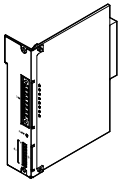
Safety module

CAMC-G-S1

FESTO

Safety function STO
as per EN 61800-5-2

for motor controller
CMMP-AS-...-M3



759286
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Translation of the original instructions
GDCP-CAMC-G-S1-EN

Identification of hazards and instructions on how to prevent them:

Warning
Hazards that can cause death or serious injury.

Caution
Hazards that can cause minor injury or serious property damage.

Other symbols:

Note
Property damage or loss of functionality.

Recommendations, tips, references to other documentation

Essential or useful accessories

Information on environmentally sound usage

Text designations:

- Activities that may be carried out in any order.

1. Activities that may be carried out in the order stated.

– General lists

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Instructions on this documentation

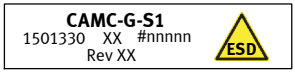
This documentation is to ensure work with the safety function STO - “Safe Torque Off” in accordance with EN 61800-5-2 is performed safely by using the safety module CAMC-G-S1 for motor controller CMMP-AS-...-M3.

- In addition, always observe the general safety regulations on the CMMP-AS-...-M3.

You will find the general safety regulations on the CMMP-AS-...-M3 in the hardware documentation, GDCP-CMMP-M3-HW-... ➔ Tab. 2.
Observe the information regarding safety and on the requirements for product use in Section 1.2.

Product identification

This documentation refers to the following versions:
– Safety module CAMC-G-S1, from revision 1.5.
– Motor controller CMMP-AS-...-M3, firmware from version 4.0.1501.1.0.
– FCT plug-in CMMP-AS from Version 2.0.x.

Type plate (typical)	Significance	
	Type designation	CAMC-G-S1
	Part number	1501330
	Date of manufacture	XX
	Serial number	#nnnnn
	Revision status	Rev XX

Tab. 1 Type plate CAMC-G-S1

Service

Please consult your regional contact if you have any technical questions.

Documentation

You will find additional information on the motor controller in the following documentation:

User documentation on the motor controller CMMP-AS-...-M3	
Name, type	**Contents**
Description of hardware, GDCP-CMMP-M3-HW-...	Assembly and installation of all variants/power classes (1-phase, 3-phase), pin allocations, error messages, maintenance.
Description of commissioning, GDCP-CMMP-M3-FW-...	Commissioning with FCT + functional description (firmware). Overview of FHPP, field bus, safety technology.
Description of FHPP, GDCP-CMMP-M3-C-HP-...	Control and parameterisation of the motor controllers via the Festo profile FHPP with the following field buses: CANopen, PROFIBUS, DeviceNet, EtherCAT.
Description of CiA 402 (DS 402), GDCP-CMMP-M3-C-CO-...	Control and parameterisation of the motor controller via the device profile CiA 402 (DS 402) with the following field buses: CANopen and EtherCAT.
Description of CAM editor, P.BE-CMMP-CAM-SW-...	Cam disc functionality (CAM) of the motor controller.
Description of the safety module, GDCP-CAMC-G-S1-...	Functional safety technology for the motor controller with safety function STO.
Help for FCT plug-in CMMP-AS	Interface and functions of plug-in CMMP-AS for the Festo Configuration Tool. ➔ www.festo.com

Tab. 2 Documentation on the motor controller CMMP-AS-...-M3

1 Safety and requirements for product use

1.1 Safety

1.1.1 General safety information

- In addition, always observe the general safety regulations on the CMMP-AS-...-M3.

You will find the general safety regulations on the CMMP-AS-...-M3 in the hardware documentation, GDCP-CMMP-M3-HW-... ➔ Tab. 2, page 6.

Note

Loss of the safety function.

Non-compliance with environmental and connection conditions can lead to loss of the safety function.

- Observe the specified environmental and connection conditions, in particular the input voltage tolerances ➔ Technical data, Appendix A.1.

Note

Incorrect handling can damage the safety module or controller.

- Before mounting and installation work, switch off the supply voltage. Switch on the supply voltage only when the mounting and installation work is complete.
- Never unplug a module from, or plug a module into the motor controller when it is energised!

- Observe the handling specifications for electrostatically-sensitive devices.

1.1.2 Intended use

The safety module CAMC-G-S1 serves as an expansion of the motor controller CMMP-AS-...-M3 to achieve the safety function:

– Safely switched-off torque – “Safe Torque Off” (STO) with SIL3 according to EN 61800-5-2 / EN 62061 / IEC 61508 or category 4 / PL e according to EN ISO 13849-1.

The motor controller CMMP-AS-...-M3 with safety module CAMC-G-S1 is a product with safety-relevant functions and is intended for installation in machines or automation systems and for use as follows:

– in a faultless technical condition,
– in its original condition, without any modifications by the user,
– within the product’s limits as defined by the technical data (➔ Appendix A.1),
– in an industrial environment.

The safety module CAMC-G-S1 can be operated in all motor controllers CMMP-AS-...-M3 that have an Ext3 slot for safety equipment. It cannot be plugged into one of the Ext1 or Ext2 slots for interfaces.

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

1.1.3 Possible incorrect application

Improper use includes the following possible cases of incorrect application:
- use in a device other than the CMMP-AS-...-M3,
- use outdoors,
- use in a non-industrial area (residential area),
- use in applications where switching off can result in hazardous movements or conditions.

Note
- The STO function is insufficient as the sole safety function for drives subject to permanent torque (e.g. suspended loads).
- Bypassing of safety equipment is impermissible.
- Repairs on the module are impermissible!

The STO (Safe Torque Off) function does not provide protection against electric shock, only against hazardous movements!
➔ Hardware documentation, GDCP-CMMP-M3-HW-...

1.1.4 Achievable safety level, Safety function to EN ISO 13849-1 / EN 61800-5-2

The safety module fulfills the basic test requirements
- Category 4 / PL e to EN ISO 13849-1,
- SIL CL 3 to EN 61800-5-2 / EN 62061 / IEC 61508,

and can be used in applications up to cat. 4 / PL e to EN ISO 13849-1 and SIL 3 to EN 62061 / IEC 61508.
The achievable safety level depends on the other components used to achieve a safety function.

1.2 Requirements for product use

- Make this documentation available to the design engineer and installer or person responsible for commissioning the machine or system in which this product will be used.
- Ensure compliance with specifications in the documentation at all times. Also take into account the documentation for the other components and modules (e.g. motor controller, lines, etc.).
- Take into account the legal regulations applicable to the destination, as well as:
  – regulations and standards,
  – regulations of the testing organisations and insurers,
  – national specifications.
- For emergency stop applications, protection against automatic restart must be provided according to the required safety category. This can be achieved through an external safety switching device, for example.

1.2.1 Technical requirements

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

- Comply with the connection and environmental conditions of the safety module (➔ Appendix A.1), the motor controller and all connected components.
  The product can be operated in accordance with the relevant safety guidelines only if the limit values or load limits are observed.
- Observe the warnings and instructions in this documentation.

1.2.2 Qualification of the specialist personnel (requirements for personnel)

The device may only be placed in operation by a qualified electrical engineer who is familiar with:

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

1.2.3 Diagnostic coverage (DC)

Diagnostic coverage depends on the connection between the motor controller with safety module and the control loop system as well as the implemented diagnostic measures ➔ Section 5.4.
If a potentially hazardous disturbance is recognised during diagnosis, appropriate measures for maintaining the safety level must be implemented.

➔ **Note**
Check whether cross-circuit detection of the input circuit and the connection wiring is required in your application.
If needed, use a safety switching device with horizontal cross-circuit detection to activate the safety module.

1.2.4 Range of applications and certification

The motor controller with built-in safety module is a safety component in accordance with the machinery directive; the motor controller bears the CE mark.
Standards and test values which the product must comply with and fulfils can be found in the section "Technical data" (➔ Appendix A.1). The product-relevant EU directives can be found in the declaration of conformity.

Certificates and the declarations of conformity for this product can be found at www.festo.com.

2 Product description for safety module CAMC-G-S1

2.1 Product overview

2.1.1 Purpose

As processes become increasingly automated, protecting people from potentially hazardous movements is gaining in importance. Functional safety describes the measures offered by electrical or electronic devices that are required to reduce or eliminate malfunction-induced hazards. In normal operation, safety devices prevent human intervention in hazardous areas. In certain operating modes, during set-up for example, people also need to be in hazardous areas. In such situations, the machine operator must be protected by drive and internal control measures.
Integrated functional safety technology provides the conditions required by controller and drive for the optimised realisation of safety functions. Planning and installation complexity is reduced. The use of integrated functional safety technology increases machine functionality and availability over the levels achieved by conventional safety technology.

Type	Description
CAMC-G-S1	Safety module with STO function and DIP switches.
CAMC-DS-M1	Switch module with DIP switches, **no safety functions**.

Tab. 2.1 Overview of the safety and switching modules for the CMMP-AS-...-M3

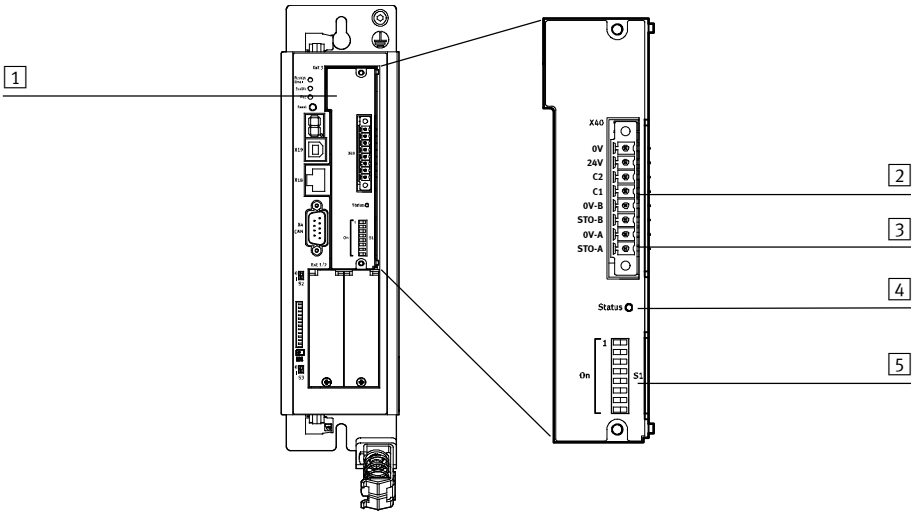
2.1.2 Supported devices

The safety module CAMC-G-S1 can only be used in motor controllers in conformity with Section 1.1.2.
The motor controllers CMMP-AS-...-M3 are delivered without a safety module in the Ext3 slot.
The use of safety module CAMC-G-S1 enables the safety functions, described in this documentation for the integrated functional safety of safety stops, to be expanded.

If no safety functions are required, the switch module CAMC-DS-M1 must be ordered and inserted in the Ext3 slot for safety modules.

2.1.3 Control sections and connections

The safety module CAMC-G-S1 has the following control sections, connections and display components:



1 Motor controller CMMP-AS-...-M3 with Ext3 slot for safety modules
2 Digital I/O-interface [X40] for control of the STO function
3 Pin 1 of the interface [X40]
4 LED for status display (functional safety status)
5 DIP-switch (activation/configuration of the fieldbus-communication in the motor controller)

Fig. 2.1 Operator panel and connections CAMC-G-S1

2.1.4 Scope of delivery

Safety module CAMC-G-S1	
Safety module with mounting accessories (2 screws with spring washer)	Module Safe Torque Off
Plug for control cables	PHOENIX Mini-Combicon MC 1.5/8-STF-3.81 BK
Brief description with mounting instructions	German / English / Spanish / French / Italian / Chinese

Tab. 2.2 Scope of delivery

2.2 Function and application

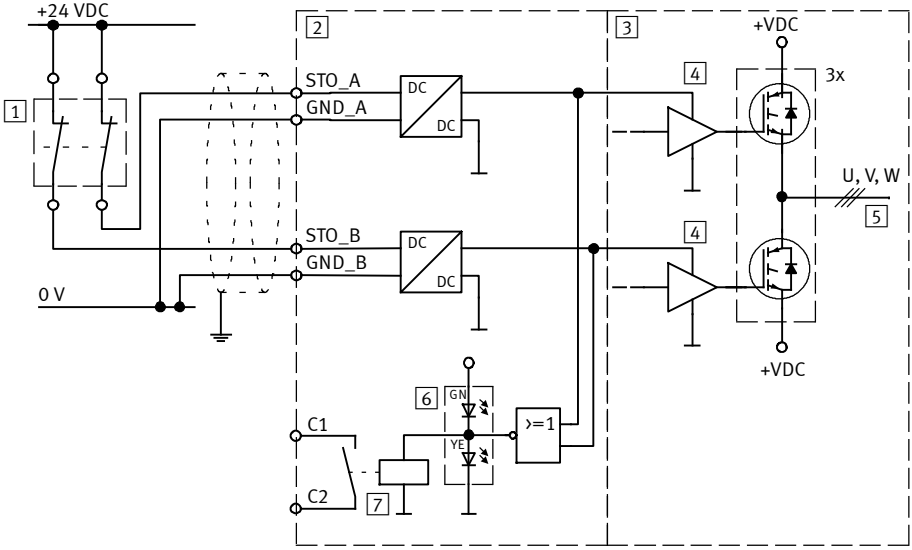
The safety module CAMC-G-S1 has the following performance characteristics:
– “Safe Torque Off” (STO) function
– Potential-free acknowledgement contact for the operating status,
– Designed as a plug-in module that can be plugged in from the outside thus enabling retrofits,
– Suitable solely for series CMMP-AS-...-M3 motor controllers.

The “Safe Stop 1” (SS1) function can be realised by employing a suitable external safety switching device and appropriate motor controller CMMP-AS-...-M3 circuitry.

2.2.1 Description of the safety function STO

Use the function “Safe Torque Off” (STO) whenever you have to reliably disconnect the energy supply to the motor in your particular application.

The function “Safely Torque Off” switches off the driver supply for the power semiconductor, thus preventing the power end stage supplying the voltage required by the motor ➔ Fig. 2.2.



1 Safety circuit (switch, relay, safety switching device)
2 Safety module CAMC-G-S1
3 Power end stage in the CMMP-AS-...-M3 (only one phase illustrated)
4 Driver supply
5 Motor connection
6 LED (green / yellow), status display
7 Feedback contact

Fig. 2.2 “Safe Torque Off” – Operating principle for the CMMP-AS-...-M3

The power supply to the drive is reliably disconnected via the active safety function STO “Safe Torque Off”. The drive cannot generate torque and so cannot perform any hazardous movements. With suspended loads or other external forces, additional measures must be taken to reliably prevent sagging (e.g. mechanical holding brake). In the STO “Safe Torque Off” state, the standstill position is not monitored.
The machine must be stopped in a safe manner, e.g. via a safety switching device. This applies specifically to vertical axes without self-locking mechanism, clamping unit or counterbalance.

Note
There is a risk that the drive will advance in case of multiple errors in the CMMP-AS-...-M3.
If the output stage of the motor controller fails while in the STO status (simultaneous short circuit of 2 power semiconductors in different phases), a limited dwell movement of the rotor may result. The rotation angle / path corresponds to a pole pitch. Examples:
– Rotary axis, synchronous machine, 8-pin ➔ movement < 45° at the motor shaft.
– Linear motor, pole pitch 20 mm ➔ movement < 20 mm at the moving part.

2.2.2 Overview of interface [X40]

On its front, the safety module provides an 8-pin connection [X40] for control ports, feedback contact and a 24 V auxiliary supply for external sensors ➔ Section 3.2.
The safety function STO is requested solely via the two digital control ports STO-A and STO-B. A safety circuit for additional interfaces at the CMMP-AS...-M3 motor controller is neither required nor intended.

Cross-circuit detection in the input circuit is not carried out by the safety module.

The status of the motor controller is reported back to an external safety switching device through a potential-free acknowledgment contact (normally open). This enables a downwards-compatible activation in a mixed configuration, comprising a CMMP-AS (previous series with the “Safe Stop” function to be realised via the connection [X3]) and the CMMP-AS-...-M3 ➔ Section 6.3.
The interface [X40] permits the direct connection of active and passive sensors, since a 24 V supply voltage (auxiliary supply) with corresponding reference potential is lead out.

Connections	Description
STO-A (Pin 1) 0V-A (Pin 2)	Control port A for the STO function with corresponding reference potential. 1) – Request for “Safe Torque Off” (STO) at Low (0 signal), together with STO_B.
STO-B (Pin 3) 0V-B (Pin 4)	Control port B for the STO function with corresponding reference potential. 1) – Request for “Safe Torque Off” (STO) at Low (0 signal), together with STO_A.
C1 (Pin 5) C2 (Pin 6)	Feedback contact for the “Safe Torque Off” (STO) status, e.g. to an external controller.
	– Feedback contact opened: “Safe Torque Off” (STO) not active
	– Feedback contact closed: “Safe Torque Off” (STO) active
24 V (Pin 7) 0 V (Pin 8)	Auxiliary supply, e.g. for safety peripherals (24 V DC logic supply of the motor controller).

1) Control inputs 24 V, high active, based on EN 61131-2, deviating signal level ➔ Appendix A, Tab. A.8

Tab. 2.3 Function of the module [X40] connections

The connections are electrically isolated from each other in groups and from the 24 V supply to the motor controller ➔ Appendix A.1.4, Tab. A.11.

2.2.3 Control ports STO-A, 0V-A / STO-B, 0V-B [X40]

The safety function STO (Safe Torque Off) is requested via the two control ports STO-A and STO-B. They permit the direct connection of safe semiconductor outputs (electronic safety switching devices, active safety sensors, e.g. light curtains with OSSD signals) and of switch contacts (safety switching device with relay outputs, passive safety sensors, e.g. forcibly-guided position switches) ➔ e.g. Section 3.2.2, Fig. 3.2.

To request the safety function STO (Safe Torque Off), the 24 V control voltage at both control ports STO-A and STO-B is switched off (0 V).

If the two control ports are switched off simultaneously or within a defined discrepancy time, the STO function is active.

For control ports STO-A and STO-B, an undervoltage monitoring mechanism is integrated to eliminate the possibility of invalid voltage ranges for the downstream electronics, as well as an overvoltage monitoring mechanism to protect against overvoltage.

Tab. A.8 Appendix A.1.4 describes the technical data for the control ports within the specified operating range of the logic voltages.

Tolerance ranges are defined for the input voltage range of control ports STO-A and STO-B. The amount of energy stored in the safety module components (e.g. capacitors) depends on the input voltage level. During switching operations, these energies must be charged or discharged. Consequently, switch-off time values for the transition to the safe state (STO) and the tolerance time vis-a-vis OSSD signals (buffer time) depend on the input level.

The time response requirements are contained in the technical specifications in the Appendix A.1.4. The time response itself is described in Section 2.4.

Discrepancy time

The transition between the safe and the unsafe state is initiated via level changes at the control ports STO-A and STO-B of the safety module CAMC-G-S1. According to the safety function specification, the two levels must be identical otherwise an error message will be generated. The finite state machine in the motor controller internally monitors the driver supply voltage after the control ports have been activated. Due to component tolerances or bouncing safety controller ports, for example, these level changes do not normally occur precisely at the same time. The firmware tolerates this for as long as the second input occurs within a defined time, the so-called discrepancy time. If this time is exceeded, the motor controller generates an error message.
The default discrepancy time is 100 ms.
Recommendation: Always switch STO-A and STO-B simultaneously.

Test pulse

Temporary test pulses from safety controllers are tolerated and thus do not trigger the STO function. The tolerance to test pulses from sensors with OSSD signals is rated for the operating range specified in accordance with Appendix A.1.4, Tab. A.9. The permissible test pulse length is dependent upon the control voltage level at inputs STO-A and STO-B.

Example: Input voltage for STO-A and STO-B = 24 V
➔ OSSD signals with a test pulse length of 3.5 ms are tolerated.

2.2.4 Feedback contact C1, C2 [X40]

If the **STO function is inactive**, the feedback contact opens. This is the case, for example, when only one of the two control voltages STO-A or STO-B is present, if the 24 V logic power supply is switched off or if the supply voltage fails.
When the **STO function is active**, the relay contact is closed.

The feedback contact has a single channel and may be used for diagnostic purposes, but not in the safety circuit.
Tab. A.10 Appendix A.1.4 describes the electrical data, Tab. A.9 the time response of the feedback contact.
When the 24 V supply to the basic device is turned on and off, the switching status of the relay may – due to the internal supply voltages powering up at a different speed – deviate briefly (approx. 100 ms) from the state of the control ports STO-A and STO-B.

2.2.5 Auxiliary supply 24V, 0V [X40]

The motor controller CMMP-AS...-M3 with safety module CAMC-G-S1 provides a 24 V auxiliary supply to [X40]. This can be employed when using the feedback contact C1/C2 or to supply external, active sensors.

Tab. A.11 Appendix A.1.4 describes the electrical data for the auxiliary supply.

2.2.6 Status display

To display the status of the safety function, the safety module has an LED on its front ➔ Section 5.4.1. The status LED displays the module's operating state (green = STO inactive, yellow = STO active). The display corresponds to the state of the feedback contact C1/C2.

2.2.7 DIP switch

Located on the front of the safety module are DIP switches. These switches have no safety function. The meaning of the individual switches depends on the interface used for the fieldbus communication. The fieldbus communication can be activated/deactivated or a station address can be set, for example, via the DIP switches.

2.3 Functionalities in motor controller CMMP-AS-...-M3

The following functions in motor controller CMMP-AS-...-M3 are not certified to EN 61800-5-2. They are functional supplements and offer additional diagnostics options.
Error messages generated by the safety module, such as exceeding the discrepancy time, are detected and analysed by the non-safety finite state machine of the motor controller. If conditions for an error status are detected, an error message is generated. In this case, it cannot always be guaranteed that power end stage has been safely switched off.
The safety module CAMC-G-S1 controls only the provisioning of the driver supply for the motor controller CMMP-AS-...-M3. Although input voltage levels are monitored area by area, the safety module does not have its own error analysis function and is unable to display errors.

➔ **Note**
When error messages are acknowledged, all acknowledgeable errors regarding functional safety are also always acknowledged ➔ Section 5.4.2.

The motor controller CMMP-AS-M3 monitors the status of the control ports STO-A and STO-B. Consequently, the motor controller firmware detects the request for the safety function STO (Safe Torque Off) and various non-safety functions are then performed:
- Detection of deactivated driver supply for the power semiconductor via the safety module,
- Deactivation of the drive controller and activation of the power semiconductor (PWM),
- The holding brake controller is deactivated (if configured),
- Finite state machine on the motor controller with activation analysis (discrepancy time),
- Detection of application-related error messages,
- Hardware diagnostics,
- Status and error display via display, digital outputs, fieldbuses etc.

Note
The brake is activated by the motor controller's non-safety firmware.

Note
If one of the control ports STO_A or STO_B is deactivated with an active output, the drive coasts unbraked if no holding brake is connected.
This can cause damage to the machine. It is therefore recommended that a holding brake is connected to the motor controller.

Please check whether the motors with holding brake you use is designed to decelerate and bring the motor to a standstill via the holding brake, should malfunction occur.

The safe state can be requested when the power semiconductor (PWM) is activated. The two driver supply voltage states are detected and analysed in 10 ms cycles If they are unequal over a prolonged period, an error message is triggered ➔ Section 5.4.2. The safety function presupposes that the two signals have the same status. Unequal signals are tolerated only during a transition period, the so-called "discrepancy time" ➔ Section 2.2.3.
The finite state machine in motor controller CMMP-AS-...-M3 has its own status in parallel to the safety module CAMC-G-S1. Due to the discrepancy time analysis, this finite state machine may reach the "Safe status" only with a considerable delay. Accordingly, this state can also be signalled via digital outputs or a fieldbus only with a considerable delay. The power end stage itself is then, however, "safely switched off". This finite state machine is processed within the 10 ms cycle.
This generally results in a graded response speed as per Tab. 2.4:

Function	Response time	Reaction
Switching time from high to low	T_STO-A/B_OFF	➔ Section A.1.4, Tab. A.8
Switching time from low to high	T_STO-A/B_ON	➔ Section A.1.4, Tab. A.8
Detection of driver supply failure	$t_{Reaction} \leq 125$ µs	Activation of the power semiconductor (PWM) is switched off
Activation of holding brake	$t_{Reaction} \leq 10$ ms	Activation of the holding brake after detection of the driver supply failure
Signal analysis and status display	$t_{Reaction} \leq 10$ ms	Status transitions in the internal finite state machine, triggering an error message and showing the status on the display if necessary

Tab. 2.4 Detection and response times of the driver supply voltage

2.4 Time behaviour

Functionally, the STO-A and STO-B inputs are identical. The switch sequence of STO-A/STO-B is interchangeable across all diagrams.

2.4.1 Basic time behaviour STO

Fig. 2.3 displays the basic time behaviour of the safety module. The time specifications can be found in table Tab. 2.5.

CAMC-G-S1

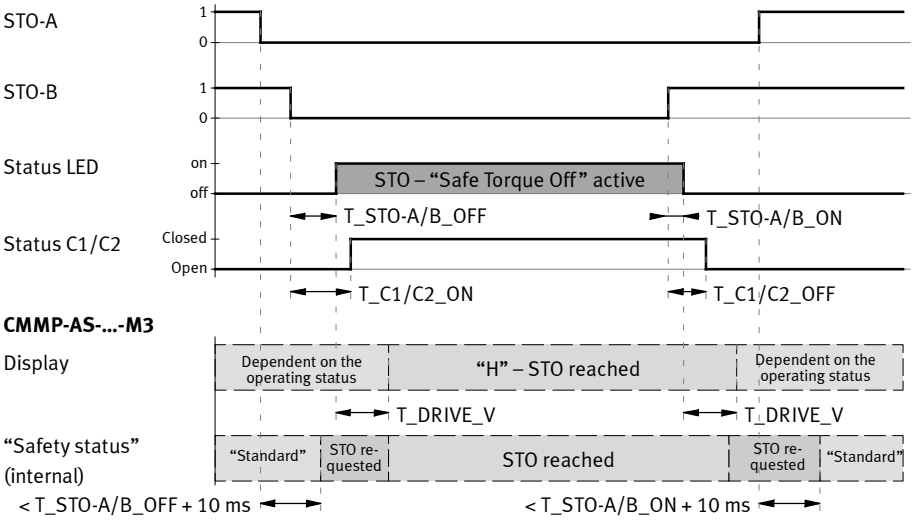


Fig. 2.3 Basic time behaviour when activating and deactivating the safety function STO

Time	Description	Value
T_STO-A/B_OFF	STO-A/B – Switching time from High to Low	➔ Section A.1.4, Tab. A.8
T_STO-A/B_ON	STO-A/B – Switching time from Low to High	➔ Section A.1.4, Tab. A.8
T_C1/C2_ON	C1/2 – Switching time closing	➔ Section A.1.4, Tab. A.10
T_C1/C2_OFF	C1/2 – Switching time opening	➔ Section A.1.4, Tab. A.10
T_DRIVE_V	Delay of the CMMP-AS-M3	0 ... 10 ms

Tab. 2.5 Time specifications to Fig. 2.3

2.4.2 Time behaviour for activating STO during operation with restart

Fig. 2.4 displays the time behaviour starting from interruption of the control voltage to STO-A/B ,as well as the sequence required to allow the device to restart. The time specifications can be found in Tab. 2.6. Notes:

– The holding brake is activated via the motor controller, not a safety function.
– The coasting of the motor, irrespective of brake activation/deactivation, is displayed.
– The setpoint value is only activated when the holding brake delay T_BRAKE_V has expired.

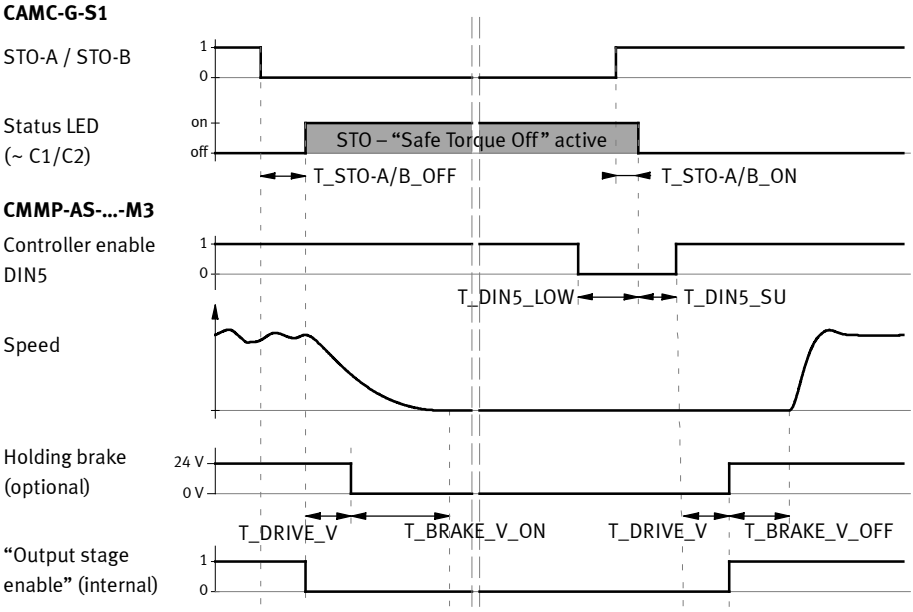


Fig. 2.4 Time behaviour when activating the safety function STO with restart

Time	Description	Value
T_STO-A/B_OFF	STO-A/B – Switching time from High to Low	➔ Section A.1.4, Tab. A.8
T_STO-A/B_ON	STO-A/B – Switching time from Low to High	➔ Section A.1.4, Tab. A.8
T_DIN5_LOW	Time for which the DIN5 must be Low before STO-A/B is switched on again	0 ms
T_DIN5_SU	Time for which the DIN5 must be Low after switching on STO-A/B again and status change of the STO module	> 20 ms
T_DRIVE_V	Delay of the CMMP-AS-M3	0 ... 10 ms
T_BRAKE_V_ON	Switch off delay of the holding brake	Dependent on the brake [1]
T_BRAKE_V_OFF	Switch on delay of the holding brake	Dependent on the brake [2]

1) Physical delay until the brake closes.

2) Minimum time: Physical delay until the brake opens. This time can be parameterised in the controller via a large value.

Tab. 2.6 Time specifications to Fig. 2.4

2.4.3 Time behaviour for activating SS1 during operation with restart

The time behaviour in Fig. 2.5 is based on the typical circuit for SS1 in Section 3.3.2, starting from control signal S1 for K1. The time specifications can be found in Tab. 2.7.

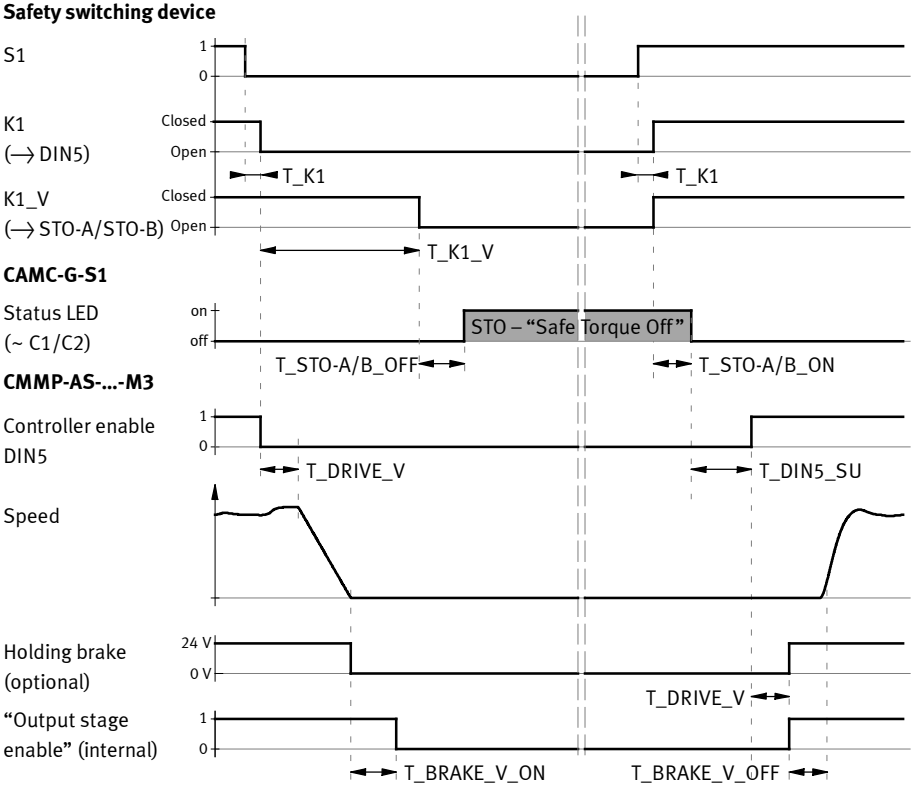


Fig. 2.5 Time behaviour when activating the safety function SS1 (external switching) with restart

Time	Description	Value
T_K1	Delay between the switching of S1 and the closing of the undelayed contact K1	➔ Data sheet for the safety switching device
T_K1_V	Delay between S1 and the opening of the relapse delayed contact K1	Can be set on the safety switching device
T_STO-A/B_OFF	STO-A/B – Switching time from High to Low	➔ Section A.1.4, Tab. A.8
T_STO-A/B_ON	STO-A/B – Switching time from Low to High	➔ Section A.1.4, Tab. A.8
T_DRIVE_V	Delay of the CMMP-AS-M3	0 ... 10 ms
T_DIN5_SU	Time for which the DIN5 must be Low after switching on STO-A/B again and status change of the STO module	> 20 ms
T_BRAKE_V_ON	Switch off delay of the holding brake	Dependent on the brake 1)
T_BRAKE_V_OFF	Switch on delay of the holding brake	Dependent on the brake 2)

1) Physical delay until the brake closes.

2) Minimum time: Physical delay until the brake opens. This time can be parameterised in the controller via a large value.

Tab. 2.7 Time specifications to Fig. 2.5

3 Assembly and installation

3.1 Mounting/Dismounting

The safety module CAMC-G-S1 is suitable only for integration into the motor controller CMMP-AS-...-M3. It cannot be operated outside the motor controller.

Warning

Danger of electric shock if the safety module is not mounted.

Contact with conducting parts will cause severe injuries and may result in death.

Before touching conducting parts during maintenance, repair and cleaning work and during long service interruptions:

1. Switch off the power to the electrical equipment and secure it to prevent a restart.
2. After switching it off, wait at least 5 minutes of discharge time and check that it is voltage-free before accessing the controller.

Note

Incorrect handling can damage the safety module or controller.

- Before mounting and installation work, switch off the supply voltage. Switch on the supply voltage only when the mounting and installation work have been completely finished.
- Never unplug a module from, or plug a module into the motor controller when it is energised!
- Observe the handling specifications for electrostatically-sensitive devices. Do not touch the printed circuit board or the pins of the manifold rail in the motor controller. Hold the safety module only by the front plate or the edge of the board.

Mounting safety module

1. Insert the safety module CAMC-G-S1 into the empty slot for Ext3 safety modules so that the board runs in the lateral guides of the slot.
2. Insert safety module; when the back of the contact strip within the motor controller is reached, carefully press it into the contact strip until it stops.
3. Then screw the safety module with the two screws onto the front of the motor controller housing.

Tighten the screws with approx. 0.35 Nm.

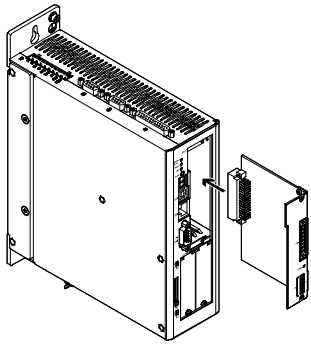


Fig. 3.1 Mounting/Dismounting

Dismounting safety module

1. Unscrew screws on the safety module.
2. Loosen the safety module by gently levering the front cover or by pulling on the counterplug by just a few millimetres.
3. Pull the safety module out of the slot.

3.2 Electrical installation

3.2.1 Safety instructions

During installation, the requirements of EN 60204-1 must be fulfilled.

Warning

Danger of electric shock in case of voltage sources without safety measures.

- Use only PELV (protective extra-low voltage) circuits to EN 60204-1 for the electric logic supply.
  Also observe the general requirements for PELV power circuits to EN 60204-1.
- Only use power sources which guarantee reliable electrical isolation of the operating voltage to EN 60204-1.

Protection against electric shock (protection against direct and indirect contact) is guaranteed in accordance with EN 60204-1 by using PELV circuits (electrical equipment of machines, general requirements). The 24 V power supply unit used in the system must satisfy the requirements of EN 60204-1 for DC power supply (behaviour during power interruptions, etc.).
The cable is connected via a plug, making it easier to replace the safety module.

Make sure that no jumpers or the like can be inserted parallel to the safety wiring, e.g. through the use of the maximum wire cross section of 1.5 mm² or suitable wire end sleeves with insulating collars.
Use twin wire end sleeves for looping through lines between neighbouring devices.

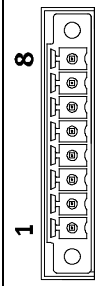
ESD protection

With non-assigned plug connectors, there is a danger of the device that other parts of the system may be damaged as a result of ESD (electrostatic discharge). Earth the system parts prior to installation and use suitable ESD equipment (e.g. shoes, earthing straps, etc.).

3.2.2 Connection [X40]

The CAMC-G-S1 safety module has a combined interface for control and acknowledgment via the plug connector [X40].

– Type on device: PHOENIX MINICOMBICON MC 1.5/8-GF-3.81 BK
– Plug (supplied as standard): PHOENIX MINICOMBICON MC 1.5/8-STF-3.81 BK, connection corresponds to Section A.1.4, Tab. A.13

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

Tab. 3.1 Pin allocation [X40] (representation of the plug connector on the module)

To ensure the STO “Safe Torque Off” functions correctly, the control ports STO-A and STO-B are to be connected in two channels with parallel wiring ➔ Section 3.3.1, Fig. 3.2.
This interface can be part of an emergency stop circuit or a protective door arrangement, for example.

3.2.3 Minimum wiring for commissioning [X40]

If a safety oriented interface is (still) not present, the switch module CAMC-DS-M1 should be used.

The module replacement must be configured and acknowledged in the FCT ➔ Section 4.3.

Also observe the DIP switch setting ➔ Section 4.2 if applicable.

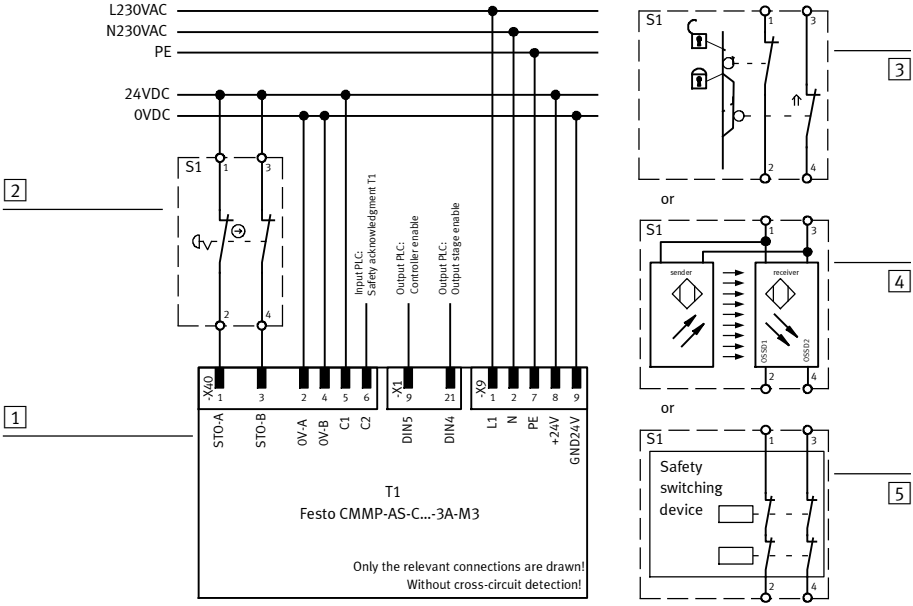
If no micro switch module is available or for the initial start-up of the motor controller without safety equipment, the motor controller CMMP-AS-...-M3 with the safety module CAMC-G-S1 can be equipped with an emergency stop switch (2) with minimum wiring as per Fig. 3.2.

Note
Safety functions must never be bypassed.

Carry out the minimum wiring of the inputs STO-A/STO-B and 0V-A/0V-B for the initial start-up so that it will be forcibly removed when the final protection wiring is executed.

3.3 Typical circuits

3.3.1 Safe Torque Off (STO)



1 Motor controller with safety module (only relevant connections illustrated)
2 Emergency stop switch
3 Protective door
4 Light curtain
5 Safety switching device

Fig. 3.2 Connection of the safety module CAMC-G-S1, example of single-phase motor controller CMMP-AS-C...-3A-M3

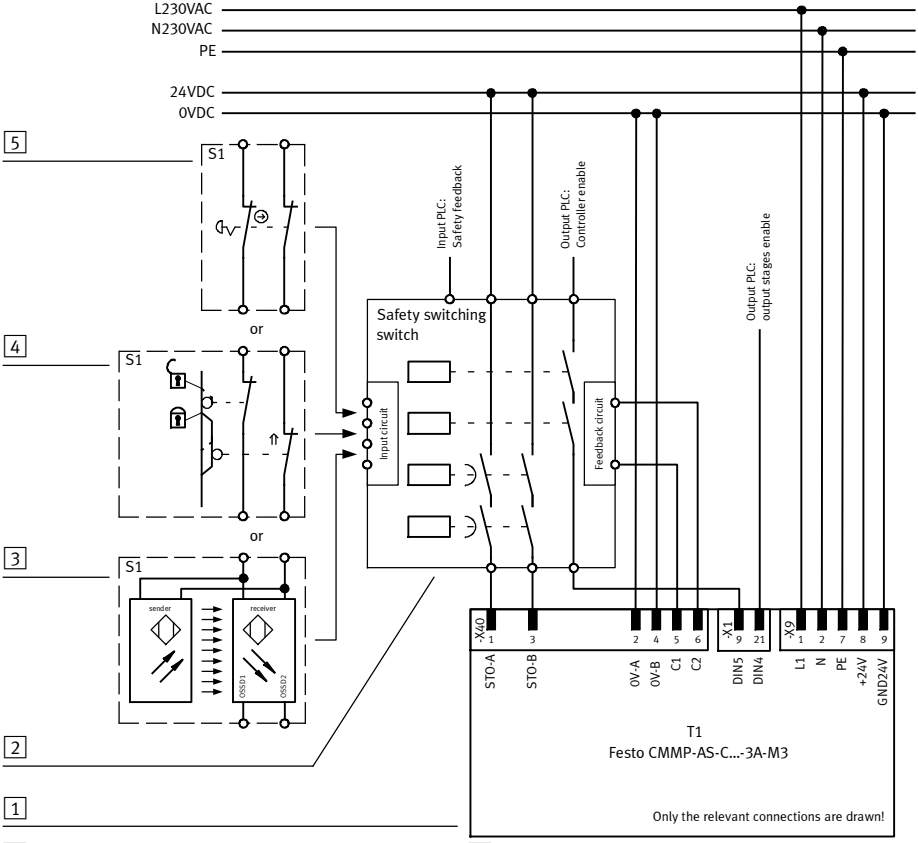
The safety function “Safe Torque Off” (STO) can be requested via various devices. The switch S1 can be, for example, an emergency stop switch, a safety door switch, a light barrier or a safety switching device. The safety request is made in 2 channels via switch S1 and routes to the 2-channel switch-off of the output stage. Once the output stage has been switched off, it is output by the floating contact C1/C2.

Notes with regard to a typical circuit:

– The motor controller with safety module does not have integrated cross-circuit detection. With direct light barrier wiring, the light barrier detects cross-circuits if designed to do so.
– When using safety switching devices, the contacts C1, C2 can be integrated in the feedback circuit of the safety switching device.
– The typical circuit shows a 2-channel structure, which is suitable for categories 3 and 4 with additional measures.
– Which additional measures are required depends on the range of applications and the safety concept of the machine.

3.3.2 Delays and safe torque switch off (SS1, “Safe Stop 1”)

The safety function “Safe Stop 1” (SS1, type C) can be requested via various devices ➔ Fig. 3.3. The switch S1 in Fig. 3.3 can be, for example, an emergency stop switch, a safety door switch or a light barrier. The safety request is made in 2-channels via switch S1 and to the safety switching device. The safety switchnig device switches off the controller enable. If the controller enable of the motor controller is switched off, the movement is automatically delayed and, if the brake is configured, brake activation is expected before the control circuit is switched off. After a time set in the safety switching device, the 2-channel output stage is switched off via STO-A/B. Once the output stage has been switched off, it is output by the floating contact C1-C2.



1 Motor controller with safety module (only relevant connections illustrated)
2 Safety switching device
3 Light curtain
4 Protective door
5 Emergency stop switch

Fig. 3.3 Typical circuit “Decelerate and safe torque off” (SS1, “Safe Stop 1”), example single-phase motor controller CMMP-AS-C...-3A-M3

Notes with regard to a typical circuit:

- The safety switching device used must switch off the controller enable (X1-9, DIN5) without a delay and the inputs STO-A and STO-B (X40-1, -3) with a delay.
- The required delay is application-dependent and must be defined specific to the application concerned. The delay must be designed so that the drive is decelerated to zero, even at maximum speed, via the quick stop ramp in the CMMP-AS...-M3, before STO-A/B are switched off.
- The electrical installation is executed in accordance with the requirements of EN 60204-1.
  For example, the safety switching device and the motor controller are located in the same control cabinet, so that faults can be excluded for a cross-circuit or earth fault between the cables (acceptance test on the control cabinet for faultless wiring).
- The typical circuit exhibits a 2-channel structure, which is suitable for categories 3 and 4 with additional measures.
- Which additional measures are required depends on the range of applications and the safety concept of the machine.

4 Commissioning

Note
Loss of the safety function!
Lack of the safety function can result in serious, irreversible injuries, e.g. due to uncontrolled movements of the connected actuators.
- Operate the safety module only:
  - in a built-in condition and
  - when all safety measures have been implemented.
- Validate the safety function to complete commissioning ➔ Section 4.4.

Incorrect wiring, use of an incorrect safety module or external components that were not selected according to the safety category, result in loss of the safety function.

- Carry out a risk evaluation for your application and select the circuitry and components accordingly.
- Note the examples ➔ Section 3.3.

4.1 Before commissioning

Perform the following steps to prepare for commissioning:
1. Ensure that the safety module is correctly mounted (➔ Section 3.1).
2. Check the electrical installation (connecting cable, pin allocation ➔ section 3.2). Are all protective earth conductors connected?

4.2 DIP switch setting

DIP switches for activating and controlling the fieldbus configuration are located on the safety module. The functionality of the DIP switch is identical to that of the switch module CAMC-DS-M1 and independent of the fieldbus interface used.

Set the DIP switches as described in the hardware documentation GDCP-CMMP-M3-HW-... or the corresponding fieldbus-specific documentation ➔ Tab. 2, page 6.

4.3 Parameterisation with FCT

4.3.1 Setting the configuration

Functional safety depends on modifications being traceable. To guarantee this, the specifications for module type, serial number and version are stored in the safety module. These data are stored in the motor controller as comparison values, enabling a modification to the components to be detected.
To configure the safety module, insert into the FCT the safety module used in the “Configuration” page of the plug-in CMMP-AS by means of “Create new drive configuration” or “Modify drive configuration” ➔ Fig. 4.1.

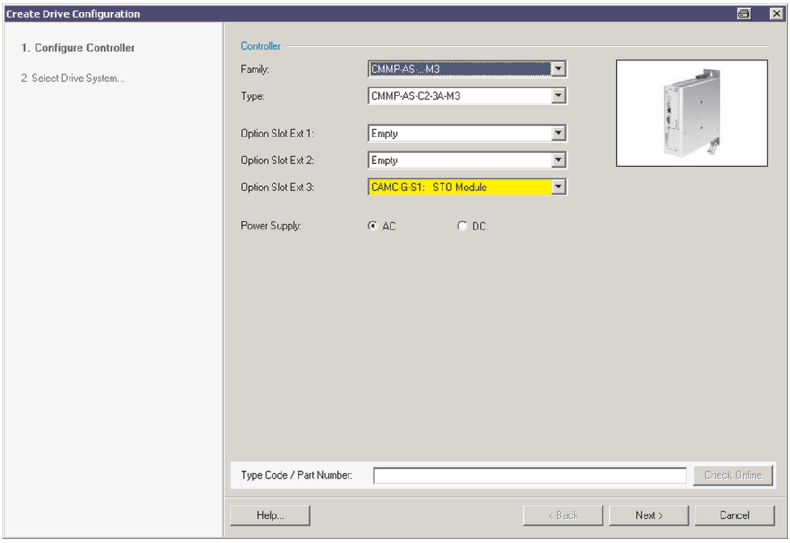


Fig. 4.1 FCT plug-in CMMP-AS: Create/edit drive configuration

Then transfer module type, serial number and version of the module to the page “Options slot Ext 3” ➔ Section 4.3.2.

4.3.2 Accept the module and the status display of the module

When a modification is detected, e.g. a module replacement, a non-acknowledgeable error is triggered. To be able to place the application with the motor controller back in operation, the modification must be “configured”. That means, the modification must be explicitly accepted or confirmed. With the safety or switch modules, these traceable modifications relate to a module replacement.
The following rules apply:

– The replacement of a safety module CAMC-G-S1 with an identical module does not need to be confirmed, as long as the module versions are compatible. If the versions are incompatible, it may be necessary to upgrade the motor controller with updated firmware.
– A replacement involving different module types (switch module CAMC-DS-M1, safety module CAMC-G-S1 and safety module CAMC-G-S3) must always be confirmed.

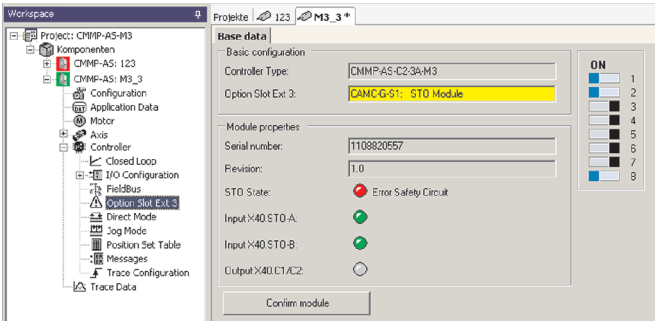


Fig. 4.2 FCT plug-in CMMP-AS: See “Option slot Ext 3”

- Confirm the mounted module with the “Accept module” button.

The status of the safety module or the safety function is displayed under “Properties”, ➔ Tab. 4.1.

Properties	Display	Status
Serial number	Display of the module’s serial number.	
Status: Display of the module’s -status	Green	Normal mode (no STO requested)
	Yellow	STO requested and achieved
	Red	Safety circuit error
Input X40.STO-A: Display of the input status	Grey	Safety function requested, STO-A = Low
	Green	No safety function requested, STO-A = High
Input X40.STO-B: Display of the input status	Grey	Safety function requested, STO-B = Low
	Green	No safety function requested, STO-B = High
Output X40.C1/C2: Display of the relay contact	Orange	Safety function active, relay contact closed
	Grey	Safety function inactive, relay contact open

Tab. 4.1 Properties/status of the safety module

4.3.3 Display log file of the motor controller

Error and status messages, such as a module replacement for example, are logged in the non-volatile, permanent diagnostic memory of the CMMP-AS-...-M3. You can readout these messages from the online register “Diagnostics” ➔ Fig. 4.3.

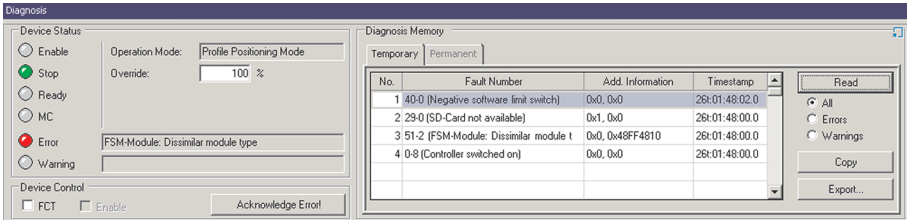


Fig. 4.3 FCT plug-in CMMP-AS: Register “Diagnostics”

4.4 Function test, validation

Note
The STO function must be validated after the installation and after changes to the installation.
This validation must be documented by the person performing commissioning. To assist you with the commissioning, questions for risk minimisation are summarised below in the form of sample checklists.

The checklists below are no substitute for safety training.
No guarantee can be provided for the completeness of the checklist.

No.	Questions	Correct	Completed
1.	Were all operating conditions and interventions taken into account?	Yes ☐ No ☐	☐
2.	If the "3-step method" for risk minimisation was applied, i. e. 1. Inherently safe design, 2. Technical and possibly additional safety measures, 3. User information on the residual risk?	Yes ☐ No ☐	☐
3.	Were the hazards eliminated or the hazard risk reduced as far as practically possible?	Yes ☐ No ☐	☐
4.	Can it be guaranteed that the implemented measures will not pose new hazards?	Yes ☐ No ☐	☐
5.	Have the users been adequately informed and warned about the residual risks?	Yes ☐ No ☐	☐
6.	Can it be guaranteed that the operators' working conditions have not deteriorated due to the safety measures taken?	Yes ☐ No ☐	☐
7.	Are the safety measures taken mutually compatible?	Yes ☐ No ☐	☐
8.	Was adequate consideration given to the potential consequences of using a machine designed for commercial/industrial purposes in a non-commercial/industrial area?	Yes ☐ No ☐	☐
9.	Can it be guaranteed that the implemented measures will not severely impair the machine's ability to perform its function?	Yes ☐ No ☐	☐

Tab. 4.2 Questions for validation in accordance with EN ISO 12100-1:2010 (example)

No.	Questions	Correct	Completed
1.	Has a risk assessment been conducted?	Yes ☐ No ☐	☐
2.	Have an error list and a validation plan been drawn up?	Yes ☐ No ☐	☐
3.	Was the validation plan, including analysis and inspection, processed and a validation report compiled? The validation procedure must include the following inspections as a minimum:	Yes ☐ No ☐	☐
	a) Component check: Is the CMMP-AS-...-M3 used with the CAMC-G-S1 (inspection using the rating plates)	Yes ☐ No ☐	☐
	b) Is the wiring correct (check against the wiring diagram)?	Yes ☐ No ☐	☐
	Have any short-circuit bypasses been removed?	Yes ☐ No ☐	☐
	Has a safety switching device been wired to X40?	Yes ☐ No ☐	☐
	Is the safety switching device certified and wired in accordance with the application's requirements?	Yes ☐ No ☐	☐
	c) Functional inspections:	Yes ☐ No ☐	☐
	Pressing the emergency stop button on the unit. Is the drive shut down?	Yes ☐ No ☐	☐
	If only STO-A is activated - is the drive shut down immediately and the "discrepancy time violation" error (Display 52-1) reported in the CMMP-AS-M3 after the discrepancy time has lapsed?	Yes ☐ No ☐	☐
	If only STO-B is activated - is the drive shut down immediately and the "discrepancy time violation" error (Display 52-1) is reported in the CMMP-AS-M3 after the discrepancy time has lapsed?	Yes ☐ No ☐	☐
	Is a short circuit detected between STO-A and STO-B or has a suitable fault exclusion been defined?	Yes ☐ No ☐	☐
	Only when using a safety switching device with analysis of the feedback contact C1/C2: Is the drive shut down on a short-circuit from C1 to C2?	Yes ☐ No ☐	☐
	Is a restart inhibited? i.e. no movement occurs when the emergency stop button is pressed and the enable signals are active unless a start command is acknowledged beforehand.	Yes ☐ No ☐	☐

Tab. 4.3 Questions for validation in accordance with EN ISO 13849-1 and 2 (example)

5 Operation

5.1 Obligations of the operator

The operational capability of the safety equipment must be checked at adequate intervals. It is the responsibility of the operator to choose the type of check and time intervals in the specified time period. The check must be made in a way that proves proper functioning of the safety equipment in interaction with all components.

5.2 Maintenance and care

The safety module does not require any maintenance.

5.3 Protective functions

5.3.1 Voltage monitoring

The input voltages at STO-A and STO-B are monitored. If the input voltage at STO-A or STO-B is too high or too low, the driver supply for the power semiconductors of the motor controller are safely switched off. The power output stage (PWM) is thus switched off.

5.3.2 Protection against overvoltage and reverse polarity

The control inputs STO-A and STO-B are protected against overvoltage and reverse polarity of the control voltage ➔ Section A.1.4, Tab. A.8.
The 24 V DC supply voltage for the motor controller routed to [X40] is short-circuit resistant.

5.4 Diagnostics and troubleshooting

5.4.1 Status indicators

Display on the safety module

The operating status is displayed on the two-colour LED of the safety module.

LED	Status	Description
Off	Not safe = STO status not active	Safety module or motor controller has no operating voltage.
Green	Not safe = STO status not active	The power output stage in the motor controller for supply of the motor can be active or inactive.
Yellow	Safe = STO status active	The power output stage in the motor controller for supply of the motor is switched off safely.

Tab. 5.1 LED display on the safety module

Display on the motor controller

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 off on the LED of the safety module. No special display is intended for the "unsafe status"; the normal status displays of the motor controller are represented.

Tab. 5.2 Seven segment display on the motor controller

5.4.2 Error messages

When an error occurs, the motor controller shows an error message cyclically in the seven-segment display on the front of the motor controller. The error message consists of an E (for Error), a main index (xx) and sub-index (y), e.g.: E 5 1 0.

Warnings have the same number as an error message. The difference is that a warning is displayed with a prefixed and suffixed hyphen, e.g. - 1 7 0 -.

Tab. 5.3 lists the error messages that are relevant for the functional safety in combination with the safety module CAMC-G-S1.

The complete list of error messages can be found in the hardware documentation GDCP-CMMP-M3-HW-... of the motor controller used.

Where an error message cannot be acknowledged, the cause must first be remedied in accordance with the recommended measures. Then reset the motor controller, and check whether the cause of the error, and the error message, have been eliminated.

Error message	Meaning	Measures
51-0 [1]	No / unknown safety module – No safety module or unknown module type detected	• Install a safety or micro switch module appropriate for the firmware and hardware. [2] • Load a firmware suitable for the safety or switch module, see type designation on the module.
	– Internal voltage error of the safety module or micro switch module	• Module presumably defective. If possible, replace with another module.
51-2 [1]	Safety module: Different module type – Type or version of the module does not fit the design	• For module replacement: Module type not yet in design. Accept installed safety or micro switch module ➔ Section 4.3.1.
51-3 [1]	Safety module: Different module version – Module type or version is not supported.	• Install a safety or micro switch module appropriate for the firmware and hardware. [2] • Load a firmware suitable for the module, see type designation on the module. [2]
52-1	Safety module: Discrepancy time expired	• Control ports STO-A and STO-B are not actuated simultaneously. • Control ports STO-A and STO-B are not wired in the same way. • Check discrepancy time.
52-2	Safety module: Failure of driver supply with active PWM activation	This error message does not occur on devices supplied ex-works. It may occur when using a customised CMMP-AS-M3 device firmware. • The safe status was requested with enabled power output stage. Check link to the safety-oriented interface.

1) The messages of error group 51 cannot be acknowledged.

2) ➔ Product identification on page 5.

Tab. 5.3 Error messages relating to the safety module

6 Conversion and module replacement

6.1 Safety module replacement

6.1.1 Repair

Repair of the module is not permissible. If necessary, replace the complete module.

6.1.2 Removal and installation

Information on removing and installing the safety module can be found here:
- Mounting/dismounting the safety module ➔ Section 3.1.
- Accept the serial number of the replaced safety module ➔ Section 4.3.2.

6.2 Decommissioning and disposal

Observe the information for dismantling the safety module in Section 3.1.

Disposal

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

6.3 Replacing the previous series CMMP-AS with the CMMP-AS-...-M3

CMMP-AS

The devices of the previous CMMP-AS series have an integrated STO “Safe Torque Off” in accordance with EN ISO 13849-1, Cat. 3 / PLd. The two-channel arrangement required by the STO function is achieved via two separate switch-off paths:

- 1. Switch-off path: Output stage enable via [X1.21], switch-off of the power output phase (PWM signals disabled). The power semiconductor drivers are no longer activated by pulse patterns.
- 2. Switch-off path: Power supply to the six output stage power semiconductors IGBTs via [X3] is interrupted by means of a relay. The driver supply for the power semiconductors (IGBT optocouplers) is disconnected by means of a relay. This prevents the pulse pattern (PWM signals) reaching the power semiconductors.

The CMMP-AS also has a floating feedback contact ([X3] Pins 5 and 6) which, as a diagnostics output, indicates the presence of the driver supply.

CMMP-AS-...-M3

Devices of the CMMP-AS-M3 series feature, in combination with the CAMC-G-S1, the safety function STO “Safe Torque Off” in accordance with EN 61800-5-2 SIL3, and/or EN ISO 13849-1, Cat. 4 / PL e.
The two switch-off paths are realised via the control ports STO-A [X40.1] and STO-B [X40.3].
The potential-free acknowledgement contact ([X40] Pins 5 and 6) is also present.

Modifications to the connection wiring

Converting an existing application with STO from CMMP-AS to CMMP-AS-M3 requires the following modifications to be made to the connection wiring.

- 1. Switch-off path:
  Retain output stage enable wiring [X1.21] and route in parallel to STO-A [X40.1].
  Connect GNDA [X40.2] to 0 V [X40.8] to link the reference potential.
- 2. Switch-off path:
  Now route driver supply wiring [X3.RELAY] to STO-B [X40.3].
  Connect GNDB [X40.4] with 0 V [X40.8] to link the reference potential.
- Feedback contact:
  Relay connection for the feedback contacts [X3.5] and [X3.6] to [X40.5] and [X40.6].

Note
During operation, the feedback contacts on the CMMP-AS and the CMMP-AS-M3 shows compatible behaviour.
When the logic supply (24 V) is switched off, they behave differently:
– CMMP-AS: Contact closed.
– CMMP-AS-...-M3: Contact open.

Information for configuration

The CMMP-AS-...-M3 exhibits a higher peak power than the CMMP-AS. Depending on the application, higher positioning speeds can therefore be reached. Use of this feature represents an essential modification to the machine.

Note
The parameter set of the CMMP-AS must be transferred with the same values to the parameter block of the CMMP-AS-...-M3. If these values are increased, which in turn poses a higher risk, a new risk assessment must be performed on the machine.

Note
Once the motor controller has been replaced, the safety function must be validated in accordance with the machine manufacturer’s specifications.

A Technical appendix

A.1 Technical data

A.1.1 Safety engineering

Safety indicators			
Safety function		STO	– Safe Restart Interlock (STO, Safe Torque Off) to EN 61800-5-2 with SIL3 – Safe Restart Interlock (STO, Safe Torque Off) to EN ISO 13849-1 with category 4 and PL e
SIL		SIL 3 / SIL CL3	Safety integrity level to EN 61800-5-2
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	[%]	97.5	Average diagnostic coverage
HFT		1	Hardware failure tolerance
SFF	[%]	99.2	Safe failure fraction
PFH		1.07×10^{-10}	Probability of dangerous failure per hour
PFD		2.3×10^{-5}	Probability of dangerous failure on demand
T	[Years]	20	Proof test interval Duration of use in accordance with EN ISO 13849-1
MTTFd	[Years]	100	Mean time to dangerous failure Calculated at 1450 years, limited to 100 years

Tab. A.1 Technical data: Safety indicators

Safety specifications	
Product type testing	The functional safety equipment of the product was certified by an independent testing authority in accordance with section 1.1.4; see EC product type test certificate ➔ www.festo.com
Certifying body	TÜV 01/205/5165/11
Reliable component	Yes

Tab. A.2 Technical data: Safety specifications

A.1.2 General

Mechanical		
Length/width/height	[mm]	112.6 x 87.2 x 28.3
Weight	[g]	75
Slot		Slot Ext3 for safety module
Note on materials		RoHS-compliant

Tab. A.3 Technical data: Mechanical

Certifications (safety module CAMC-G-S1 for motor controller CMMP-AS-...-M3)	
CE marking (see declaration of conformity) ➔ www.festo.com	In accordance with EU EMC Directive
	In accordance with EU machine directive
	The device is intended for industrial use. Measures for interference suppression may need to be implemented in residential areas.

Tab. A.4 Technical data: Certification

A.1.3 Operating and environmental conditions

Transport		
Temperature range	[°C]	–25 ... +70
Air humidity	[%]	0 ... 95, at max. 40 °C ambient temperature
Maximum transportation duration		Maximum 4 weeks over the entire product life cycle

Tab. A.5 Technical data: Transport

Storage		
Storage temperature	[°C]	–25 ... +55
Air humidity	[%]	5 ... 95, non-condensing or protected against condensation
Permissible altitude	[m]	< 3000 (above sea level)

Tab. A.6 Technical data: Storage

Ambient conditions		
Ambient temperature	[°C]	0 ... +40 (outside the motor controller housing)
Cooling		By means of ambient atmosphere in the motor controller, no forced ventilation
Permissible setup altitude	[m]	< 2000 (above sea level)
Protection class		IP20 (mounted in the CMMP-AS-...-M3).
Air humidity	[%]	Relative air humidity up to 90 % non-condensing
Degree of contamination in accordance with EN 61800-5-1		2
		The integrated safety equipment requires compliance with degree of contamination 2 and thus a protected fitting space (IP54). This must always be ensured through appropriate measures, e.g. through installation in a control cabinet.

Tab. A.7 Technical data: Ambient conditions

A.1.4 Electrical data

Control ports STO-A, 0V-A / STO-B, 0V-B [X40]		
Nominal voltage	[V]	24 (related to 0V-A/B)
Voltage range	[V]	19.2 ... 28.8
Permissible residual ripple	[%]	2 (related to nominal voltage 24 V)
Overvoltage discharge	[V]	31 (disconnect in case of error)
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]	1 (typical; maximum 5)
Maximum positive test impulse length at logic 0	[µs]	< 300 (related to nominal voltage 24 V and intervals > 2 s between impulses)

Tab. A.8 Technical data: Electrical for ports STO-A and STO-B

Switch-off time to power output stage inactive and maximum tolerance time for test pulse											
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 pulse at 24 V signal	[ms]	<2.0	<2.0	2.0	2.5	3.0	3.5	4.5	5.0	5.5	6.0

Tab. A.9 Typical switch-off time and minimum tolerance time for test pulse (OSSD signals)

Feedback contact C1, C2 [X40]		
Version		Relay contact, normally open
Max. voltage	[V DC]	< 30 (overvoltage-proof up to 60 V DC)
Nominal current	[mA]	< 200 (not short circuit proof)
Voltage drop	[V]	≤ 1
Residual current (contact opened)	[µA]	< 10
Switching time closing (T_C1/C2_ON)	[ms]	< (STO-A/B_OFF [1)] + 5 ms)
Switching time opening (T_C1/C2_OFF)	[ms]	< (STO-A/B_ON [1)] + 5 ms)

1) STO-A/B_OFF, STO-A/B_ON ➔ Tab. A.8

Tab. A.10 Technical data: Electrical data of the feedback contact C1/C2

Auxiliary supply 24V, 0V [X40] – output		
Version		Logic supply voltage routed out of the motor controller (fed in at [X9], not additionally filtered or stabilised). Reserve polarity protected, overvoltage-proof up to 60 V DC.
Nominal voltage	[V]	24
Nominal current	[mA]	100 (short circuit proof, max 300 mA)
Voltage drop	[V]	≤ 1 (for nominal current)

Tab. A.11 Technical data: Electrical data of the auxiliary supply output

Electrical isolation	
Electrically isolated potential ranges	STO-A / 0V-A
	STO-B / 0V-B
	C1 / C2
	24V / 0V (Logic supply to the motor controller)

Tab. A.12 Technical data: Electrical isolation [X40]

Cabling		
Max. cable length	[m]	30
Screening		When wiring outside the control cabinet, use screened cable. Guide screening into the control cabinet / attach to the side of the control cabinet.
Cable 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. A.13 Technical data: Cabling to [X40]

B Glossary

Term/abbreviation	Description
Cat.	Safety category in accordance with EN ISO 13849-1, Stages 1-4.
CCF	Common Cause Failure in accordance with EN ISO 13849-1.
DC avg	Average Diagnostic Coverage in accordance with IEC 61508 and EN 61800-5-2.
EMERGENCY SWITCHING OFF	In accordance with EN 60204-1: Electrical safety in case of emergency by switching off the electrical energy to all or part of the installation. EMERGENCY SWITCHING OFF is to be used where a risk of electric shock or other electrical risk exists.
Emergency stop	In accordance with EN 60204-1: Functional safety in an emergency by bringing a machine or movable parts to a standstill. Emergency stop is used to stop a process or a motion if this creates a danger.
FCT	Festo Configuration Tool, software for configuration and commissioning
HFT	Hardware Fault Tolerance in accordance with IEC 61508.
MTTFd	Mean Time To dangerous Failure: Time in years up to the first dangerous failure occurs with 100 % probability in accordance with EN ISO 13849-1.
OSSD	Output Signal Switching Device: Output signals with 24 V cycle rates for error detection.
PFD	Probability of Failure on Demand in accordance with IEC 61508.
PFH	Probability of Dangerous Failures per Hour in accordance with IEC 61508.
PL	Performance Level in accordance with EN ISO 13849-1: Stages a ... e.
Safety switching device	Device for executing safety functions or restoring the machine to a safe status after the power supply to dangerous machine functions has been switched off. The desired safety function is achieved only in combination with other measures, although switch-off can occur on a motor controller, for example.
SFF	Safe Failure Fraction [%] in accordance with IEC 61508.
SIL	Safety Integrity Level, discrete stages for defining the requirements for the safety integrity of safety functions in accordance with IEC 61508, EN 62061 and EN ISO 13849.
SIL CL	Maximum SIL that can be required from a sub-system.
STO	Safe Torque Off in accordance with EN 61800-5-2.
T	Duration of use in accordance with EN ISO 13849-1.

Tab. B.1 Terms and abbreviations

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