For DC link coupling, connect only one device directly to the distribution network of the current source. Connect the coupled devices to the 3 mains phases using cross-wiring. ²⁾
TN-C system with neutral conductor and protective earth function combined in a single conductor, the PEN conductor.	Fig. 31C	System is supported. Connect device to the distribution network of the current source as follows: – Connect L1, L2, L3. – Use PEN as PE only.
TN-C-S system with neutral conductor and protective earth function combined in a single conductor, the PEN conductor, in one part of the system	Fig. 31B1	For DC link coupling, connect only one device directly to the distribution network of the current source. Connect the coupled devices to the 3 mains phases using cross-wiring. ²⁾

1) ➔ IEC 60364-1 Chapter 312.2.

2) With cross-wiring, only 1 main switch and 1 circuit breaker is permissible for the device compound.

Tab. 17: Permissible and impermissible TN systems

TT system

TT system	Reference ¹⁾	Information
TT system with separate neutral conductor and PE conductor in the overall system. The N conductor is connected directly to the current source.	Fig. 31F1	System is supported. Connect device to the distribution network of the current source as follows: – Connect L1, L2, L3. – Use PEN as PE only. For DC link coupling, connect only one device directly to the distribution network of the current source. Connect the coupled devices to the 3 mains phases using cross-wiring. ²⁾

1) → IEC 60364-1 Chapter 312.2.

2) With cross-wiring, only 1 main switch and 1 circuit breaker is permissible for the device compound.

Tab. 18: TT system

IT system

IT system	Reference ¹⁾	Information
IT system with insulation of active parts separated from protection earth or connected via high impedance. The exposed conductive parts are connected to local earthing.	Fig. 31G1	System is supported. – The permissible system voltage of the CMMT-AS is 300 V in accordance with IEC 61800-5-1. Observe the restrictions set out in IEC 61800-5-1 when operating the CMMT-AS in an IT network! – Use an insulation monitoring system so that insulation faults can be detected immediately (earth-leakage monitor). – Interrupt the internal connection of the internal mains filter to PE → Interrupting the connection of the internal mains filter to PE (for IT networks only). – Use external filter measures that ensure CE conformity. Connect device to the distribution network of the current source as follows: – Connect L1, L2, L3. – Do not connect N. For DC link coupling, connect only one device directly to the distribution network of the current source. Connect the coupled devices to the 3 mains phases using cross-wiring.

1) → IEC 60364-1 Chapter 312.2.

Tab. 19: IT system

After removing the connection of the internal mains filter to PE, the device is not classified in respect of emitted interference in accordance with EN 61800-3. External filter measures are required.

When operating servo drives in IT networks, the distributor must provide an EMC concept for the overall system.

This comprises as a minimum:

- A concept for feedback of the converter leakage currents into the converter DC link circuit (Y capacitors to the DC link circuit)
- Use of external filter measures such as mains filter and converter output filter

Earth-leakage monitor

For IT systems, an earth-leakage monitor is required so that an insulation fault between the mains phase and PE can be detected immediately. An insulation fault must be rectified immediately after detection.

Leakage currents in IT systems

High-frequency leakage currents to protective earthing (PE) may be encountered even in IT systems (IT = Isolé Terre) during operation of the servo drive. The leakage currents flow to the PE through the coupling capacitances of the motor cable and the motor and back to the servo drive through the coupling capacitance of the isolating transformer via the load supply. The coupling capacitances can be minimised by selection of a suitable isolating transformer and keeping the motor cable as short as possible.

⚠ WARNING**Risk of injury from electric shock.**

The servo drive generates high-frequency leakage currents, which can lead to dangerous contact currents on the external conductors and the neutral conductor of the IT system. Touching the mains conductor or the neutral conductor can result in serious injuries or death.

- Before working on the IT systems, disconnect the servo drive from the mains.

Interrupting the connection of the internal mains filter to PE (for IT networks only)

Before using the CMMT-AS in IT networks, the internal connection of the integrated mains filter to PE must be interrupted. Interrupting the connection prevents unwanted disconnection of the device because of faults and damage to the integrated filter.

The connection of the mains filter to PE is interrupted by removing screws on the right side of the housing. The screw is covered by a housing element or a protective cap. The number of connections to be disconnected depends on the product variant.

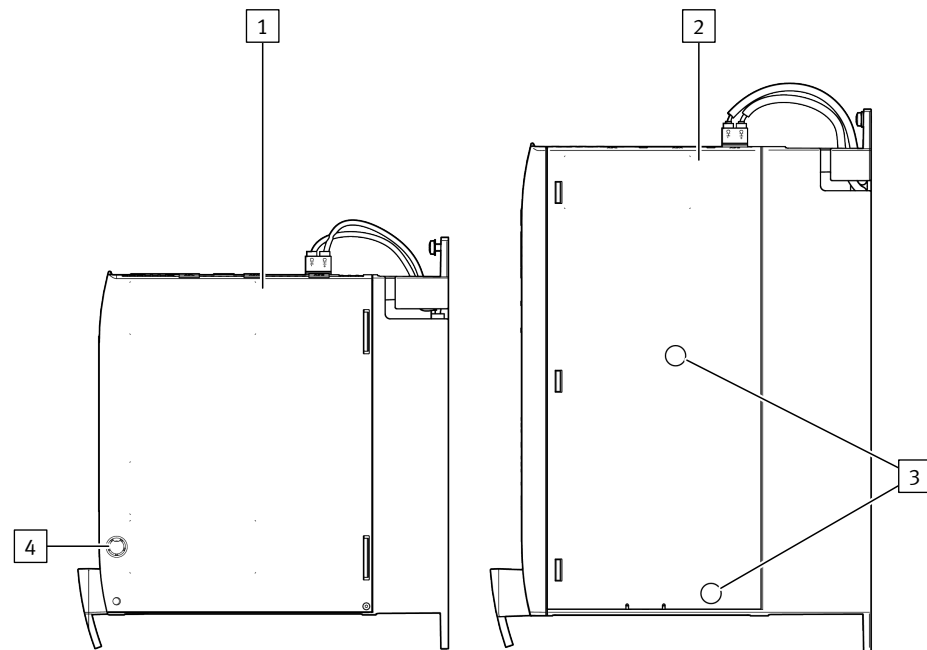


Fig. 11: Housing element or protective caps on the right-hand side of the housing

1 CMMT-AS-C2/C3/C5-11A-P3

3 Protective cap

2 CMMT-AS-C7/C12/C18/C25-11A-P3

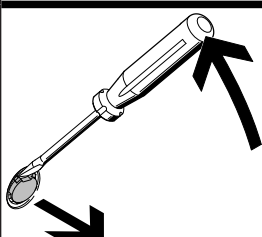
4 Housing element

Product variant	Connections to PE	Comment
CMMT-AS-C2-11A-P3-...-S1 CMMT-AS-C3-11A-P3-...-S1 CMMT-AS-C5-11A-P3-...-S1	1	Before unscrewing the screw, the housing element in front of the screw must be broken out. A protective cap for sealing the recess in the housing is included in the scope of delivery for the plug sets NEKM-C6-...-S and NEKM-C6-...-D (accessories from Festo).
CMMT-AS-C7-11A-P3-...-S1 CMMT-AS-C12-11A-P3-...-S1 CMMT-AS-C18-11A-P3-...-S1 CMMT-AS-C25-11A-P3-...-S1	2	Before removing the 2 screws, the 2 protective caps must be removed. The protective caps have 2 opposing snap hooks that prevent them from falling out. 

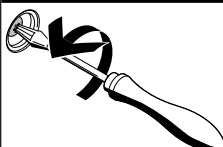
Tab. 20: Number of connections to be disconnected

To interrupt the connection of the filter capacitors to PE:

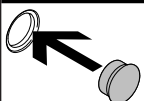
1. Completely disconnect the servo drive from the power supply.
2. Wait 5 minutes until the DC link circuit has discharged.
3. Remove the housing component or protective caps as follows:

CMMT-AS-	C2/C3/C5	C7/C12/C18/C25
	Place a suitable screwdriver against the upper notch provided in the housing recess and carefully lever the housing element out using the screwdriver.	Use a suitable screwdriver to carefully feel the position of a snap hook of the protective cap. Insert the screwdriver there and carefully remove the protective cap.

4. Unscrew screw(s) as follows

CMMT-AS-	C2/C3/C5	C7/C12/C18/C25
	Unscrew the screw carefully and completely with a size T10 screwdriver.	Unscrew the two screws carefully and completely with a size T10 screwdriver.

5. Push in the protective cap as follows:

CMMT-AS-	C2/C3/C5	C7/C12/C18/C25
	Push the protective cap fully into the housing recess as contact protection.	Push both protective caps back fully into the housing recesses as contact protection.

For operation in other networks:

- Restore the internal connection of the mains filter to PE by screwing in the screw(s)
- CMMT-AS-C2/C3/C5: tightening torque 1.4 Nm ± 15%.
- CMMT-AS-C7/C12/C18/C25: tightening torque 1.0 Nm ± 15%.

7.5 Connection of the mains side PE conductor

For safety reasons all PE conductors must always be connected prior to commissioning. Observe the regulations of EN 60204-1 when implementing protective earthing.

Always connect PE connection on the mains side (PE rail in the control cabinet) at the following positions:

- PE pin of the connection [X9A]
 - PE connection (earthing screw) next to the upper slot of the cooling element
- The cross section of the PE conductors must be at least equal to the cross section of the mains conductors L at [X9A]. Wire individually wired devices in a star shape. Observe the requirements for cross-wiring for cross-wired devices. Recommendation: use copper earthing strap (advantageous for EMC).

1. Fit a suitable cable lug to the PE conductors for the earthing screw.
2. Tighten earthing screw with a size T20 TORX screwdriver (tightening torque $1.8 \text{ Nm} \pm 15 \%$).

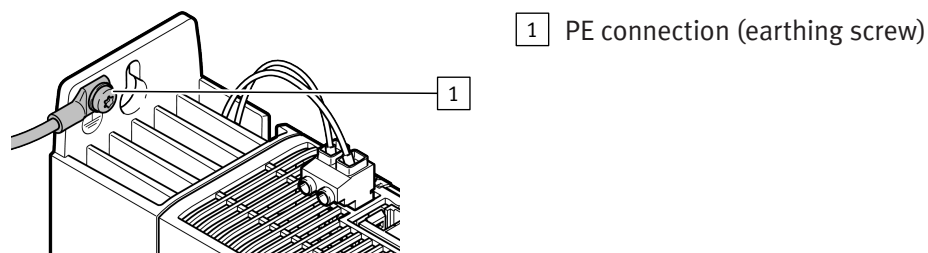


Fig. 12: PE connection (earthing screw)

7.6 Information on EMC-compliant installation

A mains filter is integrated into the device. The mains filter fulfils the following tasks:

- Guarantees the device's immunity to interference
- Limits the conducted emissions of the device

The device fulfils the requirements of the relevant product standard EN 61800-3 with suitable installation and wiring of all connecting cables.

The category that the device fulfils is dependent on the filter measures used and the motor cable length. The integrated mains filter is designed so that the device fulfils the following categories when operated as an individual device:

CMMT-AS...	PWM [kHz]	Required measures	Max. permissible motor cable length [m]
Category C2: operation in the first environment (residential area)			
-C2-11A-P3	8	Line choke	10
-C3-11A-P3 -C5-11A-P3	8	– (none)	10
-C7-11A-P3 -C12-11A-P3	8	– (none)	10
-C18-11A-P3 -C25-11A-P3	8	External mains filter and line choke	10
Category C3: operation in the second environment (industrial area)			
-C2-11A-P3	8	– (none)	50
-C3-11A-P3 -C5-11A-P3		External mains filter	100
-C7-11A-P3 -C12-11A-P3		– (none)	25
		External mains filter	100
-C18-11A-P3	8	– (none)	50
-C25-11A-P3		External mains filter	100

Tab. 21: Category according to the cable length

Required measures

Measures	Description
Line choke	With product CMMT-AS-C2-... install a suitable line choke with three partial windings for mains supply lines L1, L2 and L3 for compliance with the mains harmonics in accordance with EN 61000-3-2 – accessories. With the products CMMT-AS-C18/C25-... install a suitable line choke with three partial windings for mains supply lines L1, L2, and L3 for compliance with the mains harmonics in accordance with EN 61800-3-12 - see the following information.
Snap ferrite	With the products CMMT-AS-C18/C25-... suitable snap ferrites for category C2 must be installed on the line to [X18], e.g. Würth snap ferrite 74272211 or compatible. Run the line 4x through the snap ferrite.
External mains filter	Install a suitable external mains filter – accessories.

Tab. 22: Installation measures for operation in the area of the specified category

To install a line choke → 7.7 Connection examples.

- If set-up and commissioning are performed by a professional with the necessary experience in configuring and commissioning drive systems, including their EMC aspects, category C2 devices can be used (first environment, residential area).
- Limit values for the harmonic currents in the mains supply (EN 61000-3-2 or EN 61000-3-12) will apply for operation of category C2 devices, based on the connected load of the machine. Please check whether this is the case for your facility/system.

As a rule, compliance with the limit values for harmonic currents requires the use of external filter measures, e.g. installation of a line choke.

- The C18/C25 devices have mains currents over 16A_{RMS}, therefore the requirements from EN 61000-3-12 apply. The devices meet the standards requirements for category C2 under the following conditions:
 - Use of a series reactor ≥ 3.5 mH for mains supplies with a short-circuit power ratio $R_{SCE} \geq 350$ (corresponds to a mains impedance ≤ 30 m Ω)
 - Use of a series reactor ≥ 7.0 mH for mains supplies with a short-circuit power ratio $R_{SCE} \geq 250$ (corresponds to a mains impedance ≤ 40 m Ω)
 - The short-circuit power S_{sc} at the connection point of the system to the mains supply is greater than or equal to:
 - 4.331 kW when using a series reactor ≥ 7.0 mH
 - 6.063 kW when using a series reactor ≥ 3.5 mH < 7.0 mH

It is the responsibility of the installer or operator (if necessary after consultation with the grid operator) that these devices are only connected to a connection point with a short-circuit power $S_{sc} \geq 4.331$ kW or ≥ 6.063 kW.

- Category C3 devices are intended for use in the second environment only (industrial environment). Use in the first environment is not permitted.

This product can generate high-frequency malfunctions, which may require interference suppression measures in residential areas.

In practice, the combination of the installed components and their characteristics will influence the achievable length of the motor cable. Examples for determining achievable motor cable lengths with Festo motors → 10.4.1 Cable lengths in combination with Festo motors.

Cable lengths and cable shield

- Only use suitable cables that fulfil the requirements of EN 60204-1.
- Observe the max. permissible cable lengths and requirements for shielding.
- Observe shield support requirements.

Port		Max. cable length [m]	Cable shield
[X1A]	Inputs/outputs for the higher-order PLC	3	unshielded
[X1C]	Inputs/outputs for the axis	100 ¹⁾	Unshielded/shielded ²⁾
[X2]	Encoder 1	100 ³⁾	shielded
[X3]	Encoder 2	100 ³⁾ EnDat 2.1: maximum 20 m	shielded
[X6A]	Motor phase connection	dependent on category → Tab. 21 Category according to the cable length	shielded
[X6B]	Motor auxiliary connection	100 ¹⁾	shielded
[X9A]	Power supply and DC link circuit connection	Single device: 2 Device compound: 0.5	unshielded
[X9B]	Braking resistor	2 ⁴⁾	shielded ⁴⁾
[X9C]	Logic voltage supply	Single device: 2 Device compound: 0.5	unshielded
[X10]	Device synchronisation	Single device: 3 Device compound: 0.5	double shielded (CAT 5)
[X19]	RTE (port 1 and port 2)	30	double shielded (CAT 5)
[X18]	Standard Ethernet	30	double shielded (CAT 5)

1) With cable lengths > 25 m, take account of the voltage drop on the cables by selecting appropriate wire cross sections.

2) For safety-related applications, use a shielded cable outside the control cabinet. Otherwise, a shield is not absolutely essential, but is recommended.

3) Adhere to the maximum permissible cable length for the encoder used.

4) With connection of an external braking resistor

Tab. 23: Cable lengths and cable shield

Shielded cables without a shielded plug housing have short unshielded cable ends at both ends by definition.

Make unshielded cable ends as short as possible.

Maximum permissible length of unshielded wires at the connection:

- [X6A] max. 120 mm
- [X6B] max. 150 mm
- [X1C] max. 150 mm

Laying cables

Comply with general guidelines for EMC-compliant installation, e.g.:

- Do not run signal cables parallel to power cables.
- Maintain required minimum distances between signal cables and power cables dependent on the installation conditions. Signal cables must be physically separated from the power cables as far as possible.
- Avoid crossing signal cables with power cables or running them at a 90° angle in relation to one another.

EMC-compliant installation of the motor cable and encoder cables

- Keep motor cable as short as possible to minimise the leakage currents and losses in the motor cable.
- Connect the motor cable shield under the shield clamp in the lower area on the front of the housing, ensuring a large-area connection. The motor cable shield must be connected to the associated servo drive so that the leakage currents can flow back into the servo drive from which they originate.
- Connect the PE inner conductor of the motor cable to the PE connection point of the motor connection [X6A].

- Connect the shield of the motor cable to the PE over a large surface area on the motor side (e.g. via the shield connection provided on the motor connector or the shield support surface in the motor junction box).
- If separate cables are used for the holding brake and the temperature sensor, connect the respective shield to the corresponding PE connection point of the motor auxiliary connection [X6B].
- Connect the shield of the encoder cable on both ends: on the device side to the respective plug housing, on the motor side to the encoder or plug housing.
- Route the signal cables [X2], [X3], [X10], [X1C] and [X6B] downward and ensure strain relief using cable binders at the cut-outs of the servo drive shield clamp.

7.7 Connection examples

Connection plan, 3-phase mains connection

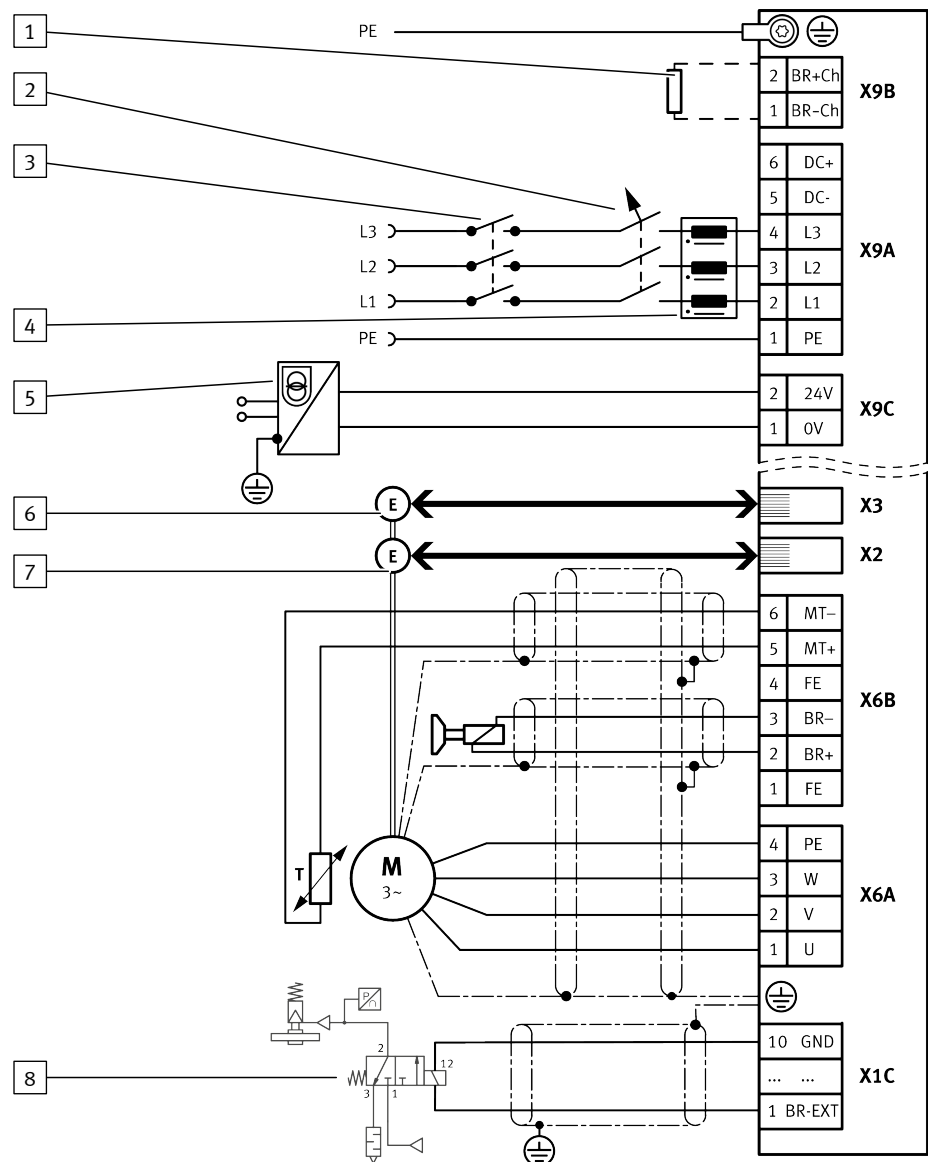


Fig. 13: Connection example

- | | |
|--|---|
| 1 Braking resistor | 5 PELV fixed power supply for 24 V supply |
| 2 Circuit breaker or 3 x fuses | 6 Encoder 2 (optional) |
| 3 Main switch/main contactor | 7 Encoder 1 |
| 4 Line choke if required (for category C2) | 8 Example of external brake |

7.8 Interfaces

7.8.1 [X1A], inputs and outputs for the higher-order PLC

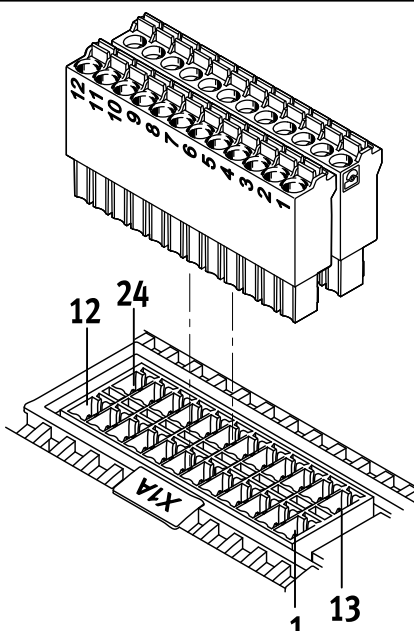
The I/O interface [X1A] is located on the top of the device.

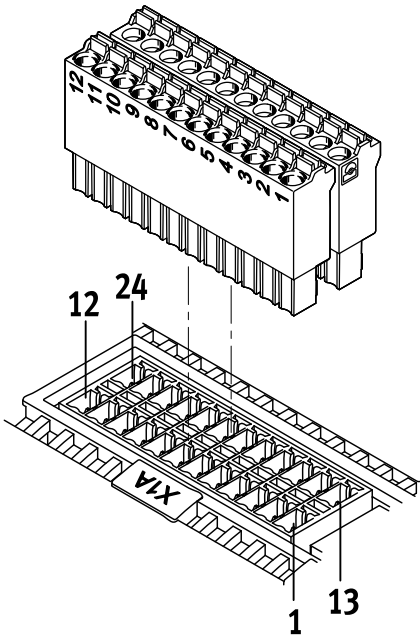
This interface offers access to functional and safety-related inputs and outputs of the device. They include, for example:

- Digital inputs for 24 V level (PNP logic)
- Digital outputs for 24 V level (PNP logic)
- Signal contact for safety chain (RDY-C1, RDY-C2)
- differential analogue input ± 10 V control voltage

The inputs and outputs of this I/O interface are used for coupling to a higher-order PLC. The safety-related inputs and outputs are connected to a safety relay unit.

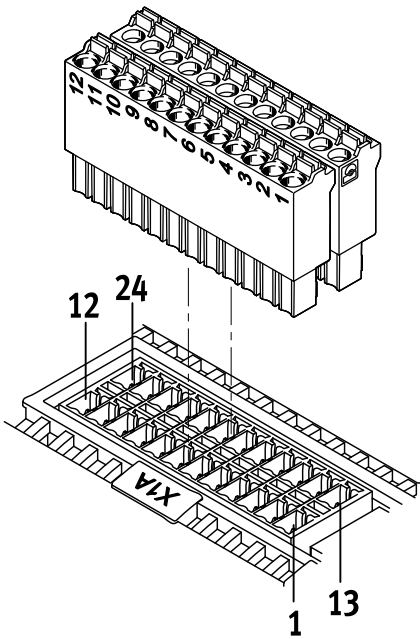
CMMT-AS-...-S3

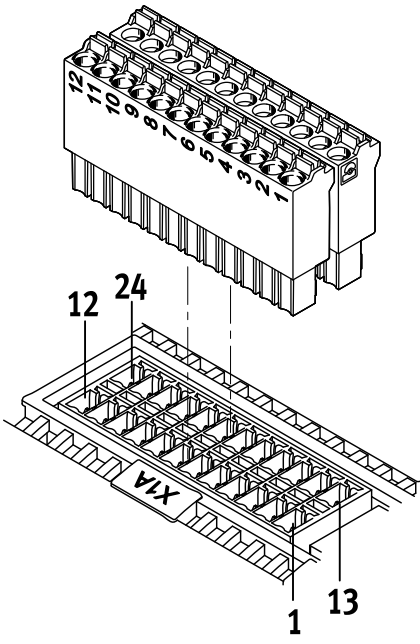
[X1A]	Pin	Function	Description
	24	RDY-C1	Normally open contact: ready for operation message (Ready)
	23	RDY-C2	
	22	SOUT0	Feedback on configurable input 0
	21	SOUT1	Feedback on configurable input 1
	20	SOUT2	Feedback on configurable input 2
	19	SOUT3	Feedback on configurable input 3
	18	SIN4	single-channel configurable input 4 (non-inverted)
	17	GND	Reference potential
	16	TRG0	fast output for triggering external components, channel 0
	15	TRG1	like TRG0, but channel 1
	14	CAP0	fast input for position detection, channel 0
	13	CAP1	like CAP0, but channel 1
	12	#SIN0-A	2-channel configurable input 0, channel A
	11	#SIN0-B	2-channel configurable input 0, channel B
	10	#SIN1-A	2-channel configurable input 1, channel A
	9	#SIN1-B	2-channel configurable input 1, channel B
	8	#SIN2-A	2-channel configurable input 2, channel A
	7	#SIN2-B	2-channel configurable input 2, channel B
	6	#SIN3-A	2-channel configurable input 3, channel A
	5	#SIN3-B	2-channel configurable input 3, channel B
	4	ERR-RST	functional and safety-related error acknowledgment
	3	CTRL-EN	Power stage enable

[X1A]	Pin	Function	Description
	2	AIN0	Differential analogue input
	1	#AIN0	

Tab. 24: Inputs and outputs for the higher-order PLC with the CMMT-AS-...-S3

CMMT-AS-...-S1

[X1A]	Pin	Function	Description
	24	RDY-C1	Normally open contact: ready for operation message (Ready)
	23	RDY-C2	
	22	STA	Diagnostics output Safe torque off acknowledge
	21	SBA	Diagnostics output Safe brake control acknowledge
	20	—	reserved, do not connect
	19	—	
	18	SIN4	Release brake request
	17	GND	Reference potential
	16	TRG0	fast output for trig- gering external components, channel 0
	15	TRG1	like TRG0, but channel 1
	14	CAP0	fast input for position detec- tion, channel 0
	13	CAP1	like CAP0, but channel 1
	12	#STO-A	Safe torque off control input, channel A
	11	#STO-B	Safe torque off control input, channel B
	10	#SBC-A	Safe brake control control input, channel A
	9	#SBC-B	Safe brake control control input, channel B
	8	—	reserved, do not connect
	7		
	6		
	5		

[X1A]	Pin	Function	Description
	4	ERR-RST	Error acknowledgement
	3	CTRL-EN	Power stage enable
	2	AIN0	Differential analogue input
	1	#AIN0	

Tab. 25: Inputs and outputs for the higher-order PLC with the CMMT-AS-...-S1

CMMT-AS-...-S3/S1

Requirements for the mating plugs (2 required)	
Design	FMC-1,5/12-ST-3,5 from PHOENIX CONTACT or compatible
Signal contacts	12 (12-pin, 1-row)
Nominal current	8 A
Rated voltage (III/2)	160 V
Pitch	3.5 mm
Stripping length	10 mm

Tab. 26: Requirements for the mating plugs

CMMT-AS-...-S3/S1

Requirements for the connecting cable	Single device	Device compound
Shielding	unshielded	
Min. conductor cross-section incl. plastic wire ferrule	0.25 mm²	–
Max. conductor cross-section including plastic wire ferrule	0.75 mm²	–
Min. conductor cross-section including double plastic wire ferrule	–	0.25 mm²
Max. conductor cross-section including double plastic wire ferrule	–	0.5 mm²
Max. length	3 m	0.5 m

Tab. 27: Requirements for the connecting cable

Brief description of inputs and outputs at the connection [X1A] with the CMMT-AS-...-S3

Signal name	Name	Function	can be parameterised
X1A.24	Ready 1 (RDY-C1)	Normally open contact; ready If the device is ready for operation, the contact is closed. If there is an error, the contact is opened.	no
X1A.23	Ready 2 (RDY-C2)		

Signal name	Name	Function	can be parameterised
X1A.22	Diagnosis SIN0 (SOUT0)	Diagnostic output for the safety sub-function at the assigned configurable 2-channel input SIN0-A/B, SIN1-A/B, SIN2-A/B or SIN3-A/B. The output only switches to high if the safety sub-function has been requested via 2 channels and the safety sub-function is active (for detailed information see → Manual Safety sub-function).	yes
X1A.21	Diagnosis SIN1 (SOUT1)		
X1A.20	Diagnosis SIN2 (SOUT2)		
X1A.19	Diagnosis SIN3 (SOUT3)		
X1A.18	Parameterisable input (SIN4)	single-channel configurable input 4 (non-inverted)	yes
X1A.17	0 V (GND)	Reference potential for I/O signals; internally connected to 0 V of the 24 V logic supply. Therefore, only use if the I/O signals are electrically isolated from the 24 V logic supply on the opposite side (controller).	
X1A.16	Trigger 0 (TRG0)	Trigger output channel 0 (fast output for triggering external components) The output switches based on a reference position. Logical switching statuses can be output by virtual position switches, rotor position switches and cam controllers via the output.	yes
X1A.15	Trigger 1 (TRG1)	Trigger output channel 1 (like TRG0, but channel 1)	
X1A.14	Capture, channel 0 (CAP0)	fast input for position detection, channel 0 The current actual position of the encoder is saved when the parameterised edge change occurs. The higher-order controller can call up the stored actual positions via the active fieldbus.	
X1A.13	Capture, channel 1 (CAP1)	fast input for position detection, channel 1 (like CAP0, but channel 1)	
X1A.12	Safety sub-function 0, channel A (#SINO-A)	The safety sub-function parameterised for the relevant 2-channel input is requested with low level at both channels. For detailed information see → Manual Safety sub-function.	yes
X1A.11	Safety sub-function 0, channel B (#SINO-B)		
X1A.10	Safety sub-function 1, channel A (#SINO-A)		
X1A.9	Safety sub-function 1, channel B (#SINO-B)		
X1A.8	Safety sub-function 2, channel A (#SINO-A)		
X1A.7	Safety sub-function 2, channel B (#SINO-B)		
X1A.6	Safety sub-function 3, channel A (#SINO-A)		
X1A.5	Safety sub-function 3, channel B (#SINO-B)		
X1A.4	Acknowledge error (ERR-RST)	Acknowledgeable error messages can be acknowledged with a rising edge at this input.	yes
X1A.3	Release (CTRL-EN)	Response can be parameterised. – Response 1: the closed-loop controller can only be enabled via the drive profile when high level is pending. – Response 2: on a rising edge, the closed-loop controller is enabled without taking the drive profile into account. The drive is energised and is in the operating mode requested during the signal transition. – Response 3: enabling of the closed-loop controller can only be controlled via the drive profile. If the request is withdrawn, the drive is braked in accordance with a response of stop category 1. On completion of the braking ramp, the brake engages, and the power stage is functionally switched off.	yes

Signal name	Name	Function	can be parameterised
X1A.2	AIN0	Differential analogue input for typical input level of ± 10 V	yes
X1A.1	#AIN0	The following setpoint values and limits can be specified via the analogue input in the form of analogue voltage: – Setpoint values for position, speed or force/current – Limits for speed or force/current	

Tab. 28: Inputs and outputs at the connection [X1A]

Brief description of inputs and outputs at the connection [X1A] with the CMMT-AS-...-S1

Signal name	Name	Function	can be parameterised
X1A.24	Ready 1 (RDY-C1)	Normally open contact; ready	no
X1A.23	Ready 2 (RDY-C2)	If the device is ready for operation, the contact is closed. If there is an error, the contact is opened.	
X1A.22	Safe torque off acknowledge (STA)	Diagnostic output for the safety sub-function STO; the output only switches to high when the safety sub-function STO is requested over 2 channels and the control of the power output stage is switched off safely over 2 channels (detailed information on this ➔ Manual Safety sub-function).	
X1A.21	Safe brake control acknowledge (SBA)	Diagnostic output for the safety sub-function SBC; the output only switches to high when the safety sub-function SBC is requested over 2 channels and both brake outputs are switched off safely (detailed information on this ➔ Manual Safety sub-function).	
X1A.20	n. c.	reserved for future extensions; do not connect	
X1A.19	n. c.		
X1A.18	Release brake (SIN4)	When the level at this input is high, the brake can be functionally released if the function has been previously configured in the servo drive. However, a requested SBC function always has higher priority, and this results in the brake not being triggered/enabled.	yes
X1A.17	0 V (GND)	Reference potential for I/O signals; internally connected to 0 V of the 24 V logic supply. Therefore, only use if the I/O signals are electrically isolated from the 24 V logic supply on the opposite side (controller).	yes
X1A.16	Trigger 0 (TRG0)	Trigger output channel 0 (fast output for triggering external components) The output switches based on a reference position. Logical switching statuses can be output by virtual position switches, rotor position switches and cam controllers via the output.	
X1A.15	Trigger 1 (TRG1)	Trigger output channel 1 (like TRG0, but channel 1)	
X1A.14	Capture, channel 0 (CAP0)	fast input for position detection, channel 0 The current actual position of the encoder is saved when the parameterised edge change occurs. The higher-order controller can call up the stored actual positions via the active fieldbus.	
X1A.13	Capture, channel 1 (CAP1)	fast input for position detection, channel 1 (like CAP0, but channel 1)	
X1A.12	Safe torque off, channel A (#STO-A)	The safety sub-function STO is requested when the signal level at the inputs #STO-A and #STO-B is low. Control of the power output stage is then safely blocked. If the safety sub-function STO is not required, both inputs must be connected to 24 V so that the motor can be moved (detailed information on this ➔ Manual Safety sub-function).	no
X1A.11	Safe torque off, channel B (#STO-B)		

Signal name	Name	Function	can be parameterised
X1A.10	Safe brake control, channel A (#SBC-A)	The safety sub-function SBC is requested when the signal level at the inputs #SBC-A and #SBC-B is low. The control outputs for the motor holding brake and external clamping unit are then switched off. If the safety sub-function SBC is not required, both inputs must be connected to 24 V so that the motor can be moved (detailed information on this → Manual Safety sub-function).	no
X1A.9	Safe brake control, channel B (#SBC-B)		
X1A.8	n. c.		
X1A.7	n. c.		
X1A.6	n. c.		
X1A.5	n. c.	reserved for future extensions; do not connect	
X1A.4	Acknowledge error (ERR-RST)	Acknowledgeable error messages can be acknowledged with a rising edge at this input.	no
X1A.3	Release (CTRL-EN)	Response can be parameterised. – Response 1: the closed-loop controller can only be enabled via the drive profile when high level is pending. – Response 2: on a rising edge, the closed-loop controller is enabled without taking the drive profile into account. The drive is energised and is in the operating mode requested during the signal transition. – Response 3: enabling of the closed-loop controller can only be controlled via the drive profile. If the request is withdrawn, the drive is braked in accordance with a response of stop category 1. On completion of the braking ramp, the brake engages, and the power stage is functionally switched off.	yes
X1A.2	AIN0	Differential analogue input for typical input level of ± 10 V	yes
X1A.1	#AIN0	The following setpoint values and limits can be specified via the analogue input in the form of analogue voltage: – Setpoint values for position, speed or force/current – Limits for speed or force/current	

Tab. 29: Inputs and outputs at the connection [X1A]

Internal structure of digital inputs (DIN) – not applicable for STO inputs with the CMMT-AS-...-S1

The following equivalent circuit shows an example of the internal design of a digital input (DIN).

The digital inputs are designed for +24 V level corresponding to type 3 in accordance with EN 61131-2. The digital inputs are not electrically isolated and have integrated EMC protective functions.

Two-channel safe inputs correspond in their internal design to two 1-channel inputs. However, the equivalent circuit is not valid for the STO inputs. Information on 2-channel safe inputs → Manual Safety sub-function.

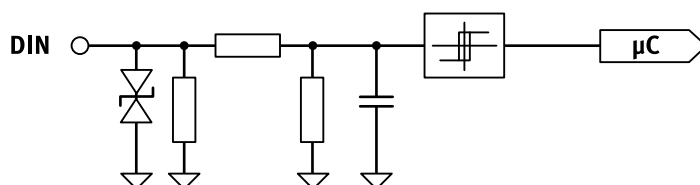


Fig. 14: Internal design of digital inputs (DIN)

Internal design of digital outputs (DOUT)

The digital outputs TRG0 and TRG1 supply +24 V signals, which are implemented with a high-side driver.

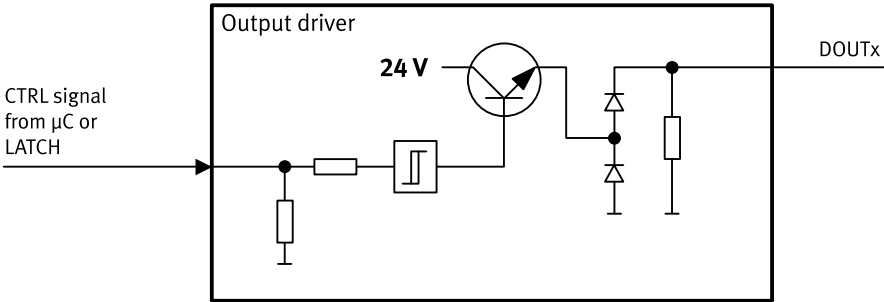


Fig. 15: Internal design of digital outputs (DOUT)

Internal design of ana-
logue input 0 (AIN0)

The analogue input AIN0 is a differential input for typical input levels of ± 10 V. The differential amplifier filters out high-frequency interference signals.

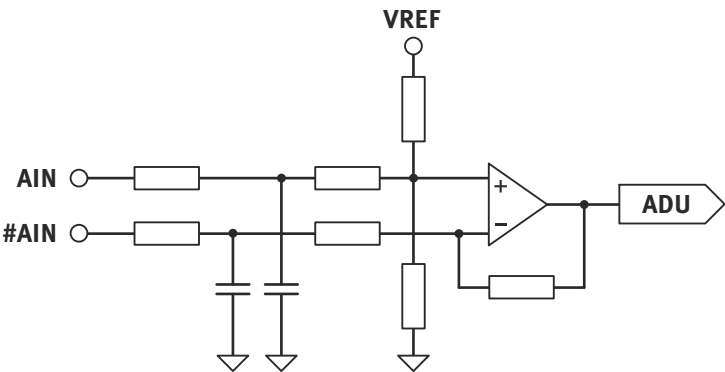


Fig. 16: Internal design of analogue input 0 (AIN0)

7.8.2 [X1C], inputs and outputs for the axis

The I/O interface [X1C] is located on the front of the device. This interface makes functional and safety-related inputs and outputs available for components on the axis. Output BR-EXT is used in conjunction with the safety sub-function Safe brake control → Manual Safety sub-function.

[X1C]	Pin	Function	Description
	10	GND	Reference potential
	9	24V	Power supply output for sensors
	8	GND	Reference potential
	7	LIM1	Digital input for limit switch 1 (PNP logic, 24 V DC)
	6	LIM0	Digital input for limit switch 0 (PNP logic, 24 V DC)
	5	GND	Reference potential
	4	24 V	Power supply output for sensors
	3	–	reserved, do not connect
	2	REF-A	Digital input for reference switch (PNP logic, 24 V DC)
	1	BR-EXT	Output for connecting an external clamping unit

Tab. 30: Inputs and outputs for the axis

Requirements for mating plugs	
Design	DFMC 1,5/ 5-ST-3,5 from PHOENIX CONTACT or compatible
Signal contacts	10 (5-pin, 2-row)
Nominal current	8 A
Rated voltage (III/2)	160 V
Pitch	3.5 mm
Stripping length	10 mm

Tab. 31: Requirements for mating plugs

Cable requirements	
Shielding	Unshielded/shielded ¹⁾
Min. conductor cross-section including plastic wire end sleeve	0.25 mm ²
Max. conductor cross-section including plastic wire end sleeve	0.75 mm ²
Max. length	100 m

1) For safety-related applications, use a shielded cable outside the control cabinet. Otherwise, a shield is not absolutely essential, but is recommended.

Tab. 32: Cable requirements

Requirements for the shield support

Connecting the shield

- On the device side, connect the cable shield to the shield clamp for the motor cable.
- On the machine side, connect the cable shield to an earthed machine part.

7.8.3 [X2], encoder interface 1

The encoder interface [X2] is located on the front panel of the device. The encoder interface [X2] is primarily designed for connecting the position encoder integrated into the motor.

Supported standards/protocols	Supported encoders
Hiperface	SEK/SEL 37 SKS/SKM 36
EnDat 2.2	ECI 1118/EBI 1135 ECI 1119/EQI 1131 ECN 1113/EQN 1125 ECN 1123/EQN 1135
EnDat 2.1	Only in combination with Festo EMMS-AS series motors that have an integrated encoder with EnDat 2.1 protocol
Only for CMMT-AS -...- MP: BiSS-C	Absolute encoders with BiSS interface that support the BiSS C protocol
Digital incremental encoders with square-wave signals and with RS422-compatible signal output (differential A, B, N signals)	ROD 426 or compatible
Analogue SIN/COS incremental encoders with differential analogue signals with 1 V _{SS}	HEIDENHAIN LS 187/LS 487 (20 µm signal period) or compatible
Encoders with asynchronous two-wire communication interface (RS485)	Nikon MAR-M50A or compatible (18 bit data frames)

Tab. 33: Standards and protocols supported by the encoder interface [X2]

NOTICE**Damage to the sensor when sensor type is changed.**

The servo drive can provide 5 V or 10 V sensor supply. Through configuration of the sensor, the supply voltage is established for the sensor. The sensor can be damaged if the configuration is not adjusted before connection of another sensor type.

- When changing the sensor type: Comply with specified steps.



Permissible encoder combinations for the safety sub-functions: → 1.2 Applicable documents, Manual Safety sub-function.

Change of encoder type

1. Disconnect encoder from the device.
2. Set up and configure new encoder type in the CMMT-AS.
3. Save settings in the CMMT-AS.
4. Switch off CMMT-AS.
5. Connect new encoder type.
6. Switch CMMT-AS back on.

Voltage drops in the encoder cable are compensated at the connection [X2] for encoders that feature purely digital communication and require a regulated +5 V supply (EnDat 2.1, Nikon).

The connection [X2] is designed as an RJ45 socket. An LED is integrated into the RJ45 bushing. With digital incremental encoders, the LED lights up green when the encoder interface is active. With encoders featuring a communication interface, the LED lights up green when there is a connection to the encoder.

Requirements for mating plugs	
Design	VS-08-RJ45-5-Q/IP20 from PHOENIX CONTACT or compatible
Number of pins	8
Shielded	Yes
Nominal current	> 1 A
Rated voltage	120 V AC
Degree of protection	IP20

Tab. 34: Requirements for mating plugs

Requirements for the connecting cable	
Characteristics	– Encoder cable for servo drives, shielded – Optical shield cover > 85 % – Separately twisted signal pairs – Recommended design: (4 x (2 x 0.25 mm²))¹⁾
Max. cable length	100 m ¹⁾

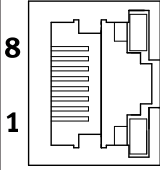
1) In the case of encoders with no compensation for voltage drops or in the case of very long cables, thicker supply cables may be required.

Tab. 35: Requirements for the connecting cable

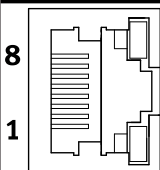
Connecting the encoder cable shield

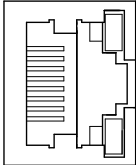
1. On the device side, connect the encoder cable shield to the plug housing.
2. On the motor side, connect the encoder cable shield to the encoder or encoder plug.

Requirements for the shield support

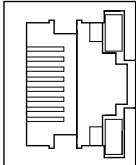
Pin allocation EnDat encoder (EnDat 2.1 and EnDat 2.2) and BiSS-C-Geber (CMMT-AS-...-MP only)				
[X2]	Pin	Function	Value	Description
	1	SCLK	5 V _{SS} , R _I = 120 Ω	Clock line, output, RS485-compliant, differential
	2	#SCLK		
	3	VCC-IN	Measured value	only for EnDat 2.1: encoder voltage back measurement, differential
	4	DATA	Differential signal: 5 V _{SS} , R _I = 120 Ω	Data cable, bidirectional, RS485-compliant, differential
	5	#DATA		
	6	#VCC-IN	Measured value	only for EnDat 2.1: encoder voltage back measurement, differential, inverse
	7	VCC1	– EnDat 2.1: 5.00 V ... 5.50 V, max. 250 mA – EnDat 2.2: 9.50 V ... 10.50 V, max. 250 mA – BiSS-C: 5.00 V ... 10.50 V (default 5.00 V), max. 250 mA	Encoder supply, switchable – EnDat 2.1: 5 V – EnDat 2.2: 10 V – BiSS-C: 5 V, 10 V
	8	GND	0 V	Reference potential of encoder supply
	Housing	FE, connected to PE	–	The housing is used as a support for the cable shield and is connected to the PE.

Tab. 36: EnDat encoder and BiSS-C encoder

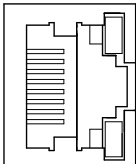
Pin allocation of Hiperface encoder				
[X2]	Pin	Function	Value	Description
	1	COS	1 V _{SS} , R _I = 120 Ω	COS track signal from the high-resolution incremental encoder, RS485-compliant, differential
	2	#COS		
	3	SIN	1 V _{SS} , R _I = 120 Ω	SIN track signal from the high-resolution incremental encoder, RS485-compliant, differential
	4	DATA	5 V _{SS} , R _I = 120 Ω	Hiperface data cable, bidirectional, asynchronous, 115 kbit/s RS485-compliant, differential
	5	#DATA		
	6	#SIN	1 V _{SS} , R _I = 120 Ω	SIN track signal from the high-resolution incremental encoder, RS485-compliant, differential, inverse

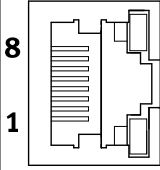
Pin allocation of Hiperface encoder				
[X2]	Pin	Function	Value	Description
	7	VCC1	9.50 V ... 10.50 V max. 250 mA	Encoder supply, switchable; Hiperface: 10 V
	8	GND	0 V	Reference potential for supply
	Housing	FE, connected to PE	—	The housing is used as a support for the cable shield and is connected to the PE.

Tab. 37: Hiperface encoder

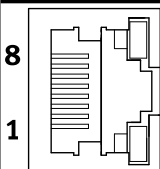
Pin allocation for digital incremental encoders				
[X2]	Pin	Function	Value	Description
	1	A	5 V _{SS} , R _i = 120 Ω	A-track signal from the incremental encoder, RS485-compliant, differential
	2	#A		
	3	B	5 V _{SS} , R _i = 120 Ω	B-track signal from the incremental encoder, RS485-compliant, differential
	4	N	5 V _{SS} , R _i = 120 Ω	Zero pulse or N-track signal from the incremental encoder, RS485-compliant, differential
	5	#N		
	6	#B	5 V _{SS} , R _i = 120 Ω	B-track signal from the incremental encoder, RS485-compliant, differential, inverse
	7	VCC1	5.00 V ... 10.50 V (default 5.00 V), max. 250 mA	Encoder power supply, switchable; incremental encoder: 5 V or 10 V Voltage drop in the encoder cable is not compensated
	8	GND	0 V	Reference potential for supply
	Housing	FE, connected to PE	—	The housing is used as a support for the cable shield and is connected to the PE.

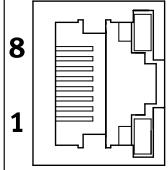
Tab. 38: Digital incremental encoders

Pin allocation for analogue SIN/COS incremental encoders				
[X2]	Pin	Function	Value	Description
	1	COS	1 V _{SS} , R _i = 120 Ω	COS track signal from the high-resolution incremental encoder, RS485-compliant, differential
	2	#COS		

Pin allocation for analogue SIN/COS incremental encoders				
[X2]	Pin	Function	Value	Description
	3	SIN	1 V _{SS} , R _i = 120 Ω	SIN track signal from the high-resolution incremental encoder, RS485-compliant, differential
	4	N	5 V _{SS} , R _i = 120 Ω	Zero pulse or N-track signal from the incremental encoder, RS485-compliant, differential
	5	#N		
	6	#SIN	1 V _{SS} , R _i = 120 Ω	SIN track signal from the high-resolution incremental encoder, RS485-compliant, differential, inverse
	7	VCC1	5.00 V ... 5.50 V, max. 250 mA	Encoder supply, switchable; SIN/COS encoder: 5 V Voltage drop in the encoder cable is not compensated
	8	GND	0 V	Reference potential for supply
	Housing	FE, connected to PE	—	The housing is used as a support for the cable shield and is connected to the PE.

Tab. 39: Analogue SIN/COS incremental encoders

Pin allocation for encoders with asynchronous communication interface				
[X2]	Pin	Function	Value	Description
	1	—	—	—
	2	—		
	3	VCC-IN	Measured value	Encoder voltage back measurement, differential
	4	DATA	5 V _{SS} , R _i = 120 Ω	Data cable, bidirectional, asynchronous, max. 4000 kbit/s, RS485-compliant, differential
	5	#DATA		
	6	#VCC-IN	Measured value	Encoder voltage back measurement, differential, inverse
	7	VCC1	5.00 V ... 5.50 V, max. 250 mA	Encoder supply, switchable; 5 V Voltage drop in the encoder cable is compensated

Pin allocation for encoders with asynchronous communication interface				
[X2]	Pin	Function	Value	Description
	8	GND	0 V	Reference potential for supply
	Housing	FE, connected to PE	–	The housing is used as a support for the cable shield and is connected to the PE.

Tab. 40: Encoders with asynchronous communication interface

7.8.4 [X3], encoder interface 2

The encoder interface [X3] is located on the front panel of the device. The encoder interface [X3] primarily serves to connect a second position encoder to the axis (e.g. to enable precise positioning control for the axis or as a redundant measuring system for safe motion monitoring).

Supported standards/protocols	Supported encoders
Only for CMMT-AS-...-MP: Hiperface	SEK/SEL 37 SKS/SKM 36
Only for CMMT-AS-...-MP: EnDat 2.2	ECI 1118/EBI 1135 ECI 1119/EQI 1131 ECN 1113/EQN 1125 ECN 1123/EQN 1135
Only for CMMT-AS-...-MP: EnDat 2.1	Only in combination with Festo EMMS-AS series motors that have an integrated encoder with EnDat 2.1 protocol
Digital incremental encoders with square-wave signals and with RS422-compatible signal outputs (differential A, B, N signals)	ROD 426 or compatible ELGO LMIX 22
Analogue SIN/COS incremental encoders with differential analogue signals with 1 V _{ss}	HEIDENHAIN LS 187/LS 487 (20 µm signal period) or compatible

Tab. 41: Standards and protocols supported by the encoder interface [X3]



Permissible encoder combinations for the safety sub-functions → 1.2 Applicable documents, Manual Safety sub-function.

[X3] is designed to be electrically compatible with [X2] but does not support all encoders and functions like [X2].

The connection [X3] is designed as an RJ45 socket. An LED is integrated into the RJ45 bushing. The LED indicates the connection status. If there is a connection to the encoder, the LED lights up green.

Requirements for mating plugs	
Design	VS-08-RJ45-5-Q/IP20 from PHOENIX CONTACT or compatible
Number of pins	8
Shielded	Yes
Nominal current	> 1 A
Rated voltage	120 V AC
Degree of protection	IP20

Tab. 42: Requirements for mating plugs

Requirements for the connecting cable	
Characteristics	- Encoder cable for servo drives, shielded - Optical shield cover > 85 % - Separately twisted signal pairs - Recommended design: (4 x (2 x 0.25 mm²))¹⁾
Max. cable length	100 m ¹⁾ EnDat 2.1: maximum 20 m

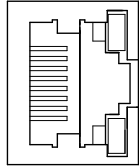
1) In the case of encoders with no compensation for voltage drops or in the case of very long cables, thicker supply cables may be required.

Tab. 43: Requirements for the connecting cable

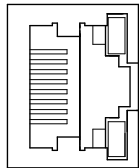
Requirements for the shield support

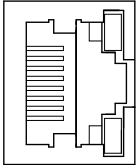
Connecting the encoder cable shield

- On the device side, connect the encoder cable shield to the plug housing.
- On the motor side, connect the encoder cable shield to the encoder or encoder plug.

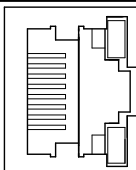
Pin allocation of EnDat encoder (EnDat 2.1 and EnDat 2.2, CMMT-AS-...-MP only)				
[X3]	Pin	Function	Value	Description
	1	SCLK	5 V _{SS} , R _I = 120 Ω	Clock line, output, RS485-compliant, differential
	2	#SCLK		
	3	VCC-IN	Reserved	No back measurement of the encoder voltage
	4	DATA	Differential signal: 5 V _{SS} , R _I = 120 Ω	Data cable, bidirectional, RS485-compliant, differential
	5	#DATA		
	6	#VCC-IN	Reserved	No back measurement of the encoder voltage
	7	VCC1	– EnDat 2.1: 5.00 V ... 5.50 V, max. 250 mA – EnDat 2.2: 9.50 V ... 10.50 V, max. 250 mA	Encoder supply, switchable – EnDat 2.1: 5 V – EnDat 2.2: 10 V
	8	GND	0 V	Reference potential of encoder supply
	Housing	FE, connected to PE	–	The housing is used as a support for the cable shield and is connected to the PE.

Tab. 44: EnDat encoder

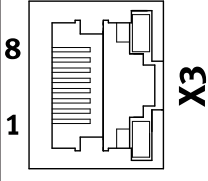
Pin allocation of Hiperface encoder (CMMT-AS-...-MP only)				
[X3]	Pin	Function	Value	Description
	1	COS	1 V _{SS} , R _I = 120 Ω	COS track signal from the high-resolution incremental encoder, RS485-compliant, differential
	2	#COS		
	3	SIN	1 V _{SS} , R _I = 120 Ω	SIN track signal from the high-resolution incremental encoder, RS485-compliant, differential

Pin allocation of Hiperface encoder (CMMT-AS-...-MP only)				
[X3]	Pin	Function	Value	Description
	4	DATA	5 V _{SS} , R _i = 120 Ω	Hiperface data cable, bidirectional, asynchronous, 115 kbit/s RS485-compliant, differential
	5	#DATA		
	6	#SIN	1 V _{SS} , R _i = 120 Ω	SIN track signal from the high-resolution incremental encoder, RS485-compliant, differential, inverse
	7	VCC1	9.50 V ... 10.50 V max. 250 mA	Encoder supply, switchable; Hiperface: 10 V
	8	GND	0 V	Reference potential for supply
	Housing	FE, connected to PE	—	The housing is used as a support for the cable shield and is connected to the PE.

Tab. 45: Hiperface encoder

Pin allocation for digital incremental encoders				
[X3]	Pin	Function	Value	Description
	1	A	5 V _{SS} , R _i = 120 Ω	A-track signal from the incremental encoder, RS485-compliant, differential
	2	#A		
	3	B	5 V _{SS} , R _i = 120 Ω	B-track signal from the incremental encoder, RS485-compliant, differential
	4	N	5 V _{SS} , R _i = 120 Ω	Zero pulse or N-track signal from the incremental encoder, RS485-compliant, differential
	5	#N		
	6	#B	5 V _{SS} , R _i = 120 Ω	B-track signal from the incremental encoder, RS485-compliant, differential, inverse
	7	VCC1	5.00 V ... 10.50 V (default 5.00 V), max. 250 mA	Encoder power supply, switchable; incremental encoder: 5 V or 10 V Voltage drop is not compensated
	8	GND	0 V	Reference potential for supply
	Housing	FE, connected to PE	—	The housing is used as a support for the cable shield and is connected to the PE.

Tab. 46: Digital incremental encoders

Pin allocation for analogue SIN/COS incremental encoders				
[X3]	Pin	Function	Value	Description
	1	COS	1 V _{SS} , R _i = 120 Ω	COS track signal from the high-resolution incremental encoder, RS485-compliant, differential
	2	#COS		
	3	SIN	1 V _{SS} , R _i = 120 Ω	SIN track signal from the high-resolution incremental encoder, RS485-compliant, differential
	4	N	5 V _{SS} , R _i = 120 Ω	Zero pulse or N-track signal from the incremental encoder, RS485-compliant, differential
	5	#N		
	6	#SIN	1 V _{SS} , R _i = 120 Ω	SIN track signal from the high-resolution incremental encoder, RS485-compliant, differential, inverse
	7	VCC1	5.00 V ... 5.50 V, max. 250 mA	Encoder supply, switchable; SIN/COS encoder: 5 V Voltage drop is not compensated
	8	GND	0 V	Reference potential for supply
	Housing	FE, connected to PE	–	The housing is used as a support for the cable shield and is connected to the PE.

Tab. 47: Analogue SIN/COS incremental encoders

7.8.5 [X10], SYNC IN/OUT

The interface [X10] is located on the front panel of the device. The interface [X10] permits master-slave coupling. In the master-slave coupling, the axes of several devices (slave axes) are synchronised via a device (master axis). The SYNC interface can be configured for different functions and can be used as follows:

Possible functions	Description
Incremental encoder output	Output of a master axis that emulates encoder signals (encoder emulation)
Incremental encoder input	Input of a slave axis for receiving the encoder signals of a master axis

Tab. 48: Possible functions of the connection [X10]

The connection [X10] is designed as an RJ45 socket. An LED is integrated into the RJ45 bushing. The LED shows whether the interface has been activated. If the interface has been activated, the LED is green. The CMMT-AS cannot detect whether an encoder is connected.

Requirements for mating plugs	
Design	VS-08-RJ45-5-Q/IP20 from PHOENIX CONTACT or compatible
Number of pins	8

Requirements for mating plugs	
Shielded	yes
Nominal current	> 1 A
Rated voltage	120 V AC
Degree of protection	IP20

Tab. 49: Requirements for mating plugs

Requirements for the connecting cable	
Characteristics	– Encoder cable for servo drives, shielded – Optical shield cover > 85% – Separately twisted signal pairs – recommended design: (4 x (2 x 0.25 mm²))
Max. cable length	3 m

Tab. 50: Requirements for the connecting cable

Requirements for the shield support

Connect the connecting cable shield to the plug housings on both sides.

Possible connections

Connection possibilities	Description
Direct connection of 2 devices	Two devices can be connected directly with a patch cable (point-to-point connection). Recommendation: use patch cable of category Cat 5e; maximum length: 25 cm
Connection of multiple devices via RJ45 T adapter and patch cables	A maximum of 16 devices may be connected. Recommendation: use T adapter and patch cables of category Cat 5e; maximum length per cable: 25 cm
Connection of multiple devices via patch cables and a connector box (accessories → www.festo.com/catalogue)	A maximum of 16 devices may be connected. Recommendation: use patch cables of category Cat 5e; maximum length per cable: 100 cm

Tab. 51: Connection possibilities

Direct connection of 2 devices

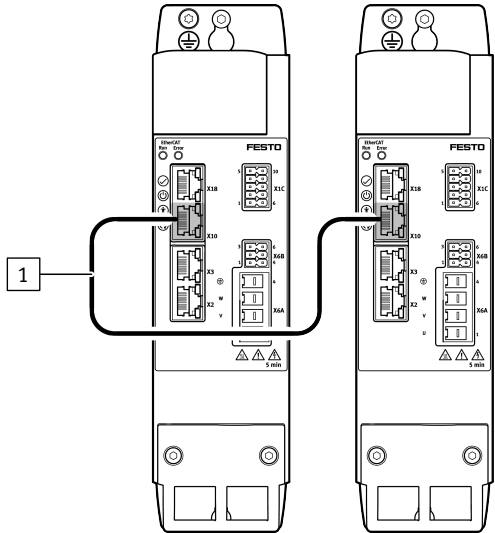


Fig. 17: Point-to-point connection

1 Point-to-point connection

Connection of multiple devices via RJ45 T adapter and patch cables

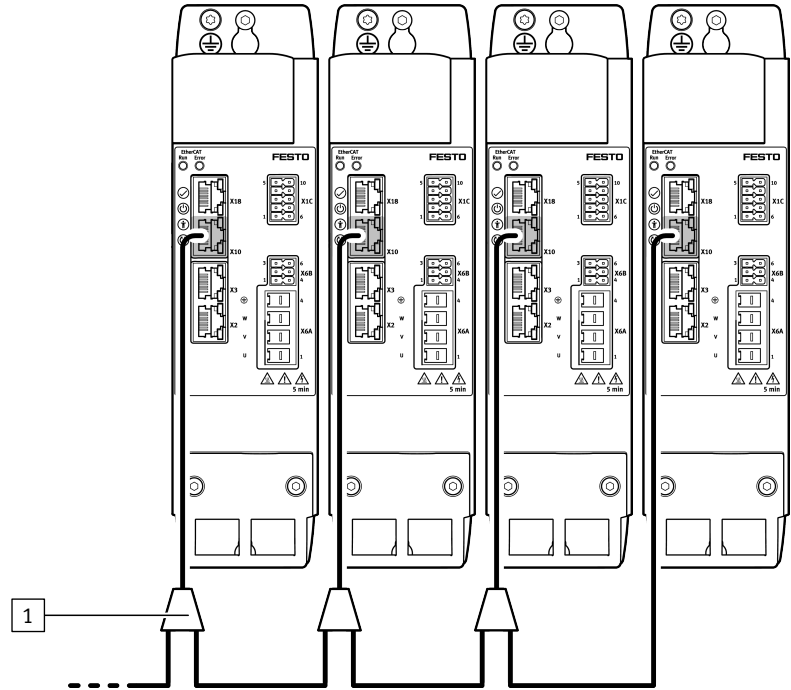


Fig. 18: Connection via RJ45 T adapter and patch cables

1 RJ45 T adapter

Connection of multiple devices via patch cables and a connector box

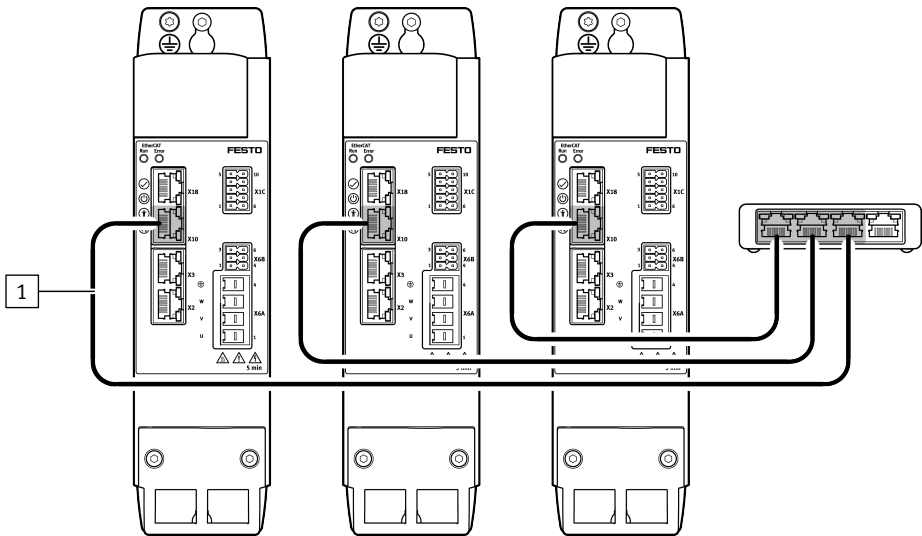
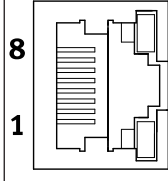


Fig. 19: Connection via a hub

1 Connection via a connector box

Incremental encoder In/Out				
[X10]	Pin	Function		Description
8 1 X10	1	A	5 V _{SS} , R _i = 120 Ω	A-track signal ¹⁾ , RS485-compliant, differential
	2	#A		
	3	B	5 V _{SS} , R _i 120 Ω	B-track signal ¹⁾ , RS485-compliant, differential
	4	Z	5 V _{SS} , R _i = 120 Ω	Zero pulse or Z-track signal ¹⁾²⁾ , RS485-compliant, differential
	5	#Z		

Incremental encoder In/Out				
[X10]	Pin	Function		Description
	6	#B	5 V _{SS} , R _i = 120 Ω	B-track signal ¹⁾ , RS485-compliant, differential, inverse
	7	n. c.	–	–
	8	GND	0 V	Reference potential for supply
	Housing	FE, connected to PE	–	The housing is used as a support for the cable shield and is connected to the PE.

1) of an input or output channel, depending on the configuration

2) depending on the firmware version

Tab. 52: Incremental encoder In/Out



Functions of [X10] supported by the firmware version → Manual/online help plug-in, software, function, fieldbus, device profile.

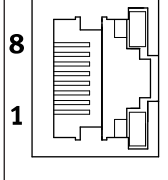
7.8.6 [X18], standard Ethernet

The interface [X18] is located on the front panel of the device. The following can be performed via the interface [X18] using the commissioning software:

- Diagnostics
- Parameterisation
- Controller
- Firmware updates

The interface is designed to conform to the standard IEEE 802.3. The interface is electrically isolated and intended for use with limited cable lengths → Tab. 55 Requirements for the connecting cable. For this reason, the insulation coordination approach differs from IEEE 802.3 and must conform instead to the applicable product standard IEC 61800-5-1.

The connection [X18] is designed as an RJ45 socket. Two LEDs are integrated in the RJ45 socket to display the status.

Standard Ethernet				
[X18]	Pin	Function		Description
	1	TX+		Transmitted data+
	2	TX–		Transmitted data–
	3	RX+		Received data+
	4	n. c.		not connected
	5	n. c.		
	6	RX–		Received data–
	7	n. c.		not connected
	8	n. c.		
	Housing	FE, connected to PE		The housing is used as a support for the cable shield and is connected to the PE.

Tab. 53: Standard Ethernet

Mating plug requirements	
Design	VS-08-RJ45-5-Q/IP20 from PHOENIX CONTACT or compatible
Number of pins	8
Shielded	yes
Nominal current	> 1 A
Rated voltage	120 V AC
Degree of protection	IP20

Tab. 54: Mating plug requirements

Requirements for the connecting cable	
Characteristics	CAT 5, patch cable, double shielded
Max. cable length	30 m

Tab. 55: Requirements for the connecting cable

The following connections are possible via the Ethernet interface:

Connections	Description
Point-to-point connection	The device is connected directly to the PC via an Ethernet cable.
Network connection	The device is connected to an Ethernet network.

Tab. 56: Options for connection

The device supports the following methods of IP configuration (based on IPv4):

Methods	Description
Obtain IP address automatically (DHCP client)	The device obtains its IP configuration from a DHCP server in the network. This method is suitable for networks with a DHCP server installed.
Fixed IP configuration	The device uses a fixed IP configuration. The IP configuration of the device can be permanently assigned manually. However, the device can only be addressed if the assigned IP configuration matches the IP configuration of the PC. Factory setting: 192.168.0.1

Tab. 57: Options for IP configuration

Requirements for the shield support

- Connect the cable shield to the plug housings on both sides.

Possible connections

- Connect CMMT to your network via a hub/switch or directly to the PC.

7.8.7 [X19], Real-time Ethernet (RTE) port 1 and port 2

The interface [X19] is located on the top of the device. The interface [X19] permits RTE communication. The following protocols are supported by the interface [X19]:

Product variant	Supported protocol
CMMT-AS-...-MP	EtherCAT, EtherNet/IP, Modbus TCP, PROFINET ➔ 4.3 Setting bus protocol
CMMT-AS-...-EC	EtherCAT
CMMT-AS-...-EP	EtherNet/IP, Modbus TCP
CMMT-AS-...-PN	PROFINET

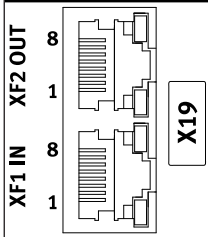
Tab. 58: Supported protocols

The physical level of the interface fulfils the requirements according to IEEE 802.3. The interface is electrically isolated and intended for use with limited cable lengths
→ Tab. 61 Requirements for the connecting cable.

The interface [X19] offers 2 ports.

- Port 1, labelled on the device with [X19, XF1 IN]
- Port 2, labelled on the device with [X19, XF2 OUT]

2 LEDs are integrated into each of the two RJ45 bushings. The behaviour of the LEDs depends on the bus protocol. Both LEDs are not always used.

Real-time Ethernet (RTE) port 1 and port 2			
[X19]	Pin	Function	Description
	1	TX+	Transmitted data+
	2	TX–	Transmitted data–
	3	RX+	Received data+
	4	n. c.	not connected
	5	n. c.	
	6	RX–	Received data–
	7	n. c.	not connected
	8	n. c.	
	Housing	FE, connected to PE	The housing is used as a support for the cable shield and is connected to the PE.

Tab. 59: [X19], RTE port 1 and port 2

Requirements for mating plugs	
Design	VS-08-RJ45-5-Q/IP20 from PHOENIX CONTACT or compatible
Number of pins	8
Shielded	yes
Nominal current	> 1 A
Rated voltage	120 V AC
Degree of protection	IP20

Tab. 60: Requirements for mating plugs

Requirements for the connecting cable	
Characteristics	CAT 5, patch cable, double shielded
Max. cable length	30 m

Tab. 61: Requirements for the connecting cable

Requirements for the shield support

Connection to the controller

- Connect the cable shield to the plug housings on both sides.
- If possible, and if supported by the bus protocol, build ring redundancy into the connection with the controller.

7.9 Motor connection

7.9.1 [X6A], motor phase connection

The connection [X6A] is located on the front of the device. The following connections to the motor are established via the connection [X6A]:

- Motor phases U, V, W
- PE connection



Incorrect circuitry of PE and motor phases results in a device defect, jerking or uncontrolled start-up of the motor when the power supply is switched on.

[X6A]	Pin	Function	Description
	4	PE	Protective earthing, motor
	3	W	third motor phase
	2	V	second motor phase
	1	U	first motor phase

Tab. 62: Motor phase connection

The cable shield of the motor cable must be placed on the support surface on the bottom front of the housing and the motor cable fastened with the shield clamp.

Requirements for mating plugs	
Design	ISPC5/ 4-STGCL-7,62 from PHOENIX CONTACT or compatible
Power contacts	4
Nominal current	41 A
Rated voltage (III/2)	1000 V
Pitch	7.62 mm
Stripping length	– for plastic wire ferrules: 15 mm – for non-plastic wire ferrules: 10 mm

Tab. 63: Requirements for mating plugs

Requirements for the connecting cable	
Wires and shielding	– 4 power wires, shielded – Extra optional wires, e.g. for the holding brake (shielded separately) and the motor temperature sensor (shielded separately)
Design	Only use cables that ensure reinforced isolation between the motor phases and the shielded signals of the holding brake and motor temperature sensor in accordance with IEC 61800-5-1. ➔ 7.9.4 Shield support of the motor cable
Max. cable length	➔ 7.6 Information on EMC-compliant installation
Max. capacitance	< 250 pF/m
Nominal cross section of power wires ¹⁾	
CMMT-AS-C2/C3/C5-11A-P3	0.75 mm ² ... 1.5 mm ²
CMMT-AS-C7/C12-11A-P3 ²⁾³⁾	0.75 mm ² ... 2.5 mm ²
CMMT-AS-C18/C25-11A-P3	2.5 mm ² ... 6 mm ²
Cable diameter of the stripped cable or shield sleeve (clamping range of the shield clamp)	
CMMT-AS-C2/C3/C5-11A-P3	11 mm ... 15 mm
CMMT-AS-C7/C12-11A-P3	12 mm ... 17 mm

Requirements for the connecting cable	
CMMT-AS-C18/C25-11A-P3	14 mm ... 19 mm
The only motor cables permitted are those that fulfil the requirements of EN 61800-5-2, Annex D.3.1 and the requirements of EN 60204-1.	

- 1) Shield clamp and mating plug also allow larger cross sections.
- 2) at 0.75 mm², check whether the shield diameter is sufficient for a clean clamping
- 3) 2.5 mm² recommended for cable lengths of 50 m and over to limit the voltage drop of the available output voltage.

Tab. 64: Requirements for the connecting cable

Festo offers prefabricated motor cables as accessories → 3 Additional information.

- Only use motor cables that have been approved for operation with the Festo servo drive. Motor cables of other manufacturers are permitted if they meet the specified requirements.

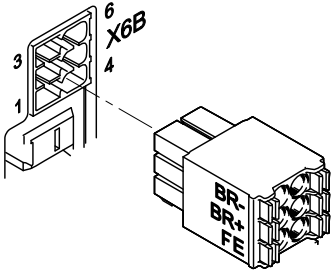
7.9.2 [X6B], motor auxiliary connection

The connection [X6B] is located on the front of the device. The holding brake of the motor and the motor temperature sensor can be connected to the connection [X6B]. The output for the holding brake is controlled both functionally and by the safety part for the Safe brake control safety sub-function. The safety part has priority in the event of a request (switching off the output) → Manual Safety sub-function.

To allow motor temperature monitoring, the following are supported:

- N/C and N/O contacts
- KTY 81 ... 84 (silicon temperature sensors)
- PTC (PTC resistor, positive temperature coefficient)
- NTC (NTC resistor, negative temperature coefficient)
- Pt1000 (platinum measuring resistor)

The servo drive monitors whether the motor temperature violates an upper or lower limit. With switching sensors, only the upper limit value can be monitored (e.g. with a normally closed contact). The limit values and the error response can be parameterised.

[X6B]	Pin	Function	Description
	6	MT–	Motor temperature (negative potential)
	5	MT+	Motor temperature (positive potential)
	4	FE	Functional earth connected to protective earth
	3	BR–	Holding brake (negative potential)
	2	BR+	Holding brake (positive potential)
	1	FE	Functional earth connected to protective earth

Tab. 65: Motor auxiliary connection

Requirements for mating plugs	
Design	DFMC 1,5/ 3-ST-3,5 from PHOENIX CONTACT or compatible
Signal contacts	6 (3-pin, 2-row)
Nominal current	8 A

Requirements for mating plugs	
Rated voltage (III/2)	160 V
Pitch	3.5 mm
Stripping length	10 mm

Tab. 66: Requirements for mating plugs

Requirements for the connecting cable	
Design	– 2 wires for the line to the holding brake, twisted in pairs, separately shielded – 2 wires for the line to the temperature sensor, twisted in pairs, separately shielded
Min. conductor cross-section including plastic wire end sleeve	0.25 mm ²
Max. conductor cross-section including plastic wire end sleeve	0.75 mm ²
Max. length	100 m ¹⁾

1) With cable lengths > 25 m, take account of the voltage drop on the cables by selecting appropriate wire cross sections.

Tab. 67: Requirements for the connecting cable

Requirement for the temperature sensor in the motor

- electrically reinforced isolation from the motor phases in accordance with IEC 61800-5-1, voltage class C, overvoltage category III.

Requirements for the shield support

- Connect the cable shield on both sides.
- Make unshielded cable ends as short as possible.

Length of unshielded cable ends		
Product variant	recommended	max.
CMMT-AS-C2/C3/C5-11A-P3	150 mm	200 mm
CMMT-AS-C7/C12-11A-P3		
CMMT-AS-C18/C25-11A-P3		

Tab. 68: Recommended and maximum lengths of unshielded cable ends

7.9.3 Electronic overload and over temperature protection for the motor

The CMMT-AS allows the motor to be electronically protected against overload and provides over temperature protection with the following protective functions:

Protective functions	Description	Measures required during installation and commissioning
Temperature monitoring of the motor	The motor temperature is monitored for an upper and lower limit value, including hysteresis. The limit values can be parameterised.	– Connect the temperature sensor to connection [X6B] (both switching and analogue temperature sensors are supported) – Parameterise the temperature limit values in accordance with the type of motor used, e.g. using the device-specific plug-in. Comply with the permissible limit values of the motor.
Electronic current limiting and I ² t monitoring of the motor current	The motor current is monitored electronically and limited in accordance with the limit values specified in the standard → EN 61800-5-1, Tab. 29. Motor currents and I ² t time constant can be parameterised.	– Parameterise the nominal current, maximum current and I²t time constant of the motor, e.g. using the device-specific plug-in.
Thermal memory in the event of motor switch-off	Supported, not parameterizable	– None

Protective functions	Description	Measures required during installation and commissioning
Thermal memory in the event of a power supply failure	Supported, not parameterizable	– None
Speed-sensitive overload protection	Parameterisable	– Parameterise I²t monitoring with speed-dependent scaling, e.g. with the device-specific plug-in. - Such as for: – Synchronous servo motors (lower permissible current at high rotational speed) – Fan motors (lower permissible current at low rotational speed)

Tab. 69: Protective functions for the motor

The specified parameters are preset for Festo motors. The parameters can be adapted in the plug-in.

7.9.4 Shield support of the motor cable

Requirements for the motor cable shield support on the device side

The type of shield support depends on the design of the motor cable. For example, if a hybrid cable is used to connect the motor, holding brake and temperature sensor, the following options are available for connecting the shield on the device side:

Option 1: all motor cable shields are jointly connected over a wide surface area using a shield sleeve at the cable end and are connected below the shield clamp on the front of the CMMT-AS.

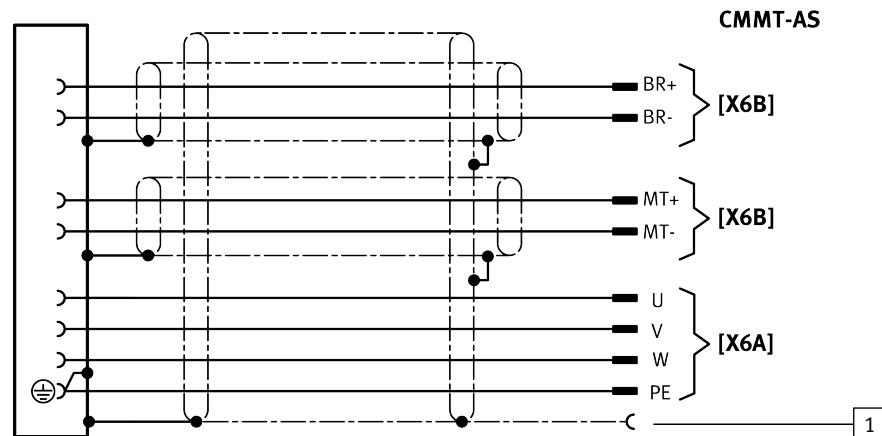


Fig. 20: Joint shield support for all cable shields, example

1 Shield sleeve

Option 2: the outside shield of the motor cable is connected separately over a wide surface area below the shield clamp on the front of the CMMT-AS. The inside shields are connected separately to the designated FE pin of the connection [X6B].

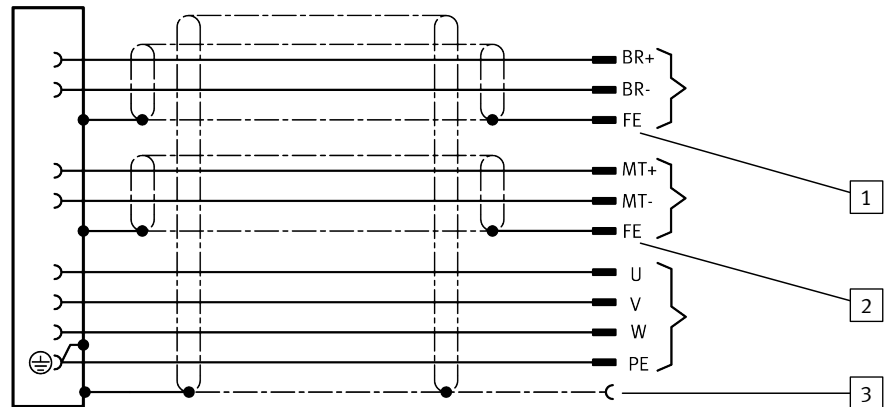


Fig. 21: Separate shield support for all cable shields, example

- 1 Inside shield connected separately 3 Shield sleeve
2 Inside shield connected separately

- Make unshielded cable ends as short as possible.

Mounting the shield clamp

The lower section on the front of the housing is used as a shield support surface. The shield support surface, together with the shield clamp, allows the motor cable shield to be connected over a wide surface area → Fig. 22

1. Using the shield clamp, press the motor cable shield or the conductive shield end sleeve of the motor cable onto the shield support surface of the housing.
2. Use a size T20 TORX screwdriver to tighten the retaining screws (2x) of the shield clamp. Pay attention to the clamping range and observe the tightening torque specified below.

Property	Value	Comment
CMMT-AS-	C2/C3/C5-11A-P3	
Clamping range	11 mm ... 15 mm	Diameter of the stripped cable or shield sleeve
Tightening torque for the retaining screws in the case of block mounting	1.8 Nm ± 15 %	In the case of block mounting, the shield clamp makes full contact with the base of the housing (cable diameter 11 mm)
Minimum tightening torque with larger cable diameter (> 11 mm ... 15 mm)	0.5 Nm ± 15 %	Make sure that a greater tightening torque does not crush the connecting cable in the clamping area by excessive pressure.

Tab. 70: Tightening torque and clamping range CMMT-AS-C2/C3/C5-11A-P3

Property	Value	Comment
CMMT-AS-	C7/C12-11A-P3	
Clamping range	12 mm ... 17 mm	Diameter of the stripped cable or shield sleeve
Tightening torque for the retaining screws in the case of block mounting	1.8 Nm ± 15 %	In the case of block mounting, the shield clamp makes full contact with the base of the housing (cable diameter 12 mm)
Minimum tightening torque with larger cable diameter (> 12 mm ... 23 mm)	0.5 Nm ± 15 %	Make sure that a greater tightening torque does not crush the connecting cable in the clamping area by excessive pressure.

Tab. 71: Tightening torque and clamping range of CMMT-AS-C7/C12-11A-P3

Property	Value	Comment
CMMT-AS-	C18/C25-11A-P3	
Clamping range	14 mm ... 19 mm	Diameter of the stripped cable or shield sleeve
Tightening torque for the retaining screws in the case of block mounting	1.8 Nm ± 15 %	In the case of block mounting, the shield clamp makes full contact with the base of the housing (cable diameter 12 mm)
Minimum tightening torque with larger cable diameter (> 12 mm ... 23 mm)	0.5 Nm ± 15 %	Make sure that a greater tightening torque does not crush the connecting cable in the clamping area by excessive pressure.

Tab. 72: Tightening torque and clamping range of CMMT-AS-C18/C25-11A-P3

Longer screws M4 x 30 - 8.8 screws are required for the hybrid cable from Festo with a nominal cross section of the power cores of 6 mm². The screws are included with the Festo hybrid cable.

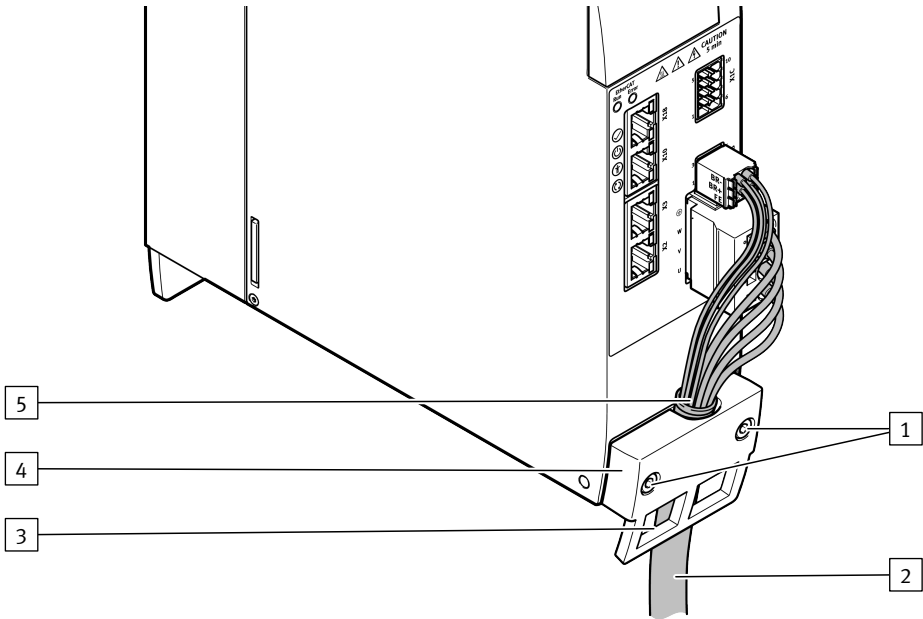


Fig. 22: Shield clamp of the motor cable

- | | |
|---|---|
| 1 Retaining screws of the shield clamp (2x) | 4 Shield clamp |
| 2 Motor cable | 5 Motor cable shield connected over a large surface area below the shield clamp |
| 3 Cut-out for mounting cable binders (2x) | |

Motor cable shield support on the motor side

Detailed information on the motor-side connection with Festo motor cables

➔ Assembly instructions for the motor cable ➔ www.festo.com/sp.

- Connect all shields to the PE over a wide surface area on the motor side, e.g., by means of the shield connection provided on the motor connector or the shield support surface in the motor junction box.

Mounting and strain relief for additional cables

For example, additional cables can be attached at the shield clamp with cable binders.

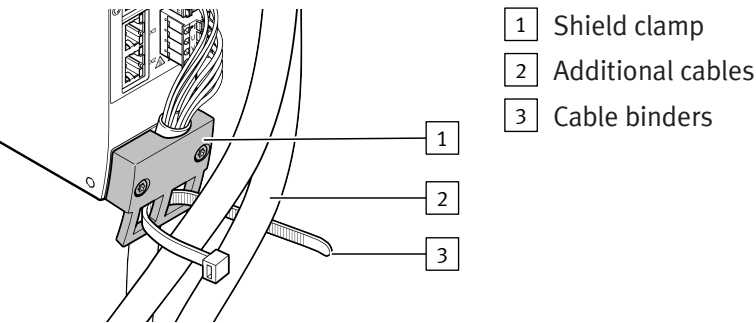


Fig. 23: Strain relief at the shield clamp

7.10 Power and logic voltage supply

7.10.1 [X9A], power supply and DC link connection

The connection [X9A] is located on the top of the device.

The power unit of the device is supplied with electrical voltage through the connection [X9A]. In addition, the connection provides pins for DC link coupling.

- Power unit of the device supplied with 3-phase mains voltage (200 V AC ... 480 V AC)
- Optional: DC link coupling of 3-phase devices of the same CMMT-AS series

Cross-wiring of the mains and logic voltage supply is possible with and without DC link coupling (→ 7.11 Cross-wiring).



The connections for the power voltage supply and the DC link are not protected against wiring errors. The reversal of the connections results in a device defect during switch-on.

With cross-wiring, observe the polarity of the DC link connection on all devices.

[X9A]	Pin	Function	Description
	6	DC+	DC link positive potential
	5	DC-	DC link negative potential
	4	L3	Mains supply phase L3
	3	L2	Mains supply phase L2
	2	L1	Mains supply phase L1
	1	PE	Protective grounding

Tab. 73: Power supply and DC link

Requirements for mating plugs	
Version for single wiring connection	SPC 5/ 6-ST-7,62 from PHOENIX CONTACT or compatible
Design for cross-wiring	TSPC 5/ 6-ST-7,62 from PHOENIX CONTACT or compatible
Number of pins	6
Nominal current	41 A
Rated voltage (III/2)	1000 V
Pitch	7,62 mm
Stripping length	15 mm

Tab. 74: Requirements for mating plugs

Requirements for the connecting cable	Single device	Device compound
Number of insulated wires and shielding	4 insulated wires, unshielded	Without DC link coupling: 4 wires, unshielded With DC link coupling: 6 wires, unshielded
Min. conductor cross-section including plastic wire ferrule	0.5 mm ²	1.5 mm ²
Max. conductor cross-section including plastic wire ferrule	4 mm ²	4 mm ²
Max. conductor cross section including non-plastic wire ferrule	6 mm ²	6 mm ²
Max. length	2 m	≤ 0.5 m

Tab. 75: Requirements for the connecting cable

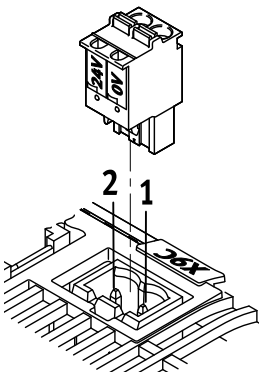
7.10.2 [X9C], logic voltage supply

The connection [X9C] is located on the top of the device. The device is supplied with logic voltage via the connection [X9C].

⚠ WARNING

Risk of injury due to electric shock.

- For the electrical power supply with extra-low voltages, use only PELV circuits that guarantee a reinforced isolation from the mains network.
- Observe IEC 60204-1/EN 60204-1.
- Only connect PELV circuits with an output current of max. 25 A. Otherwise, use a separate external fuse: 25 A.

[X9C]	Pin	Function	Description
	2	24 V DC	positive potential of logic voltage supply
	1	0 V	Reference potential for logic voltage supply

Tab. 76: Logic voltage supply

Mating plug requirements	
Design for single wiring connection	FKC 2.5/2-ST-5.08 from PHOENIX CONTACT or compatible
Design for cross-wiring	TFKC 2.5/2-ST-5.08 from PHOENIX CONTACT or compatible
Number of pins	2
Nominal current of single mating plug	12 A
Nominal current of double mating plug	12 A (for device); 16 A (for looping through)
Rated voltage (III/2)	320 V
Pitch	5.08 mm
Strip length	10 mm

Tab. 77: Mating plug requirements

Requirements for the connecting cable	Single device	Device compound
Number of insulated wires and shielding	2 insulated wires, unshielded	2 insulated wires, unshielded
Min. conductor cross section incl. wire end sleeve with plastic sleeve	0.5 mm ²	0.5 mm ²
Max. conductor cross section incl. plastic wire end sleeve	2.5 mm ²	2.5 mm ²
Max. length	2 m	0.5 m

Tab. 78: Requirements for the connecting cable

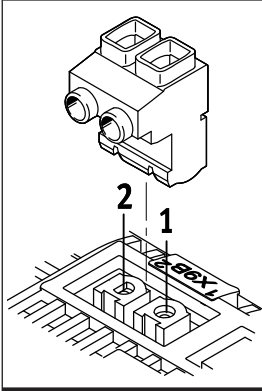
7.10.3 [X9B], connection for braking resistor

The connection [X9B] is located on the top of the device. The internal braking resistor or a suitable external braking resistor is attached to the connection [X9B]. During braking, the motor works as a generator. In these cases, the motor feeds electrical energy back into the DC link circuit. The excess energy must be absorbed by the braking resistor and converted into heat.

The braking resistor integrated into the device is sufficient for many applications with moderate cycle times and small moving loads. Therefore, it is often the case that an external braking resistor is not required.

- Connect an external braking resistor if larger pulse or continuous powers have to be absorbed during braking than the integrated braking resistor permits.

The braking resistor is also used as a pre-charging resistor for the DC link circuit. The DC link circuit cannot be loaded without a braking resistor. If a braking resistor is not connected, the device reports an error.

[X9B]	Pin	Function	Description
	2	BR+Ch	Braking resistor positive connection
	1	BR-Ch	Braking resistor negative connection

Tab. 79: Connection for the braking resistor

Mating plug requirements	
Design	GIC 2,5 HCV/2-ST-7,62 from PHOENIX CONTACT or compatible
Number of pins	2
Nominal current	16 A
Rated voltage (III/2)	1000 V
Pitch	7.62 mm
Strip length	8 mm
Tightening torque of the screw terminals	0.5 ... 0.6 Nm ¹⁾

1) Specification of the manufacturer at the time the documentation was approved

Tab. 80: Mating plug requirements

Requirements for the connecting cables of external braking resistors	
Number of insulated wires and shielding	2 wires, shielded
Min. conductor cross section incl. wire end sleeve with plastic sleeve	0.25 mm²
Max. conductor cross section incl. plastic wire end sleeve	2.5 mm²
Max. cable length	2 m
Wiring	inside the control cabinet, shield connected to PE

Tab. 81: Requirements for the connecting cable

Requirements for the shield support when an external braking resistor is connected

- On the device side, connect the cable shield to the earthing screw next to the upper slot of the cooling element.

Selection of suitable external braking resistors

The connected braking resistor must fulfil the following requirements:

- External braking resistors must meet the requirements of the IEC 61800-5-1 standard.
- The braking resistor must be designed for operation with high pulse energy during braking.
- The braking resistor must be suitable for the DC link voltage that occurs.

- The resistance value of the braking resistor must be low enough for the highest braking power to be absorbed (typically 2 ... 2.5 times the nominal power of the motor).
- The resistance value of the braking resistor must be within the permitted range so the brake chopper in the device is not overloaded. Therefore, only use suitable braking resistors, i.e. those that are compatible with the power stage performance data of the servo drive used in terms of their voltage, current and pulse energy capacity.

Technical data for the integrated braking resistor and additional requirements for external braking resistors → 10.2.3 Electrical data for braking resistor (internal/external) [X9B]

Overload protection for external braking resistors

The external braking resistor can be monitored by the firmware of the device with the help of a thermal model calculation. Consequently, the CMMT-AS must be parameterised as follows:

- Activation of external braking resistor
- Input of the following data: resistance value, continuous power and permissible pulse energy

When the pulse energy limit is reached, the brake chopper is switched off. If the DC link voltage rises again as a result, the power stage switches off with the message “Overvoltage in the DC link circuit”.

7.11 Cross-wiring

Cross-wiring makes it possible to set up a device compound consisting of up to 10 servo drives CMMT-AS. The different cross-wiring options are as follows:

- Cross-wiring of I/O signals at the connection [X1A]
- Cross-wiring of the mains and logic voltage supply without DC link coupling
- Cross-wiring of the mains and logic voltage supply with DC link coupling

7.11.1 Cross-wiring of the I/O signals at the connection [X1A]

The following table shows which signals of the connection [X1A] in the device compound can be connected directly to the same signals of neighbouring devices:

Signal name	Type	Short identifier	Function	Information
X1A.24	–	RDY-C1	Normally open contact: "ready for operation message (Ready)"	Max. 10 devices, series connection of the contacts
X1A.23		RDY-C2		
X1A.22	DOUT	STA	Safe torque off acknowledge	Max. 10 devices, parallel connection
X1A.21	DOUT	SBA	Safe brake control acknowledge	
X1A.20	–	–	reserved, do not connect	–
X1A.19	–	–		
X1A.18	DIN	SIN4	Release brake request	Max. 10 devices, parallel connection
X1A.17	–	GND	Reference potential	Max. 10 devices, must be cross-wired
X1A.16	DOUT	TRG0	Like TRG1	Use separately!
X1A.15	DOUT	TRG1	Fast output for triggering external components	

Signal name	Type	Short identifier	Function	Information
X1A.14	DIN	CAP0	Like CAP1	Intended for separate use, cross-wiring not usually advisable, max. 10 devices, parallel connection
X1A.13	DIN	CAP1	Fast input for position detection	
X1A.12		#STO-A	Safe torque off, channel A	Max. 10 devices, parallel connection
X1A.11	DIN	#STO-B	Safe torque off, channel B	
X1A.10		#SBC-A	Safe brake control, channel A	
X1A.9	DIN	#SBC-B	Safe brake control, channel B	
X1A.8	—	—	reserved, do not connect	—
X1A.7				
X1A.6				
X1A.5				
X1A.4	DIN	ERR-RST	Functional error acknowledgment	Max. 10 devices, parallel connection
X1A.3	DIN	CTRL-EN	Power stage enable	
X1A.2	AIN	AIN0	Differential analogue input	Cross-wiring is only advisable if several servo drives are to receive the same set-point value via AIN0.
X1A.1		#AIN0		

Tab. 82: Information on cross-wiring of the I/O signals at the connection [X1A]

- Cross-wire the I/O signals at the connection [X1A] with the required mating plug in combination with double wire end sleeves.

Example for cross-wiring of I/O signals

The following image is a schematic diagram of the cross-wiring based on the example of the signal contact (RDY-...), a 1-channel input (here IN) and a 1-channel diagnostic output (here SOUT; digital output of a safety sub-function, e.g. SBA).

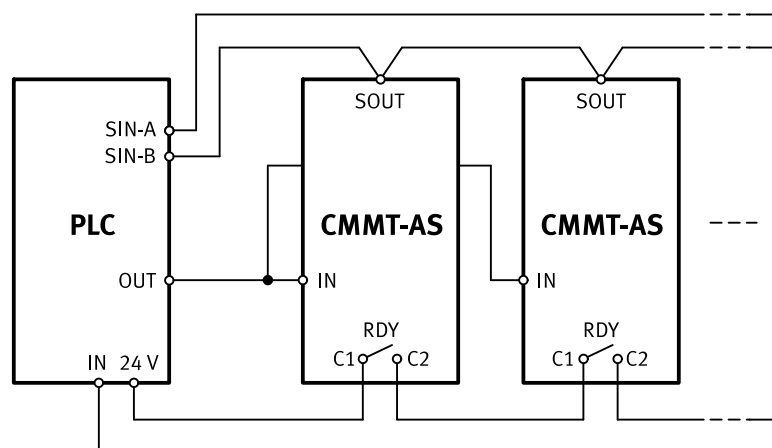


Fig. 24: Cross-wiring, example

The signal contacts (RDY-...) are connected in series. For the status “Contact closed”, this results in an AND operation. The result of the operation is forwarded to a digital input (IN) of the higher-order PLC.

1-channel digital inputs (IN) are connected in parallel to an output (OUT) of the PLC. If, for example, all CTRL-EN inputs of the device compound are connected in parallel to a digital output, the enables for the device compound power stages can be controlled via this one digital output.

In the case of cross-wired diagnostic outputs (e.g. STA and SBA), the common status is the result of a logical AND operation. A high signal will only be present at the two inputs of the safety PLC (here SIN-A and SIN-B) if all diagnostic outputs (here SOUT) are delivering HIGH signals. Thanks to the ring-shaped cross-wiring of the diagnostic outputs, a cable break can be detected in the PLC by means of sensing at the beginning (SIN-A) and end (SIN-B) of the signal chain.

When there is cross-wiring of I/O signals, the following should also be cross-wired:

- Reference potentials GND (X1A.17) of all cross-wired servo drives
- Logic supply

7.11.2 Cross-wiring of the mains and logic voltage supply

Cross-wiring of the mains and logic voltage supply	Description
... without DC link coupling	The connections for the mains and logic voltage supply are cross-wired and connected to the applicable voltage source. The DC link circuits are not connected.
... with DC link coupling	The connections for the mains and logic voltage supply are cross-wired and connected to the applicable voltage source. In addition, the DC link circuits of the devices are cross-wired (DC link coupling).

Tab. 83: Options for cross-wiring of the mains and logic voltage supply

Cross-wiring is easily implemented with the help of the double mating plugs, which are available as accessories.

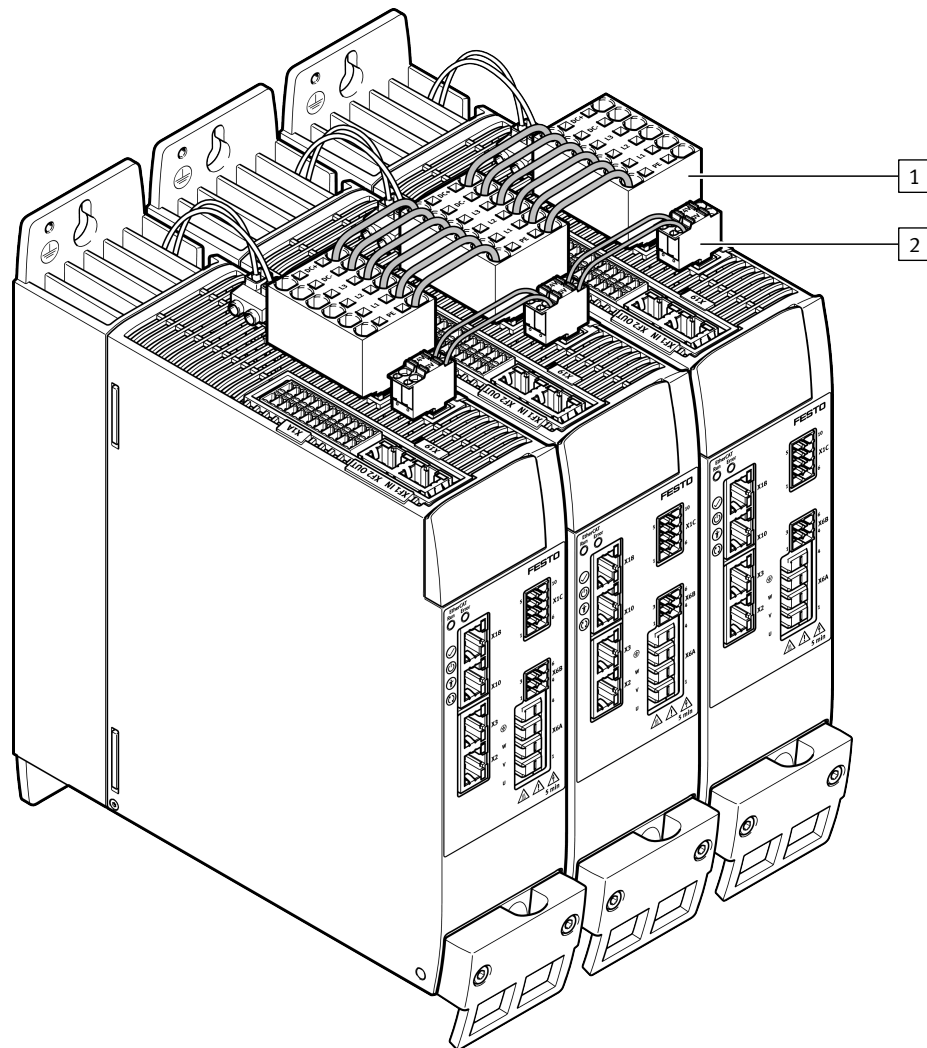


Fig. 25: Cross-wiring CMMT-AS-...-11A-P3, basic representation

- | | |
|--|--|
| <p>1 Double mating plug at the connection [X9A]</p> | <p>2 Double mating plug at the connection [X9C]</p> |
|--|--|

DC link coupling

If several servo drives of type CMMT-AS are used in an application, DC link coupling may be advisable.

With DC link coupling, the energy recovered during braking can be provided to other servo drives through the DC link circuit instead of being converted almost completely into heat via braking resistors. This improves the energy efficiency of the device compound by making use of the recovered energy.

In addition, DC link coupling results in the following:

- Increased DC link circuit capacitance thanks to shared use of the DC link circuit capacitors
- Increase in the braking energy to be absorbed due to shared use of the braking resistors

Rules for cross-wiring the mains and logic voltage supply with and without DC link coupling

NOTICE

Errors in the cross-wiring can destroy the internal electronics.

- Always observe rules for cross-wiring.

- Only cross-wire devices with the same mains voltage. The devices must therefore be all 1-phase devices or all 3-phase devices with the same mains voltage supply and DC link voltage. Cross-wiring the mains and DC link voltage between

1-phase devices and 3-phase devices is not permitted and will result in immediate destruction of the servo drive! The logic voltage supply can be through-connected.

- For 1-phase devices: connect all devices to the same mains phase.
- For 3-phase devices: connect all devices to the same 3 mains phases.
- Place higher-power devices closer to the mains infeed.
- Insert a suitable fuse into the mains supply line for line protection and semiconductor protection.
- Do not exceed the maximum number of devices in the device compound.

A device compound may consist of a maximum of 10 devices. However, the permitted number is dependent on the performance data of the devices used and the parameterised nominal currents of the connected motors. The number is limited by the maximum permitted total current and the maximum permitted total nominal power (dependent on the conductor cross section of the cross-wiring).

- Always connect all devices to the mains supply, even with DC link coupling. Connecting only one device or only one part of the device compound to the mains supply is not permitted. Such wiring can overload and destroy devices.

Braking resistors in the device compound

- A braking resistor must be connected to each device in the device compound (internal or external).
- If devices with different output powers are combined, dimension the braking resistors in accordance with the output power of the devices. This is ensured if the internal braking resistors are used.

Fuse protection of a device compound

A shared external fuse is required at the mains connection of the devices. The fuse fulfils the following functions:

- Line protection; the rated current of the fuse must be less than or equal to the acceptable current rating of the selected conductor cross section.
- Semiconductor protection; the diode rectifiers of the devices are not protected against short circuit currents in the DC link circuit.

Recommendation:

- Use automatic circuit breakers as line protection with appropriate tripping current and switching characteristic C. For additional information → 7.3 Mains fuse.
- Use class J short circuit current limiting fuses if the device is to be operated in electrical networks with an SCCR rating > 10 kA. For additional information → 7.3 Mains fuse.

Data for operation in a device compound (CMMT-AS-...-11A-P3)

A device compound may consist of a maximum of 10 devices. However, the permitted number is dependent on the performance data of the devices used.

The number is limited by the value of the maximum permitted total current and the maximum permitted total nominal power of the device compound and depends on the conductor cross section.

Choice of mains protection

1. Determine total mains current of the device compound.
2. Determine total current of the logic supply.
3. Select the required conductor cross section for the cross-wiring.
4. Select the required mains protection while also considering the conductor cross section and the standard classification (according to UL or CE approval).

Permissible maximum values → Tab. 16 Line protection requirements.

Rough calculation to determine the mains current

For 3-phase devices, the mains current can be calculated approximately as follows:

$$I_{\text{mains}} = 0.0024 \text{ A/W} \times P_{\text{nom,out}}$$

I_{mains} : mains current [A]; $P_{\text{nom,out}}$: nominal power (electrical) at motor connection [W]

Example

2 servo drives each drive one motor (e.g. CMMT-AS-C5-11A-P3 for motor 1, CMMT-AS-C12-11A-P3 for motor 2).

Motor 1:

- Mechanical nominal power ($P_{\text{nom, mech}}$) of 2000 W
- assumed degree of efficiency of the motor: 80%

$$P_{\text{nom,out}} = 2000 \text{ W} \div 0.8 = 2500 \text{ W}$$

Motor 2:

- Mechanical nominal power ($P_{\text{nom, mech}}$) of 5400 W
- assumed degree of efficiency of the motor: 90%

$$P_{\text{nom,out}} = 5400 \text{ W} \div 0.9 = 6000 \text{ W}$$

Required fuse

$$I_{\text{mains}} = 0.0024 \text{ A/W} \times 8500 \text{ W} = 20.4 \text{ A}$$

Fuse is designed for I_{mains} : 20.4 A_{rms}

Examples of possible device combinations

The following table shows examples of possible device combinations, plus the fuse protection required when the load on the servo drive is 100% of its nominal power:

Conductor cross section at [X9A]	Max. permitted current	Example of device combinations	Required current [A _{rms}]	Selected fuse protection
4 mm ²	According to IEC standard ¹⁾ : 25 A	10 x CMMT-AS-C2-11A (each 2 A _{eff})	20	C20
		1 x CMMT-AS-C3-11A (3 A _{eff}) 2 x CMMT-AS-C5-11A (6 A _{eff}) 1 x CMMT-AS-C7-11A (9 A _{eff})	24	C25
		1 x CMMT-AS-C3-11A (3 A _{eff}) 1 x CMMT-AS-C18-11A (22 A _{eff})	25	C25
	According to UL standard ²⁾ : 20 A	10 x CMMT-AS-C2-11A (each 2 A _{eff})	20	C20
		2 x CMMT-AS-C3-11A (each 3 A _{eff}) 1 x CMMT-AS-C5-11A (5 A _{eff}) 1 x CMMT-AS-C7-11A (9 A _{eff})	20	C20
6 mm ²	In accordance with IEC standard ¹⁾ : 32 A	10 x CMMT-AS-C2-11A (each 2 A _{eff})	20	C20
		5 x CMMT-AS-C2-11A (each 2 A _{eff}) 2 x CMMT-AS-C3-11A (each 3 A _{eff}) 1 x CMMT-AS-C12-11A (15 A _{eff})	31	C32
		1 x CMMT-AS-C3-11A (3 A _{eff}) 1 x CMMT-AS-C25-11A (29 A _{eff})	32	C32
	In accordance with UL standard ²⁾ : 30 A	3 x CMMT-AS-C2-11A (each 2 A _{eff}) 1 x CMMT-AS-C7-11A (each 9 A _{eff}) 1 x CMMT-AS-C12-11A (15 A _{eff})	30	C30
		2 x CMMT-AS-C3-11A (3 A _{eff}) 1 x CMMT-AS-C18-11A (22 A _{eff})	28	C30

1) Specifications according to DIN VDE 0298-4:2013, permissible currents according to EN 60204-1 may differ (depending on laying method and temperature)

2) Specifications according to UL 61800-5-1:2012

Tab. 84: Examples of possible device combinations

Cross-wiring without DC link coupling

All contacts for the mains and logic voltage supply are cross-wired at connections [X9A] and [X9C]. The DC link circuits are not cross-wired (DC+/DC-). The first device is connected to both voltage sources. 3-phase devices with the same power class and 3-phase devices with different power classes can be connected. If the 24 V logic supply used has a nominal output current > 25 A, a fuse/circuit breaker is required. Type of fuse: “slow-blowing” fuse or circuit breaker with “C characteristic”

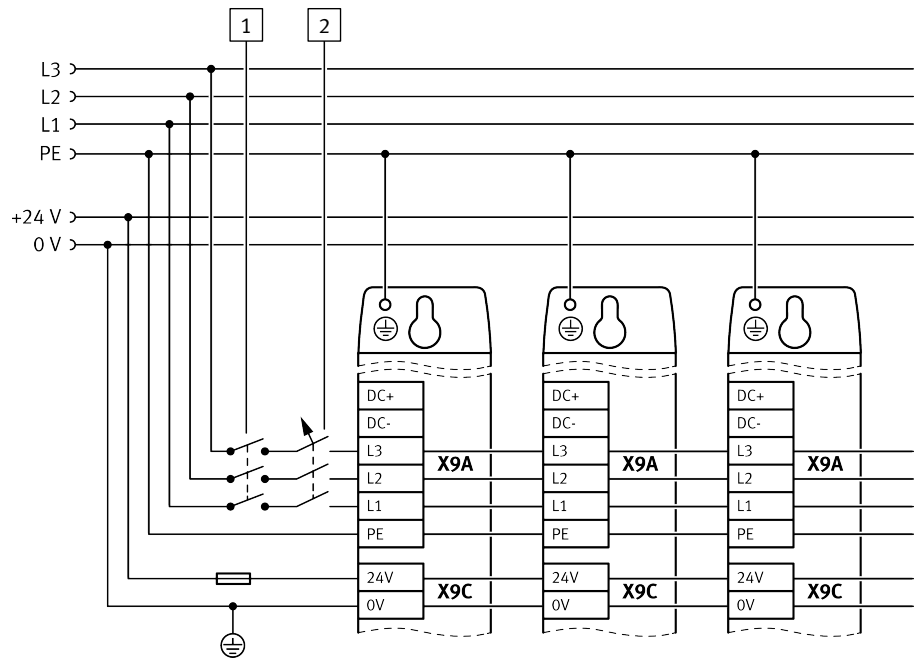


Fig. 26: Cross-wiring without DC link coupling (CMMT-AS-...-11A-P3)

1 Main switch

2 Circuit breaker

Cross-wiring with DC link coupling

All contacts at the connections [X9A] and [X9C] are cross-wired. The first device is connected to the mains voltage supply and the logic voltage supply. Mains voltage, logic voltage and DC link voltage are connected between the coupled devices. 3-phase devices with the same power class and 3-phase devices with different power classes can be connected. If the 24 V logic supply used has a nominal output current > 25 A, a fuse/circuit breaker is required. Type of fuse: “slow-blowing” fuse or circuit breaker with “C characteristic”

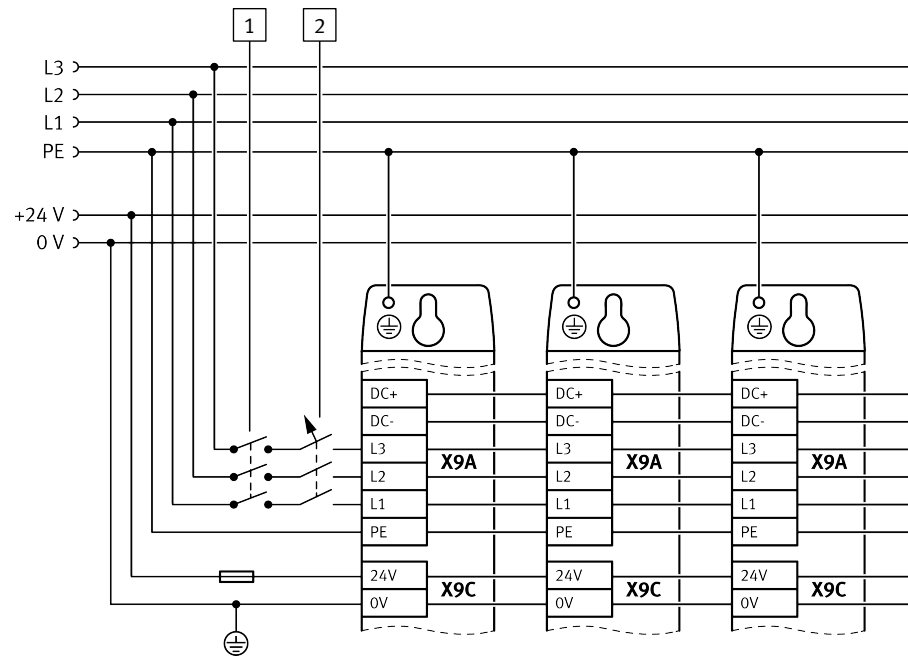


Fig. 27: Cross-wiring with DC link coupling (CMMT-AS-...-11A-P3)

1 Main switch

2 Circuit breaker

8 Malfunctions

8.1 Diagnostics via LED

LEDs for indicating status information are on the front and top of the device. The number of LEDs depends on the product design. There are up to 11 LEDs on the front of the device. There are up to 4 LEDs on the top of the device at connections [X19], XF1 IN and XF2 OUT.

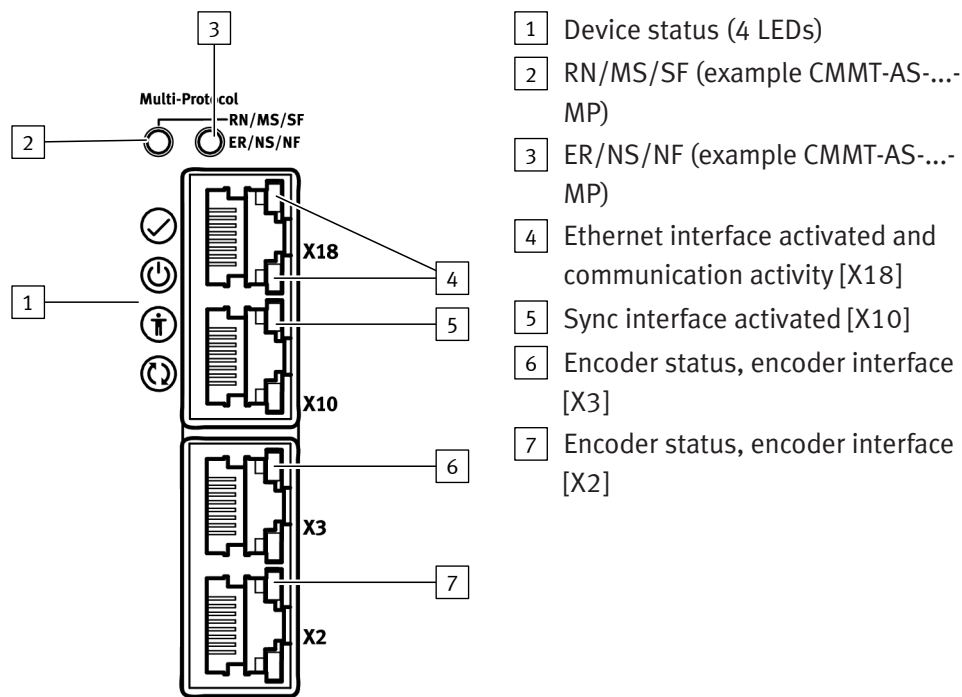


Fig. 28: LEDs on the front

8.1.1 Device status displays

LED	Designation	Brief description
✓	Status LED	Indicates the general device status
⏻	Power LED	Indicates the status of the power supply
👤	Safety LED	Indicates the status of the safety equipment
🔄	Application status LED	Indicates the identification sequence and is reserved for future extensions

Tab. 85: Device status LEDs (status, power, safety and application status LEDs)

LED test

After the device is switched on, it runs through an initialisation phase. During the initialisation phase, the device performs an LED test. During the LED test, the 4 device status LEDs are activated simultaneously. The 4 device status LEDs are yellow for a short time.

✓ Status LED, display of the device status

LED	Meaning
fast red flashing	Unexpected exception error. – Restart device – Service case
flashing red	An error is pending.
Flashing orange	The servo drive is currently performing a firmware update.
flashing yellow	A warning is pending.
yellow light	The servo drive is in the initialisation phase.

LED	Meaning
 flashing green	The servo drive is ready, and the power stage is switched off (Ready).
 green light	The power stage and the closed-loop controller are enabled.

Tab. 86: Status LED

Power LED, status of the power supply

LED	Meaning
 flashing yellow	The logic voltage and AC supply are present. The intermediate circuit is being charged.
 yellow light	The logic voltage supply is present, but the AC supply is lacking.
 green light	The logic voltage supply is present, and the intermediate circuit is charged.

Tab. 87: Power LED

Safety LED, status of the safety engineering

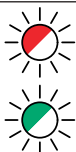
Malfunctions of the safety sub-functions are detected and displayed in the functional device.

Malfunctions are externally reported by the functional part, including via the additional communication interfaces (bus, commissioning software).

LED	Meaning
 flashing red	Error in the safety part or a safety condition has been violated.
 flashing yellow	The safety sub-function has been requested but is not yet active.
 yellow light	The safety sub-function has been requested and is active.
 flashing green	Parameterisation operating mode of the safe parameters. The control of the power stage is not possible (STO active); the brake outputs are in the safe state (SBC active).
 green light	Ready, a safety sub-function has not been requested.

Tab. 88: Safety LED

Application status

LED	Meaning
	Identification sequence active (for optical identification of the device in a network), which can be activated via the parameterisation software
	Activation of factory parameter set
	Reserved for future extensions
	

LED	Meaning
 flashing green	Reserved for future extensions
 green light	

Tab. 89: Application status LED

Special function of the start program (bootloader) during firmware updates

When the bootloader starts the update procedure, the status LED flashes yellow at half-second intervals. The power LED, safety LED and application status LED remain off.

If an error occurs during a firmware update, the status LED flashes red at one-second intervals. The frequency of flashing corresponds to the error number specified in the following table. After flashing, there is a pause of 3 s. Then the procedure repeats.

Error number	Description
1	The start program has detected a CRC error in the firmware after switching on.
2	The start program has detected a CRC error in the Firmware Update Package after switching on.
3	The start program has detected another fatal error that prevents the device from being started.

Tab. 90: Error messages of the start program (bootloader)

8.1.2 Interface status [X2], [X3], [X10], [X18]

LED at [X2] and [X3]; encoder status

LED	Meaning
 green light	– for digital incremental encoders: encoder evaluation active. – for encoders with communication interface: connection to the encoder established.

Tab. 91: LED at [X2] and [X3]

LED at [X10]; sync connection status

LED	Meaning
 green light	Interface is activated.

Tab. 92: LED at [X10]

CMMT-...-MP: LEDs on [X18]; connection status of the Ethernet interface

LED	Meaning (top LED)
 off	Interface is deactivated.
 green light	Interface is activated.
 flashing green	Communication activity.

Tab. 93: Top LED at [X18]

LED	Meaning (bottom LED)
 off	reserved

Tab. 94: Bottom LED at [X18]

**CMMT-...-EC/EP/PN:
LEDs on [X18]; con-
nection status of the
Ethernet interface**

LED	Meaning (top LED)
 off	Interface is deactivated.
 green light	Interface is activated.

Tab. 95: Top LED at [X18]

LED	Meaning (bottom LED)
 off	no communication activity
 flashing yellow	Communication activity detected.

Tab. 96: Bottom LED at [X18]

8.1.3 Device and interface status, EtherCAT

Together with the 2 LEDs on the top, the RN or Run LED and the ER or Error LED on the front display the bus/network status.

**EtherCAT, LED RN or
Run; operating status**

LED	Meaning	Remedy
 off	The device is in the Init status (initialisation).	–
 flashing green	The device is in the pre-operational status.	–
 flashing green ¹⁾	The device is in the safe-operational status.	–
 green light	The device is in the operational status (normal operating status).	–

1) Single flash: short single flash (1x flash, pause, 1x flash, etc.)

Tab. 97: LED RN or Run

**EtherCAT, LED ER or
Error; error status**

LED	Meaning	Remedy
 off	no error	–
 flashing red	invalid configuration, general configuration error, a status change specified by the master is not possible.	Eliminate configuration error.
 flashing red ¹⁾	Local error, the slave device application has independently changed the EtherCAT status. This can have the following causes: – A host watchdog time-out has occurred. – Synchronisation error, the device switches automatically to the safe-operational status.	–
 flashing red ²⁾	A process data watchdog time-out has occurred.	–

1) Single flash: short single flash (1x flash, pause, 1x flash, etc.)

2) Double flash: short double flash (2x flash, pause, 2x flash, etc.)

Tab. 98: LED ER or Error

**EtherCAT, LINK/
ACTIVITY LED; connec-
tion status at XF1 IN and
XF2 OUT**

LED	Meaning	Remedy
 off	no network connection	Check network connection.
 flickers green (approx. 10 Hz)	Data traffic activity (traffic).	–
 green light	Network connection is OK (link).	–

Tab. 99: LED at XF1 IN and XF2 OUT

8.1.4 Device and interface status, PROFINET

Together with the 4 LEDs on the top, the NF LED on the front displays the bus/network status.

In the case of devices with multi-protocol CMMT-AS-...-MP, the SF LED indicates common errors for PROFINET communication.

**CMMT-...-MP: PROFINET,
LED NF; bus error**

LED	Meaning	Remedy
 off	no error	–
 flashes red (2 Hz)	Network error: – no data transfer – no configuration	Check network configuration and network connection.
 red light	Network error: – no physical connection to the network	Check network connection.

Tab. 100: LED NF with the CMMT-...-MP

**CMMT-...-MP: PROFINET,
LED SF; common error**

LED	Meaning	Remedy
 off	no error	–
 flashing red (1 Hz, 3 s)	DCP signal service is triggered via the bus (Discovery and basic Configuration Protocol).	–
 red light	– At least one station in the network is no longer available for data exchange. – With active PROFDiagnostic (Activate diagnostics): device error of the servo drive	Check devices in the network. Check whether devices in the network are required for operation of the system.

Tab. 101: LED SF with the CMMT-...-MP

**CMMT-...-PN: PROFINET,
LED NF; bus error**

LED	Meaning	Remedy
 off	no error	–
 flashes red (2 Hz)	Network error: – no data transfer – no configuration – no network connection or network connection is malfunctioning	Check network configuration and network connection.

Tab. 102: LED NF with the CMMT -...- PN

PROFINET, LEDs at XF1 IN and XF2 OUT; connection status, data traffic

LED	Meaning of the green LED	Remedy
 off	no network connection	Check network connection.
 green light	Network connection is OK (link).	—

Tab. 103: Green LED at XF1 IN and XF2 OUT

LED	Meaning of the yellow LED	Remedy
 off	no data traffic	—
 flashing yellow	Data traffic activity (traffic).	—

Tab. 104: Yellow LED at XF1 IN and XF2 OUT

8.1.5 Device and interface status, EtherNet/IP

Together with the 4 LEDs on the top (link/activity), the MS LED and NS LED on the front display the bus/network status.

EtherNet/IP, MS LED; module status

LED	Meaning	Remedy
 off	No logic voltage supply.	Check logic voltage supply.
 flashing green	Device is not configured.	Perform configuration.
 green light	normal operating status	—
 flashing red/green	Device is performing a self-test.	—
 flashing red	rectifiable error, possibly a configuration error	Check configuration.
 red light	error cannot be rectified	Contact Festo Service ➔ www.festo.com .

Tab. 105: MS LED

EtherNet/IP, NS LED; network status

LED	Meaning	Remedy
 off	The device is switched off or has no IP address.	Switch on device or check IP address.
 flashing green	The device has an IP address but no CIP connection. It may be that the device is not assigned to a master/scanner.	Eliminate configuration error.
 green light	Normal operating status. The device is online and has a CIP connection.	—
 flashing red/green	Device is performing a self-test.	—
 flashing red	One or more I/O connections are in the time-out status.	Check the physical connection to the master/scanner.
 red light	The IP address of the device has already been assigned.	Check and correct IP addresses in the network.

Tab. 106: NS LED

EtherNet/IP, LED at XF1 IN and XF2 OUT; connection status, data traffic

LED	Meaning of the green LED	Remedy
 off	no network connection	Check network connection.
 green light	Network connection is OK (link).	–

Tab. 107: Green LED at XF1 IN and XF2 OUT

LED	Meaning of the yellow LED	Remedy
 off	no data traffic	–
 flickers yellow	Data traffic activity.	–

Tab. 108: Yellow LED at XF1 IN and XF2 OUT

9 Disassembly

Disassemble in reverse order of mounting.

Before disassembly

1. Switch off the power supply at the main switch.
2. Secure the system against accidental reactivation.
3. Wait at least 5 minutes until the intermediate circuit has discharged.
4. Let the device cool down to room temperature.
5. Before touching the power connections [X6A], [X9A], [X9B], check to ensure they are free of voltage.
6. Disconnect all electrical cables.

For disassembly of the device

- Loosen retaining screws (2x) and remove the device from the mounting surface.

10 Technical data

10.1 General technical data

General technical data	
Declaration of conformity	➔ www.festo.com/sp
Type ID code	CMMT-AS
Type of mounting	Mounting plate, attached with screws
Mounting position	Vertical, mounted on closed surface, free convection with unhindered air flow from bottom to top
Dimensions (H*W*D)	➔ 6 Assembly
Product weight [kg]	CMMT-AS-C2-11A-P3: 2.1 CMMT-AS-C3-11A-P3: 2.1 CMMT-AS-C5-11A-P3: 2.2 CMMT-AS-C7-11A-P3: 4.1 CMMT-AS-C12-11A-P3: 4.1 CMMT-AS-C18-11A-P3: 4.3 CMMT-AS-C25-11A-P3: 4.3

General technical data	
Displays	– Device status display: 4 LEDs – Bus-specific status: – CMMT-AS-...-MP: 2 LEDs – CMMT-AS-...-EC: 2 LEDs – CMMT-AS-...-EP: 2 LEDs – CMMT-AS-...-PN: 1 LEDs – Interface status [X19] (IN, OUT): – CMMT-AS-...-MP: 4 LEDs – CMMT-AS-...-EC: 2 LEDs – CMMT-AS-...-EP: 4 LEDs – CMMT-AS-...-PN: 4 LEDs – Interface status [X2], [X3], [X10], [X18]: 4 LEDs – Interface activity [X18]: 1 LED
Control elements	Optional: operator unit CDSB
Parameterisation interface	– [X18], Ethernet; parameterisation and configuration via commissioning software → www.festo.com/sp – [X19] IN/OUT, RT Ethernet; parameterisation and configuration via bus protocol – [X5], configuration/data transfer via the removable operator unit
RT Ethernet protocol	CMMT-AS-...-MP: EtherCAT, EtherNet/IP, Modbus TCP, PROFINET CMMT-AS-...-EC: EtherCAT CMMT-AS-...-EP: EtherNet/IP, Modbus TCP CMMT-AS-...-PN: PROFINET

Tab. 109: General technical data

Ambient conditions, transport	
Transport temperature [°C]	–25 ... +70
Relative humidity [%]	5 ... 95 (non-condensing)
Max. transportation duration [d]	30
Permissible altitude [m]	12000 (above sea level) for 12 h
Vibration resistant	Vibration test and free fall in packaging in accordance with EN 61800-2

Tab. 110: Ambient conditions, transport

Ambient conditions, storage	
Storage temperature [°C]	–25 ... +55
Relative humidity [%]	5 ... 95 (non-condensing)
Permissible altitude [m]	3000 (above sea level)

Tab. 111: Ambient conditions, storage

Ambient conditions, operation	
Ambient temperature at nominal power [°C]	0 ... +40
Ambient temperature with derating [°C] (–3%/°C at 40°C ... 50°C)	0 ... +50
Cooling	Via ambient air in the control cabinet; from CMMT-AS-C5-11A-P3 also via forced ventilation through an integrated fan
Temperature monitoring	Monitoring of: – Cooling element (power module) – Air in the device Switch-off if temperature is too high or too low

Ambient conditions, operation		
Relative humidity	[%]	5 ... 90 (non-condensing), no corrosive media permitted near the device
Permissible setup altitude above sea level at nominal power	[m]	0 ... 1000
Permissible setup altitude above sea level with derating (–10%/1000 m at 1000 m ... 2000 m)	[m]	0 ... 2000 Operation above 2000 m is not permitted!
Degree of protection in accordance with EN 60529		IP20 (with attached mating plug X9A and with intended mounting on closed backwall, otherwise IP10)
Requirements for installation space		Install in a control cabinet with at least IP54, design as “closed electrical operating area” in accordance with IEC 61800-5-1, Chap. 3.5
Protection class		I
Overvoltage category		III
Contamination level		2 (or better)
Vibration resistance in accordance with		IEC 61800-5-1 and EN 61800-2
Shock resistance in accordance with		EN 61800-2

Tab. 112: Ambient conditions, operation

Service life		
Service life of the device with rated load in S1 operation ¹⁾ and 40°C ambient temperature	[h]	25000
Service life of the device at < 50 % rated load in S1 operation ¹⁾ and 40 °C ambient temperature	[h]	50000

1) Continuous operation with constant load

Tab. 113: Service life

Materials		
CMMT-AS	C2/C3/C5-11A-P3	C7/C12/C18/C25-11A-P3
Housing	Plastic	Plastic, aluminium sheet
Cooling profile	Die-cast aluminium	

Tab. 114: Materials

10.2 Technical data, electrical

10.2.1 Load voltage supply [X9A]

Electrical data, load voltage supply [X9A]				
Number of phases		3		
Voltage range	[V AC]	200 – 10 % ... 480 + 10 %		
Voltage range with derating (–1.5 %/10 V AC)	[V AC]	400 ... 530		
Nominal operating voltage	[V AC]	400		
System voltage in accordance with IEC 61800-5-1	[V AC]	300		
Mains frequency	[Hz]	48 ... 62		
Network connection/allowed mains types of system earthing ¹⁾		L1 → L2 → L3: TT, TN, IT		
Required quality of the mains supply		Corresponds to the requirements of EN 61800-3 if not specified otherwise		
Alternative DC supply feed ²⁾	[V DC]	80 ... 700		
CMMT-AS-		C2-11A-P3	C3-11A-P3	C5-11A-P3
Mains current consumption at nominal power approx.	[A _{RMS}]	2	3	6
Short circuit current rating (SCCR)	[kA]	100 for operation in WYE 400 V/230 V power supply systems 10 for operation in WYE 480 V/277 V power supply systems For operation in 480 V WYE networks with SCCR > 10 kA → 10.3 Technical data of UL/CSA certification		
CMMT-AS-		C7-11A-P3	C12-11A-P3	C18-11A-P3
Mains current consumption at nominal power approx.	[A _{RMS}]	9	15	22
Short circuit current rating (SCCR)	[kA]	10		

1) in accordance with IEC 60364-1

2) Parameterisation required → Manual/online help plug-in, software, function, fieldbus, device profile

Tab. 115: Load voltage supply

Technical data for DC link circuit and brake chopper

Electrical data, DC link circuit		
DC link voltage with feed of nominal voltage at the mains input	[V DC]	540 ... 560
Permitted maximum voltage	[V DC]	< 800

Tab. 116: DC link circuit

The DC link voltage is continuously monitored by the firmware of the device. The switching thresholds can be parameterised. The device can therefore be adapted to different supply voltages.

Default switching thresholds on delivery:

- Undervoltage: 450 V
- Overvoltage: 800 V

The pre-charging time of the DC link circuit is controlled and monitored by the firmware. The firmware monitors whether the DC link circuit can be charged within the correct time window. The soft start relay is only closed if the voltage difference

between the mains voltage and DC link voltage is small enough (DC link circuit is charged) and once a defined minimum period has elapsed following detection of the mains voltage (0.5 s).

Electrical data, brake chopper		
Brake chopper switching threshold ON	[V DC]	typ. 760
Brake chopper hysteresis ON/OFF	[V DC]	typ. 5
Protective function	If an external braking resistor is used, the data of this external braking resistor has to be parameterised correctly. Protective functions: – Detection of short circuits to DC+ with fast switch-off of the brake chopper and the power output stage – Monitoring of the pulse energy and the continuous power of the braking resistor by the firmware with switch-off of the braking resistor and of the power output stage when the power limit is reached	

Tab. 117: Brake chopper

10.2.2 Logic voltage supply [X9C]

Electrical data, logic voltage supply			
Logic voltage range	[V DC]	24 ± 20 %	
Nominal voltage	[V DC]	24	
Starting current (with 28.8V)	[A]	Typically 5 (with primary-side connection of the 24 V logic supply) Maximum 50 (with hard switching to the previously switched-on logic supply)	
Protective functions		– Polarity reversal – Short circuit to 0 V (24 V outputs)	
CMMT-AS-		C2-11A-P3	C3-11A-P3
Current consumption (without holding brake, CDSB, digital I/Os and auxiliary supply output unloaded), ¹⁾	[A]	0.5	0.5
Current consumption (with safe inputs at 24 V, with holding brake), ²⁾	[A]	1.5	1.8
Current consumption (with holding brake, with CDSB, digital I/Os and auxiliary supply outputs with load and with fan, if present) ²⁾	[A]	2.0	2.5

Electrical data, logic voltage supply				
CMMT-AS-	C7-11A-P3	C12-11A-P3	C18-11A-P3	C25-11A-P3
Current consumption (without holding brake, CDSB, digital I/Os and auxiliary supply output unloaded), ³⁾ [A]	0.5	0.5	0.7	0.7
Current consumption (with safe inputs at 24 V, with holding brake), ⁴⁾ [A]	2.0	2.0	3.0	3.0
Current consumption (with holding brake, with CDSB, digital I/Os and auxiliary supply outputs with load and with fan) ²⁾ [A]	2.5	2.5	3.5	3.5

1) including current for the safe inputs

2) including current consumption for power stage ON and for the safe inputs

3) including current for the safe inputs

4) including current consumption for power stage ON and for the safe inputs

Tab. 118: Logic voltage supply

10.2.3 Electrical data for braking resistor (internal/external) [X9B]

Integrated braking resistor [X9B]				
CMMT-AS-	C2-11A-P3	C3-11A-P3	C5-11A-P3	
Resistance [Ω]	130	130	130	
Pulse power [W]	5000	5000	5000	
Pulse energy [Ws]	850	850	850	
Continuous power (CE specification) at 70 °C ambient temperature ¹⁾²⁾ [W]	48	48	58	
Continuous power (cUL specification) at 70 °C ambient temperature ¹⁾ [W]	30	30	36	
CMMT-AS-	C7-11A-P3	C12-11A-P3	C18-11A-P3	C25-11A-P3
Resistance [Ω]	47	47	24	24
Pulse power [W]	13600	13600	24000	24000
Pulse energy [W/s]	1200	1200	1200	1200
Continuous power (CE specification) at 70 °C ambient temperature ³⁾⁴⁾ [W]	100	100	100	100
Continuous power (cUL specification) at 70 °C ambient temperature ¹⁾ [W]	100	100	65	65

1) Air temperature in the cooling duct (braking resistor mounting position)

2) The power monitoring of the internal braking resistor is fundamentally based on the cUL continuous power specification. The (higher) CE continuous power is permissible in the CE scope of application. It can be used by configuring the CMMT-AS for the use of an external braking resistor with the specified performance data.

3) Air temperature in the cooling duct (braking resistor mounting position)

4) The power monitoring of the internal braking resistor is fundamentally based on the cUL continuous power specification. The (higher) CE continuous power is permissible in the CE scope of application. It can be used by configuring the CMMT-AS for the use of an external braking resistor with the specified performance data.

Tab. 119: Integrated braking resistor [X9B]

Requirements for external braking resistor [X9B]					
CMMT-AS-		C2-11A-P3	C3-11A-P3	C5-11A-P3	
Max. resistance	[Ω]	250	250	130	
Min. resistance	[Ω]	130	130	80	
Pulse power	[W]	4400	4400	7200	
Permissible pulse energy (for the brake chopper)	[Ws]	2500	2500	6000	
Operating voltage	[V DC]	≥ 900	≥ 900	≥ 900	
Parasitic inductance	[μH]	≤ 200	≤ 200	≤ 200	
Thermal protection		yes, possible to monitor the power in the braking resistor in the device firmware			
CMMT-AS-		C7-11A-P3	C12-11A-P3	C18-11A-P3	C25-11A-P3
Max. resistance	[Ω]	85	60	40	30
Min. resistance	[Ω]	60	40	30	20
Pulse power	[W]	9600	14440	20000	28800
Permissible pulse energy (for the brake chopper)	[kWs]	10	15	20	28
Operating voltage	[V DC]	≥ 900	≥ 900	≥ 900	≥ 900
Parasitic inductance	[μH]	≤ 150	≤ 150	≤ 100	≤ 100
Thermal protection		yes, possible to monitor the power in the braking resistor in the device firmware			

Tab. 120: Requirements for external braking resistor [X9B]

10.2.4 Motor connection power specifications [X6A]

Internal protective functions detect short circuits between 2 motor phases and short circuits of a motor phase to PE. If a short circuit is detected, the pulse-width modulation signals are switched off.

Parameters for the power specifications		
Nominal voltage of mains connection	[V AC]	400
Ambient temperature (air)	[°C]	≤ 40
Setup altitude	[m]	≤ 1000

Tab. 121: Parameters

Power specifications during operation with the given parameters [X6A]					
CMMT-AS-		C2-11A-P3	C3-11A-P3	C5-11A-P3	
Pulse-width modulation frequency	[kHz]	8	8	8	
Current regulator cycle time	[μs]	62.5	62.5	62.5	
Nominal output power (S1 operation; cos(φ) > 0.8)	[W]	800	1200	2500	
Nominal current (S1 operation)	[A _{RMS}]	1.7	2.5	5	
Max. output power (S2 operation; cos(φ) > 0.8)	[W]	2400	3600	7500	
Maximum current	[A _{RMS}]	5.1	7.5	15	
CMMT-AS-		C7-11A-P3	C12-11A-P3	C18-11A-P3	C25-11A-P3
Pulse-width modulation frequency	[kHz]	8	8	8	8
Current regulator cycle time	[μs]	62.5	62.5	62.5	62.5
Nominal output power (S1 operation; cos(φ) > 0.8)	[W]	4000	6000	9000	12000

Power specifications during operation with the given parameters [X6A]					
Nominal current (S1 operation)	[A _{RMS}]	7	12	18	25
Max. output power (S2 operation; cos(φ) > 0.8)	[W]	10 000	17 000	27 000	36 000
Maximum current	[A _{RMS}]	21	36	54	75
CMMT-AS-		...-11A-P3			
Output voltage range	[V _{RMS}]	3 x 0 ... input			
Output voltage with feed of nominal voltage and nominal power	[V _{RMS}]	380			
Output frequency	[Hz]	0 ... 599			
CMMT-AS-		C2-11A-P3	C3-11A-P3	C5-11A-P3	
Duration for maximum current (f _s > 5 Hz)	[s]	2			
Duration for maximum current at standstill (f _s ≤ 5 Hz); minimum cycle time 1 s!	[s]	0.1			
CMMT-AS-		C7-11A-P3	C12-11A-P3	C18-11A-P3	C25-11A-P3
Duration for maximum current (f _s > 5 Hz)	[s]	2			
Duration for maximum current at standstill (f _s ≤ 5 Hz); minimum cycle time 1 s!	[s]	0.1		0.2	

Tab. 122: Motor connection power specifications [X6A]

If the parameters do not conform to those stated, the power specifications listed above will not be achieved. In this case, the following deratings apply. The deratings refer simultaneously to nominal output power, max. output power, nominal current and maximum current.

Derating	
Changed mains voltage 180 V AC ... 400 V AC	– no derating with current – reduced achievable rotational speed/speed and power with reduced mains voltage – the specified nominal current must not be exceeded
Changed mains voltage 400 V AC ... 530 V AC	[%] -1.5/10 V AC
Ambient temperature (air) 40°C ... 50°C	[%] -3/°C
Setup altitude > 1000 m (1000 m ... 2000 m)	[%] -10/1000 m

Tab. 123: Derating

Temperature monitoring			
CMMT-AS-	C2-11A-P3	C3-11A-P3	C5-11A-P3
Power unit temperature			
Warning	[°C] 80	100	80
Shutdown	[°C] > 85	> 105	> 85
Air temperature			
Warning	[°C] 70	70	70
Shutdown	[°C] > 75	> 75	> 75
Shutdown if air temperature too low	[°C] 0	0	0

Temperature monitoring					
CMMT-AS-		C7-11A-P3	C12-11A-P3	C18-11A-P3	C25-11A-P3
Power unit temperature					
Warning	[°C]	75	75	75	80
Shutdown	[°C]	> 80	> 80	> 80	> 85
Air temperature					
Warning	[°C]	85	85	70	75
Shutdown	[°C]	> 90	> 90	> 75	> 80
Shutdown if air temperature too low	[°C]	0	0	0	0

Tab. 124: Temperature monitoring

10.2.5 Motor auxiliary connection [X6B]

Motor temperature monitoring [X6B]	
Analogue sensors	Analogue temperature sensors with gain and offset – KTY 81 ... 84 (silicon temperature sensors) – PTC (PTC resistor, positive temperature coefficient) – NTC (NTC resistor, negative temperature coefficient) – Pt1000 (platinum measuring resistor)
Digital sensors	– N/C contact – N/O contact

Tab. 125: Motor temperature monitoring [X6B]

Output of holding brake [X6B]					
CMMT-AS		-C2-11A-P3	-C3-11A-P3	-C5-11A-P3	
Max. continuous output current	[A]	1	1	1.3	
Maximum voltage drop from + 24 V input at connection [X9A] to the brake output at [X6B]	[V DC]	0.8	0.8	1	
Max. permissible inductive load	[H]	< 5	< 5	< 5	
CMMT-AS		-C7-11A-P3	-C12-11A-P3	-C18-11A-P3	-C25-11A-P3
Max. continuous output current	[A]	1.5	1.5	2.3	2.3
Maximum voltage drop from + 24 V input at connection [X9A] to the brake output at [X6B]	[V DC]	1.0	1.0	1.0	1.0
Max. permissible inductive load	[H]	< 5	< 5	< 5	< 5
CMMT-AS		-11A-P3-S3			
Design		High and low-side switch, PM switching			
Maximum dwell time	[months]	3			
Test pulse length	[µs]	Parameterisable, low or dark test pulses			
Test pulse interval	[ms]	Minimum 500, maximum 29500, alternating interval			
Protective functions		– Protection against inductive loads – Short circuit protected 0 V/FE – Short circuit BR+ to BR– when output is switched on – Overvoltage-proof up to 60 V The brake output also shuts down in the event of a fault if there is an overvoltage on the logic supply. – Thermal overload protection			

Output of holding brake [X6B]	
Error detection	Voltage at output despite brake having shut down Diagnostics possible via: – Diagnostic output for safety sub-function SBC – Error message on device
CMMT-AS	-11A-P3-S1
Design	High-Side-Switch
Test pulses	The test pulses of the associated control input #SBC-A are mapped to the output with a switching delay.
Protective functions	– Short circuit protected 0 V/FE – Overvoltage-proof up to 60 V The brake output also shuts down in the event of a fault if there is an overvoltage on the logic supply. – Thermal overload protection
Error detection	Voltage at output despite brake having shut down Diagnostics possible via: – Diagnostic output for safety sub-function SBC – Error message on device

Tab. 126: Output of holding brake [X6B], 3-phase devices

10.2.6 Encoder interfaces [X2], [X3]

CMMT-AS-...-EC/EP/PN: EnDat 2.1 encoder on [X2]	
CMMT-AS-...-MP: EnDat 2.1 encoder on [X2], [X3]	
Parameterisable no. of encoder pulses	1 ... 16777216 position values/revolution (24 bit)
Angular resolution/interpolation	Not applicable; digital angle signal from encoder
Clock signal [MHz]	RS422/485; maximum 2
Data channel [MHz]	RS422/485; maximum 2
Input impedance data [Ω]	RS422/485; 120
Output supply [mA]	Maximum 250 (at 5.00 V ... 5.50 V)
Support: mechanical multiturn encoder	Yes, up to 4096 revolutions
Support: battery-buffered multiturn encoder	No
Support: encoder parameter memory	Yes, controller parameters saved in encoder
Support: encoder error messages	Yes, supported
Encoder communication failure	Up to 2 corrupt/failed encoder messages tolerated. After this an error message will be generated.

Tab. 127: EnDat 2.1 encoder on [X2], [X3]

CMMT-AS-...-EC/EP/PN: EnDat 2.2 encoder on [X2]	
CMMT-AS-...-MP: EnDat 2.2 encoder on [X2], [X3]	
Parameterisable no. of encoder pulses	1 ... 16777216 position values/revolution (24 bit)
Angular resolution/interpolation	Not applicable; digital angle signal from encoder
Clock signal [MHz]	RS422/485; maximum 4
Data channel [MHz]	RS422/485; maximum 4
Input impedance data [Ω]	RS422/485; 120
Output supply [mA]	Maximum 250 (at 9.50 V ... 10.50 V)

CMMT-AS-...-EC/EP/PN: EnDat 2.2 encoder on [X2] CMMT-AS-...-MP: EnDat 2.2 encoder on [X2], [X3]	
Support: mechanical multiturn encoder	Yes, up to 4096 revolutions
Support: battery-buffered multiturn encoder	Yes, up to 16 bit; battery buffer not integrated in CMMT-AS (cable adapter/box required)
Support: encoder parameter memory	Yes, controller parameters saved in encoder
Support: encoder error messages	Yes, supported
Encoder communication failure	Up to 2 corrupt/failed encoder messages tolerated. After this an error message will be generated.

Tab. 128: EnDat 2.2 encoder on [X2]

CMMT-AS-...-EC/EP/PN: Hiperface encoder on [X2] CMMT-AS-...-MP: Hiperface encoder on [X2], [X3]	
Parameterisable no. of encoder pulses	1 ... 1024 periods/revolution (10 bit)
Angular resolution/interpolation	Minimum 10 bits/period
Hiperface data channel [MHz]	RS422/485; maximum 4 (Hiperface 9.6 kbit/s to 115 kbit/s)
Input impedance for data channel [Ω]	RS422/485; 120
Track signals SIN, COS [V]	2.5 ± 20% (DC offset on SIN, #SIN, COS, #COS)
[Vss]	1 ± 10% (differential signal SIN - #SIN, COS - #COS)
Input impedance SIN, COS [Ω]	120 (differential input)
Cut-off frequency SIN, COS [kHz]	CMMT-AS-...-EC/EP/PN: approx. 50 (high-resolution track) CMMT-AS-...-MP: approx. 250 (high-resolution track)
Noise-free angular resolution within one SIN, COS period [Bit]	10 (measured on noise-free SIN/COS signals)
Noise-free angular resolution with SEK/SEL 37 per motor revolution [Bit]	Min. 12, typically 13 (10 m motor/encoder cable, drive-regulation active)
Noise-free angular resolution with SKS/SKM 36 per motor revolution [Bit]	Min. 15, typically 17 (10 m motor/encoder cable, drive-regulation active)
Output supply [V]	10 ± 10 %
[mA]	Maximum 250
Support: mechanical multiturn encoder	Yes, up to 4096 revolutions
Support: battery-buffered multiturn encoder	Yes, up to 16 bit; battery buffer not integrated in CMMT-AS (cable adapter/box required)
Support: encoder parameter memory	Yes, controller parameters saved in encoder
Encoder signal monitoring	Vector length monitoring for SIN/COS signals, signal amplitude range -3 0%... +20 %,error message if position determination is no longer possible. A cyclical comparison of the position values of the SIN/COS signals with the absolute position read via the data channel detects miscounting by an entire signal period.

Tab. 129: Hiperface encoder on [X2], [X3]

CMMT-AS-...-MP: BiSS-C encoder at [X2]		
Parameterisable no. of encoder pulses		1 ... 16777216 position values/revolution (24 bit)
Angular resolution/interpolation		Not applicable; digital angle signal from encoder
Clock signal	[MHz]	RS422/485 clock signal; maximum 10
Data channel	[MHz]	RS422/485 synchronous communication; bit rate maximum 10
Input impedance data	[Ω]	RS422/485; 120
Output supply	[V]	5.00 ... 10.50 (default 5.00 V)
	[mA]	Maximum 250 mA
Support: mechanical multiturn encoder		Yes, 16 bit
Support for battery-buffered multi-turn encoder		Yes, up to 16 bit; battery buffer not integrated in CMMT-AS (cable adapter/box required)
Support: encoder parameter memory		Yes, controller parameters saved in the encoder
Support: encoder error messages		Yes, supported
Support for voltage measurement		Yes, supported
Encoder communication failure compensation		Yes, the controller extrapolates position values linearly. Up to two corrupted or failed encoder telegrams are tolerated. After this an error message will be generated.

Tab. 130: BiSS-C encoder at [X2]

SIN/COS encoder at [X2], [X3]		
Parameterisable no. of encoder pulses		1 ... 65536 periods/revolution (16 bit)
Angular resolution/interpolation		Minimum 10 bits/period
Track signals SIN, COS	[V]	2.5 ± 20% (DC offset on SIN, #SIN, COS, #COS)
	[Vss]	1 ± 10% (differential signal SIN - #SIN, COS - #COS)
Input impedance SIN, COS	[Ω]	120 (differential input)
Cut-off frequency f_{crit} SIN, COS	[kHz]	- For connection [X2]: - with CMMT-AS-...-EC/EP/PN: approx. 50 (high-resolution track) - with CMMT-AS-...-MP: approx. 250 (high-resolution track) - For connection [X3]: - with CMMT-AS-...-EC/EP/PN: approx. 50 (high-resolution track) - with CMMT-AS-...-MP-S1: approx. 50 (high-resolution track) - with CMMT-AS-...-MP-S3: approx. 250 (high-resolution track)
Noise-free angular resolution within one SIN, COS period	[Bit]	10 (measured on noise-free SIN/COS signals)
Noise-free angular resolution with LS 187 (20 µm signal period)	[nm]	< 100
Output supply	[V]	5 ± 5 %
	[mA]	Maximum 250
Support: mechanical multiturn encoder		No

SIN/COS encoder at [X2], [X3]	
Support: battery-buffered multiturn encoder	No
Support: encoder parameter memory	No
Encoder signal monitoring	Vector length monitoring for SIN/COS signals, signal amplitude range –3 0%... +20 %,error message if position determination is no longer possible.

Tab. 131: SIN/COS encoder at [X2], [X3]

Digital incremental encoder at [X2], [X3]	
Parameterisable no. of encoder pulses	1 ... 262144 periods/revolution (18 bit)
Angular resolution/interpolation	4x evaluation as 4 steps (2 bits) per period
Tracking signals A/B/N [MHz]	RS422/485; maximum 4
Input impedance A/B/N [Ω]	120 (differential input)
Cut-off frequency f_{crit} A/B/N [MHz]	> 4
Output supply	[V] 5.00 ... 10.50 (default 5.00 V)
	[mA] Maximum 250 unregulated (no Sense cable)
Support: mechanical multiturn encoder	No
Support: battery-buffered multiturn encoder	No
Support: encoder parameter memory	No
Encoder signal monitoring	No, no direct encoder signal monitoring

Tab. 132: Digital incremental encoder at [X2], [X3]

Encoder with asynchronous communication interface at [X2]	
Parameterisable no. of encoder pulses	1 ... 16777216 position values/revolution (24 bit)
Angular resolution/interpolation	Not applicable; digital angle signal from encoder
Clock signal [MHz]	Not applicable, asynchronous communication
Data channel	RS422/485, asynchronous communication Bit rate: 1 MHz/2 MHz/4 MHz 18 bit/frame
Input impedance A/B/N [Ω]	RS422/485; 120
Output supply	[V] 5.00 ... 5.50
	[mA] Maximum 250
Support: mechanical multiturn encoder [Bit]	Yes, 16
Support: battery-buffered multiturn encoder	Yes, up to 16 bit; battery buffer not integrated in CMMT-AS (cable adapter/box required)
Support: encoder parameter memory	Yes, controller parameters saved in encoder
Support: encoder error messages	Yes, supported
Encoder signal monitoring	Up to 2 corrupt/failed encoder messages tolerated. After this an error message will be generated.

Tab. 133: Encoder with asynchronous communication interface at [X2]

10.2.7 Inputs, outputs, ready contact at [X1A]

Operating ranges of digital inputs drawing current

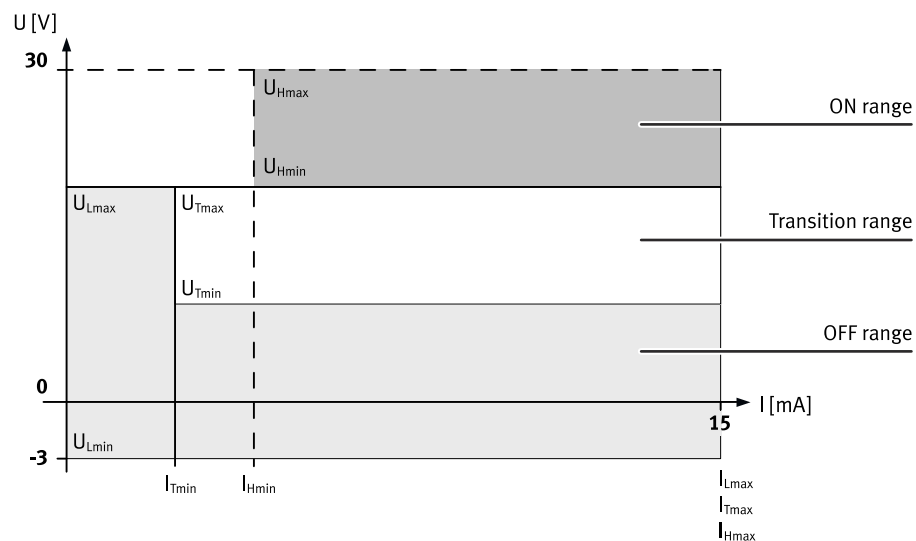


Fig. 29: Operating ranges of digital inputs drawing current

CMMT-AS-...-S3

Control inputs #SIN0-A/B ... #SIN3-B, SIN4 and ERR-RST to [X1A]			ZVEI ¹⁾
Specification	Meets the requirements of a type 3 input according to EN 61131-2		—
	The inputs correspond to a sink of type C0 (test pulse duration of the safety controller freely selectable) according to ZVEI position paper CB24I. They are compatible with sources of type C0 (within the scope of the parameterisable test pulse filtering), C1, C2 and C3.		C0)
Nominal voltage [V DC]	24		—
Permissible voltage range [V DC]	−3 ... 30		—
Supply error $U_{60VFail}$ [V]	30 ... 60		—
Maximum input voltage high level U_{Hmax} [V]	30		—
Minimum input voltage high level U_{Hmin} [V]	11		—
Maximum input voltage low level U_{Lmax} [V]	5		—
Minimum input voltage low level U_{Lmin} [V]	−3		—
Maximum input current at high level I_{Hmax} [mA]	#SIN0-A/B ... #SIN3-B: 15 SIN4 and ERR-RST: 20		—
Minimum input current at high level I_{Hmin} [mA]	5		—
Maximum input current at low level I_{Lmax} [mA]	5.5		—
Maximum input current in the transition area I_{Tmax} [mA]	12		—
Minimum input current in the transition area I_{Tmin} [mA]	2		—
Input capacitance C_{in} [nF]	< 10		C_L
Input inductance L_n [H]	< 0		L_L

Control inputs #SIN0-A/B ... #SIN3-B, SIN4 and ERR-RST to [X1A]			ZVEI ⁽¹⁾
Parallel connection		For parallel connection of several inputs, the digital output of the safety relay unit must be able to supply at least the maximum input current I _{Hmax} of an input multiplied by the number of connected devices.	–
Test pulses			
Test pulse length	[ms]	Parameterisable	t _i
Test pulse interval	[s]	≥ 0.1	T
Input resistance R	[ohm]	≥ 950	R
Timing		Test pulses from two-channel inputs must never occur simultaneously or overlap.	

1) Information according to ZVEI position paper CB24I

Tab. 134: Control inputs #SIN0-A/B ... #SIN3-B and SIN4 on and ERR-RST [X1A]

Diagnostic outputs SOUT0 ... SOUT3 to [X1A]			ZVEI ¹⁾
Design	Unbalanced push-pull outputs PM-switching, single-pole output (low-dominant)		–
	Outputs type C, class 0, compatible with sinks of type: C0 C1 C2 according to ZVEI position paper CB24I.		C0)
Voltage range	[V DC]	18 ... 30	–
Permissible output current at high level $I_{H,Nenn}$	[mA]	15	Nominal current I_N
Voltage loss at high level $I_{H,Nenn}$	[V]	< 3	–
Permissible output current at low-level ²⁾ $I_{L,Nom}$	[mA]	< -400	–
Voltage loss at $I_{L,nom}$	[V]	< 1.5	–
Permissible output current with logic supply switched off I_{out} (maximum)	[mA]	$-1.0 \dots +1.0$	
Pulldown resistor $R_{pulldown}$	[kΩ]	< 50 (ca. 0.6 mA at 24 V)	–
Short circuit/overcurrent protection	Short circuit-proof, feedback-proof, overvoltage-resistant up to 60 V		–
Temperature protection	Not provided because diagnostic output		–
Feed-in strength $I_{L,FB}$	[mA]	< -400	–
Switching delay from control gate	[ms]	< 1	–
Loads			
Resistive load (minimum)	[kΩ]	1.2	–
Inductive load	[μH]	< 10	L_L
Capacitive load ³⁾	[nF]	< 10	C_L
Test pulses ⁴⁾			
Test pulse length	[μs]	parameterisable	t_i
Test pulse interval	[ms]	30000	T

Diagnostic outputs SOUT0 ... SOUT3 to [X1A]		ZVEI ¹⁾
Diagnostics in status 1	Diagnosable error type	
Cyclic test pulse through dynamic change of the output signals to detect internal errors of the servo drive.	Short circuit from SOUT to 24V Note: no detection of cross-circuits between the SOUT diagnostic outputs. Due to the push-pull topology and the low-dominant response of the output, detection of cross-circuits between the SOUT diagnostic outputs is not possible.	
Diagnostics in status 0	Diagnosable error type	
Temporal and logical monitoring of the output signal with reference to the control signal of the internal logic.	Short circuit from SOUT to 24 V	

1) Information according to ZVEI position paper CB24I

2) Current flows from outside via the internal low-side switch to 0 V reference potential of 24 V supply

3) Requires connection of the output to a Type 3 input

4) The output is subjected to low test pulses by the safety module when switched on (1-state). The length of the low test pulses can be parameterised. In the off state (0 state) testing with high test pulses is not performed.

Tab. 135: Diagnostic outputs SOUT0 ... SOUT3 to [X1A]

CMMT-AS-...-S1

Control inputs #STO-A and #STO-B at [X1A]		
Specification		Based on type 3 in accordance with EN 61131-2; deviating current consumption
Nominal voltage	[V DC]	24
Permissible voltage range ¹⁾	[V DC]	−3 ... 30
Maximum input voltage high level U _{Hmax}	[V]	28.8
Minimum input voltage high level U _{Hmin}	[V]	17
Maximum input voltage low level U _{Lmax}	[V]	5
Minimum input voltage low level U _{Lmin}	[V]	−3
Maximum input current at high level I _{Hmax}	[mA]	75
Minimum input current at high level I _{Hmin}	[mA]	50
Maximum input current at low level I _{Lmax}	[mA]	75
Minimum input current in the transition area I _{Tmin}	[mA]	1.5
Tolerance for low test pulses		
Tolerated low test pulses t _{STO,TP} up to max.	[ms]	1
Minimum time between low test pulses at U _{H min} < U _{STO-A/B} ≤ 20 V	[ms]	200
Minimum time between low test pulses at U _{STO-A/B} > 20 V	[ms]	100

Control inputs #STO-A and #STO-B at [X1A]	
Tolerance for high test pulses ²⁾	
Tolerated highest pulses $t_{STO,TP}$ [ms] up to maximum	1
Minimum time between the high [ms] test pulses at $U_{STO-A/B} < U_{Lmax}$	200

1) Each channel has a separate overvoltage monitor for the power supply at the input. If the voltage at the input exceeds the permissible maximum value, the channel is shut down.

2) High test pulses must never occur simultaneously at inputs #STO-A and #STO-B, but only with a time offset.

Tab. 136: Control inputs #STO-A and #STO-B at [X1A]

Control inputs #SBC-A and #SBC-B at [X1A]	
Specification	Based on type 3 in accordance with EN 61131-2
Nominal voltage [V DC]	24
Permissible voltage range [V DC]	-3 ... 30
Maximum input voltage high level U_{Hmax} [V]	30
Minimum input voltage high level U_{Hmin} [V]	13
Maximum input voltage low level U_{Lmax} [V]	5
Minimum input voltage low level U_{Lmin} [V]	-3
Maximum input current at high level I_{Hmax} [mA]	15
Minimum input current at high level I_{Hmin} [mA]	5
Maximum input current at low level I_{Lmax} [mA]	15
Minimum input current in the transition area I_{Tmin} [mA]	1.5
Tolerance for low test pulses	
Tolerated low test pulses $t_{SBC,TP}$ [ms] up to max.	1
Minimum time between low test pulses at $U_{Hmin} < U_{SBC-A/B} \leq 20 V$ [ms]	200
Minimum time between the low test pulses at $U_{SBC-A/B} > 20 V$ [ms]	100
Tolerance for high test pulses ¹⁾	
Tolerated highest pulses $t_{SBC,TP}$ [ms] up to maximum	1
Minimum time between the high test pulses at $U_{STO-A/B} < U_{Lmax}$ [ms]	200

1) High test pulses must not occur simultaneously at inputs #SBC-A and #SBC-B but only with a time offset.

Tab. 137: Control inputs #SBC-A and #SBC-B at [X1A]

Diagnostic outputs STA and SBA at [X1A]	
Design	Asymmetrical push-pull output
Voltage range [V DC]	18 ... 30

Diagnostic outputs STA and SBA at [X1A]		
Permissible output current at high level	[mA]	15
Voltage loss at high level	[V]	< 3
Permissible output current at low-level ¹⁾	[mA]	< -400
Voltage loss at low-level	[V]	< 1.5
Pull down resistor	[kΩ]	< 50
Protective function		– Short-circuit proof – Feedback-proof – Overvoltage-proof up to 60 V
Loads		
Resistive load (minimum)	[kΩ]	1.2
Inductive load	[μH]	< 10
Capacitive load ²⁾	[nF]	< 10
Test pulses		
Test pulses at outputs		None (for time-offset test pulses on the associated A/B control inputs)

1) Current flows from outside via the internal low-side switch to 0 V reference potential of 24 V supply

2) Requires connection of the output to a Type 3 input

Tab. 138: Diagnostic outputs STA and SBA at [X1A]

CMMT-AS-...-S1/S3

Digital inputs at [X1A] without safety inputs		
Specification		Based on type 3 in accordance with EN 61131-2; deviating current consumption
Nominal voltage	[V DC]	24
Permissible voltage range	[V DC]	-3 ... 30
Maximum input voltage high level $U_{H \max}$	[V]	30
Minimum input voltage high level $U_{H \min}$	[V]	13
Maximum input voltage low level $U_{L \max}$	[V]	5
Minimum input voltage low level $U_{L \min}$	[V]	-3
Maximum input current at high level $I_{H \max}$	[mA]	15
Minimum input current at high level $I_{H \min}$	[mA]	5
Maximum input current at low level $I_{L \max}$	[mA]	15
Minimum input current in transition range $I_{T \min}$	[mA]	1.5
Data for inputs CAP0, CAP1		
Delay time in the hardware	[μs]	< 2
Minimum permissible pulse length (high or low)	[μs]	10
Time resolution/accuracy (high or low)	[μs]	< 1
Tolerance for low test pulses		no

Digital inputs at [X1A] without safety inputs		
Data for remaining inputs		
Delay time in the hardware	[μs]	< 200
Minimum permissible pulse length (high or low)	[μs]	1000
Tolerance for low test pulses	[ms]	1
Minimum period length between test pulses	[ms]	100

Tab. 139: Digital inputs at [X1A] without safety inputs

Digital trigger outputs TRG0 and TRG1 at [X1A]		
Design		High-side switch without test pulse monitoring
Voltage range	[V DC]	18 ... 30
Permissible output current at high level	[mA]	20
Protective function		– short-circuit proof – feedback-proof to 30 V – Automatic switch-off in event of over-temperature (> 150 °C)
Loads		
Resistive load (minimum)	[kΩ]	1.2
Inductive load	[μH]	< 10
Capacitive load ¹⁾	[nF]	< 10

1) Requires connection of the output to a Type 3 input

Tab. 140: Digital trigger outputs TRG0 and TRG1 at [X1A]

Ready contact at [X1A]		
Design		N/O contact (electronic) The N/O contact is not fully isolated from the logic supply. The CMMT-AS can check the function of the contact via a diagnostic pickoff.
Voltage range	[V DC]	18 ... 30
Permissible output current with contact closed	[mA]	50
Permissible leakage current with contact open	[μA]	< 100
Pull down resistor	[kΩ]	Approx. 50
Short-circuit protection		Not short-circuit proof
Overvoltage strength	[V]	Up to max. 60
Loads (X1A.24 connected to 24 V logic voltage supply; load between X1A.23 and GND24)		
Resistive load (minimum)	[Ω]	600
Inductive load	[μH]	< 10
Capacitive load ¹⁾	[nF]	< 10
Switching delay from control gate	[ms]	< 5

1) Requires connection of the output to a Type 3 input

Tab. 141: Ready contact at [X1A]

Analogue input AIN0 at [X1A]		
Design		Differential analogue input, signal pair AIN0/#AIN0 with reference to GND
Measuring range	[V DC]	–10 ... +10

Analogue input AIN0 at [X1A]		
Gain error	[%]	± 1
Offset error	[mV]	± 50
Resolution	[Bit]	12
Input bandwidth	[kHz]	2
Input impedance	[kΩ]	Approx. 70
In-phase suppression	[dB]	Approx. 40 (in in-phase voltage range ± 12 V to GND)
Input capacitance	[nF]	Typically 1 (for 1 kΩ)
Permissible voltage range	[V DC]	–30 ... 30

Tab. 142: Analogue input AIN0 at [X1A]

10.2.8 Inputs and outputs for the axis [X1C]

Inputs LIM0, LIM1 at [X1C]		
Specification		Based on type 3 in accordance with EN 61131-2; deviating current consumption
Nominal voltage	[V]	24
Permissible voltage range	[V]	–3 ... 30
Maximum input voltage high level ($U_{H\ max}$)	[V]	30
Minimum input voltage high level ($U_{H\ min}$)	[V]	13
Maximum input voltage low level ($U_{L\ max}$)	[V]	5
Minimum input voltage low level ($U_{L\ min}$)	[V]	–3
Maximum input current at high level ($I_{H\ max}$)	[mA]	15
Minimum input current at high level ($I_{H\ min}$)	[mA]	5
Maximum input current at low level ($I_{L\ max}$)	[mA]	15
Minimum input current in transition range ($I_{T\ min}$)	[mA]	1.5
Delay time in the hardware	[μs]	< 200
Minimum permissible pulse length (high or low)	[μs]	1000
Tolerance for low test pulses	[ms]	1.5
Minimum permissible pulse length (high or low)	[μs]	1000
Minimum period length between test pulses	[ms]	100

Tab. 143: Inputs LIM0, LIM1

CMMT-AS-...-S3

Output BR-EXT at [X1C]		
Design		High-side switch, PP switching Each P-switch is controlled independently by different safety channels
Voltage range $U_{H,Nom}$	[V DC]	18 ... 30
Rated current at high level $I_{H,Nom}$	[mA]	100
Current range for 1-signal	[mA]	≤ 120, continuously at maximum voltage
Temporary overload	[mA]	≤ 0.2 for maximum 50 ms at cycle time 1 s

Output BR-EXT at [X1C]		
Voltage drop at high level	[V]	≤ 3
Leakage current at low level	[mA]	≤ 0.1, flowing through the connected load
Pull down resistor	[kΩ]	≤ 50
Load resistance	[kΩ]	≤ 15
Load capacity	[nF]	≤ 10 If necessary, adjust the test pulse duration and the readback time of test pulses to the load current and the capacity of the load.
Load inductivity	[mH]	≤ 100
Shutdown time	[ms]	≤ 1, at maximum capacitive load
Test pulse duration t_{TP-Low}	[μs]	Parameterisable, low or dark test pulses
Test pulse duration $t_{TP-High}$	[μs]	Maximum 125 high or bright test pulses due to internal testing
Test pulse interval	[ms]	Minimum 500, maximum 29500, alternating interval
Protective function		– Short-circuit proof – Feedback-proof – Overvoltage-proof up to 60 V – Thermal overload protection
Error detection		Voltage at output despite brake having shut down Diagnostics possible via: – Diagnostic output for safety sub-function SBC – Error message on device
Diagnostics in status 1		Diagnosable error type
Cyclic test pulse by dynamic change of the output signals		Short circuit from BR-EXT to 24 V
Time and logic monitoring of the output signal with reference to the control signal of the internal logic		Short circuit from BR-EXT to 0 V
Diagnostics in status 0		Diagnosable error type
Time and logic monitoring of the output signal with reference to the control signal of the internal logic		Short circuit from BR-EXT to 24 V
Monitoring the time spent in the switched-off state		Multiple errors

Tab. 144: Output BR-EXT

The second brake/external clamping unit output BR-EXT is compatible with Festo pneumatic exhaust valves VUVG with an operating voltage of 24 V DC.

CMMT-AS-...-S1

Output BR-EXT at [X1C]		
Design		High-Side-Switch
Voltage range	[V DC]	18 ... 30
Permissible output current at high level	[mA]	100
Voltage loss at high level	[V]	< 3
Pull down resistor	[kΩ]	< 50
Test pulses		The test pulses of the associated control input #SBC-B are mapped to BR-EXT subject to a switching delay.
Minimum time between test pulses	[ms]	100

Output BR-EXT at [X1C]		
Protective function		– Short-circuit proof – Feedback-proof – Overvoltage-proof up to 60 V – Thermal overload protection
Error detection		Voltage at output despite brake having shut down Diagnostics possible via: – Diagnostic output for safety sub-function SBC – Error message on device
Loads		
Minimum resistive load	[Ω]	240
Inductive load	[mH]	< 100
Capacitive load	[nF]	< 10

Tab. 145: Output BR-EXT

Power supply for external devices at [X1C] (X1C.4 and X1C.9)		
Output voltage	[V DC]	+24 ± 20 %
Maximum output current	[mA]	100
Protective function		– Polarity reversal – Short circuit to 0 V – Feedback-proof

Tab. 146: Power supply at [X1C]

10.2.9 SYNC IN/OUT [X10]

The individual signal lines are differentially terminated with a terminating resistance. The terminating resistance is:

- For low frequencies (DC instance) approx. 700 Ω
- For high frequencies (AC instance) approx. 120 Ω

Encoder emulation/incremental encoder output [X10]		
No. of output marks	[strokes/rev]	CMMT-AS-...-MP: 1 ... 65535 CMMT-AS-...-EC/-PN/-EP: 1 ... 16383
Angular resolution/interpolation		4x evaluation as 4 steps (2 bits) per period
Tracking signals A/B	[MHz]	RS422/485; max.1
Tracking signals Z	[kHz]	RS422/485; valid up to a max. output frequency A/B of 100; Z signal can be shut down
Output impedance A/B/N $R_{a,diff}$	[Ω]	Differential 120
Permissible load on output		FAN-OUT = 16 (16 inputs on other CMMT-AS)
Critical frequency A/B/N	[MHz]	4 (FAN-OUT = 1); 0,1 (FAN-OUT = 16)

Tab. 147: Encoder emulation/incremental encoder output [X10]

Incremental encoder/counter input [X10]		
Tracking signals A/B/Z	[MHz]	RS422/485; max. 1
No. of input marks	[strokes/rev]	CMMT-AS-...-MP: 1..262144 CMMT-AS-...-EC/-PN/-EP: 1..16383
Angular resolution/interpolation		4x evaluation as 4 steps (2 bits) per period
Input impedance A/B/N $R_{e,diff}$	[Ω]	Differential 120 in series with 120 pF high-frequency signal termination, additionally 700 parallel, low-frequency signal termination

Tab. 148: Incremental encoder/counter input [X10]



Functions of [X10] supported by the firmware version → Manual/online help plug-in, software, function, fieldbus, device profile.

10.2.10 Standard Ethernet [X18], parameterisation interface

Standard Ethernet [X18], parameterisation interface	
Design	in accordance with IEEE 802.3:2012-00 ¹⁾
Connection design	RJ45
Transmission rate [Mbps]	10/100 (full/half duplex)
Supported protocols	TCP/IP
IP address set at factory (pre-setting)	192.168.0.1

1) Restriction: the interface is galvanically isolated and intended for use with limited cable lengths. Deviating from IEEE 802.3, the isolation coordination is implemented in accordance with the valid product standard IEC 61800-5-1: DVC A, system voltage ≤ 50 V.

Tab. 149: Standard Ethernet [X18]

10.2.11 Real-time Ethernet [X19] ([XF1 IN], [XF2 OUT])

Real-time Ethernet [X19] ([XF1 IN], [XF1 OUT])				
Design	RTE communication, physical level in accordance with IEEE 802.3: 2012-00 ¹⁾			
Bus connection design [XF1 IN]	RJ45			
Bus connection design [XF2 OUT]	RJ45			
Max. transmission rate [Mbps]	100			
Communication profiles				
CMMT-AS-	EC	EP	PN	MP
EtherCAT protocol	x	–	–	x
– CiA 402	x	–	–	x
– CoE (CANopen over EtherCAT)	x	–	–	x
– EoE (Ethernet over EtherCAT)	x	–	–	x
– FoE (File Access over EtherCAT)	x	–	–	x
EtherNet/IP protocol	–	x	–	x
– DriveProfile	–	x	–	x
– Implicit Messaging	–	x	–	x
– Explicit Messaging	–	x	–	x
PROFINET protocol	–	–	x	x
– PROFIdrive	–	–	x	x
– PROFINET RT	–	–	x	x
– PROFINET IRT	–	–	x	x

1) Restriction: the interface is galvanically isolated and intended for use with limited cable lengths.

Tab. 150: Real-time Ethernet [X19]

10.3 Technical data of UL/CSA certification

In combination with the UL inspection mark on the product, the information in this section must also be observed in order to comply with the certification conditions of Underwriters Laboratories Inc. (UL) for USA and Canada.

UL/CSA certification information	
Product category code	NMMS / NMMS7 (Power Conversion Equipment)
File number	E331130_Vol-1_Sec-3

UL/CSA certification information	
Considered standards	UL61800-5-1 Adjustable Speed Electrical Power Drive Systems CSA C22.2 No. 274-17 – Adjustable Speed Drive
UL mark	
UL control number	4PU8

Tab. 151: UL/CSA certification information

- Use in an environment with pollution degree 2 (or better).
- Use only Cu cables that have a permissible constant insulation temperature of at least 75 °C at the following connections:
 - [X6A], motor connection
 - [X9A], power supply and DC link circuit connection
 - [X9B], connection for braking resistor
 - [X9C], logic voltage supply
- Operate the CMMT-AS-C25-11A-P3 with a maximum nominal motor current of 24 A_{RMS}.
- The CMMT-AS-C2/C3/C5-11A-P3 is suitable for the following power supply networks:
 - Type WYE 480 V/277 V with a short circuit current rating of SCCR 10 kA
 - Type WYE 400 V/230 V with a short circuit current rating of SCCR 100 kA
 For operation in type WYE 480 V/277 V power supply networks with SCCR > 10 kA → Fig. 30
- The CMMT-AS-C7/C12/C18/C25-11A-P3 is suitable for the following power supply networks:
 - Type WYE 480 V/277 V with a short circuit current rating of SCCR 10 kA
 For operation in type WYE 480 V/277 V power supply networks with SCCR > 10 kA → Fig. 30
- Permissible and impermissible mains types of system earthing:
 - According to the UL standard, the TT system with separate neutral conductor and PE conductor is not permitted in the overall system.
- UL: The integrated semiconductor short-circuit protection does not protect the downstream power circuit. The power circuit must be protected in conformity with the National Electrical Code and all other local regulations.
CSA: The integrated semiconductor short-circuit protection does not protect the downstream power circuit. The power circuit must be protected in conformity with the Canadian Electrical Code, part I.

Requirements for circuit breakers (automatic circuit breakers) and fuses			
Overcurrent protective device		Circuit breaker	Class J Fuse only CMMT-AS-C2/C3/C5-11A-P3
Max. approved rated current	[A]	30	25
Short circuit current rating SCCR of mains fuse	[kA]	min. 10	min. 100
Rated voltage	[V AC]	480	600

Tab. 152: Requirements for circuit breakers and fuses

Line protection requirements		
Description	Cable cross section at [X9A]	Mains fuse [A] ¹⁾
	[mm²]	
Minimum fuse protection	1.5	CMMT-AS-C2/C3/C5/C7/C12/C18/C25-11A-P3: 6 CMMT-AS-C7/C12/C18/C25-11A-P3: 15
Maximum fuse protection of an individual device or a device compound		
Without heat-resistant line	4	20
	6	30

1) Specifications according to UL 61800-5-1:2012; for cUL, only use Cu cables that have a permissible constant insulation temperature of at least 75°C.

Tab. 153: Line protection requirements

Electrical data, load voltage supply [X9A]	
CMMT-AS-	C2/C3/C5/C7/C12/C18/C25-11A-P3...
Network connection/allowed mains types of system earthing ¹⁾	L1 → L2 → L3: TN, IT

1) In accordance with UL 61800-5-1

Tab. 154: Load voltage supply

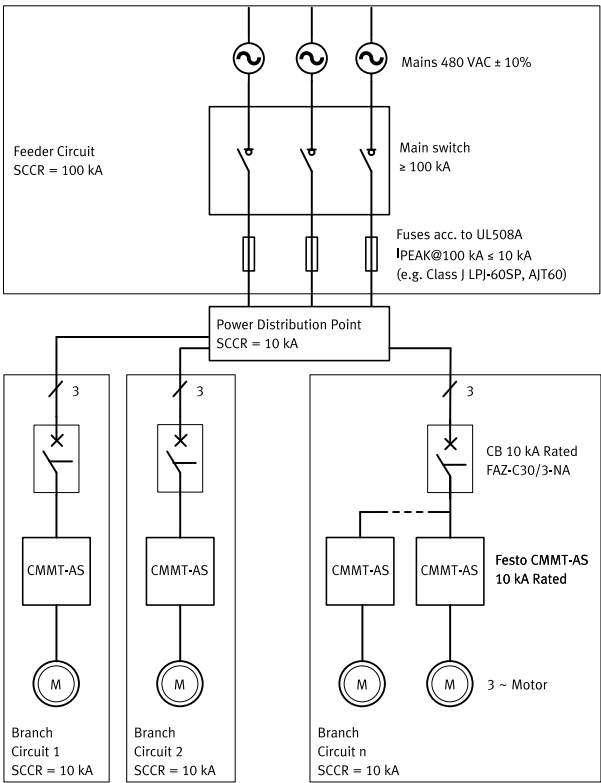


Fig. 30: Required circuitry for device variants with supply networks with SCCR >10 kA and nominal voltage >400 V AC

10.4 Operation of the servo drive in the system

10.4.1 Cable lengths in combination with Festo motors

The permissible motor cable length depends on the combination of components in use and their properties, e.g. from:

- Emitted interference and immunity to interference (EMC aspects) → 10.4.1.1 Motor cable lengths with Festo motors
- Voltage for releasing the holding brake in the motor → 10.4.1.2 Holding brake voltage drop
- Voltage drop in the motor cable → 10.4.1.3 Voltage drop in the motor cable

All aspects must be taken into account. The resulting shortest cable length is the permissible cable length of the drive system.

10.4.1.1 Motor cable lengths with Festo motors

With reference to EMC aspects, the following maximum motor cable lengths are permissible for an individual device in combination with Festo motors:

CMMT-AS...	PWM [kHz]	required measures	Max. permissible motor cable length [m]		
			EMMT-AS	EMME-AS	EMMS-AS
Category C2: operation in the first environment (residential area)					
-C2-11A-P3	8	Line choke	10	10	10
-C3-11A-P3 -C5-11A-P3	8	– (none)	10	10	10
-C7-11A-P3 -C12-11A-P3	8	– (none)	10	10	10
-C18-11A-P3 -C25-11A-P3	8	External mains filter and line choke	10	10	10
Category C3: operation in the second environment (industrial area)					
-C2-11A-P3 -C3-11A-P3 -C5-11A-P3	8	– (none)	50	25	50
		External mains filter	100		100
-C7-11A-P3 -C12-11A-P3	8	– (none)	25	25	25
		External mains filter	100		100
-C18-11A-P3 -C25-11A-P3	8	– (none)	50	25	50
		External mains filter	100	25	100

Tab. 155: Maximum motor cable lengths in combination with Festo motors

- Observe the requirements for the motor cable → 7.9.1 [X6A], motor phase connection.

Required measures

→ 7.6 Information on EMC-compliant installation

Measures for the device compound

If the devices are used in a device compound with coupled mains supply and DC link coupling, the following applies:

- The internal mains filter is sufficient for compliance with category C3 with cable lengths up to 25 m per servo drive.
- An external mains filter is always required to comply with category C3 with cables longer than 25 m.

10.4.1.2 Holding brake voltage drop

The voltage drop on the cables to the holding brake can result in a holding brake in the motor not being able to open reliably. Festo recommends calculating the resulting input voltage for the holding brake.

Increasing the logic voltage supply from 24 V to a maximum of 24 V + 20% enables the use of longer cables.

Formula for calculating the input voltage for the holding brake in the motor U_{HB}

Input voltage for the holding brake U_{HB}	
$U_{HB} = \frac{U_{LS}}{\frac{U_{BR,drop}}{I_{BR,max}} + 2 \cdot \frac{\rho_{cu} \cdot L}{A} + \frac{U_{HB,rated}^2}{P_{HB,rated}}} \cdot \frac{U_{HB,rated}^2}{P_{HB,rated}}$	
Technical data for servo drive	
U_{LS}	minimum input voltage at the logic supply of the servo drive
$U_{BR,drop}$	maximum voltage drop from the logic supply to the output for the holding brake
$I_{BR,max}$	maximum output current of the servo drive at the output for the holding brake
Motor cable technical data	
ρ_{cu}	Specific resistance of copper (warm cable)
L	Cable length
A	Cross section of the cable for the holding brake
Motor technical data	
$U_{HB,rated}$	Nominal voltage of the holding brake
$P_{HB,rated}$	Nominal power of the holding brake in the motor

Tab. 156: Calculation formula for determining the input voltage for the holding brake

The calculated voltage U_{HB} must be greater than the minimum permissible voltage of the holding brake $U_{HB,min}$.

Example

The following example shows the calculation of the input voltage for the holding brake for a drive system consisting of servo drive CMMT-AS-C5-11A-..., servo motor EMMT-AS-100-L-HS-RMB and motor cable NEBM-M23G15-EH -...- Q10N-R3LEG14 with the following values:

- $U_{LS} = 22.8$ V; application-dependent, permissible range → Table 118
- $U_{BR,drop} = 1.0$ V; see technical data for servo drive → Table 126
- $I_{BR,max} = 1.5$ A; see technical data for servo drive → Table 126
- ρ_{cu} (warm cable) = $0.021 \Omega \text{ mm}^2/\text{m}$
- $L = 32$ m; application-dependent, required length
- $A = 1.0 \text{ mm}^2$; see motor cable
- $U_{HB,rated} = 24$ V; see technical data for motor
- $P_{HB,rated} = 24$ W; see technical data for motor
- $U_{HB,min} = 21.6$ V; see technical data of motor (24 V -10%)

$$U_{HB} = \frac{22.8 \text{ V}}{\frac{1.0 \text{ V}}{1.5 \text{ A}} + 2 \cdot \frac{0.021 \Omega \text{ mm}^2/\text{m} \cdot 32 \text{ m}}{1.0 \text{ mm}^2} + \frac{(24 \text{ V})^2}{24 \text{ W}}} \cdot \frac{(24 \text{ V})^2}{24 \text{ W}} = 21.0 \text{ V}$$

The calculated voltage U_{HB} is less than the minimum permissible voltage $U_{HB,min}$. The required minimum voltage is no longer reached. In the example, the required cable length could be achieved by increasing the logic supply voltage from 22.8 V to 24 V.

To calculate the maximum possible cable length L for the correct control of the holding brake, the above formula can be changed as follows:

$$L = \frac{A}{2\rho_{cu}} \left(\frac{U_{LS}}{U_{HB,min}} \cdot \frac{U_{HB,rated}^2}{P_{HB,rated}} - \frac{U_{BR,drop}}{I_{BR,max}} - \frac{U_{HB,rated}^2}{P_{HB,rated}} \right)$$

10.4.1.3 Voltage drop in the motor cable

The length of the motor cable has an influence on the attainable output voltage on the motor side under load conditions. Excessively large voltage drops reduce the maximum achievable rotational speed of the drive system.

The maximum voltage drop on the phases of the motor cable should not exceed the following values in applications at maximum current:

Servo drive	recommended maximum voltage drop
CMMT-AS-C2/C3/C5/C7/C12-11A-P3 (3-phase devices)	36 V

Tab. 157: Maximum voltage drop on the motor phases (recommendation)

Formula for calculating the voltage drop on the motor cable U_{ML}

Voltage drop in the motor cable U_{ML}	
$U_{ML} = I_{max} \cdot 2 \cdot \rho_{cu} \cdot \frac{L}{A}$	
I_{max}	maximum current in the application, e.g. current in the acceleration phase
ρ_{cu}	Specific resistance of copper (warm cable)
L	Cable length
A	Cross section of the cable (motor phases)

Tab. 158: Calculation formula for determining the voltage drop on the motor cable

Example

The following example shows the calculation of the voltage drop on the servo drive CMMT-AS-C5-11A-..., servo motor EMMT-AS-100-L-HS-RMB and motor cable NEBM-M23G15-EH-...-Q10N-R3LEG14 with the following values:

- $I_{max} = 12.0$ A; application-dependent
- ρ_{cu} (warm cable) = $0.021 \Omega \text{ mm}^2 / \text{m}$
- $L = 32$ m; application-dependent, required length
- $A = 2.5 \text{ mm}^2$; see power cable motor cable

$$U_{ML} = 12 \text{ A} \cdot 2 \cdot 0.021 \frac{\Omega \text{ mm}^2}{\text{m}} \cdot \frac{32 \text{ m}}{2.5 \text{ mm}^2} = 6.45 \text{ V}$$

The calculated voltage drop is less than the recommended limit value. The motor cable thus has a sufficient cable cross section.

To calculate the maximum possible cable length L based on the voltage drop on the motor cable, the above formula can be changed as follows:

$$L = \frac{U_{ML}}{I_{max}} \cdot \frac{A}{2\rho_{cu}}$$

10.4.2 Power loss

The power losses of the installed components must be taken into account when selecting a suitable control cabinet (thermal design).

The power loss of the servo drive consists of the following:

- Power loss of the logic part; it is independent of the load and the motion profile and can be regarded as constant
- Power dissipation of the power output stage; it is dependent on the load and the motion profile and the efficiency of the other components
- Power loss in the braking resistor

Formula for calculating the average power loss P_V

Mean power loss P_V	
$P_V = U_{LS,nominal} \cdot I_{LS,inactive} + P_{Mot,avr} \cdot \left(\frac{1}{\eta} - 1\right) + P_{Br,avr}$	
$U_{LS,nominal}$	Logic voltage supply at the servo drive

Mean power loss P_v	
$I_{LS,inactive}$	Current of the logic supply in the inactive status
$P_{Mot,avr}$	linear mean value of the electrical output power (average value)
η	Efficiency
$P_{Br,avr}$	Mean power loss in the braking resistor

Tab. 159: Calculation formula for determining the average power loss

If the linear average of the electrical output power is not available, the effective value of the power can also be used for the calculation (Root Mean Square of Power). This value can be determined using a suitable Festo design tool after entering the travel profile, e.g. with the PositioningDrives design tool, see dynamic data for the Motor.

This root mean square value is based on the calculation of a few support points of the positioning profile and should provide a sufficiently high value for the calculation.

Determination of the average power loss in the braking resistor

The average power loss of the braking resistor is also calculated by the Festo design tool. If a design tool is not available, the average power loss can also be estimated in a simplified manner:

Mean power loss $P_{Br,avg}$	
$P_{Br,avr} \leq \eta_{system} \cdot \frac{1}{t_{cycle}} \cdot \sum (W_{kin} + W_{pot})$	
$P_{Br,avg}$	Mean power loss in the braking resistor
η_{system}	Assumed overall efficiency for servo drive, motor and mechanical components. Typical values for toothed belt axes as a function of the average drive power: – 500 W: approx. 70% – 2000 W: approx. 80% – > 2000 W: ca. 85 % The values are lower for ball screw axes.
t_{cycle}	Cycle time of the movement process
W_{kin}	Kinetic energy of the system $W_{kin} = \frac{1}{2}mv^2$
W_{pot}	Potential energy in the system, e.g. Z-axis $W_{pot} = m \cdot g \cdot h$

Tab. 160: Calculation formula for determining the average power loss in the braking resistor

In doing so, the total moving mass, including slides and moving system parts, must be assumed for the mass m . All kinetic and potential energies that lead to recuperation must be added up within the movement cycle.

Example

The following example shows the calculation of the average power loss for a drive system consisting of servo drive CMMT-AS-C5-11A-..., servo motor EMMT-AS-100-L-HS-RMB and motor cable M23G15-EH...-Q10N-R3LEG14 without taking into account the power loss of the braking resistor with the following values:

- $U_{LS,nominal} = 24 \text{ V}$; see technical data for servo drive → Table118
- $I_{LS,inactive} = 0.5 \text{ A}$; see technical data for servo drive → Table118
- $P_{Mot,avr} = 370 \text{ W}$; application-dependent
- $\eta = 94\%$; simplifying assumption, efficiency depends on the current operating point
- $P_{Br,avr} = 10 \text{ W}$

$$P_v = 24 \text{ V} \cdot 0,5 \text{ A} + 370 \text{ W} \cdot \left(\frac{1}{0,94} - 1 \right) + 10 \text{ W}$$

$$P_v = 12 \text{ W} + 23,6 \text{ W} + 10 \text{ W} \approx 46 \text{ W}$$



The power loss of the braking resistor only has to be taken into account if the power dissipation in the control cabinet is effective. An external braking resistor only has to be taken into account if it is mounted in the control cabinet.

Festo SE & Co. KG

Ruiter Straße 82
73734 Esslingen
Germany

Phone: +49 711 347-0
www.festo.com