

# CMMP-AS-...-M0

## Motor controller



**FESTO**

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8219373

Brief instruction | Safety function, STO  
8219373  
2024-07c  
[8219375]

Original instructions

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### 1 Applicable documents

All available documents for the product ➔ [www.festo.com/sp](http://www.festo.com/sp).

This documentation refers to the following versions:

- Motor controller CMMP-AS-...-M0, firmware from version 4.0.1501.2.

Specified standards/directives	
EN 61800-5-1:2007 + A1:2017	EN 62061:2005 + AC:2010 + A1:2013 + A2:2015
EN 61800-5-2:2017	EN ISO 13849-1:2015
EN 60204-1:2006+A1:2009+AC:2010	IEC 61508-1/.../-7:2010

Tab. 1

### 2 Safety

#### 2.1 General safety instructions

- Also always observe the general safety regulations for the motor controller CMMP-AS-...-M0.
- The general safety regulations for the CMMP-AS-...-M0 can be found in the hardware documentation GDGP-CMMP-M0-HW-....

#### NOTICE

**Loss of the safety function!**

The safety functions might fail if you do not comply with the parameters required for the surroundings and connections.

- Observe the specified environmental and connection conditions, in particular the input voltage tolerances ➔ 13 Technical data.

#### NOTICE

**Damage to the motor controller due to incorrect handling.**

Incorrect handling may cause damage.

- Switch off the power supply before mounting and installation work. Do not switch on the supply voltages until mounting and installation work is completely finished.
- Observe the handling specifications for electrostatically sensitive devices.

#### 2.2 Intended use

The motor controller CMMP-AS-...-M0 supports the following safety function:

- Safe Torque Off (STO) with SIL 3 in accordance with EN 61800-5-2/EN 62061/IEC 61508 and/or category 4/PL e in accordance with EN ISO 13849-1.

The motor controller CMMP-AS-...-M0 is intended for installation in machines or automation systems and to be used as follows:

- in excellent technical condition,
- in its original condition, without unauthorised modifications,
- within the limits of the product defined by the technical data ➔ 13 Technical data,
- in an industrial environment.

#### NOTICE

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

### 2.3 Foreseeable misuse

The following examples of foreseeable misuse are among those not approved as intended use:

- use outdoors,
- use in non-industrial areas (residential areas),
- use in applications where switching off can result in hazardous movements or conditions.

#### NOTICE

- The STO function must not be used as the sole safety function for drives subject to permanent torque (e.g. suspended loads).
- Safety devices must not be bypassed.
- Repairs on the module are prohibited!

The STO (Safe Torque Off) function does not provide protection from electric shock, only from hazardous movements!

➔ Hardware documentation, GDGP-CMMP-M0-HW-...

#### 2.4 Achievable safety level, safety function in accordance with EN ISO 13849-1/EN 61800-5-2

The motor controller CMMP-AS-...-M0 with integrated STO safety function fulfils the requirements for

- Category 4/PL e in accordance with EN ISO 13849-1,
- SIL CL 3 in accordance with EN 62061,

and can be used in applications up to cat. 4/PL e in accordance with EN ISO 13849-1 and SIL 3 in accordance with EN 61800-5-2/EN 62061/IEC 61508.

The achievable safety level depends on the other components used to implement a safety function.

### 3 Requirements for product use

- Make this documentation available to the design engineer, installer and personnel responsible for commissioning the machine or system in which this product is used.
- Make sure that the specifications in the documentation are observed at all times. When so doing, also take into account the documentation for the other components and modules (e.g. motor controller, cables etc.).
- Take into account the legal regulations applicable for the location as well as:
  - instructions and standards,
  - regulations of testing organisations and insurers,
  - national specifications.
- If the safety function is required, protection against automatic restart in accordance with the required category must be installed. For example, an external safety relay unit can be used.

#### 3.1 Technical prerequisites

General information on correct and safe use of the product, which must be observed at all times:

- Observe the connection and ambient conditions of the motor controller (➔ 13 Technical data) and all connected components as specified in the technical data.  
Only compliance with the limit values and/or load limits will enable operation of the product in accordance with the relevant safety directives.
- Observe the notes and warnings in this documentation.

#### 3.2 Qualification of the specialist technicians (requirements for staff)

The device may only be set into operation by a qualified electrical technician who is familiar with:

- the installation and operation of electrical control systems,
- the applicable instructions for operating safety engineering systems,
- the applicable instructions for accident prevention and occupational safety and
- the documentation for the product.

#### 3.3 Diagnostic coverage (DC)

Diagnostic coverage depends on the integration of the motor controller into the control loop system as well as the implemented diagnostics measures ➔ 10 Diagnostics and fault clearance.

If a potentially dangerous malfunction is recognised during diagnostics, appropriate measures must be taken to maintain the safety level.

#### NOTICE



Check whether detection of shorts across contacts of the input circuit and the connection wiring is required in your application.

If necessary, use a safety relay unit with detection of shorts across contacts to control the safety function.

#### 3.4 Range of application and approvals

The motor controller with integrated safety function is a safety-related part of controllers. For details of the safety-oriented standards and test values that the product complies with and fulfils, see ➔ 13 Technical data.

The product-relevant directives are listed in the declaration of conformity ➔ [www.festo.com/sp](http://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. 2: Product conformity

4 Product overview

The motor controller CMMP-AS-...-M0 has a digital I/O interface [X40] for control of the STO safety function.

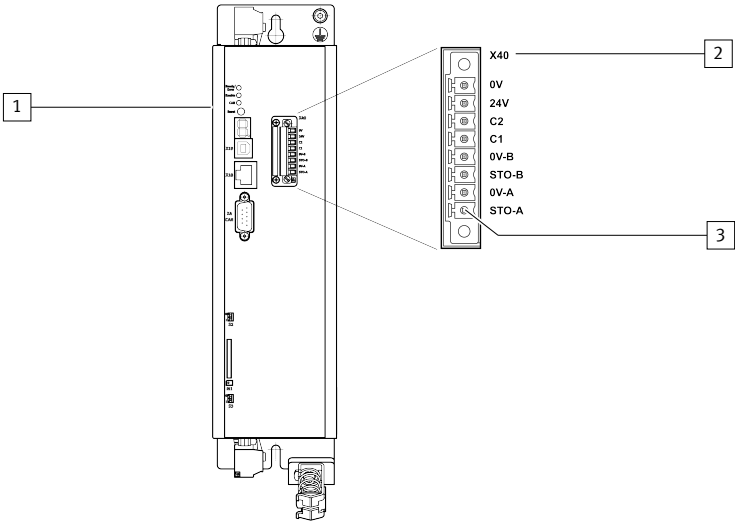


Fig. 1: Motor controller CMMP-AS-...-M0

- 1
- Motor controller CMMP-AS-...-M0
- 2
- Digital I/O interface [X40] for control of the STO function
- 3
- Pin 1 of the interface [X40]

5 Function and application

The motor controller CMMP-AS-...-M0 has the following safety-related performance feature.

- Achieving the “Safe Torque Off” (STO) function,
- Potential-free feedback contact.

5.1 Description of the safety function

The power supply to the drive is safely disconnected when the STO “Safe Torque Off” safety function is active. The drive cannot generate torque and so cannot perform any dangerous movements. The standstill position is not monitored. The machine must be brought to a standstill in a safe manner, e.g. with a safety relay unit.

NOTICE

There is a danger that the drive will advance if there are multiple errors in the CMMP-AS-...-M0.

If the power stage of the motor controller fails during the STO state (simultaneous short circuit of 2 power semiconductors in different phases), this can result in a limited detent movement of the rotor. The rotation angle/travel corresponds to one pole pitch. Examples:

- rotary axis, synchronous machine, 8-pole → movement < 45° at the motor shaft.
- linear motor, pole pitch 20 mm → movement < 20 mm at the moving part.

5.2 Control inputs STO-A, 0V-A/STO-B, 0V-B [X40]

The STO safety function is requested exclusively by switching off the control voltage (0 V) at the two digital control inputs STO-A and STO-B. Safety circuitry for additional interfaces at the CMMP-AS...-M0 is not required or intended. Detection of shorts across contacts of the input circuit is not carried out. According to the specification of the safety function, both levels at STO-A/B must be identical. If both channels are not actuated simultaneously, the STO is still active on the first request.

The state machine in the motor controller internally monitors the driver supply voltages as a result of the control of the control inputs. The level change of both inputs must take place within the discrepancy time (defined: 100 ms). If a channel is not switched off, this is interpreted as an error and results in an error message. Always switch STO-A and STO-B simultaneously.

Test pulses from safety controllers are tolerated within a certain range → 13 Technical data – Electrical data.

5.3 Feedback contact C1, C2 [X40]

The status of the motor controller is reported back to an external safety relay unit via a potential-free feedback contact (N/O contact).

The feedback contact has a single channel and may only be used for monitoring.

6 Mounting/removal

The safety circuit is integrated in the motor controller CMMP-AS-...-M0 and cannot be removed.

7 Electrical installation

7.1 Safety instructions

The requirements of EN 60204-1 must be fulfilled for the installation.

⚠ WARNING

**Danger of electric shock from voltage sources without protective measures.**

- Use only PELV circuits in accordance with EN 60204-1 (protective extra-low voltage, PELV) for the electrical logic power supply. Also take into account the general requirements for PELV circuits in accordance with EN 60204-1.
- Use only power sources that guarantee reliable electrical isolation of the operating voltage from the mains in accordance with EN 60204-1.

Protection from electric shock (protection from direct and indirect contact) in accordance with EN 60204-1 (Electrical equipment of machines, General requirements) is guaranteed with the use of PELV circuits. The 24 V fixed power supply used in the system must meet the requirements of EN 60204-1 for DC power supplies (response in the event of voltage interruptions etc.).

→ Make sure that bridges or the like cannot be inserted parallel to the safety wiring. For example, use the maximum wire cross section of 1.5 mm² or appropriate wire end sleeves with insulating collars.

Use twin wire end sleeves for looping cables between adjacent devices.

ESD protection

Damage may be caused to the device or to other system parts at unassigned plugs as a result of ESD (electrostatic discharge). Earth the system parts prior to installation and use appropriate ESD equipment (e.g. shoes, earthing straps etc.).

7.2 Connection [X40]

The motor controller CMMP-AS-...-M0 has a combined interface for open-loop control and feedback via the plug [X40] for the integrated safety function.

Plugs	Pin	Designation	Value	Description
8        1	8	0V	0 V	Reference potential for auxiliary supply voltage.
	7	24V	+24 V DC	Auxiliary supply voltage (from the 24 V DC logic supply of the motor controller).
	6	C2)	–	Feedback contact for the “STO” status on an external controller.
	5	C1)		
	4	0V-B	0 V	Reference potential for STO-B.
	3	STO-B	0 V / 24 V	Control input B for the STO function.
	2	0V-A	0 V	Reference potential for STO-A.
	1	STO-A	0 V / 24 V	Control input A for the STO function.

Tab. 3: Pin allocation [X40] (diagram of the plug on the device)

The STO-A and STO-B control inputs must be connected in parallel over two channels to ensure the STO “Safe Torque Off” function.

For example, this interface can be part of an emergency stop circuit or a safety door installation.

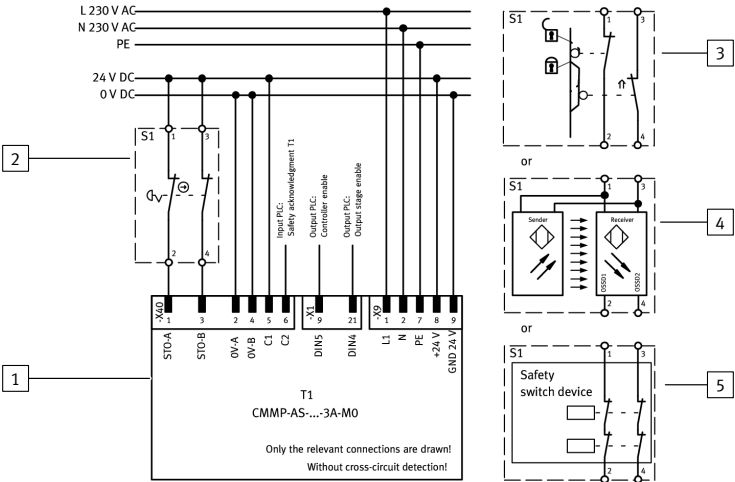


Fig. 2: Connection of the motor controller CMMP-AS -...- M0, example of a single-phase motor controller controller CMMP-AS -...- 3A-M0

- 1
- Motor controller with safety function (only relevant connections)
- 2
- Emergency stop switch
- 3
- Safety door
- 4
- Light curtain
- 5
- Safety relay unit

For initial commissioning of the motor controller without safety engineering, the motor controller CMMP-AS-...-M0 can be wired with a minimum circuit in accordance with → Fig. 2 with an emergency stop switch [2].

NOTICE
Safety functions must never be bypassed.

Install the minimum circuits for the STO-A/STO-B and 0V-A/0V-B inputs for initial commissioning in such a way that they must be removed when the final safety circuitry is installed.

8 Commissioning

NOTICE
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The term “commissioning” does not mean the first intended use by the end customer. It refers to commissioning by the manufacturer during setup of the machine.

NOTICE
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Loss of the safety function!

- Absence of safety function can result in serious, irreversible injuries, e.g. due to unintentional movements of the connected actuator technology.
- Only operate the safety function if all protective measures have been initiated.
  - The safety function must be tested and a corresponding validation procedure must be carried out prior to intended use.

Incorrect wiring or the use of incorrect external components that have not been selected in accordance with the safety category can result in failure of the safety function.

– Carry out a risk assessment for your application and select the circuitry and components accordingly.

8.1 Prior to commissioning

- Carry out the following steps in preparation for commissioning:
1. Make sure that the motor controller is correctly mounted.
  2. Check the electrical installation (connecting cables, contact assignment → 7 Electrical installation). All PE conductors connected?

8.2 Function test

NOTICE
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The STO function must be validated after installation and after changes to the installation.

This validation must be documented by the person who commissions the device. As an aid to commissioning, you will find examples of check lists in the description for CMMP-AS-M0-S1-....

9 Operation and use

9.1 Obligations of the operator


The functionality of the safety device must be tested at appropriate intervals. It is the responsibility of the operator to choose the type and frequency of the checks within the specified time period. The manner in which the test is conducted must make it possible to verify that the safety device is functioning perfectly in interaction with all components.

9.2 Maintenance and care

The safety function in the motor controller CMMP-AS-...-M0 is maintenance-free.

10 Diagnostics and fault clearance

10.1 Status display

Display	Description
	“H”: the motor controller is in the “safe status”. This does not have the same meaning as the information on the status of the safety function STO (Safe Torque Off). This can only be read from the status LED of the safety module. There is no special display for the “unsafe status”; the normal status indicators of the motor controller are displayed.

Tab. 4: 7-segment display on the motor controller

10.2 Malfunction messages

The motor controller displays malfunctions cyclically in the seven-segment display on the front of the motor controller. Error messages are displayed by “E” (for error), a main index (xx) and a sub-index (y), e.g. E 5 1 0. Warnings have the same number, but are shown with bars before and after, e.g. - 1 7 0 -. The error messages relevant for functional safety are listed below.

→ The complete list of error messages can be found in the hardware documentation GDCP-CMMP-M0-HW-... of the motor controller used.

If error messages cannot be acknowledged, you must first eliminate the cause. Then reset the motor controller, and check whether the cause of the error and thus the error message have been cleared.

Error	Cause	Actions
51-0 <sup>1)</sup>	Reserved	–
51-1 <sup>1)</sup>	Safety function: driver function defective – Internal voltage error of the STO circuit	– Safety circuit defective. No action possible, please contact Festo. If possible, replace with another motor controller.
51-2 <sup>1)</sup>	Reserved	–
51-3 <sup>1)</sup>	Reserved	–

Error	Cause	Actions
52-1	Safety function: discrepancy time expired	– Control inputs STO-A and STO-B are not actuated simultaneously. – Control inputs STO-A and STO-B are not wired in the same direction. – Check discrepancy time.
52-2	Safety function: driver supply failure with active PWM control	– The safe status was requested with power output stage enabled. Check integration into the safety-oriented interface.

1) The messages of error group 51 cannot be acknowledged.  
Tab. 5: Error numbers in connection with the safety function

11 Repair or replacement of the integrated safety circuit

Repair or maintenance of the integrated safety circuit is not permissible. If necessary, replace the entire motor controller.

12 Decommissioning and disposal

Observe the local regulations for environmentally appropriate disposal of electronic modules.

13 Technical data

Approval information, safety engineering	
CE	
Type-examination	The functional safety engineering of the product has been certified by an independent testing body, see EC-type examination certificate → <a href="http://www.festo.com/sp">www.festo.com/sp</a>
Certificate issuing authority	TÜV Rheinland, Certification Body of Machinery, NB 0035
Certificate no.	01/205/5262.03/25

Tab. 6: Approval information, safety engineering

Safety engineering		
Safety reference data		
Safety function	STO	– Safe restart interlock (STO, Safe Torque Off) in accordance with EN 61800-5-2 with SIL 3 – Safe restart interlock (STO, Safe Torque Off) in accordance with EN ISO 13849-1 with category 4 and PL e
SIL	SIL 3	Safety integrity level in accordance with EN 61800-5-2/IEC 61508
	SIL CL 3	SIL Claim Limit for a subsystem in accordance with EN 62061
Category	4	Classification in category in accordance with EN ISO 13849-1
PL	PL e	Performance level in accordance with EN ISO 13849-1
DCavg [%]	97	Average diagnostic coverage
HFT	1	Hardware fault tolerance
SFF [%]	99.2	Safe failure fraction
PFH	1.27 x 10 <sup>-10</sup>	Probability of dangerous failure per hour
PFD	2.54 x 10 <sup>-5</sup>	Probability of dangerous failure on demand
T [years]	20	Proof test interval Service life in accordance with EN ISO 13849-1
MTTFd [years]	1370	Mean time to dangerous failure.
Safety specifications		
Well-ried component		Yes, for the STO safety function

Tab. 7: Safety engineering

General technical data	
Approvals	
Certificates, declaration of conformity	→ <a href="http://www.festo.com/sp">www.festo.com/sp</a>
The device is intended for use in an industrial environment. Measures for interference suppression may be required in residential areas.	

Tab. 8: General technical data

Operating and environmental conditions for CMMP-AS-...-M0		
Permissible setup altitude above mean sea level		
– at nominal power [m]		1000
– with power reduction [m]		1000 ... 2000
Humidity [%]		0 ... 90 (non-condensing)
Degree of protection		IP20
Pollution degree in accordance with EN 61800-5-1		2 The integrated safety-engineering equipment requires compliance with pollution degree 2 and thus a protected installation space (IP54). It must always be ensured by taking appropriate measures, e.g. by installation in a control cabinet.
Operating temperature [°C]		0 ... +40

Operating and environmental conditions for CMMP-AS-...-M0	
Operating temperature [°C] with power reduction 2.5% per K	+40 ... +50
Storage temperature [°C]	-25 ... +70
Vibration and shock resistance	
– Operation	In accordance with EN 61800-5-1, section 5.2.6.4
– Transport	In accordance with EN 61800-2, section 4.3.3

Tab. 9: Operating and environmental conditions

Electrical data [X40]											
Control inputs STO-A, 0V-A/STO-B, 0V-B											
Nominal voltage	[V]	24 (related to 0V-A/B)									
Voltage range	[V]	19.2 ... 28.8									
Permissible residual ripple	[%]	2 (based on nominal voltage 24 V)									
Overvoltage shut-down	[V]	31 (shutdown in case of fault)									
Nominal current	[mA]	20 (typical; maximum 30)									
Starting current	[mA]	450 (typical, duration approx. 2 ms; max. 600 at 28.8 V)									
Input voltage threshold											
– Switching on	[V]	approx. 18									
– Switching off	[V]	approx. 12.5									
Switching time from high to low (STO-A/B_OFF)	[ms]	10 (typical; maximal 20 at 28.8 V)									
Switching time from low to high (STO-A/B_ON)	[ms]	5 (typical; maximum 7)									
Maximum positive test pulse length with logic 0	[µs]	< 300 (related to nominal voltage 24 V and intervals > 2 s between pulses)									
Switch-off time to power output stage inactive and maximum tolerance time for test pulses											
Input voltage (STO-A/B)	[V]	19	20	21	22	23	24	25	26	27	28
– Typical switch-off time (STO-A/B_OFF)	[ms]	4.0	4.5	5.0	6.0	6.5	7.0	7.5	8.0	8.5	9.5
– Maximum tolerance time for test pulses with 24 V signal	[ms]	< 2.0	< 2.0	2.0	2.5	3.0	3.5	4.5	5.0	5.5	6.0
Feedback contact C1, C2											
Design	Relay contact, N/O contact										
Max. voltage	[V DC]	< 30 (overvoltage-proof up to 60 V DC)									
Nominal current	[mA]	< 200 (not short-circuit-proof)									
Voltage drop	[V]	≤ 1									
Off-state current (contact open)	[µA]	< 10									
Switching time for closing (T_C1/C2_ON)	[ms]	< (STO-A/B_OFF + 5 ms)									
Switching time for opening (T_C1/C2_OFF)	[ms]	< (STO-A/B_ON + 5 ms)									
Auxiliary supply 24V, 0V – output											
Design	Logic supply voltage of the motor controller. Protected against reverse polarity, overvoltage-proof up to 60 VDC										
Nominal voltage	[V]	24									
Nominal current	[mA]	100 (short-circuit-proof, max. 300 mA)									
Voltage drop	[V]	≤ 1 (at nominal current)									
Galvanic isolation											
Galvanically isolated potential areas	STO-A/0V-A; STO-B/0V-B; C1/C2; 24V/0V										
Wiring											
Max. cable length	[m]	30									
Shielding	Use shielded cable for wiring outside the control cabinet. Guide shielding into the control cabinet/attach to the side of the control cabinet.										
Conductor cross section (flexible conductors, wire end sleeve with insulating collar)											
– one conductor	mm²	0.25 ... 0.5									
– two conductors	mm²	2 x 0.25 (with twin wire end sleeves)									
Tightening torque M2	[Nm]	0.22 ... 0.25									

Tab. 10: Electrical data [X40]