SEW
EURODRIVE

Manual

FS

MOVIFIT® MC/FC – Functional Safety

Contents

Contents

1 General information

1.1 About this documentation

This documentation is an integral part of the product. The documentation is intended for all employees who perform assembly, installation, startup, and service work on the product.

Make sure this documentation is accessible and legible. Ensure that persons responsible for the machinery and its operation as well as persons who work on the device independently have read through the documentation carefully and understood it. If you are unclear about any of the information in this documentation or require further information, contact SEW-EURODRIVE.

1.2 Structure of the safety notes

1.2.1 Meaning of signal words

The following table shows the grading and meaning of the signal words for safety notes.

Signal word	Meaning	Consequences if disregarded
⚠ **DANGER**	Imminent hazard	Severe or fatal injuries.
⚠ **WARNING**	Possible dangerous situation	Severe or fatal injuries.
⚠ **CAUTION**	Possible dangerous situation	Minor injuries
NOTICE	Possible damage to property	Damage to the drive system or its environment.
INFORMATION	Useful information or tip: Simplifies handling of the drive system.	

1.2.2 Structure of section-related safety notes

Section-related safety notes do not apply to a specific action but to several actions pertaining to one subject. The hazard symbols used either indicate a general hazard or a specific hazard.

This is the formal structure of a safety note for a specific section:

SIGNAL WORD

Type and source of hazard.

Possible consequence(s) if disregarded.

• Measure(s) to prevent the hazard.

Meaning of the hazard symbols

The hazard symbols in the safety notes have the following meaning:

Hazard symbol	Meaning
	General hazard
	Warning of dangerous electrical voltage
	Warning of hot surfaces
	Warning of risk of crushing
	Warning of suspended load
	Warning of automatic restart

1.2.3   Structure of embedded safety notes

Embedded safety notes are directly integrated into the instructions just before the description of the dangerous action.

This is the formal structure of an embedded safety note:

⚠ **SIGNAL WORD** Type and source of hazard. Possible consequence(s) if disregarded. Measure(s) to prevent the hazard.

1.3 Rights to claim under limited warranty

Read the information in this documentation. This is essential for fault-free operation and fulfillment of any rights to claim under limited warranty. Read the documentation before you start working with the unit!

1.4 Content of the documentation

The current version of the documentation is the original.

This document contains additional safety-relevant information and conditions for use in safety-related applications.

1.5 Exclusion of liability

Read the information in this documentation, otherwise safe operation is impossible. You must comply with the information contained in this documentation to achieve the specified product characteristics and performance features. SEW-EURODRIVE assumes no liability for injury to persons or damage to equipment or property resulting from non-observance of these operating instructions. In such cases, SEW-EURODRIVE assumes no liability for defects.

1.6 Other applicable documentation

This document contains safety-relevant amendments and requirements for the use of MOVIFIT® MC and MOVIFIT® FC with safety-related disconnection of the drive to stop categories 0 or 1 in accordance with EN 60204-1, protection against restart to EN 1037, and use in applications of performance level d to EN ISO 13849-1.

Further, it describes the safety-related PROFIsafe option S11 with the corresponding safety-relevant requirements for use in safety-related applications up to SIL 3 according to EN 61508 and performance level e according to EN ISO 13849-1.

This document supplements the "MOVIFIT® ..." operating instructions and limits the application notes according to the following information. It may only be used in conjunction with the "MOVIFIT®" operating instructions.

1.7 Product names and trademarks

The brands and product names in this documentation are trademarks or registered trademarks of their respective titleholders.

1.8 Copyright notice

2 Safety concept

The described safety technology of the MOVIFIT® device has been developed and tested in accordance with performance level d to EN ISO 13849-1:2008.

This was certified by TÜV Nord. Copies of the TÜV certificate and the corresponding report are available from SEW-EURODRIVE on request.

2.1 MOVIFIT® MC safety concept

2.1.1 Functional description

The MC design of the MOVIFIT® acts as a power distributor and communication interface for controlling up to 3 MOVIMOT® drives. MOVIFIT® MC allows for the connection of an external safety controller (or an external safety relay). If the connected emergency stop device (e.g. emergency off button with latching function) is activated, the safety controller disconnects the 24 V supply voltage that is required for creating a rotating field for the connected MOVIMOT® drive.

The 24V_P supply voltage (safety-related 24 V supply voltage) is connected in the ABOX at the X29 terminal and fed to the EBOX via a plug strip. The EBOX houses electronic components, such as a short-circuit protection, voltage monitor, RS485 transceiver and coupler. The safety-related 24V_P supply voltage is routed through a polarity protection diode at the input of the EBOX. A switch-mode power supply (SMPS) generates 5 V voltage from the safety-related 24 V voltage for the RS485 transceiver and the coupler. Short-circuit protection of the positive pole of the safety-related 24 V voltage protects the contactor tracks of the MOVIFIT® and the hybrid cables connected to the MOVIFIT®. In the ABOX, the safety-related 24 V voltage is distributed to the terminal strips X71, X81, and X91 or the plug connectors X7, X8, and X9. The terminal strips of plug connectors serve to connect the respective MOVIMOT® drives. Further, the RS+, RS- signals and the supply system cables L1, L2, L3 are forwarded to the MOVIMOT® drives.

For the connection between the terminal strips X71, X81, and X91 or the plug connectors X7, X8, and X9 and the MOVIMOT® drives, SEW-EURODRIVE recommends pre-fabricated hybrid cables that have been designed and shielded especially for this purpose.

The connected MOVIMOT® inverters can de-energized all active elements that are required for creating pulse trains at the power output stage (IGBT) if the safety-related 24 V supply voltage is disconnected. This ensures that the MOVIMOT® inverter no longer supplies power to the motor for generating torque.

> With the external connection via a safety controller that
> - Is approved for at least PL d according to EN ISO 13849-1
> - Disconnects with at least PL d according to EN ISO 13849-1
>
> MOVIFIT® MC devices can be used with:
> - Safe Torque Off according to EN 61800-5-2
> - Safe Stop 1 according to EN 61800-5-2
> - Restart inhibit in accordance with EN 1037
> - In compliance with performance level d according to EN ISO 13849-1.
>
> MOVIFIT® MC supports stop categories 0 and 1 according to EN 60204-1.

2.1.2 MOVIFIT® MC block diagram

The following block diagram shows the MOVIFIT® MC safety concept:
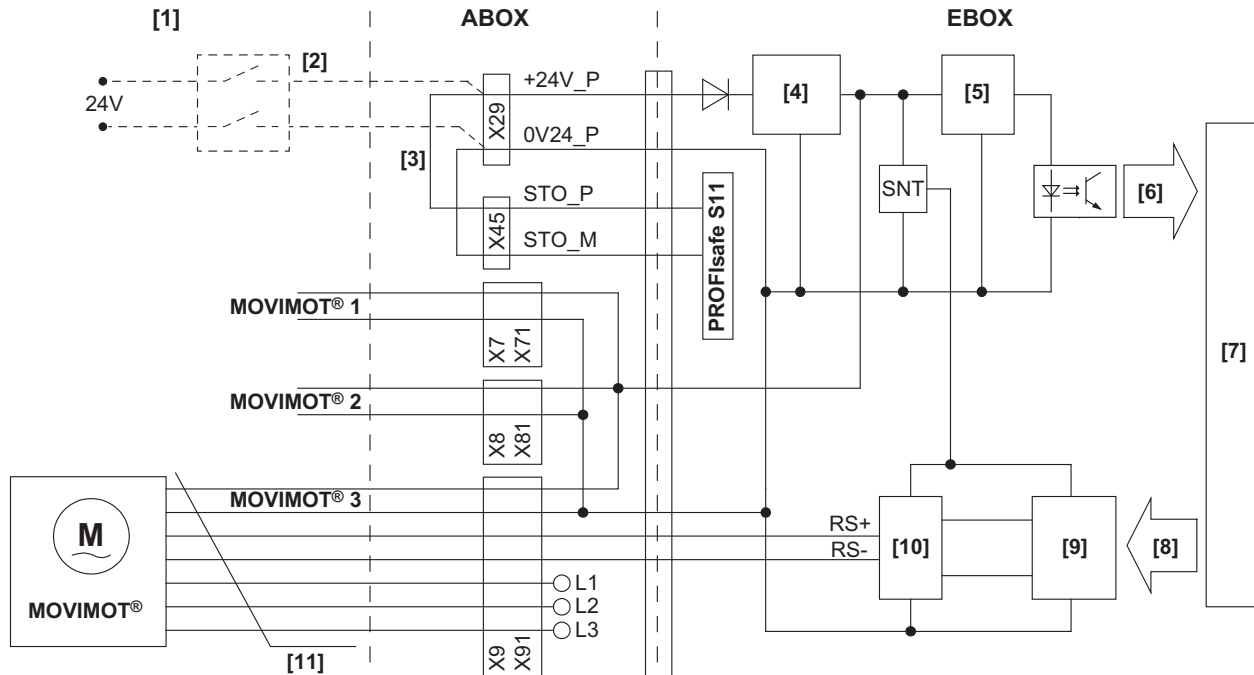
18014402603707659

[1] Field
[2] Safety controller, external (only with MOVIFIT® **without** PROFIsafe option S11)
[3] 2 jumpers between X29 and X45 (only with MOVIFIT® **with** PROFIsafe option S11)
[4] Short-circuit protection
[5] 24V_P voltage monitor
[6] Voltage status 24V_P
[7] MOVIFIT® processor
[8] Serial interface
[9] Coupler
[10] Transceiver
[11] SEW-EURODRIVE hybrid cable

2.1.3 Restrictions

⚠ WARNING

Electric shock due to dangerous voltages in the ABOX. If the safety-related 24 V voltage is disconnected, MOVIFIT® device remains connected to the line voltage.

Severe or fatal injuries.

- De-energize the new MOVIFIT® device. Observe the minimum switch-off time after disconnection from the supply system:
  - **1 minute**

- The safety concept is only suitable for performing mechanical work on driven system/machine components.
- A system/machine-specific risk assessment must at all costs be carried out by the system/machine manufacturer and be observed when using the MOVIFIT® MC device.

2.2 MOVIFIT® FC safety concept

2.2.1 Functional description

The FC design of MOVIFIT® acts as a power distributor and communication interface with an integrated frequency inverter with a power range of 0.37 to 4 kW. MOVIFIT® FC allows for the connection of an external safety controller (or an external safety relay). If the connected emergency stop device (e.g. emergency off button with latching function) is activated, the safety controller disconnects the 24 V supply voltage that is required for creating a rotating field at the inverter output.

The 24V_P supply voltage (safety-related 24 V voltage supply) is connected to terminal X29 in the ABOX and is fed to the control electronics via a plug strip, and to the EBOX via the direct plug connector. Control electronics and power section are integrated in the EBOX. The safety-related 24V_P supply voltage is routed through a polarity protection diode at the input of the EBOX. A switched-mode power supply ("SNT Safety") generates a 5 V voltage from the safety-related 24 V supply for the computer as well as the required supply voltages for the output stage control.

The supply voltages and motor voltages are connected to a terminal strip of the ABOX and fed directly to the EBOX via a power connector.

The pulse patterns generated in the computer are conditioned in the respective control and relayed to the circuit breaker. If the supply voltages for the controls are switched off, no pulse patterns can be generated at the inverter output.

This kind of disconnection ensures that all active elements required to generate a pulse pattern at the inverter output are switched off.

> With the external connection via a safety controller that
>
> • Is approved for at least PL d according to EN ISO 13849-1
>
> • Disconnects with at least PL d according to EN ISO 13849-1
>
> MOVIFIT® FC devices can be used with:
>
> • Safe Torque Off according to EN 61800-5-2
>
> • Safe Stop 1 according to EN 61800-5-2
>
> • Restart inhibit in accordance with EN 1037
>
> • In compliance with performance level d according to EN ISO 13849-1.
>
> MOVIFIT® FC supports stop categories 0 and 1 according to EN 60204-1.

2.2.2 MOVIFIT® FC block diagram
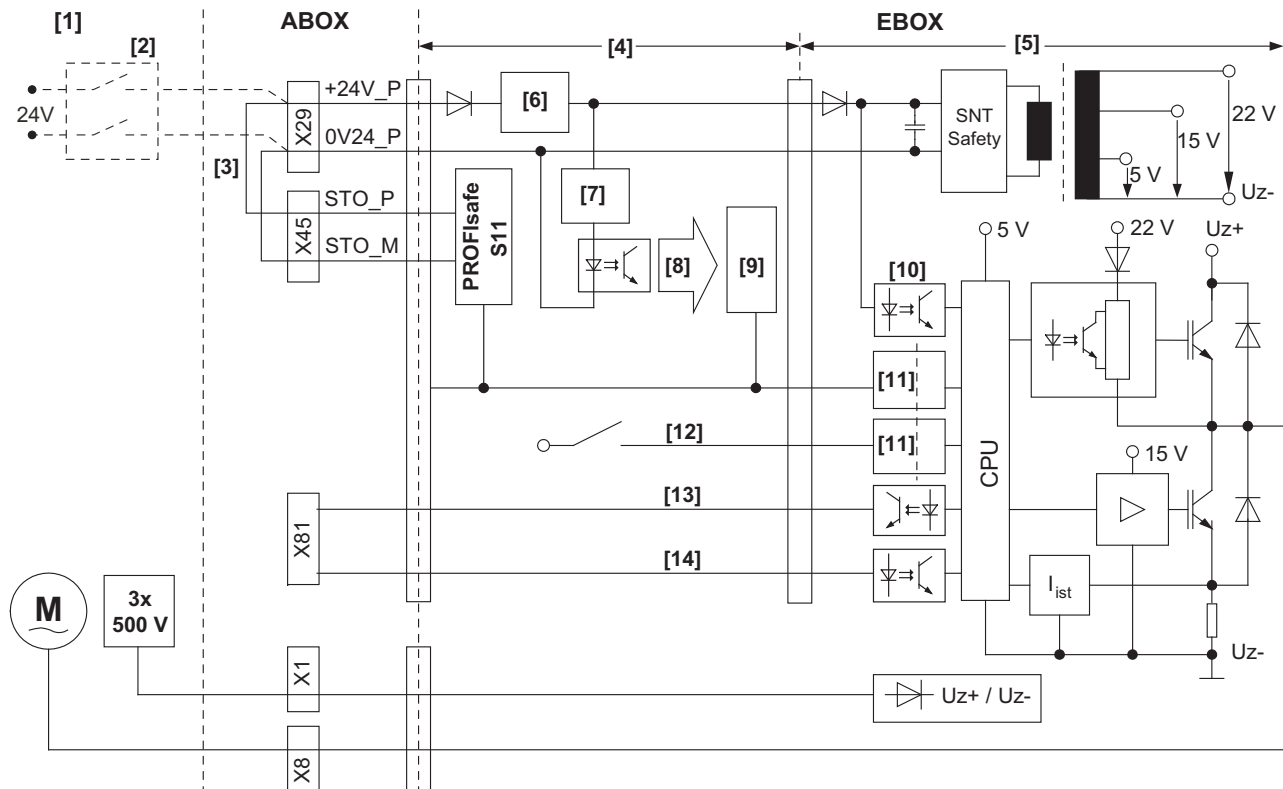
18014402603733515

[1] Field
[2] Safety controller, external
(only with MOVIFIT® **without** PROFIsafe option S11)
[3] 2 jumpers between X29 and X45
(only with MOVIFIT® **with** PROFIsafe option S11)
[4] Control electronics
[5] Power section
[6] Short-circuit protection

[7] 24V_P voltage monitor
[8] Voltage status 24V_P
[9] MOVIFIT® processor
[10] 24V_P voltage monitor
[11] Coupler
[12] Read DIP switch
[13] Digital brake output
[14] TF/TH evaluation

2.2.3 Restrictions

⚠ WARNING

Electric shock due to dangerous voltages in the ABOX. If the safety-related 24 V voltage is disconnected, MOVIFIT® device remains connected to the line voltage.

Severe or fatal injuries.

• De-energize the new MOVIFIT® device. Observe the minimum switch-off time after disconnection from the supply system:

– **1 minute**

• The safety concept is only suitable for performing mechanical work on driven system/machine components.

• A system/machine-specific risk assessment must at all costs be carried out by the system/machine manufacturer and be observed when using the MOVIFIT® FC device.

2.3 Safety concept for PROFIsafe Option S11

- PROFIsafe option S11 is an integrated safety-related electronics component with safety-related inputs and outputs (F-DI, F-DO). The safety concept of this sub-assembly is based on the fact that there is a safe state for all safety-related process values. For the PROFIsafe option S11 this value is "0", for all inputs F-DI and outputs F-DO.

- A 2-channel redundant system structure of the safety component ensures that, with suitable monitoring mechanisms, requirements for SIL 3 according to EN 61508 and performance level "e" according to EN ISO 13849-1 are fulfilled. When the system detects a fault, it reacts by reverting to a safe status. In this way, the safety function is realized in the form of safety-related inputs and outputs with connection to a higher-level safety control via the PROFIsafe communication.

- The safety-related output F-DO_STO is used to disconnect the 24 V supply to the inverter, which achieves safety-related disconnection of the drive. In this context, observe the safety concept of the MOVIFIT® MC and MOVIFIT® FC, all conditions, and all installation specifications in this publication.

> The safety class of the MOVIFIT® basic device determines the safety-related switch-off of the following overall systems:
>
> - **MOVIFIT® MC** with:
>   - PROFIsafe option S11
>   - MOVIMOT® MM..D drive
>
>   MOVIFIT® MC may only be used in applications up to Performance Level d according to EN ISO 13849-1.
>
> - **MOVIFIT® FC** with:
>   - PROFIsafe option S11
>   - Motor
>
>   MOVIFIT® FC may only be used in applications up to Performance Level d according to EN ISO 13849-1.

2.4 Safety functions

The following drive-related safety functions can be used:

2.4.1 STO – Safe Torque Off

When the STO function is active, the inverter does not supply any power to the motor. The drive cannot generate torque. This safety function corresponds to a non-controlled stop according to EN 60204-1, stop category 0.

The STO input must be disabled by a suitable external safety controller/safety relay.

The following figure illustrates the STO function:
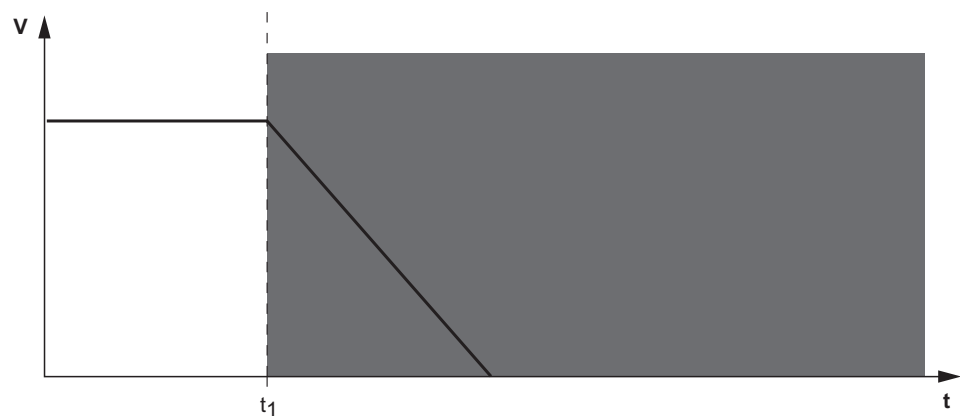
9007201225613323

Drive safety function trips
$v =$ Speed
$t =$ Time
$t_1 =$ Point of time when STO is triggered

INFORMATION

The motor coasts to a halt or is stopped mechanically.

Controlled standstill is preferred, if possible (see SS1).

2.4.2 SS1(c) – Safe Stop 1

Adhere to the following procedure:

- Decelerate the drive using an appropriate brake ramp specified via setpoint inputs.
- Disconnect the STO input (= triggering the STO function) after a specified safety-related time delay.

This safety function corresponds to a controlled stop according to EN 60204-1, stop category 1.

The following figure illustrates the SS1(c) function:
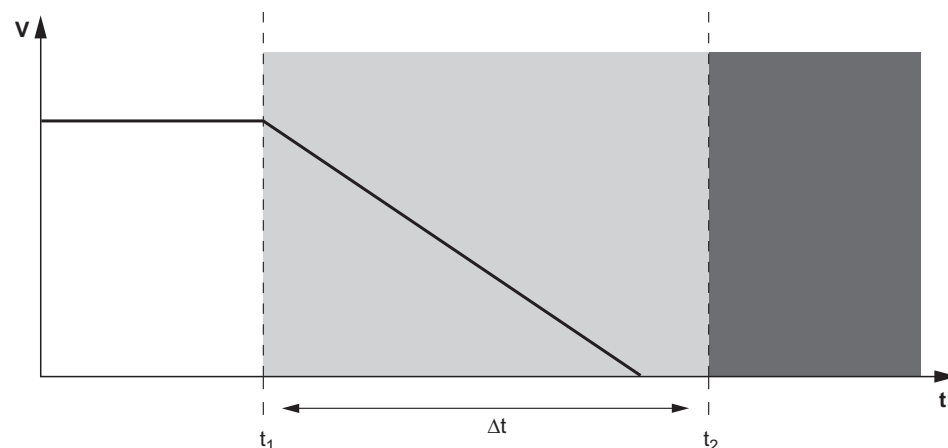
9007201225618443

Drive safety function monitoring
Drive safety function trips
v = Speed
t = Time
t_1 = Point of time when SS1(c) is activated and the braking action is triggered
t_2 = Point of time when STO is triggered
Δt = Safety-related period of time

INFORMATION

- The SS1(c) function does not monitor the stopping of the drive.
- The safety-related period of time Δt allows the drive to come to a stop. In the event of a fault, the drive does not come to a stop and becomes de-energized at the time t_2 (STO).

3 Safety conditions

The following requirements are mandatory for installation and operation of MOVIFIT® in safety-related applications according to the safety categories mentioned above. The conditions are divided into the following sections:

- Approved devices
- Installation requirements
- Requirements for the external safety controller (for digital control for safety-related disconnection)
- Requirements for external sensors and actuators (in combination with PROFIsafe Option S11)
- Startup requirements
- Operational requirements

3.1 Approved devices

3.1.1 Nameplates

Nameplate position

The following figure shows the positions of the nameplates on the ABOX:
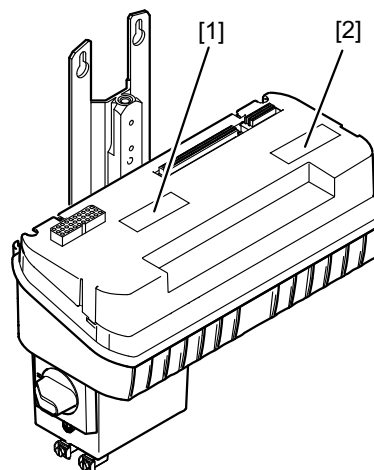
7012396683

[1] Nameplate of the complete device (EBOX and ABOX)
[2] Nameplate of the ABOX

Nameplate of the complete unit

The following figure provides an example of a nameplate of the complete MOVIFIT® FC device (EBOX and ABOX):

SO#: 01.1785033001.0001.12

Type: MTF11A015-503-P10A-11
MTA11A-503-S021-D01-00

MOVIFIT

ML01

LISTED

IND. CONT. EQ.2D06

18014405400496011

This overall device nameplate is only available if the EBOX and the ABOX have been ordered as one unit.

INFORMATION

Only components marked with the FS logo for functional safety may be installed in safety applications. For combinations of devices without FS logo (consisting of individual EBOX and ABOX), the safety function must be described in the documentation.

FS logo description

The FS logo can be displayed on the complete unit nameplate of MOVIFIT® in the following designs:

MOVIFIT® with STO (with or without S11 PROFIsafe option)

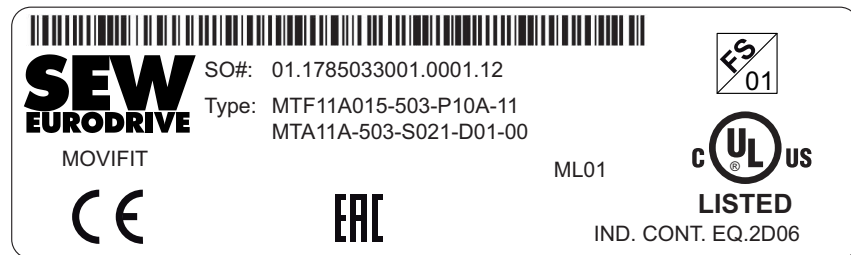For more information about MOVIFIT® with **FS01** logo, refer to the "MOVIFIT® MC / FC – Functional Safety" manual.

MOVIFIT® with S12 safety option

For more information about MOVIFIT® with **FS80** logo, refer to the "MOVIFIT® MC / FC – Functional Safety with Safety Option S12" manual.

3.1.2 Device replacement requirements

Observe the following notes during device replacement:

- In safety-related applications, a defective **EBOX** may only be replaced by an EBOX according to the type designation on the nameplate of the complete MOVIFIT® device.

- If the **ABOX** is defective in safety-related applications, you have to replace the entire MOVIFIT® device (EBOX and ABOX) with a new MOVIFIT® device with identical type designation.

3.2 Installation requirements

- Safety-related control cables are all cables between safety controller and MOVIFIT® terminal X29.

- Supply system cables and the safety-related control cables must be routed separately (Exception: When using genuine hybrid cables by SEW-EURODRIVE).

- The line length between the safety controller and MOVIFIT® may not exceed 100 m.

- To connect the MOVIFIT® device to the motor, SEW-EURODRIVE recommends using the specifically designed prefabricated hybrid cable by SEW-EURODRIVE.

- The wiring technology used must comply with EN 60204-1.

- Route the safety-related control cables EMC-compliantly.

  – Outside an electrical installation space: Shielded cables must be routed permanently (fixed) and protected against external damage, or other equivalent measures.

  – No single conductors must be routed within the installation space.

- Make sure that parasitic voltages cannot be generated in the safety-related control cables.

- Observe the values specified for safety controllers when designing the safety circuits.

- Observe the notes in the "MOVIFIT® .." and "MOVIMOT® MM..D" operating instructions for information on EMC-compliant installation.

- For all 24 V supply voltages of the MOVIFIT® device only voltage sources with safe disconnection (SELV/PELV) according to EN 60204-1 and EN 61131-2 are permitted.

  In case of a single fault, the voltage between the outputs or between any output and grounded parts may not exceed DC 60 V.

- Observe MOVIFIT® and MOVIMOT® MM..D technical specifications.

3.3   External safety controller requirements

The following requirements for the external safety controller for controlling the STO safety function apply to safety-related disconnection with binary control.

The requirements apply to both a safety controller and a safety relay.

- For safety-related approval to EN ISO 13849-1, there must be at least one approval for performance level d according to EN ISO 13849-1 and the disconnection of the safety-related control voltage must be designed for performance level d to EN ISO 13849-1 at least.

- The wiring of the safety controller must be suitable for the required safety class. Safety circuits with MOVIFIT® require 2-pole disconnection.

- The values specified for the safety controller must be strictly adhered to when designing the circuit.

- The switching capacity of the control must correspond at least to the maximum permitted limited output current of the DC 24 V voltage supply.

  Observe the manufacturer's instructions concerning the permitted contact loads and fusing that may be required for the safety contacts. If the manufacturer provides no specific information, the contacts must be protected with 0.6 times the nominal value of the maximum contact rating specified by the manufacturer.

- For wiring with crossfault monitoring, the controller must feature an option for signaling crossfault monitoring and trigger recognition.

- To ensure protection against unintended restart in accordance with EN 1037, the safety controller must be configured and connected in such a way that resetting the control device alone does not lead to a restart. A restart may only be carried out after a manual reset of the safety circuit.

- The input for the safety-related DC 24 V voltage supply of the device has an input capacitance. For detailed information, refer to the "Technical Data "chapter of the operating instructions of the respective device. This must be taken into account as load when designing the switching output.

- Other requirements of the safety controller (such as protecting the output contacts against welding) must be strictly observed. You must also observe the basic cable routing requirements from chapter "Installation requirements".

- If the safety circuit is disconnected at 2 poles, the test pulses may not be applied at the same time. The length of a test pulse must not exceed 1 ms. The interval between 2 test pulses must be at least 1 s.
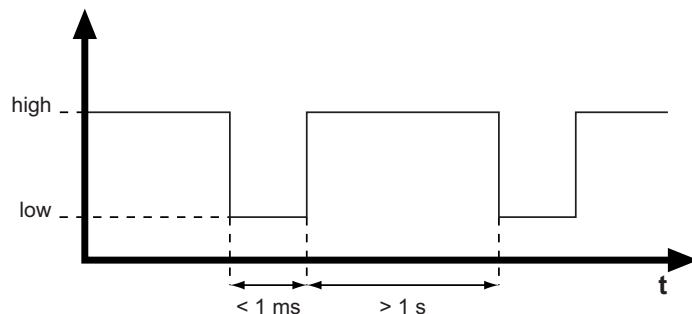
9007199938827659

Sample circuit "safety relay"

The following figure shows the disconnection of an external safety relay.
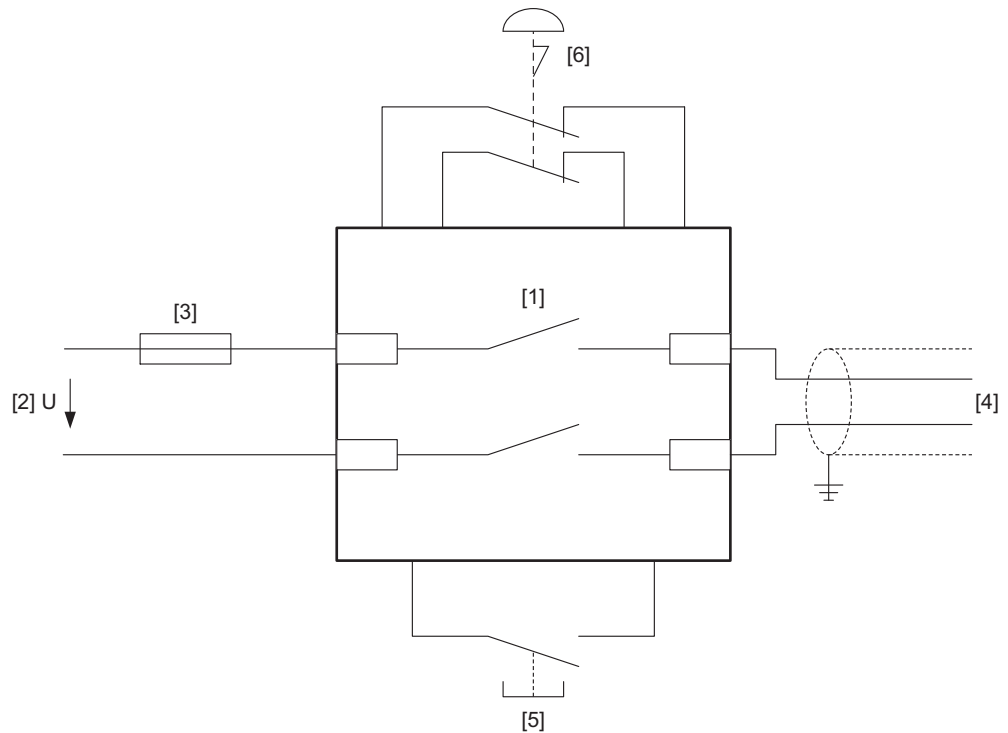
18014400103440907

[1]   Safety relay with approval
[2]   DC 24 V voltage supply
[3]   Fuses in accordance with the manufacturer's specifications of the safety relay
[4]   Safety-related DC 24 V voltage supply
[5]   Reset button for manual reset
[6]   Approved emergency stop actuating device

3.4 External sensors and actuators – requirements

The following requirements apply to using the PROFIsafe option S11.

- The project planner and the operator of the system or machine are responsible for the selection and use of external sensors and actuators to connect to the safety-related inputs and outputs of the PROFIsafe option S12.

- Note that the majority of dangerous failures for any given safety class is usually caused by the sensors and actuators.

- To meet the required performance level (PL), you have to use suitable and qualified sensors and actuators, and observe the relevant wiring diagrams and notes in chapter "Connecting the safety-related inputs/outputs of PROFIsafe option S11" (→ 🖺 36).

- With PROFIsafe option S11, you may only use sensors with contacts with the normally energized principle at the safety-related F-DI. inputs. Supply must be realized using the internal sensor supply voltage F-SS.

- For the sensor signals to be correctly detected by the safety-related inputs, the signals must not be shorter than the minimum duration of 15 ms.

3.5 Startup requirements

After parameterization and startup, the system startup engineer has to check and document the correct performance of the safety functions.

For MOVIFIT® applications with safety-related disconnection of the drive

- In stop category 0 or 1 in accordance with EN 60204-1,

- Protection against restart in accordance with EN 1037,

- And compliance with Performance Level d according to EN ISO 13849-1,

startup checks of the disconnecting device and the correct wiring must always be carried out and documented.

During startup you must include signal detection of the safety-related control voltage in the function test.

INFORMATION

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The insert labels of the MOVIFIT® EBOXes are assigned to the respective EBOX. If you take out the labels to mark them, make sure that they are re-inserted in the right EBOX.

To avoid danger in the application, the user has to check whether the fault response time of each safety function (when a failure occurs) is shorter than the maximally permitted fault response time of the application. The maximally permitted fault response time may not be exceeded!

3.6 Operation requirements

- Operation is only permitted within the limits specified in the data sheets. This applies to the external safety control as well as to MOVIFIT® and MOVIMOT®.

- You must check the safety functions on a regular basis to ensure proper functioning. The test intervals should be specified in accordance with the risk assessment.

4 Hazard caused by drive coasting

> ⚠ **WARNING**
>
> Hazard caused by coasting of the drive. Without mechanical brake or if the brake is faulty, the drive might coast to a halt.
>
> Severe or fatal injuries.
>
> - If coasting to a halt results in application-dependent hazards, take additional protective measures (for example, guards with locking device), which cover the hazardous area until persons are no longer in danger. As an alternative, you must equip the drive with a safety brake.
>
> - The additional protective covers must be designed and integrated so that they meet the requirements determined in the risk assessment of the machine.
>
> - After activating the stop command, access to the machine must remain blocked until the drive has reached standstill according to the risk. As an alternative, you must determine the access time or calculate the resulting safety clearance that must be adhered.

5 Electrical installation

5.1 Installation instructions

To guarantee electrical safety and fault-free operation, you must observe the general installation instructions and the notes in the MOVIFIT® operating instructions.

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- Observe the requirements in chapter "Safety-relevant conditions".

5.1.1 UL-compliant installation

For UL-compliant installation in conjunction with PROFIsafe option S11, observe the following note:

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For UL-compliant installation, the input current of the PROFIsafe option card must be limited to 4 A.
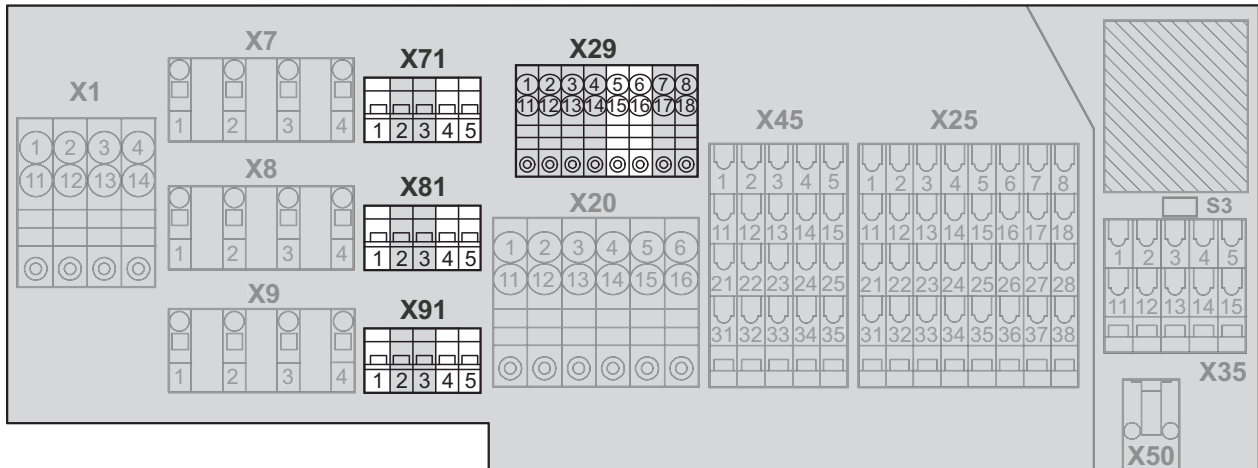
For connection examples, refer to chapter "24 V supply of the PROFIsafe option S11" (→ 🖹 35).

5.2 Safety-related disconnection MOVIFIT®

5.2.1 MOVIFIT® MC

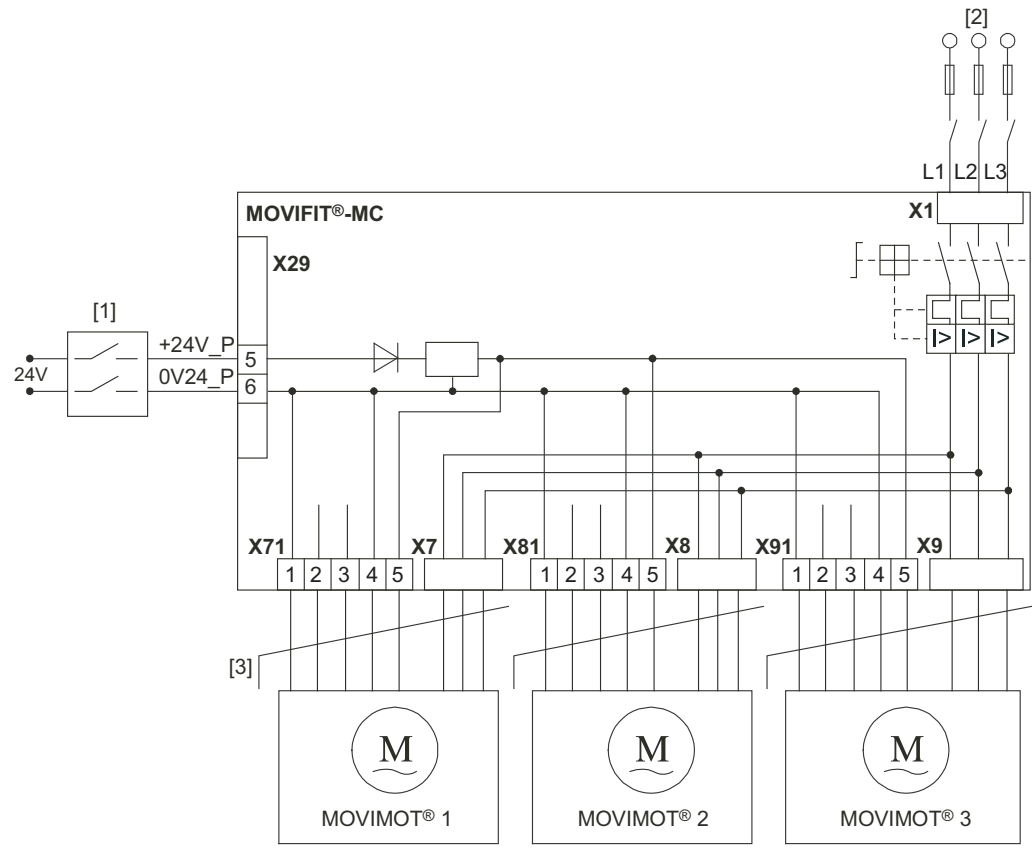**Terminals relevant for safety-related disconnection**

The following figure shows the connecting terminals of the standard ABOX "MTA...-S01.-...-00" relevant for safe disconnection of MOVIFIT® MC:

4094605451

Terminal strip	Name	Function
X29/5	+24V_P	Connection of safety-related 24 V supply voltage +24 V supply for MOVIMOT®, (IN)
X29/6	0V24V_P	Connection of safety-related 24 V supply voltage 0V24 reference potential for MOVIMOT®, (IN)
X29/15	+24V_P	Connection of safety-related 24 V supply voltage +24 V supply for MOVIMOT®, (OUT)
X29/16	0V24V_P	Connection of safety-related 24 V supply voltage 0V24 reference potential for MOVIMOT®, (OUT)
X71/1, X71/4 X81/1, X81/4 X91/1, X91/4	0V24_MM	Output of safety-related 24 V supply voltage **0V24 reference potential MOVIMOT® 1 to 3**
X71/5 X81/5 X91/5	+24V_MM	Output of safety-related 24 V supply voltage **+24 V supply voltage MOVIMOT® 1 to 3**

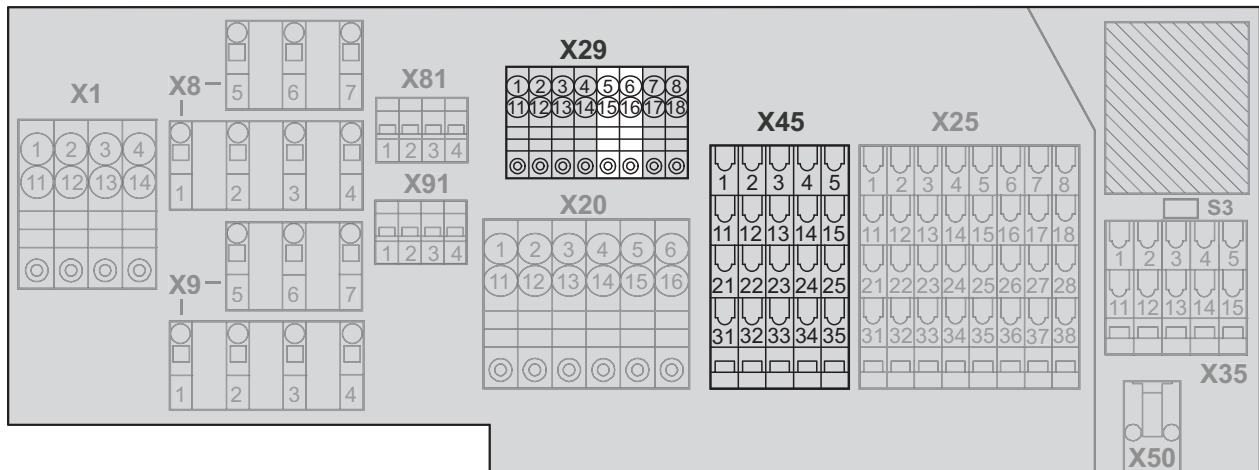**Wiring diagram MOVIFIT® MC for safety-related disconnection**

9007203349479819

[1]   External safety controller
[2]   Line connection
[3]   Hybrid cable

5.2.2 MOVIFIT® FC

Terminals relevant for safety-related disconnection

The following figure shows the connecting terminals of the standard ABOX "MTA...-S02.-...-00" relevant for safe disconnection of MOVIFIT® FC:

17454853771

Terminal strip	Name	Function
X29/5	+24V_P	Connection of safety-related 24 V supply voltage
		+24 V supply for integrated frequency inverter, (IN)
X29/6	0V24V_P	Connection of safety-related 24 V supply voltage
		0V24 reference potential for integrated frequency inverter, (IN)
X29/15	+24V_P	Connection of safety-related 24 V supply voltage
		+24 V supply for integrated frequency inverter, (OUT)
X29/16	0V24V_P	Connection of safety-related 24 V supply voltage
		0V24 reference potential for integrated frequency inverter, (OUT)

X71F plug connector for safety-related disconnection (option)

⚠ **WARNING**

No safety-related disconnection of the MOVIFIT® drive if the STO jumper plug is plugged in at the X71F plug connector.
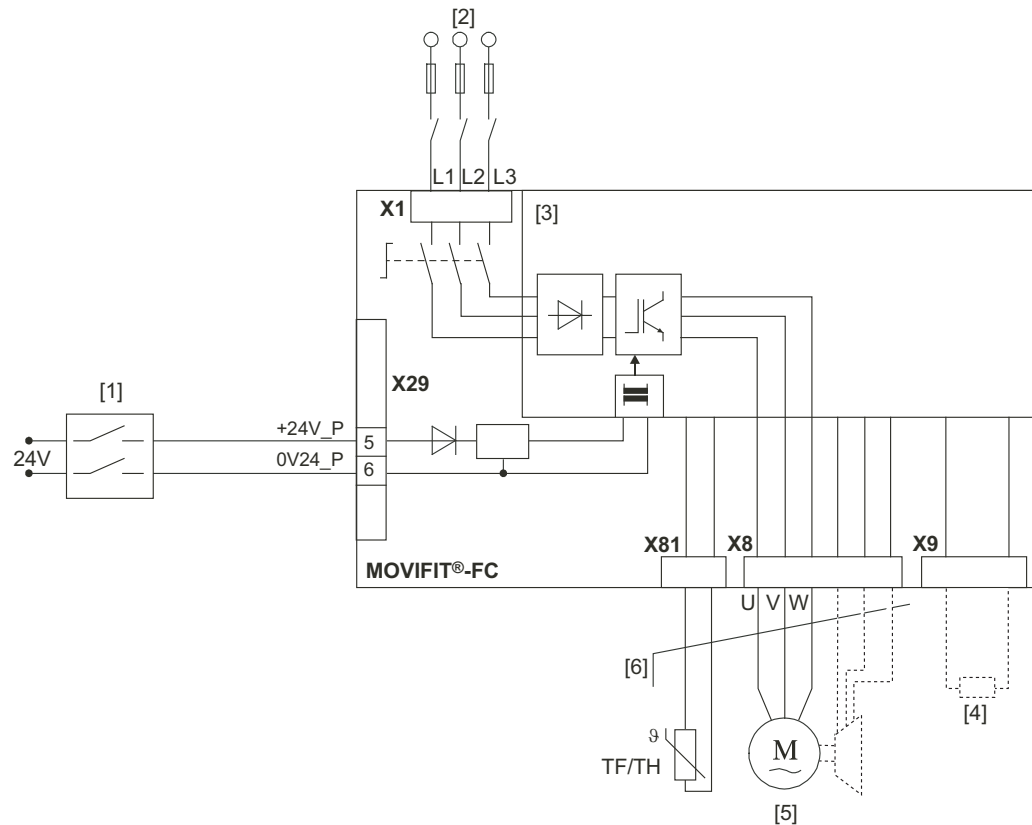
Severe or fatal injuries.

- Do not use the 24 V output (+24V_C and 0V24_C) for safety-related applications with MOVIFIT® drives.
- You may only jumper the STO connection with 24 V when the MOVIFIT® drive is not used to fulfill any safety functions.

The following table shows information about this connection:

Function
Safety-related digital output F-DO_STO for safe torque off in the drive (STO)

Connection type
M12, 5-pole, female, A-coded

Wiring diagram

17865149963

Plug connector		Name	Function	Terminals
X71F	1	+24V_C	+24 V supply for digital inputs – continuous voltage	X29/1
	2	F-DO_STO_M	Safety-related digital output F-DO_STO (sinking signal) for safe torque off in the drive (STO)	X45/15
	3	0V24_C	0V24 reference potential for digital inputs – continuous voltage	X29/2
	4	F-DO_STO_P	Safety-related digital output F-DO_STO (sourcing signal) for safe torque off in the drive (STO)	X45/5
	5	n.c.	Not connected	n.c.

Wiring diagram MOVIFIT® FC for safety-related disconnection via terminals

9007203349482507

[1] External safety controller
[2] Line connection
[3] Integrated frequency inverter
[4] Braking resistor
[5] Motor
[6] Hybrid cable

When wiring the safety-related voltage supply, possible faults according to EN ISO 13849-2:2013 in plug connectors and cables/lines have to be considered and the installation has to be designed according to the required safety class.

The drive controller does not detect short circuits in the supply line. This is why SEW-EURODRIVE recommends to connect only the safety-related voltage supply with a 2-core cable (as shown) to the terminals X29/5 and X29/6.

Wiring diagram MOVIFIT® FC for safety-related disconnection via plug connector

17451564555

[1]   External safety controller
[2]   Line connection
[3]   Integrated frequency inverter
[4]   Braking resistor
[5]   Motor
[6]   Hybrid cable

When wiring the safety-related voltage supply, possible faults according to EN ISO 13849-2:2013 in plug connectors and cables/lines have to be considered and the installation has to be designed according to the required safety class.

The drive controller does not detect short circuits in the supply line. This is why SEW-EURODRIVE recommends to connect only the safety-related voltage supply with a 2-core cable (as shown) to the X71F plug connector.

5.2.3 Group disconnection with MOVIFIT®-MC and FC

Requirements

For group drives, the safety-related 24 V voltage supply can be made available for several MOVIFIT® devices by a single safety relay.

The maximally permitted number of MOVIFIT® devices results from the maximum permitted contact load of the safety relay and the maximally permitted voltage drop of the DC 24 V supply voltage for MOVIFIT®.

Comply with the requirements and notes of the safety controller manufacturer (e.g. protecting the output contacts against welding).

During cable routing, observe the basic requirements in chapter "Safety conditions" (→ 🖹 15).

The cable length between the X24_P (ABOX, X29 terminal) and the safety controller must not exceed 100 m for to EMC reasons.

Determining the maximum number of MOVIFIT® devices

The following factors limit the number of MOVIFIT® devices that can be connected to a group drive:

- **Switching capacity of the safety controller**

  To prevent welding of the contacts, connect a fuse in front of the safety contacts in accordance with the specifications of the safety controller manual.

  The configuration must guarantee that

  – the permitted switching capacity is observed according to EN 60947-4-1 and EN 60947-5-1

  – and the prescribed fuse is installed as defined in the operating instructions of the safety controller manufacturer.

- **Maximum permitted voltage drop in the 24 V supply cable.**

  During project planning for group drives, observe the cable lengths, cable cross sections, and the maximally occurring currents for the safety-related 24 V supply voltage 24V_P. Determine resulting voltage drops. Compare the voltage drops to the permitted input voltage range of the MOVIFIT® devices.

  For MOVIFIT® MC, you also have to consider the cable lengths to the connected MOVIMOT® drives and their permitted input voltage range. The cross section of the 24 V cables in the hybrid cable from SEW-EURODRIVE (type B) is 0.75 mm².

  Perform a calculation based on the technical data of the MOVIFIT® for each group disconnection.

Wiring diagram MOVIFIT® MC/FC for safety-related group disconnection via terminals
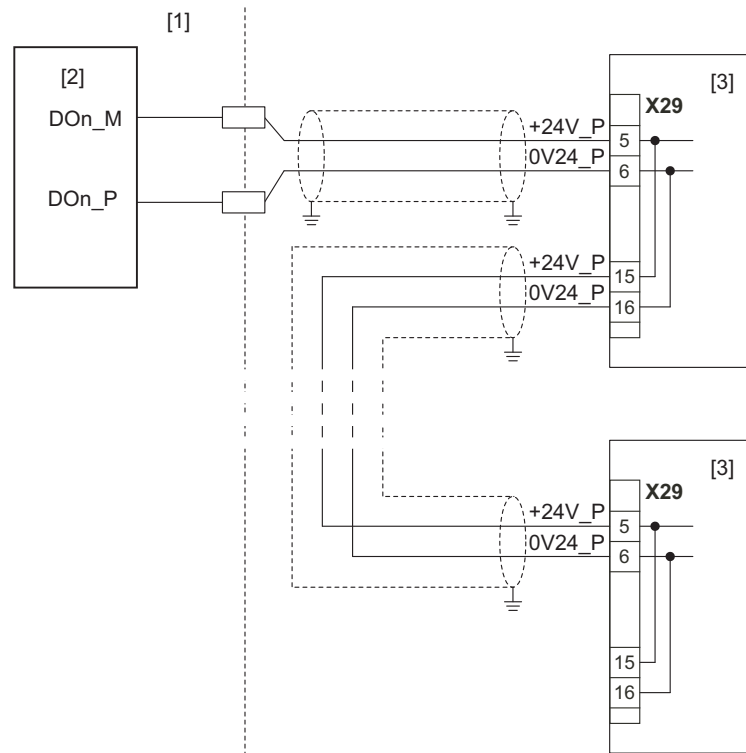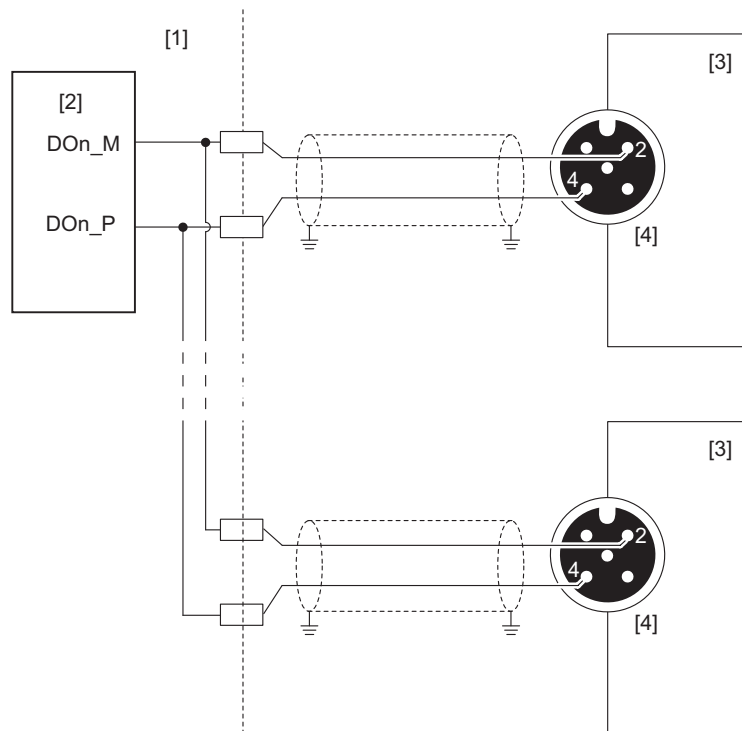

17453952523

[1]   Installation space
[2]   Safety controller
       DOn_M: Ground output
       DOn_P: Plus output
[3]   MOVIFIT®

When wiring the safety-related voltage supply, possible faults according to EN ISO 13849-2:2013 in plug connectors and cables/lines have to be considered and the installation has to be designed according to the required safety class.

The drive controller does not detect short circuits in the supply line. This is why SEW-EURODRIVE recommends to connect only the safety-related voltage supply with a 2-core cable (as shown) to the terminals X29/5 and X29/6.

Wiring diagram MOVIFIT® FC for safety-related group disconnection via plug connector (option)

17454736011

[1]   Installation space
[2]   Safety controller
      DOn_M: Ground output
      DOn_P: Plus output
[3]   MOVIFIT®
[4]   X71F: Input safety-related disconnection

When wiring the safety-related voltage supply, possible faults according to EN ISO 13849-2:2013 in plug connectors and cables/lines have to be considered and the installation has to be designed according to the required safety class.

The drive controller does not detect short circuits in the supply line. This is why SEW-EURODRIVE recommends to connect only the safety-related voltage supply with a 2-core cable (as shown) to the X71F plug connector.

5.3 PROFIsafe option S11

5.3.1 Standard /Hybrid ABOX

The following connecting terminals are relevant for PROFIsafe option S11 operation. The following figure shows an example of the ABOX connection board of MOVIFIT® FC:
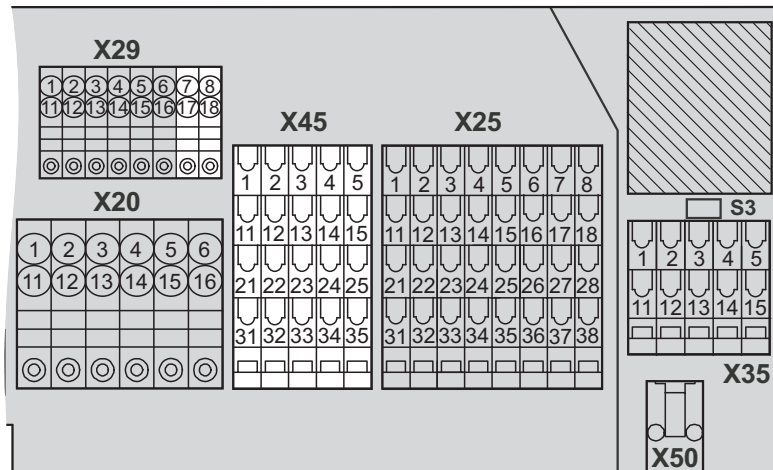

9007203349486731

24 V distributor terminal			
Distribution of supply voltage(s) for inverter/MOVIMOT® and option card			
No.		Name	Function
X29	7	+24V_O	+24 V supply for option card, supply
	8	0V24_O	0V24 reference potential for the option card, supply
	17	+24V_O	+24 V supply for option card, supply
	18	0V24_O	0V24 reference potential for the option card, supply

I/O terminal in combination with option card /S11			
No.		**Name**	**Function**
X45	1	F-DI00	Safety-related digital input F-DI00 (switching signal)
	2	F-DI02	Safety-related digital input F-DI02 (switching signal)
	3	F-DO00_P	Safety-related digital output F-DO00 (sourcing signal)
	4	F-DO01_P	Safety-related digital output F-DO01 (sourcing signal)
	5	F-DO_STO_P	Safety-related digital output F-DO_STO (sourcing signal) for safe disconnection of the drive (STO)
	11	F-DI01	Safety-related digital input F-DI01 (switching signal)
	12	F-DI03	Safety-related digital input F-DI03 (switching signal)
	13	F-DO00_M	Safety-related digital output F-DO00 (sinking signal)
	14	F-DO01_M	Safety-related digital output F-DO01 (sinking signal)
	15	F-DO_STO_M	Safety-related digital output F-DO_STO (sinking signal) for safe disconnection of the drive (STO)
	21	F-SS0	+24 V sensor supply for safety-related inputs F-DI00 and F-DI02
	22	F-SS0	+24 V sensor supply for safety-related inputs F-DI00 and F-DI02
	23	F-SS1	+24 V sensor supply for safety-related inputs F-DI01 and F-DI03
	24	F-SS1	+24 V sensor supply for safety-related inputs F-DI01 and F-DI03
	25	F-SS1	+24 V sensor supply for safety-related inputs F-DI01 and F-DI03
	31	0V24_O	OV24 reference potential for safety-related inputs/outputs
	32	0V24_O	OV24 reference potential for safety-related inputs/outputs
	33	0V24_O	OV24 reference potential for safety-related inputs/outputs
	34	0V24_O	OV24 reference potential for safety-related inputs/outputs
	35	0V24_O	OV24 reference potential for safety-related inputs/outputs

SEW EURODRIVE

5.3.2 24 V supply of the PROFIsafe option S11

The following figure shows an example of a power bus connection with 2 separate 24 V voltage circuits for the sensor/actuator supply. In this example, the PROFIsafe option S11 and the safety-related inputs/outputs are supplied by the 24V_C voltage in:
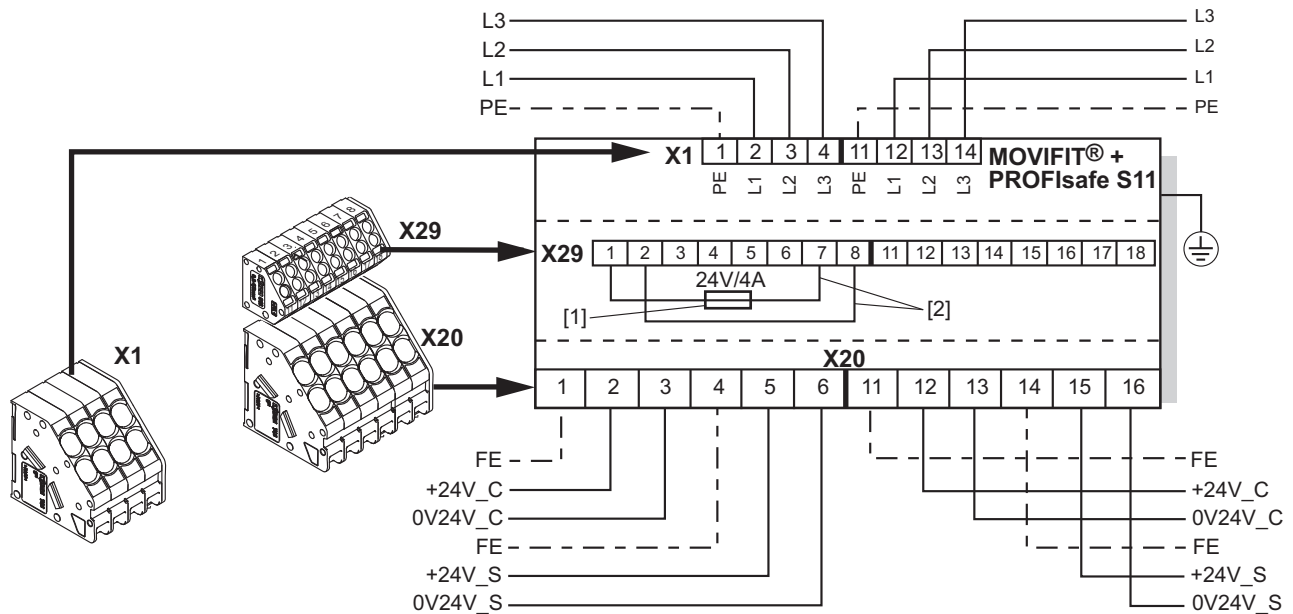
18014402604293515

[1] Example (fuse 24 V/4 A) for UL-compliant installation (depending on the installation)
[2] Example showing 24V_C supply for S11 PROFIsafe safety option

INFORMATION

SEW-EURODRIVE recommends using the 24V_C electronics and sensor voltage to supply the PROFIsafe option S11 (as shown in the figure above). Alternatively, switch the 24V_O option voltage supply and the 24V_C voltage on and off together.

Otherwise, interferences and faults may occur in communication with the safety controller because the entire safety electronics of the PROFIsafe option S11 is supplied by the 24V_O voltage. If the 24V_O voltage is switched off, the PROFIsafe station is missing in the network.

5.3.3 Connecting the safety-related inputs/outputs of PROFIsafe option S11

The safety-related inputs (F-DI.) and the safety-related outputs (F-DO. und F-DO_STO) are connected to the X45 terminal or the M12 plug connectors X41 to X44. The following chapters describe the permitted connection options.

All safety-related inputs and outputs are processed within the PROFIsafe option S11, usually in 2 channels. The safety-related inputs and outputs are therefore suitable for applications up to SIL 3 according to EN 61508 and Performance Level e according to EN ISO 13849-1. The external sensors and actuators and their wiring must comply with the required safety class.

Observe the following wiring diagrams and the lists of known faults. Further, observe the requirements in chapter "External sensors and actuators – requirements" (→ 📄 20).

F-DI./F-SS. connection

Observe the following notes for the wiring of sensors:

- You only connect sensors with contacts to the safety-related F-DI. inputs in accordance with the fail-safe principle (e.g. emergency off buttons, door contact switches etc.)

- The two sensor power supplies F-SS0 and F-SS1 are generally clocked.

- When connecting the sensors, make sure that

  – F-SS0 is connected to F-DI00 and F-DI02 via the respective sensor (fixed assignment)

  – F-SS1 is connected to F-DI01 and F-DI03 via the respective sensor (fixed assignment)

- Unassigned inputs need not be wired. An open input is always read as a "0" signal.

Permissible wiring

Only the types of wiring shown below are permitted in safety-related applications:

a) Sensors, 1-pole connection

A maximum of 4 1-pole sensors are possible.

⚠ WARNING

Hazard if no safety-related disconnection of the MOVIFIT® drive is performed. The PROFIsafe option S11 cannot detect a short circuit between a F-SS. sensor supply and a corresponding safety-related input F-DI (sensor jumpered).

Severe or fatal injuries.

• Install the wiring in such a way that a short circuit is impossible.

PROFIsafe option S11
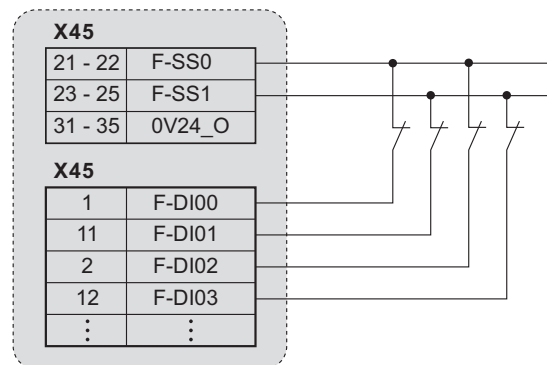
9007203349734411

The following faults are detected by internal tests and monitoring:

• Short circuit to +24 V supply voltage

• Crossfault between 2 input signals that are supplied by different F-SS. sensor supplies

• Open circuit or short circuit to reference potential is read as a "0" signal (no fault status)

If the system detects a fault, it goes to safe state. All safety-related process value (F-DI, F-DO and STO) are set to the value "0". Furthermore, the safety subassembly is passivated (see chapter "Fault table for PROFIsafe option S11" (→ 🖹 64)). The "F-STATE" LED indicates the fault status (see chapter ""F-STATE" LED" (→ 🖹 56)).

b) Sensors, 2-pole connection

A maximum of 2 2-pole sensors are possible.

> ⚠ **WARNING**
>
> Hazard if no safety-related disconnection of the MOVIFIT® drive is performed. The PROFIsafe option S11 cannot detect a short circuit between a F-SS. sensor supply and a corresponding safety-related input F-DI (sensor jumpered).
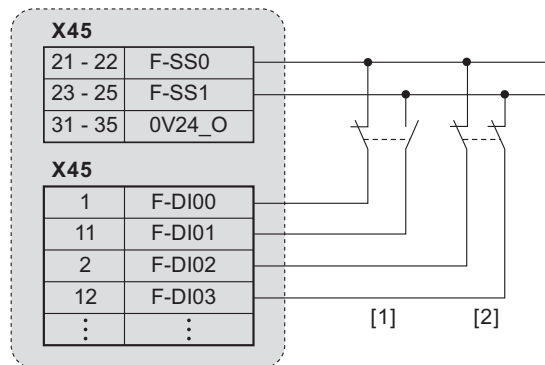>
> Severe or fatal injuries.
>
> • Install the wiring in such a way that a short circuit is impossible.

i **INFORMATION**

You must not use sensors with OSSD output.

PROFIsafe option S11

X45	
21 - 22	F-SS0
23 - 25	F-SS1
31 - 35	0V24_O

X45	
1	F-DI00
11	F-DI01
2	F-DI02
12	F-DI03
⋮	⋮

[1]   [2]

9007203349737099

[1] Non-equivalent
[2] Equivalent

i **INFORMATION**

• With this type of connection, there is no internal link and no evaluation of discrepancy time between the two input signals of a sensor.

• Signals F-DI00 and F-DI01 or F-DI02 and F-DI03 are generally transferred individually to the higher-level safety control. Logic linking and discrepancy evaluation must be realized there.

The following faults are detected by internal tests and monitoring:

• Short circuit to +24 V supply voltage

• Crossfault between the two input signals of a sensor

• Open circuit or short circuit to reference potential is read as a "0" signal (no fault status)

If the system detects a fault, it goes to safe state. All safety-related process value (F-DI, F-DO and STO) are set to the value "0". Furthermore, the safety subassembly is passivated (see chapter "Fault table for PROFIsafe option S11" (→ 🕮 64)). The "F-STATE" LED indicates the fault status (see chapter ""F-STATE" LED" (→ 🕮 56)).

F-DO. and F-DO_STO connection

- No shielded cables are required for the safety-relevant digital outputs.
- The safety-related digital outputs are 2-pole, sourcing/sinking. They are controlled by the higher-level safety controller via PROFIsafe.
- Connect the actuators to the safety-related outputs F-DO. and F.DO_STO between the sourcing and sinking output with 2 poles.
- 1-pole connection between F-DO_P, F-DO_STO_P and the reference potential GND is not permitted.
- The safety-related outputs are cyclically tested internally. Due to decoupling, the test pulses are not visible at the terminals and must not be considered during operation.

Permissible wiring

Only the following wiring option is permitted for safety applications:

> ⚠ **WARNING**
>
> Hazard if no safety-related disconnection of the MOVIFIT® drive is performed. With active output, the PROFIsafe option S11 cannot detect a short circuit between a sourcing output (F-DO._P or F-DO_STO_P) and the +24 V supply voltage.
>
> Severe or fatal injuries.
>
> • Install the wiring in such a way that a short circuit is impossible.
>
> • Or switch the output off cyclically in intervals that are suitable according to the risk assessment.

PROFIsafe option S11
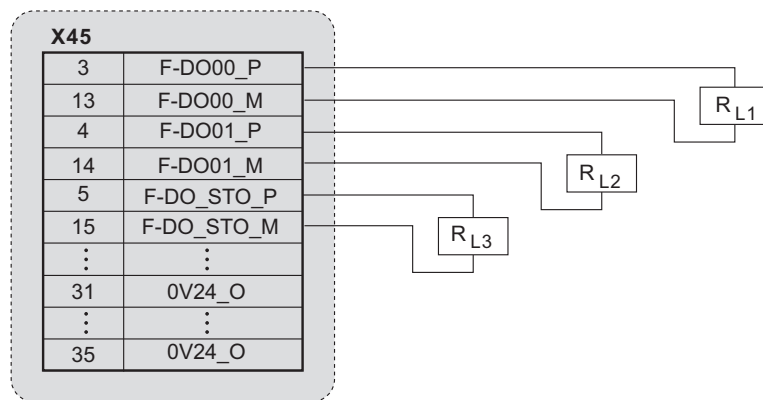
9007203349740555

$R_{L1} - R_{L3}$: Loads at safety-related outputs,
see "Technical data – PROFIsafe option S11" (→ 🗎 70)

Various external faults are detected by internal tests and monitoring.

The following faults can be detected when the output is activated:

• Short circuit between the P output and the reference potential

• Short circuit between the sinking output and the +24 V supply voltage

• Short circuit between sourcing output and sinking output

The following faults can be detected when the output is deactivated:

• Short circuit between P output or M output and +24 V supply voltage

• Short circuit between P output or M output and reference potential

If the system detects a fault, it goes to safe state. All safety-related process value (F-DI, F-DO and STO) are set to the value "0". Furthermore, the safety subassembly is passivated (see chapter "Fault table for PROFIsafe option S11" (→ 🗎 64)). The "F-STATE" LED indicates the fault status (see chapter ""F-STATE" LED" (→ 🗎 56)).

6 Startup with PROFIsafe option S11

INFORMATION

i

- The basic startup procedure is described in the relevant "MOVIFIT® .." operating instructions and the in the corresponding "MOVIFIT® Function Level Classic ..." or "MOVIFIT® Function Level Technology ..." manuals.

- This chapter describes the additional startup steps for the PROFIsafe option S11.

6.1 Setting the PROFIsafe address

Once the MOVIFIT® device including S11 option is supplied with 24 V voltage, you must enter the PROFIsafe device address (= F Destination Address) using MOVITOOLS® MotionStudio . Addresses 1 to 65534 are permitted.

Ensure that the entry made on the device matches the PROFIsafe address set in the project planning software of the bus master (e.g. Siemens STEP7 HW Config).

Enter the PROFIsafe device address (= F Destination Address) in MOVITOOLS® MotionStudio using the MOVIFIT® process data monitor, see figure below:


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[1] Entering the PROFIsafe device address (= F Destination Address)

6.2 Configuring the PROFIsafe option in STEP7

To ensure fault-free MOVIFIT® operation using PROFIsafe, you need the optional package "Distributed Safety" as of version V5.4 for the parameterization and configuration under STEP7.

1. Make sure that you have installed the latest version of the appropriate GSD file.

2. When configuring the buses for PROFIBUS DP and PROFINET IO, follow the steps described in the software manual "MOVIFIT® Function Level Classic" or "MOVIFIT® Function Level Technology ...".

3. Configure the "F module IO (2 byte)" module to slot 1 and enter the required I/O or periphery address. The following figure shows a MOVIFIT® FC configuration at the "Classic" function level in the PROFINET version.
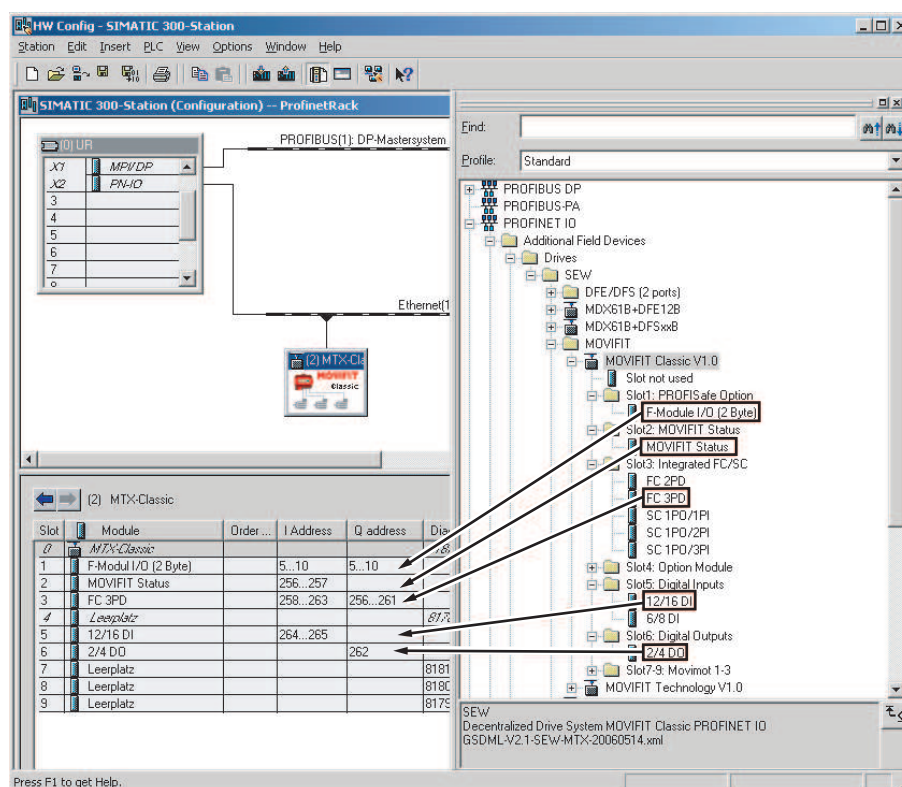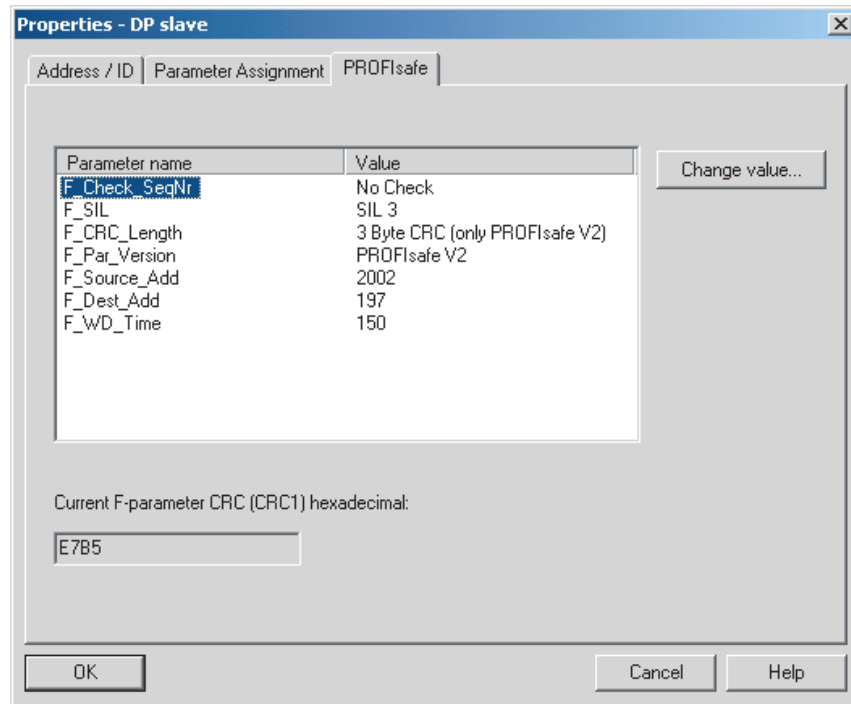

4095028107

4. Parameterize the PROFIsafe option.

6.2.1 Parameterizing the PROFIsafe option S11

Select the F module at the MOVIFIT® slot 1.

Right-click on the F module and select "Object properties" from the context menu.

Select the tab "PROFIsafe" or "F parameter". The following figure is an example of a PROFIBUS device.

4096019083

When the fieldbus or network systems starts up, the bus master sends the safety-relevant parameters in an F parameter block to the PROFIsafe option S11 of the MOVIFIT® for PROFIsafe operation. The parameters are checked for plausibility in the option. The PROFIsafe option only exchanges data with bus master after positive confirmation for this F parameter block has been received.

The following table shows the safety-related parameters that are transmitted to the PROFIsafe option. Depending on the bus system being used, the following parameters are available:

PROFIsafe F parameter	Bus system	
	PROFIBUS DP	**PROFINET IO**
F_Check_SeqNr	Fixed	Not available
F_SIL	Fixed	Fixed
F_CRC_Length	Variable	Fixed
F_Par_Version	Variable	Fixed
F_Source_Add	Fixed	Fixed
F_Dest_Add	Variable	Variable
F_WD_Time	Variable	Variable

Parameter "F_Check_ SeqNr"

This parameter determines whether the ready counter (consecutive number) is to be included in the consistency check (CRC calculation) of the F user data telegram.

The PROFIBUS version supports the following setting:

- F_Check_SeqNr = "No check"

Parameter "F_SIL"

This parameter allows F stations to check whether the safety category matches that of the F host. Safety circuits with different safety classes SIL 1 to SIL 3 (SIL = safety integrity level) are available for these safety-relevant cases according to the risk.

The S11 option supports the following setting:

- F_SIL = SIL 3

INFORMATION

The safety class SIL 3 only applies to the PROFIsafe option S11. The possible safety class for the drive safety functions depends on the type of the respective MOVIFIT® basic device.

Parameter "F_CRC_Length"

Depending on the length of the F user data (process values) and the PROFIsafe version, the length of the required CRC check value varies. This parameter communicates the anticipated length of the CRC2 key in the safety telegram to the F component.

The S11 safety option handles useful data that is less than 12 bytes in length, so that with PROFIsafe V1, a 2 byte CRC is used and with PROFIsafe V2, a 3 byte CRC is used.

The S11 option supports the following settings:

- F_CRC_Length =

  2 byte CRC (only with PROFIsafe V1 in combination with PROFIBUS)

  3 byte CRC (only with PROFIsafe V2)

Parameter "F_Par_Version"

This parameter identifies the PROFIsafe version supported by the S11 option. When using a MOVIFIT® with a PROFIBUS version, you can choose between PROFIsafe V1 and PROFIsafe V2, with a PROFINET version only PROFIsafe V2 is supported.

Parameter "F_Source_Add"

The PROFIsafe addresses are used for a clear identification of source (F_Source_Add) and destination (F_Dest_Add). The combination of source and destination address must be unique across the network and all nodes. The source address F_Source_Add is assigned automatically via STEP7 depending on the configuration of the master.

Values ranging from 1 to 65534 can be entered in parameter "F_Source_Add".

You cannot directly edit this parameter in STEP7-HW Config.

Parameter "F_Dest_Add"

Enter the PROFIsafe address, previously set for the MOVIFIT® device with MOVITOOLS® MotionStudio, in this parameter.

Values ranging from 1 to 65534 can be entered in parameter "F_Dest_Add".

Parameter "F_WD_Time"

This parameter defines a monitoring time in the failsafe PROFIsafe option S11.

A valid safety telegram must arrive from the F-CPU within this monitoring time. Otherwise the S11 option reverts to safe status.

Select a monitoring time of sufficient length so that communication can tolerate telegram delays, but also short enough for your safety application to run without restrictions.

With the S11 option, you can enter the "F_WD_Time" parameter in steps of 1 ms, ranging from 1 ms to 10 s.

7 Data exchange with PROFIsafe option S11

7.1 Introduction

MOVIFIT® devices with an integrated PROFIsafe option support parallel operation of standard and safety-related communications via a bus system or network. You can run safety-related PROFIsafe communication using PROFIBUS DP and PROFINET IO.

Data exchanges between bus master and MOVIFIT® take place via the respective communication system that simultaneously acts as a "grey channel" for the safety-related application. The bus messages transferred then contain standard information for conventional MOVIFIT® operation and the PROFIsafe safety message. Depending on the configuration, the maximum available expansion level enables parallel exchanges of PROFIsafe safety data, the parameter channel and process data between the bus master and MOVIFIT®.
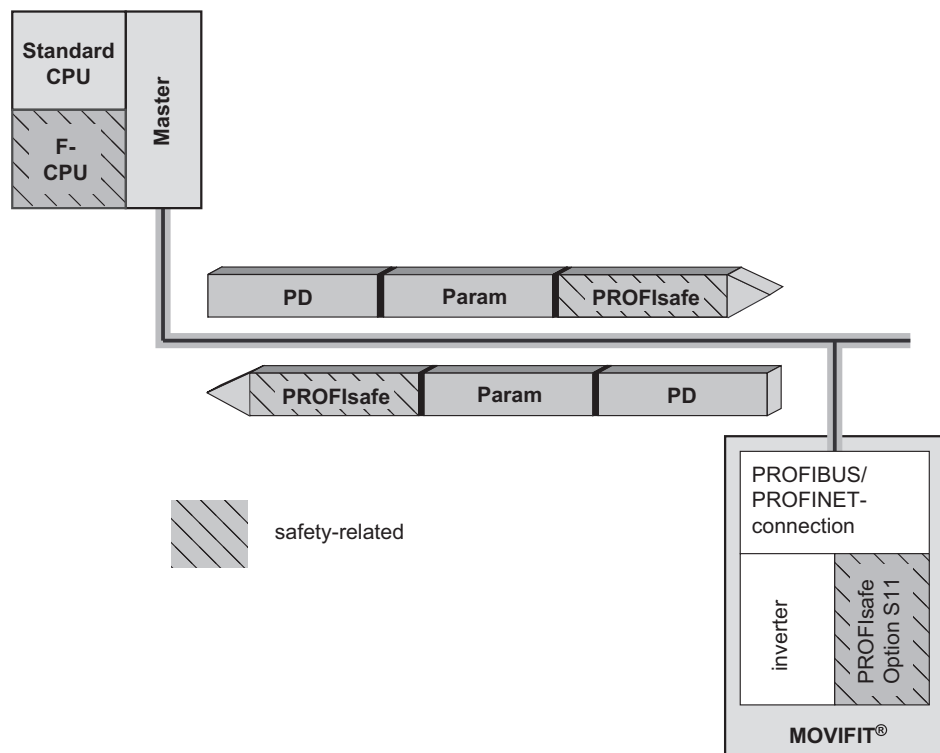
4096024331

7.2 Access to F periphery of the PROFIsafe option S11 in STEP7

For safety-related communication, the PROFIsafe option S11 requires a total of 6 bytes for the PROFIsafe telegram portion and 6 bytes for the process image. Of these, 2 bytes (= 16 bits) constitute the actual safety-related I/O data (F user data), and the remaining 4 bytes are required for storing the telegram in accordance with the PROFIsafe specifications ("PROFIsafe" header).

7.2.1 F periphery DB of PROFIsafe option S11

During compilation in the HW Config tool, the system automatically generates an F periphery DB for every PROFIsafe option S11. The F periphery DB offers a user interface in which you can evaluate or control variables in the safety program.

The symbolic name consists of the invariable prefix "F", the start address of the F periphery, and the name entered in the object properties during configuration for the F periphery (e.g. F00008_198).

The following table shows the F periphery DB of the PROFIsafe option S11:

	Address	Symbol	Data type	Function	Preset
User-controllable variables	DBX0.0	"F00008_198.PASS_ON"	Boolean	1 = activate passivation	0
	DBX0.1	"F00008_198.ACK_NEC"	Boolean	1 = acknowledgment required for reintegration with S11	1
	DBX0.2	"F00008_198.ACK_REI"	Boolean	1 = acknowledgment for reintegration	0
	DBX0.3	"F00008_198.IPAR_EN"	Boolean	Variable for resetting parameters (not supported by PROFIsafe option S11)	0
Variables that can be evaluated	DBX2.0	"F00008_198.PASS_OUT"	Boolean	Run passivation.	1
	DBX2.1	"F00008_198.QBAD"	Boolean	1 = substitute values are output	1
	DBX2.2	"F00008_198.ACK_REQ"	Boolean	1 = acknowledgement required for reintegration	0
	DBX2.3	"F00008_198.IPAR_OK "	Boolean	Variable for resetting parameters (not supported by PROFIsafe option S11)	0
	DBB3	"F00008_198.DIAG"	Byte	Service information	

PASS_ON

This variable lets you activate passivation of the PROFIsafe option S11. Provided that PASS_ON = "1", the F periphery is passivated.

ACK_NEC

> ⚠ **WARNING**
>
> Risk of unexpected start of the drive. The variable ACK_ NEC = 0 may only be parameterized if automatic reintegration is safe for the process in question.
>
> Severe or fatal injuries.
>
> • Check if automatic reintegration is permitted for the process in question.

After a fault has been corrected, the PROFIsafe option S11 is reintegrated, depending on the parameter ACK_NEC.

• ACK_NEC = 0: Automatic reintegration of S11
• ACK_NEC = 1: Reintegration of S11 with user acknowledgement

ACK_REI

In order to reintegrate PROFIsafe option S11 after the fault has been corrected, user acknowledgement with positive edge of variable ACK_REI is required. Acknowledgement is only possible if variable ACK_REQ = 1.

ACK_REQ

The F control system sets ACK_REQ = 1 after all faults in the data exchange with PROFIsafe option S11 have been corrected. After successful acknowledgement, the F control system sets ACK_REQ = 0.

PASS_OUT

Indicates whether PROFIsafe option S11 has been passivated. Substitute values are output.

QBAD

Fault during data exchange with PROFIsafe option S11. Indicates passivation. Substitute values are output.

DIAG

For service information purposes, the variable DIAG supplies non-failsafe information about faults that have occurred in the F control system. For further information, refer to the relevant F-control system manual.

7.2.2 F user data of PROFIsafe option S11

9007203350768267
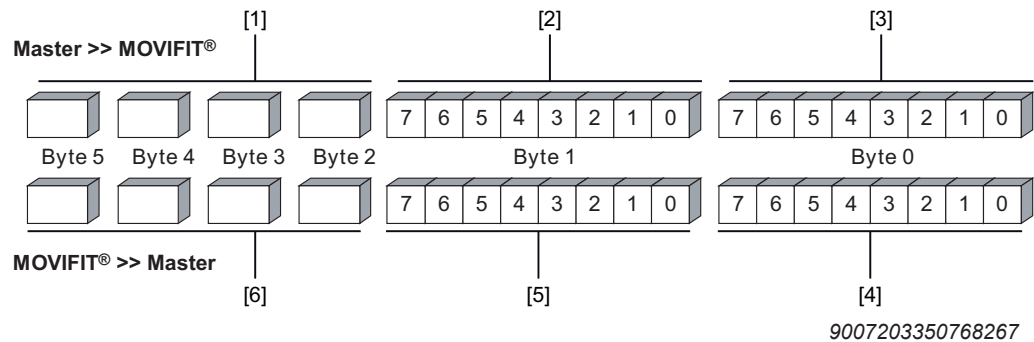
Meaning of individual bits in PROFIsafe F user data

F user data coding is based on the "PROFIdrive on PROFIsafe" V1.0 specifications (PNO order No. 3,272). The "PROFIdrive Safety Block 1" specified there is mapped in byte 0. Byte 1 is manufacturer-specific. With the PROFIsafe option S11, it is used for the safety-related inputs and outputs.

Output data

	Byte	Bit	Name	Default	Function	Comment
[3]	0	0	STO	0	Safety-related disconnection of the drive "Safe Torque Off"	0-active
		1 – 7	–	0	Reserved	Do not use.
[2]	1	0	F-DO00	0	Safety-related output 0	
		1	F-DO01	0	Safety-related output 1	
		2 – 7	–	0	Reserved	Do not use.
[1]	2 – 5	–	–	–	Reserved for PROFIsafe telegram backup	–

Input data

	Byte	Bit	Name	Default	Function	Comment
[4]	0	0	POWER_REMOVED	0	Response safety-related output F-DO_STO switched– "Power removed"	1-active
		1 – 7	–	0	Reserved	Do not use.
[5]	1	0	F-DI00	0	Safety-related input 0	
		1	F-DI01	0	Safety-related input 1	
		2	F-DI02	0	Safety-related input 2	
		3	F-DI03	0	Safety-related input 3	
		4 – 7	–	0	Reserved	Do not use.
[6]	2 – 5	–	–	–	Reserved for PROFIsafe telegram backup	–

7.2.3 Triggering the PROFIsafe-Option S11 – example

The example for triggering the failsafe functions of the PROFIsafe option S11 is based on the following assumptions:

- You have already created a safety program and a process group,
- An F control program module exists.

You can activate the failsafe functions and the F periphery as well as the evaluation of the responses by the F periphery by using flags. Note that in STEP7, flags are only permitted as links between the standard user program and the safety program. Flags may not be used as buffers for F data.

INFORMATION

SEW-EURODRIVE accepts no liability for the information provided in this example. This example does not represent a customer-specific solution. Its aim is simply to assist the reader.

The following table shows the allocation of input/output addresses to flags:

Address	Symbol	Flag	Meaning
E 8.0	S11_PowerRemoved	M 8.0	Feedback "safety-related output switched"
E 9.0	S11_FDI00	M 9.0	Safety-related input 00
E 9.1	S11_FDI01	M 9.1	Safety-related input 01
E 9.2	S11_FDI02	M 9.2	Safety-related input 02
E 9.3	S11_FDI03	M 9.3	Safety-related input 03
A 8.0	S11_STO	M 80.0	Safety-related disconnection of the drive
A 9.0	S11_FDO00	M 90.0	Safety-related output 00
A 9.1	S11_FDO01	M 90.1	Safety-related output 01
DB811.DBX0.0	"F00008_198".PASS_ON	M 10.0	Activate passivation of S11
DB811.DBX0.1	"F00008_198".ACK_NEC	M 10.1	Set parameters for reintegration of S11
DB811.DBX0.2	"F00008_198".ACK_REI	M 10.2	Activate user acknowledgement of S11
DB811.DBX2.0	"F00008_198".PASS_OUT	M 10.3	Passivation of S11 has occurred
DB811.DBX2.1	"F00008_198".QBAD	M 10.4	Fault in S11 occurred
DB811.DBX2.2	"F00008_198".ACK_REQ	M 10.5	Indicates whether user acknowledgement is required for reintegration of S11.

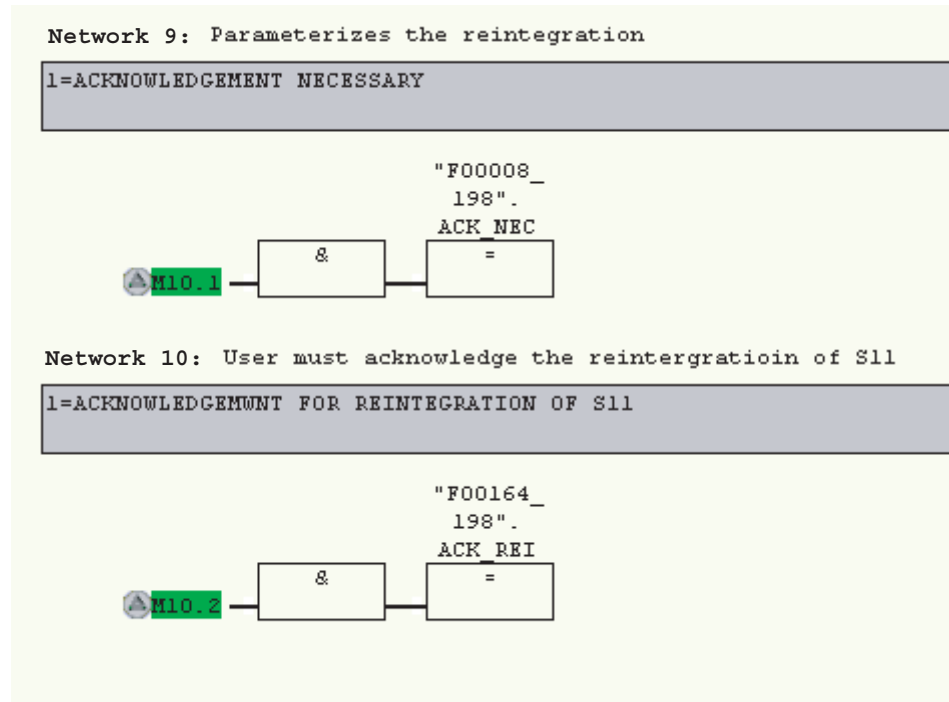**Network 1: Control STO**

Comment:

```
                          A8.0
              ┌──────┐   ┌──────┐
              │  &   │   │  =   │
  ◬M80.0 ─────┤      ├───┤      │
              └──────┘   └──────┘
```

Network 2: STO feedback

Comment:

```
                        ◬M8.0
              ┌──────┐ ┌──────┐
              │  &   │ │  =   │
  E8.0 ───────┤      ├─┤      │
              └──────┘ └──────┘
```

Network 3: Control FDO 0

Comment:

```
                          A9.0
              ┌──────┐   ┌──────┐
              │  &   │   │  =   │
  ◬M90.0 ─────┤      ├───┤      │
              └──────┘   └──────┘
```

Network 4: FDI 0 feedback

Comment:

```
                        ◬M9.0
              ┌──────┐ ┌──────┐
              │  &   │ │  =   │
  E9.0 ───────┤      ├─┤      │
              └──────┘ └──────┘
```

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```
Network 5 : F-feedback
1=PASSIVATION OUTPUT

                          &
    "F00164_                        M10.3
      198".                           =
    PASS_OUT


Network 6:  F-feedback
1=REPLACEMENT VALUES

                          &
    "F00164_                        M10.4
    198".QBAD                         =


Network 7:  F-feedback
1=ACKNOLEDGEMENT REQUEST

                          &
    "F00164_                        M10.5
      198".                           =
    ACK_REQ


Network 8: User can activate passivation
1=ACTIVATE PASSIVATION

                                  "F00008_
                                    198".
                                   PASS_ON
                          &           =
    M10.0
```

4096083851

```
Network 9: Parameterizes the reintegration
```

```
1=ACKNOWLEDGEMENT NECESSARY
```

```
                                    "F00008_
                                     198".
                                    ACK_NEC
                   ┌──────────┐     ┌──────────┐
                   │    &     │     │    =     │
          M10.1 ───┤          ├─────┤          │
                   └──────────┘     └──────────┘
```

```
Network 10: User must acknowledge the reintergratioin of S11
```

```
1=ACKNOWLEDGEMWNT FOR REINTEGRATION OF S11
```

```
                                    "F00164_
                                     198".
                                    ACK_REI
                   ┌──────────┐     ┌──────────┐
                   │    &     │     │    =     │
          M10.2 ───┤          ├─────┤          │
                   └──────────┘     └──────────┘
```

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8 PROFIsafe option S11 – response times

Response times play a decisive role in the design and execution of safety functions of systems and machines. In order to match the response time to the requirements of a safety function, always take the entire system from sensor (or command device) to actuator into account. The following times are of particular importance in connection with the PROFIsafe option S11:

- Response times of the connected sensors
- PROFIsafe cycle time
- Processing time (cycle time) in the safety controller
- PROFIsafe monitoring time "F_WD_Time"
- Internal response time of PROFIsafe option S11
- Response and switching tome aft the actuator technology (e.g. frequency inverters)

Establish the response sequence for each safety function in your application and determine the maximum response time for each case considering the relevant manufacturer data. Observe the information in the safety documentation of the used safety controller.

For data of the maximum response time of the PROFIsafe option S11, refer to chapter "Technical data of the PROFIsafe option S11" (→ 🖹 70). For detailed information about response time consideration for safety-related PROFIsafe communication, refer to the respective standard: IEC 61784-3-3.

9 Service

9.1 Diagnostics with PROFIsafe option S11

⚠ **WARNING**

Danger due to incorrect interpretation of the "FDI.", "FDO.", "STO" and "F-STATE" LEDs.

Severe or fatal injuries.

- The LEDs are not safety-related and may not be used as a safety device.

This chapter describes the option-specific LEDs for PROFIsafe option S11. In the following figure, these LEDs are shown as dark. The following figure depicts the PROFIBUS version of a MOVIFIT®-MC:
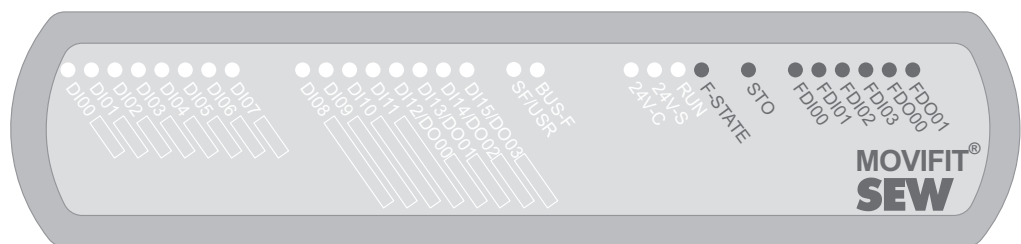
9007200284854539

9.1.1 "FDI.." LEDs

The following tables show the statuses of the "FDI00" – "FDI03" LEDs.

LED	Meaning
Yellow Illuminated	HIGH level at input F-DI..
Off	LOW level at input F-DI.. or open

9.1.2 "FDO.." LEDs

The following tables show the statuses of the "FDO00" – "FDO01" LEDs:

LED	Meaning
Yellow Illuminated	F-DO.. output is active.
Off	F-DO.. output is inactive (switched off).

9.1.3 "F-STATE" LED

The following table shows the statuses of the "F-STATE" LED:

LED	Meaning	Measure
Green Illuminated	Option S11 is currently performing a cyclical data exchange with the F-Host. Standard operating state	-
Red Illuminated	Error status in the safety part. 24V_O supply voltage not available.	• Read diagnostics in F-Host. • Eliminate the cause of error and acknowledge in the F-Host.
Off	S11 option is currently in the initialization phase. S11 option is not available or is not configured in the bus master (slot 1 is empty).	• Check voltage supply. • Check configuration of the bus master.
Red/green Flashing	An error occurred in the safety part; cause of error already remedied – acknowledgment required.	• Acknowledge fault in the F-Host (reintegration).

9.2 Diagnostics for STO

9.2.1 "STO" LED

The following table shows the statuses of the "STO" LED:

LED	Meaning
Yellow Illuminated	Drive is in Safe Torque Off ("STO active").
Off	Drive is not in Safe Torque Off ("STO inactive").

9.3   STO jumper plug

> ⚠ **WARNING**
>
> Safety-related disconnection of the MOVIFIT® drive is not possible when the STO jumper plug is used.
>
> Severe or fatal injuries.
>
> • You may only use the STO jumper plug when the MOVIFIT® drive does not fulfill any safety function.

> ⚠ **WARNING**
>
> Disablement of safety-related disconnection of other drive units due to parasitic voltages when using an STO jumper.
>
> Severe or fatal injuries.
>
> • You may only use the STO jumper when all incoming and outgoing STO connections have been removed from the drive unit.

The STO jumper plug can be connected to the X70F/X71F STO plug connector of the MOVIFIT® device. The STO jumper plug deactivates the safety functions of the MOVIFIT® device.

The following figure shows the STO jumper plug, part number 11747099:
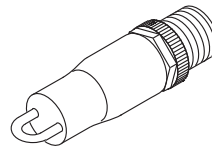
63050395932099851

9.4 Error statuses of PROFIsafe option S11

INFORMATION

i	Depending on the safety controller used, other terms may be used for "passivation" and "reintegration" in the safety controller documentation. For detailed information, refer to the safety controller documentation.

9.4.1 Error in the safety section

The S11 PROFIsafe option is able to detect various internal and external faults (at the safety-related inputs/outputs). For information on the types of faults, exact responses, and how to correct the faults, refer to the chapter "PROFIsafe Option S11 fault table". When faults occur in the safety part, the S11 option usually responds by passivation of the module and switching to substitute values instead of process values. All safety-related process values (F-DI and F-DO) are then set to "0" ($\rightarrow$ safe state).

After the fault has been corrected, the S11 option is reintegrated with a user acknowledgement.

After reintegration, the process values ready at the safe inputs (F-DI.) are made available and the now available output values are transferred to the safe outputs (F-DO.).

9.4.2 PROFIsafe timeout

⚠ WARNING

Risk of unexpected start of the drive. Automation reintegration can also be set in the safety controller.

Severe or fatal injuries.

- This function must not be used in safety-related applications.

If safety-relevant PROFIsafe communication is interrupted or delayed, the PROFIsafe option S11 also responds with passivation after the adjustable monitoring time "F_WD-Time" (see description of F parameters) has expired, and assumes the safe status. After this time has expired, the relevant module is passivated in the safety control and the associated safety-related process values for the safety application are set to "0" ($\rightarrow$ safe state).

Whenever passivation occurs, user acknowledgement is required to reintegrate the module in question.

9.4.3 Safety diagnostics via PROFIBUS DP

The status of PROFIsafe communication and S11 option fault messages is transmitted to the DP master via a status PDU in accordance with the PROFIBUS DPV1 standard.

The following figure shows the structure of the diagnostic data for PROFIsafe communication via slot 1. In slot 1, the F module for the S11 option is configured.

Byte 11 is used for transferring diagnostics messages. These are defined in the PROFIsafe specification.

Bytes 12 and 13 transfer the status and fault status of the S11 option to the higher-level DP master.

The figure below shows the structure of diagnostics data for PROFIBUS DPV1:

					Status block		
Bytes 1 – 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13
6 bytes Standard diagnostics	**Header**	**Status Type**	**Slot Number**	**Status Specifier**	**Diag User Data 0**	**Diag User Data 1**	**Diag User Data 2**
...	0x07	0x81	0x00	0x00	PROFIsafe	F-State 1	
	↑	↑	↑	↑	↑	↑	
	7 bytes Module-specific diagnostics	0x81 = Status block with status message	0x00 = Slot 1 (PROFIsafe option)	No DPV1 specifier	PROFIsafe diagnostics information in accordance with PROFIsafe profile V2.0	Cyclical F state of MOVIFIT®	

Diagnostic messages of the PROFIsafe layer

The table below shows the diagnostic messages of the PROFIsafe layer:

Byte 11	**PROFIBUS diagnostics text (German)**	**PROFIBUS diagnostics text (English)**
0_{hex} / 0_{dec}	No fault	–
40_{hex} / 64_{dec}	F_Dest_Add stimmt nicht überein	Mismatch of F_Dest_Add
41_{hex} / 65_{dec}	F_Dest_Add ist ungültig	F_Dest_Add not valid
42_{hex} / 66_{dec}	F_Source_Add ist ungültig	F_Source_Add not valid
43_{hex} / 67_{dec}	F_WD_Time ist 0 ms	F_WD_Time is 0 ms
44_{hex} / 68_{dec}	F_SIL Level größer max SIL Level	F_SIL exceeds SIL f. application
45_{hex} / 69_{dec}	Falsche F_CRC_Length	F_CRC_Length does not match
46_{hex} / 70_{dec}	Falsche F-Parameter Version	F parameter set incorrectly
47_{hex} / 71_{dec}	Fehler im CRC1-Wert	CRC1 fault

INFORMATION

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For more information on the meaning and remedy of fault messages, refer to the manuals on the PROFIBUS-DP master.

S11 option error codes

The table below shows the fault codes of the S11 option:

Byte 12	Byte 13	Designation (German)	Designation (English)	Meaning/remedy
00_{hex} / 00_{dec}	00_{hex} / 00_{dec}	No fault	–	See "PROFIsafe option S11 fault table" ($\rightarrow$ 📄 64)
	01_{hex} / 01_{dec}	Interner Ablauffehler	Internal sequence fault	
	02_{hex} / 02_{dec}	Interner System-fehler	Internal system fault	
	03_{hex} / 03_{dec}	Fehler Kommunika-tion	Communication fault	
	04_{hex} / 04_{dec}	Fehler Elektronik-versorgung	Circuitry supply voltage fault	
	14_{hex} / 20_{dec}	Interner Fehler am sicherheits-gerichteten Eingang (F-DI.)	Internal fault failsafe input	
	15_{hex} / 21_{dec}	Kurzschluss am sicherheits-gerichteten Eingang (F-DI.)	Short circuit failsafe input	
	32_{hex} / 50_{dec}	Interner Fehler am sicherheits-gerichteten Aus-gang (F-DO.)	Internal fault failsafe output	
	33_{hex} / 51_{dec}	Kurzschluss am sicherheits-gerichteten Aus-gang (F-DO.)	Short circuit failsafe output	
	34_{hex} / 52_{dec}	Überlast am sicher-heitsgerichteten Ausgang (F-DO.)	Overload at failsafe output	
	$6F_{hex}$ / 111_{dec}	Interner Kom-munikationsfehler zur S11-Option	Internal communi-nication timeout	
	$7F_{hex}$ / 127_{dec}	Fehler Initialisierung S11-Option	F init fault	

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9.4.4 Safety diagnostics via PROFINET IO

The status of PROFIsafe communication and fault messages of the S11 option are reported to the PROFINET IO controller, where they can then be diagnosed. For more information on diagnostics refer to the "MOVIFIT® function level "Classic..." or "Technology..."" manual.

Diagnostic messages of the PROFIsafe layer

The table below shows the diagnostic messages of the PROFIsafe layer:

	PROFINET diagnostics text (German)	PROFINET diagnostics text (English)
0_{hex} / 0_{dec}	No fault	–
40_{hex} / 64_{dec}	F_Dest_Add stimmt nicht überein	Mismatch of F_Dest_Add
41_{hex} / 65_{dec}	F_Dest_Add ist ungültig	F_Dest_Add not valid
42_{hex} / 66_{dec}	F_Source_Add ist ungültig	F_Source_Add not valid
43_{hex} / 67_{dec}	F_WD_Time ist 0 ms	F_WD_Time is 0 ms
44_{hex} / 68_{dec}	F_SIL Level größer max SIL Level	F_SIL exceeds SIL f. application
45_{hex} / 69_{dec}	Falsche F_CRC_Length	F_CRC_Length does not match
46_{hex} / 70_{dec}	Falsche F-Parameter Version	F parameter set incorrectly
47_{hex} / 71_{dec}	Fehler im CRC1-Wert	CRC1 fault

INFORMATION

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For more information on the meaning of fault messages and troubleshooting, refer to the PROFINET IO controller manuals.

Fault diagnostics with MOVITOOLS® MotionStudio

If the PROFIsafe option S11 detects an fault, you can display the fault number, fault description and fault response in MOVITOOLS® MotionStudio as follows:

1. Connect the PC/laptop to the MOVIFIT® device.

2. Start the MOVITOOLS® MotionStudio software (see "MOVIFIT® .." operating instructions).

3. Establish communication.

4. Scan the network. To do so, click the [Start network scan] button [1] in the toolbar (see "MOVIFIT® .." operating instructions).

[1]

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⇨ MOVITOOLS® MotionStudio displays an icon for the MOVIFIT® device in the internal bus system. The PROFIsafe option S11 is subordinate to the MOVIFIT® device (see following figure).

5. Right-click on the PROFIsafe option S11 and select [Parameter tree] from the context menu.

⇨ MOVITOOLS® MotionStudio shows the parameter tree of the PROFIsafe option S11.

6. Double-click on the "Fault diagnostics" (Fehler-Diagnose) parameter.

⇨ MOVITOOLS® MotionStudio displays the current fault number, fault description and fault response:
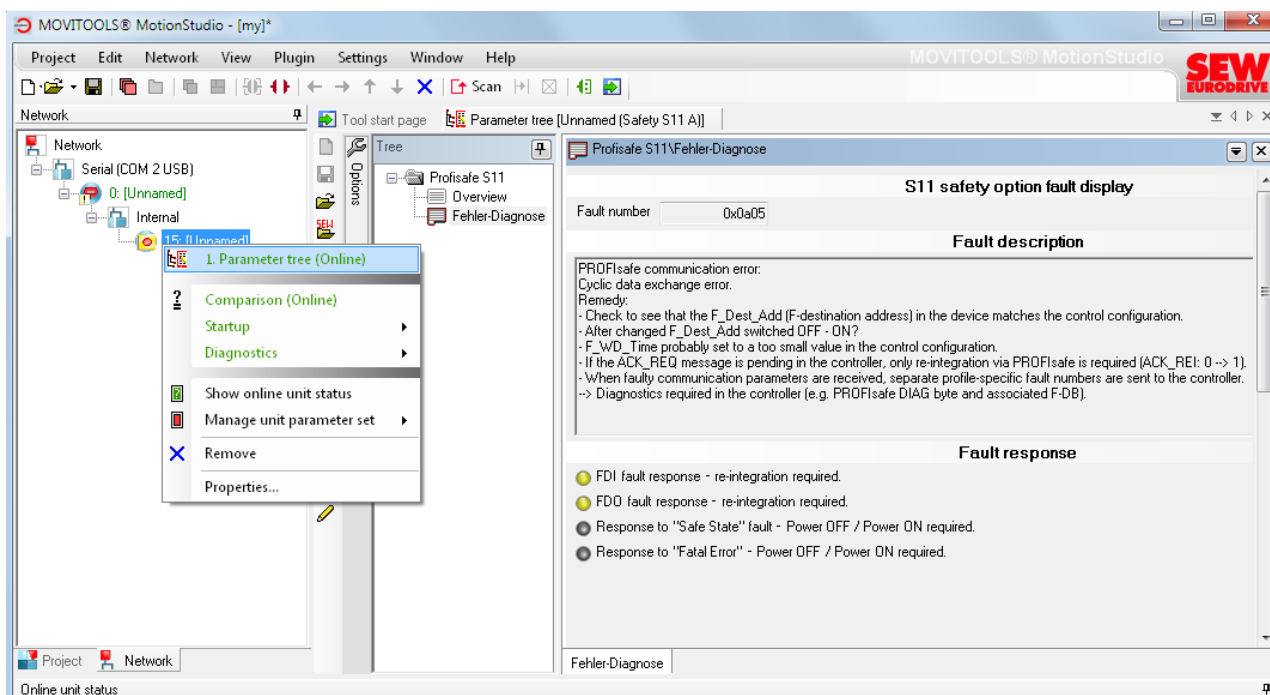
18061743499

S11 option error codes

The table below shows the fault codes of the S11 option:

	Designation (German)	Designation (English)	Meaning / fault correction
$5F00_{hex}$ / 24320_{dec}	No fault	–	See "PROFIsafe option S11 fault table" (→ 🗎 64)
$5F01_{hex}$ / 24321_{dec}	Interner Ablauffehler	Internal sequence fault	
$5F02_{hex}$ / 24322_{dec}	Interner Systemfehler	Internal system fault	
$5F03_{hex}$ / 24323_{dec}	Fehler Kommunikation	Communication fault	
$5F04_{hex}$ / 24324_{dec}	Fehler Elektronikversorgung	Circuitry supply voltage fault	
$5F14_{hex}$ / 24340_{dec}	Interner Fehler am sicherheitsgerichteten Eingang (F-DI.)	Internal fault failsafe input	
$5F15_{hex}$ / 24341_{dec}	Kurzschluss am sicherheitsgerichteten Eingang (F-DI.)	Short circuit failsafe input	
$5F32_{hex}$ / 24370_{dec}	Interner Fehler am sicherheitsgerichteten Ausgang (F-DO.)	Internal fault failsafe output	
$5F33_{hex}$ / 24371_{dec}	Kurzschluss am sicherheitsgerichteten Ausgang (F-DO.)	Short circuit failsafe output	
$5F34_{hex}$ / 24372_{dec}	Überlast am sicherheitsgerichteten Ausgang (F-DO.)	Overload at failsafe output	
$5F7F_{hex}$ / 24447_{dec}	Fehler Initalisierung S11	F init fault	

9.4.5 Fault table for PROFIsafe option S11

Code	Error	Response	Possible cause	Measure
00	No fault	–	–	–
01	Internal sequence fault	• F-DO. = 0 (disconnection of safety-related outputs) • F-DI. = 0 (→ safe state) • Passivation of S11 option	Fault in safety electronics, possibly due to EMC influence	• Check the installation (EMC) • Switch the 24 V voltage off and on again. • Reintegration of S11 option • If the fault is still present, replace the EBOX or contact SEW-EURODRIVE Service.
02	Internal system fault			
03	Communication fault		PROFIsafe communication is interrupted	• Check configuration (e.g. PROFIsafe monitoring time) • Reintegration of S11 option
04	Fault in the electronics supply		Electronics supply is outside the specified limits	• Check the installation (EMC) • Switch the 24 V voltage off and on again. • Reintegration of S11 option • If the fault is still present, replace the EBOX or contact SEW-EURODRIVE Service.
20	Internal fault at safety-related input (F-DI.)	• F-DI. = 0 (→ safe state) • Passivation of S11 option	Fault in safety electronics, possibly due to EMC influence	• Check the installation (EMC) • Switch the 24 V voltage off and on again. • Reintegration of S11 option • If the fault is still present, replace the EBOX or contact SEW-EURODRIVE Service.
21	Short circuit at safety-related input (F-DI.)		Short circuit to 24 V supply voltage or cross-fault at safety-related inputs	• Check the installation/cabling and repair the short circuit • Reintegration of S11 option

Code	Error	Response	Possible cause	Measure
50	Internal fault at safety-related output (F-DO.)	• F-DO. = 0 (disconnection of safety-related outputs) • Passivation of S11 option	Fault in safety electronics, possibly due to EMC influence	• Check the installation (EMC) • Switch the 24 V voltage off and on again. • Reintegration of S11 option • If the fault is still present, replace the EBOX or contact SEW-EURODRIVE Service.
51	Short circuit at safety-related output (F-DO.)		• Short circuit in 24 V supply voltage or reference potential • Short circuit between F-DO._P and F-DO._M	• Check the installation/cabling and repair the short circuit • Reintegration of S11 option
52	Overload at safety-related output (F-DO.)		Overload at F-DO. (current is too high!)	• Check the installation/cabling and remedy the overload • Reintegration of S11 option
111	Internal communication fault	• F-DO. = 0 (disconnection of safety-related outputs) • F-DI. = 0 ($\rightarrow$ safe state) • Passivation of S11 option	Fault in safety electronics, possibly due to EMC influence	• Check the installation (EMC) • Switch the 24 V voltage off and on again. • Reintegration of S11 option • If the fault is still present, replace the EBOX or contact SEW-EURODRIVE Service.
127	Initialization fault	• F-DO. = 0 (disconnection of safety-related outputs) • F-DI. = 0 ($\rightarrow$ safe state) • Passivation of S11 option	• F_Dest_Add is set to zero • The S11 option is not compatible with the desired (configured) safety functions	• Using MOVITOOLS® MotionStudio, set F_Dest_Add to configured value • Replace EBOX or contact SEW-EURODRIVE Service.

9.5 EBOX replacement

Order

If the EBOX is defective, order a new EBOX based on the EBOX type designation on the nameplate of the complete MOVIFIT® device, see figure below.

Replace the EBOX as follows:

9.5.1 Opening

> **⚠ WARNING**
>
> Electric shock due to dangerous voltages in the ABOX.
>
> Severe or fatal injuries.
>
> - De-energize the new MOVIFIT® device. Observe the minimum switch-off time after disconnection from the supply system:
>   - **1 minute**

When opening the device, adhere also to the safety notes in the "MOVIFIT® .." operating instructions. > Chapter "Central opening/closing mechanism".

1. Turn the central retaining screw in counterclockwise direction using a socket wrench (SW8).

2. Remove the EBOX from the ABOX.

3. Check the type designation on the nameplate of the new EBOX.

   ⇨ In case of safety-related applications the EBOX may only be replaced by a new EBOX [2] with the same type designation as the listed as EBOX type designation on the nameplate of the complete MOVIFIT® device [1].
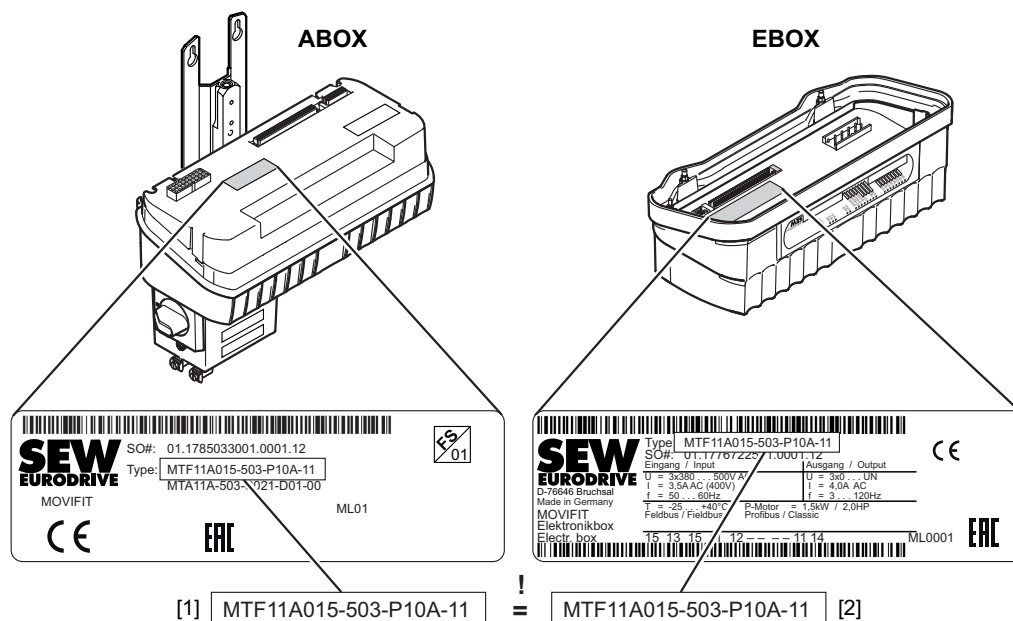
17072029323

   ⇨ This ensures the FS 01 functionality after device replacement.

9.5.2   Closing

When closing the device, adhere also to the information in the "MOVIFIT® .." operating instructions. > Chapter "Central opening/closing mechanism" > "Closing".

1. Position the new EBOX on the ABOX.

2. Turn the retaining screw in clockwise direction (tightening torque max. 7 Nm).

3. Supply the MOVIFIT® device with voltage.

INFORMATION

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A faulty S11 PROFIsafe option must be put out of operation within the next 100 hours.

10 Technical data

10.1 Safety characteristics

10.1.1 PROFIsafe option S11 characteristic safety values

The table below shows the characteristic safety values of the PROFIsafe option S11:

Designation	Characteristic safety values according to	
	IEC 62061/IEC 61508	**EN ISO 13849-1**
Safety class/underlying standards	SIL 3	PL e
Structure	1oo2D	2-channel (corresponds to category 4)
Operating mode selection	High demand	–
Probability of dangerous failure per hour (PFHd value)	< 1 x 10^{-9} 1/h	
Mission time/service life	20 years	
Proof test interval	20 years	–
Safe state	Value "0" for all safety-related F-DO process values (outputs disabled)	
Safety functions	Safety-related digital inputs/outputs (F-DI and F-DO) PROFIsafe communication	

10.1.2 MOVIFIT® MC

The following table shows the MOVIFIT® MC characteristic safety values.

Designation	Characteristic safety values according to EN ISO 13849-1
Classification	PL d
Probability of dangerous failure per hour (PFHd value)	0 (fault exclusion)
Mission time/service life	20 years
Safe state	Safe torque off
Safety functions	STO, SS1[1] according to EN 61800-5-2

1) With suitable external control

10.1.3 MOVIFIT® FC

The following table shows the MOVIFIT® FC characteristic safety values.

Designation	Characteristic safety values according to EN ISO 13849-1
Classification	PL d
Probability of dangerous failure per hour (PFHd value)	0 (fault exclusion)
Mission time/service life	20 years
Safe state	Safe torque off
Safety functions	STO, SS1[1] according to EN 61800-5-2

1) With suitable external control

10.2 Technical data – PROFIsafe option S11

10.2.1 Voltage supply

The following table shows the technical data of the voltage supply:

Designation	Value
Option voltage supply 24V_O	DC 24 V -15%/+20% according to EN 61131-2
Internal consumption	≤ 250 mA
Total current consumption	Internal consumption + output current F-DO00 + F-DO1 + F-DO_STO + F sensor supply
Electrical isolation	Isolation between safety electronics (24V_O) and all other supply voltages

10.2.2 Safety-related inputs

The following table shows the technical data of the safety-related inputs:

Designation F-DI00, F-DI01, F-DI02, F-DI03	Value
Properties	Level according to EN 61131-2 DC 24 V, type 1 No galvanic isolation
Signal level	+15 V – +30 V: "1" = contact closed -3 V – +5 V: "0" = contact open
Input resistance	ca. 5 kΩ
Input filter time	4 ms
Minimum input signal duration	15 ms
Response time (sensor switches → bit F-DI. in the PROFIsafe user data updated)	≤ 25 ms (incl. filter time)

10.2.3 Sensor supply of pulse outputs

The following table shows the technical data of the sensor supply of the pulse outputs:

Designation F-SS0, F-SS1	Value
Properties	DC 24 V output according to EN 61131-2 Protected against short circuits and overloads, no galvanic isolation
Rated current	250 mA each
Leakage current	Max. 0.5 mA
Internal voltage drop	max. 2 V
Short-circuit protection	Electronic, response value: 0.7 A – 2.1 A

10.2.4 Safety-related outputs

The following table shows the technical data of the safety-related outputs:

Designation	Value
Properties	DC 24 V outputs according to EN 61131-2, protected against short circuits and overloads
Permissible total current of outputs	≤ 2.5 A
Rated current	
F-DO00, F-DO01	2 A
F-DO_STO	1 A
Leakage current (with "0" signal)	According to standard
Internal voltage drop	Max. 3 V (sourcing and sinking output)
Short-circuit protection	Electronic, response value:
F-DO00, F-DO01	10 A – 24 A
F-DO_STO	2.8 A – 9 A
Overload protection	
F-DO00, F-DO01	2.4 A – 2.7 A
F-DO_STO	1.4 A – 1.6 A
Load resistance range	
F-DO00, F-DO01	12 Ω – 1 kΩ
F-DO_STO	24 Ω – 1 kΩ
Switching off of inductive loads	unlimited; integrated freewheeling diode
Response time (command via PROFIsafe → the output switches)	≤ 25 ms
Cable lengths	Max. 30 m

10.2.5 Ambient conditions

The following table shows the required ambient conditions:

Designation	Value
Ambient temperature for the entire unit	-25 °C to +40 °C
Climate class	EN 60721-3-3, class 3K3
Storage temperature	–25 °C to +85 °C (EN 60721-3-3, class 3K3)
Permissible oscillation and impact load	According to EN 50178
Overvoltage category	III according to IEC 60664-1 (VDE 0110-1)
Pollution class	2 according to IEC 60664-1 (VDE 0110-1) within the housing

10.3 Technical data MOVIFIT® MC (safety technology)

The table below provides the technical data for MOVIFIT® MC (safety technology). Also observe the technical data and approvals specified in the MOVIFIT® MC and MOVIMOT® MM..D operating instructions.

Designation		Value			
		Min.	**Typical**	**Max.**	**Unit**
Safety-related 24V_P supply voltage (U$_{IN}$ according to EN 61131-2)		20.4	24.0	28.8	V (DC)
Short-circuit protection for 24V_MM (electronic, response value)		1.4		4.5	A
Input capacitance, after polarity protection diode	PROFIBUS, DeviceNet™	9	10	11	µF
	PROFINET, EtherNet/IP™	18	20	22	µF
Input capacitance MOVIMOT® MM..D (up to 3 connections)		see "MOVIMOT® MM..D Functional Safety" manual			
Current consumption MOVIMOT® MM..D (up to 3 connections)					
STO response time					

10.4 Technical data MOVIFIT® FC (safety technology)

The table below provides the technical data for MOVIFIT® FC (safety technology). The technical data and approvals detailed in the MOVIFIT® FC operating instructions must also be observed.

Designation	Value			
	Min.	**Typical**	**Max.**	**Unit**
Safety-related 24V_P supply voltage (U$_{IN}$ according to EN 61131-2)	20.4	24.0	28.8	V (DC)
Input capacitance, after polarity protection diode	80	100	120	µF
Current consumption	130	150	170	mA
STO response time			150	ms

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